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Springboarding on IoE for Future Proofing Halal Industry

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Abstract

Halal Industry has expanded beyond food and beverage industry to encompass growing industries such as pharmaceutical, cosmetics, consumer goods, fashion, tourism, media and entertainment plus other services. Drivers of this economy include a third of the world population, comprising of young affluent tech savvy Muslims, and non-Muslims who are passionate about green economy. The increased interest in halal is brought on by the whole philosophy behind halal production. Specifically, halal is a new paradigm to global issues such as food safety, environmental awareness, economic sustainability and animal welfare. Integrating the different dimensions of halal economy for future proofing thus needs a new approach which can be afforded by the application of Internet of Everything (IoE). The IoE concept is based on the idea of all-round connectivity, intelligence and cognition. It means that intelligent internet connections are not restricted by Internet of Things (IoT). The IoE way of life depicts the world in which a multitude of devices, machines and conventional objects are perpetually interacting, giving them comprehensive networking opportunities, thus making them smarter. IoE is the connections between people, things, data and processes combined into a common interrelated system, the goal of which is to improve experiences and decision making. A halal ecosystem that is fortified with the implementation of IoE will ensure that halal stakeholders are abreast with present and future situations and are enabled to make timely and more effective decisions thereby future proofing their businesses and ensure sustainability of the halal industry and preserve the societal well-being.

Keywords: Halal; Internet of Everything; IoE; Future Proofing; Halal Industry

1. Introduction

To Muslims, halal and haram are fundamental issues as it directly affects them and societal well-being; halal means 'permissible for consumption and use', whilst haram 'is anything that is unlawful or forbidden' (Qaraḍāwī, 1994). With reference to the verse, "O mankind, eat whatever that is on earth (that is) lawful and good, do not follow the footsteps of Satan. Indeed, he is to you a clear enemy", it is undisputable that halal is meant for everyone, Muslims and non-Muslims (Quran 2:168). Halal is not confined to the product offered but covers everything and all stages of production; starting from source of raw material, production process and premises, every aspects of logistics, to the distribution of products to end consumers (Che Man and Sazili, 2010). Whilst halal means permissible (according to Islamic law), tayyib (ethical, safe, clean, nutritious, and quality) is primarily concerned about food safety measures (Sani and Dahlan, 2015).

Once a marginal sector, the vibrant halal industry now influences every aspect of the global supply chain. No other significant market segment has this much potential in growth and worldwide value. Halal economy has continued its rate of accelerated growth despite the paralysing disruption caused by COVID-19 pandemic and its associated restrictions. This is attested when the State of the Global Islamic Economy Report 2020/2021 reported that the global consumption of halal goods and services is expected to grow at 3.1% annually to reach USD2.4 trillion by 2024. GIER 2020/2021 also surmised that Malaysia is expected to continue to lead in the coming years, as it had done so for the past 8 consecutive years (GIER 2020/2021). As mentioned at the World Halal Business Conference 2021by Mr Abdul Rasheed Ghaffour, Deputy Governor of Bank Negara Malaysia, the rise in halal economy is driven both by the fast-growing Muslim population and the rising trend on ethical consumerism (BIS, 2021).

There is rising global awareness, that halal is not just about religion but a new paradigm to global issues such as food safety, environmental awareness, economic sustainability and animal welfare. There is also an upsurge demand for halal products by non-Muslims, as a lifestyle choice, as halal industry promotes animal welfare, social responsibility, environment friendly, stewardship to earth, economic and social justice, and ethical investment (Pacific, 2010). To obtain and maintain validity of a company's halal certification, they must continuously ensure

that their production is free from animal cruelty, environmental degradation and in promoting green marketing (Aoun and Tournois, 2015).

Coincidentally, the Sustainable Development Goals of the UN Global Compact have a lot in common with halal values. Indeed, the philosophy of halalan-toyyiban propagates good, pure, and wholesome elements in consumption and in parallel upholds responsible production processes that addresses SDG12 (ensure sustainable consumption and production patterns). Due to the comprehensive nature of halal industry, halal economy encourages inclusive economic development with the potential to create economic security, greater and better employment prospects, and ultimately improvements of the environments for a sustainable societal well-being. This condition is aligned with SDG8 which is to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

The resulting lockdowns imposed by COVID-19 pandemic caused a major disruption to the global supply chain of raw materials which adversely affected supplies and further hampered SMEs efforts to survive, remain sustainable, and expand beyond their country's border (UNCTAD, 2022). The ongoing war between Russia and Ukraine has also added greater burden to the global supply chain and consequently endangering the world's food security of even large economies such as United Kingdom (The Straits Times, 2022). Although small and medium enterprises (SMEs) are struggling to keep up with the rapid development of technology required for communications, transactions and marketing they do realise that it is now mandatory. Some governments are also giving assistance to their local SMEs to upscale their internet accessibility and digital marketing as well as providing funds for upgrading of their production equipment and machinery.

While the halal industry is becoming one of the most competitive and fast-moving sectors in the world, this sector is still heavily reliant on an uninterrupted halal supply chain, plagued by issues pertaining to halal integrity, and lack of standardised global standard. To stay relevant in the halal industry during this difficult economic climate, many businesses and other halal stakeholders are starting to invest in halal-related products, by driving innovation and creating solutions for global Muslim communities, whilst leveraging their own governments' halal initiatives. IR4.0 technology such as fintech, data science, and biotech have all been impacted by halal innovation, as has logistics and the use of blockchain for a more traceable supply chain. These initiatives can be traced to countries like Malaysia, Indonesia, Turkey, OIC countries and halal meat exporting countries. Countries who have targeted the halal tourism market has also extended service via tourism apps that leveraged on IR4.0 technology such as augmented reality and virtual reality to offer out-off the world experience.

Mohd Fadzillah, K. (2022) in his article stated that "Innovation is needed in the ever demanding and fast-growing halal sector, which is why technology is a large factor for the progress of most halal industry developments moving forward". Clearly, it is now the time that halal stakeholders take a serious look into the application of Internet of Everything (IoE) to the halal ecosystem. IoE is the connections between people, things, data and processes combined into a common interrelated system, the aim of which is to improve experiences and make smarter decisions. The effective and efficient integration of the different dimensions of halal economy can only be afforded by the application of IoE, as its model is based on the idea of all-round connectivity, intelligence and cognition. The IoE is a concept that extends the Internet of Things (IoT) which emphasise on machine-to-machine (M2M) communications to describe a more complex system that also encompasses people and processes. The IoE, also includes user-generated communications and interactions associated with the global entirety of networked devices. This interactive and totally connected system thus make IoE conducive to be used for halal ecosystem and addresses many issues that was previously thought to be unmanageable if taken on a global basis.

This study, is a preliminary literature review about the feasibility of using IoE as a springboard to future proof halal economy thereby realise a more conducive global halal ecosystem that will transverse issues regarding halal production compliance, halal certification recognition, lack of standardised halal standards, disruption of halal supply chain, halal integrity and traceability. In other words, if IoE is implemented in a holistic manner to the halal ecosystem would it provide a solution to the pertaining issues plaguing the industry and simultaneously be acceptable to all Muslims and nations? A methodological approach based on literature review will be applied to achieve the objective set. This study hopes to shed light to the current situation faced by the halal industry and enable stakeholders to grasp the implications and impact of using IoE as a facilitator for future proofing a dynamic halal industry thus enabling it to forecast impending crisis and competently function during man-made and natural disasters and ensure sustainability and continued growth.

2. Literature Review

While SDG12 (ensure sustainable consumption and production patterns) is addressed and aligned with the philosophy of halalan-toyyiban that propagates good, pure, and wholesome elements in consumption and upholds responsible production processes, SDG8 objective is to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (United Nations Sustainable Development Goals). These two SDGs can be attained through halal economy which has seen continued growth and has the potential to narrow the income gap between different societal classes, in so doing result in inclusive development for all.

Halal stakeholders should seek an alternative solution to address prevailing yet persistent halal issues and consider the opportune provided by the application of Internet of Everything (IoE) to the universal halal ecosystem. Such innovative efforts will also future proof the halal ecosystem against disruptive worldwide crisis and ensure sustainability and development of the halal economy.

2.1 Halal Economy

Rising demand for halal products and services among affluent Muslim millennials is mirrored by the largest expansion in over a decade for halal sales with Muslim spend projected to grow by 3.1% per annum to reach USD2.4 trillion by 2024 (GIER 2020/2021). Despite the catastrophic chaos brought by COVID-19 that also resulted in the disruption of global supply chains, the Islamic economy has continued to develop led by an acceleration in digital transformation, and increased government focus on food security-related investments. The drivers of the global Islamic economy continue to be reinforced by a large and growing affluent Muslim population, an increasing adherence to Islamic ethical values impacting consumption, digital connectivity, a growing number of national strategies dedicated to halal products and service development, and businesses pressured to maintain growth momentum through new markets and diversification including the emergence of non-Muslim nations and consumers (GIER 2019/2020; Azam and Abdullah, 2020). Countries continue to build more robust Islamic economy ecosystems with Malaysia currently leading the overall Global Islamic Economy Indicator (GIEI) ranking for the eighth consecutive year, Saudi Arabia moved up to second place, followed by the UAE and Indonesia (GIER 2020/2021).

Figure 1 demonstrates the reach of halal industry that covers various business sectors with revenues of each sector increasing from 2017 till 2023. However, these figures have been scaled down due to impact of COVID-19.

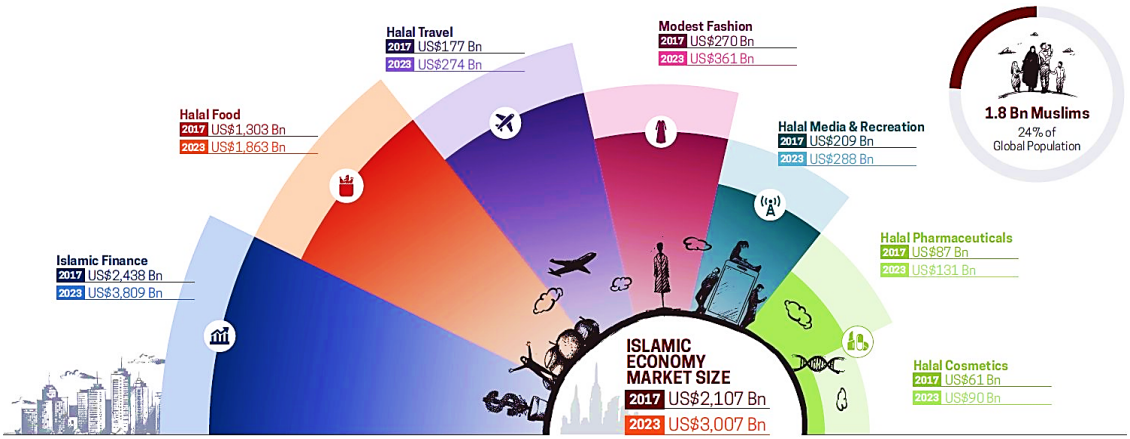

Figure 1. Global Islamic Economy
Source: GIER 2019/2020

2.2 Halal Ecosystem and Stakeholders

The Halal Ecosystem is defined as "A network of components involved in the growth cycle and delivery of halal products or services and contributes to the overall halal socio-economy. Each component in the ecosystem has its own unique activities that are interrelated with each other, creating a constant evolving relationship towards sustainability" (msiahalaldirectory.com). The State of the Global Islamic Economy Report 2020/2021 (GIER 2020/2021), highlighted that Muslims' expenditure had breached USD2.02 trillion and based on the infrastructure, support and policies implemented, Malaysia has been placed as the leading country best-positioned to capitalise on Islamic Economy, for eight consecutive years. Recognised as leading the global halal ecosystem, Malaysia's halal exports are expected to reach $9.6 billion in 2022, according to the Halal Development Corporation (HDC), with exports in the first quarter up 100% on last year signalling strong growth ahead. In 2021, exports rose by 19% to $8.3 billion. (SalaamGateway, 2022).

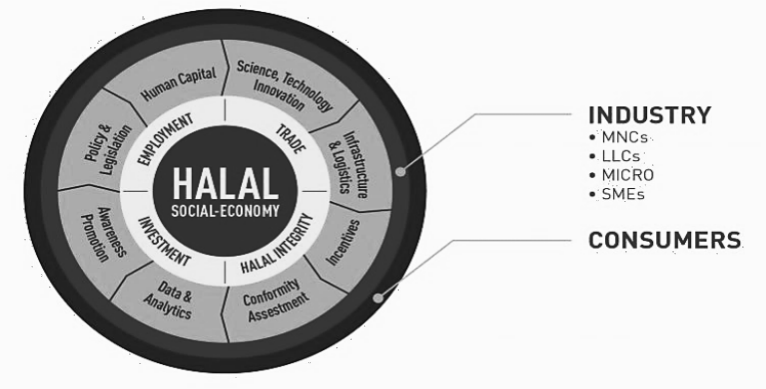

Figure 2**.** Malaysia's Halal Ecosystem
Source: Adapted from Halal Industry Master Plan 2030, msiahalaldirectory.com

2.3 Challenges and Opportunities

2.3.1 Challenges (Elasrag, 2015; Masood and Abd Rahim, 2021)

i. Due to the inconsistencies of *halal* regulations and transparency across the globe, in addition to the numerous differing *halal* certification in circulation, companies face obstacles which hinder their access to rewarding *halal* markets. The most predominant issue that businesses dread is the lack of a single *halal* standards manual and *halal* certification, coupled with multiple trademarks and logos.
   a. These issues do not include the cost of setting-up and operating abroad, costs of having multiple *halal* certificates per product for different country, not to mention the confusion, as a result of having to maintain, monitor and apply the numerous *halal* certificates
ii. Many HCBs have differing set of criteria, that they ascribe to when assessing companies for *halal* certification, due to the absence of any viable international schemes to accredit *halal* certification bodies (HCBs)
   a. Majority of *halal* food is produced in Non-Muslim countries, and is certified by independent HCB's that operate with little regulatory oversight.
iii. Halal integrity issues such as contamination, falsification of documents and etc. are encountered almost on a daily basis

2.3.2 Challenges (Elasrag, 2015; Masood and Abd Rahim, 2021)

i. OIC countries, that have expertise in *halal* food processes, have an opportunity to develop partnerships with non-OIC countries eager to strengthen their *halal* capabilities.
ii. An opportunity to develop tracking / traceability technology to ensure *halal* integrity,
iii. With the dawn of the evolving IR4.0 technology, IoE has the potential to upscale the whole *halal* industry ecosystem
iv. An increased demand for hormone free meat.
v. Halal food has the opportunity to be the global standard for safe, wholesome, humane food if producers fully adhered to the concept of *halal* and *tayyib*
   - There is an increased global demand for organic and natural food which is starting to appear among Muslim consumers, especially the younger millennials
   - Included in this is the potential of developing premier innovative *halal* brands
vi. Develop strong brands.
   - Product quality, marketing messaging, packaging and overall communication can be greatly enhanced, providing an opportunity for existing brands to enhance further and new players to differentiate through powerful branding strategy
vii. Investment opportunities in Halal food value chain integration.

2.4 Internet of Everything (IoE)

The Internet is a vast network that connects computers all over the world enabling sharing of information and communication from anywhere with an Internet connection. Leonard Kleinrock came up with the initial idea of the Internet in his article "Information Flow in Large Communication Nets" in 1961 (Bay, 2021). Then in 1962, J.C.R. Licklider said that "the future of computing will be in the form of a huge intergalactic computer network connecting people from all over the world" (Britannica). Today, this intergalactic computer network provides us

with a platform for shopping, communicating, socialising, teaching, learning and entertainment, and has become indispensable.

If anything, the pandemic has taught us that digital platforms offer viable options to continue working and communicating virtually without requiring physical presence. The Department of Statistics Malaysia reported that the ecommerce income by establishments recorded an income generation of RM279bil that in the third quarter of 2021 which is equivalent to 17.1% increase year on year. This suggests that the metaverse, if and when blended well with business strategy and social ideals, will endure the test of time, just like what happened to the ecommerce "dot-com to dot-gone" phenomenon (Murali Raman, 2022).

2.4.1 Internet of Everything (IoE)

- The Internet of Things (IoT) describes the network of physical objects (things) that are implanted with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet, independently, within the network devoid of human action. Whilst, IoE is based on the concept of all-round connectivity, intelligence and cognition whereby the pillars, comprising of people, things, data and processes, are connected to each other seamlessly and combined into a common interrelated system. IoE is aimed at improving individual experiences and enabling smarter decision making (Augur, 2018). Thereby, IoT is a part of IoE which is more comprehensive.
- The IoT, as part of IoE, has many advantages including access to information anytime, anywhere at real-time, hence, making it convenient for individuals to do their work without physically being present in their office. Human efforts can also be minimized as the devices of IoT interact and communicate (M2M) and complete certain tasks without human interaction. IoT also leads to time and cost saving since data packets can be transferred, at a faster rate, over a connected network. However, IoT has certain disadvantages such as data breach, privacy issues, unemployment, and dependability that can result in indolence.
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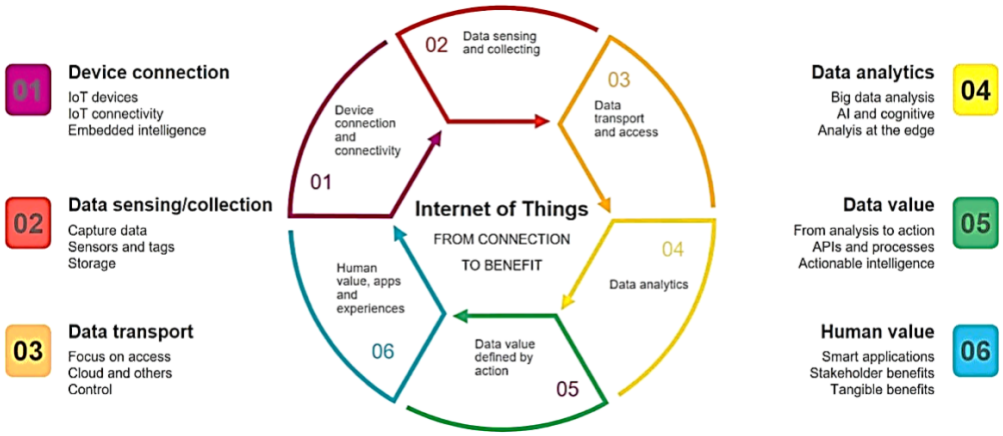

Figure 3. IoT – from connection to benefits
Source: Digital transformation and technologies through the human prism *i-SCOOP*

- Subsequently, IoE technology will enable the use of relevant information to facilitate richer informed decision making, leading towards more effective action taken, thereby providing new capabilities and richer experiences. Devices are furnished with digital features and linked to a shared network of other items/devices, people and processes, in order to generate and exchange valuable data and information, therefore expediting pertinent decision-making (Di Martino, 2018; Sakovich, 2019). Decentralization and leading edge decision making is enabled as data is processed not in a single center, but in numerous distributed nodes. The process of digital transformation leverage on cloud computing, fog computing, Artificial Intelligence (AI), machine learning (ML), IoT, Big Data (BD), Block Chain (BC), and etc.

2.4.2 Interaction between Pillars of IoE

To increase revenue, save costs and improve efficiencies, experiences and create better engagement, industry players and stakeholders need to keep update about the constantly changing business ecosystem. Digital transformation of the ecosystem will enable this to happen, as establishments will be adaptable and adequately agile to tackle the challenges and seize opportunities that is logical and delivers benefits. IoE requires advanced capabilities within the area of information sharing beyond that of IoT. Real-time data, retrieved from diverse and heterogeneous IoE environments, from simple sensors to complex robotic devices, and from autonomous service agents to human actors, will be analysed almost instantaneously (Raj, 2018). AI, incorporated into smart devices,

provides the increasing utilisation of innovative IoE-based applications, where things and people interact applicably, within a social background and multi-user environment (Miraz, 2018). Processes, the core of IoE, represent network "connections" and real-time data/information flows among IoE nodes (Langley, 2021; Miraz, 2018). The results are smart and intelligent insights that are combined in real-time and working in harmony (Masoud, 2019; Vandebroek 2016). IoE is far beyond IoT context disruptions, as it addresses the public and organizational needs for more data and actionable information. Actions and interactions within the IoE environment create and expand knowledge in a transcending process through which the four pillars acquire new knowledge and interfaces, that are generated in knowledge-creation cycles (Nonaka, 2015).

The interactions between the four pillars of IoE are as below:

- People: People gives insights via websites, applications or connected devices they use; AI algorithms and other smart technologies analyze these data to grasp human issues and deliver relevant content accordingly to assist them to quickly solve problems or make decisions.
- Things: Various physical items embedded with sensors and actuators generate data on their status and send it to the needed destination across the network.
- Data: Raw data is summarized, classified and analyzed. Information retrieved is used to control various systems and empower intelligent solutions.
- Processes: Different processes based on artificial intelligence, machine learning, social networks or other technologies ensure that the right information is sent to the right person at the right time

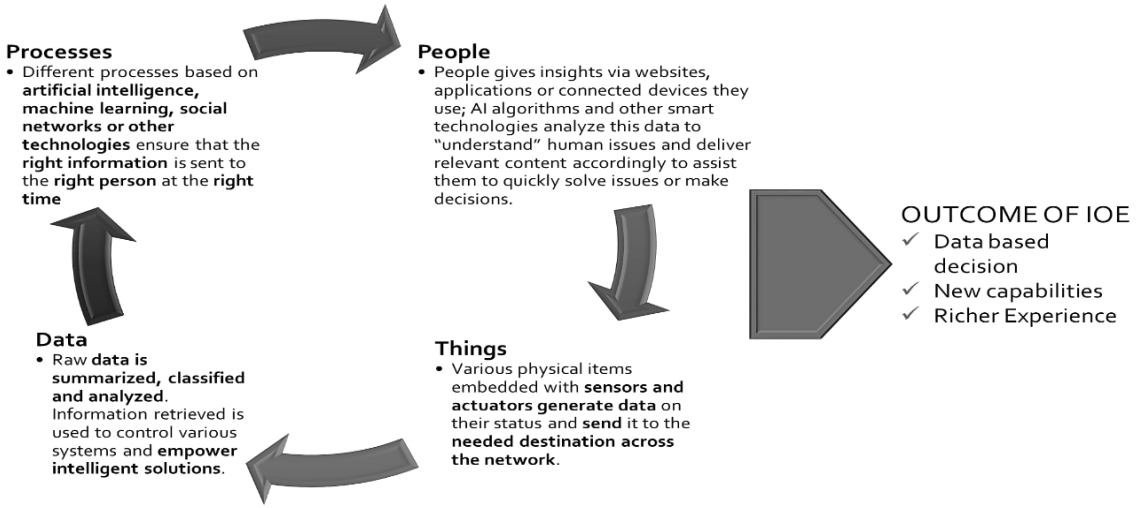

Figure 4. Interaction between Pillars of IoE

3. Discussion

As mentioned in the literature review, the halal ecosystem a dynamic all-encompassing infrastructure, consists of a network of components that are linked in an eternal progressing connection, whereby each component has its own unique activities that are interrelated with each other, creating a constant evolving relationship (Figure 5a). Whilst IoE comprises of people, IoT, data and processes, that are connected to each other seamlessly and combined into a common interrelated system. Each pillar of IoT has its own set of activities where the output (information) is shared back and integrated into the ecosystem to enable decision makers (consumers, producers, supporting agencies) to make better and opportune judgement.

Borrowing from article published by Farias da Costa (2021) Figure 5b illustrate the IoE ecosystem that would be viable to be implemented within the halal ecosystem. Sensors are planted in the devices or machines (manufacturing line, logistics, retailers, computers), and the interconnected world will enable M2M processes to take place. The data generated from M2M process is first stored and secured using blockchain, shared and relayed to a station for analysis using big data analytics and AI technology. The required information is then presented to the industry players (MNCs, LLCs, SMEs and Micro enterprises), agencies (JAKIM, HDCs, MOF, NPRA, MITI and etc.) and also consumers (consumers and users), in a timely manner, who will ultimately use the processed information to make the necessary decision by accessing the internet or app. The processes that have taken place would involve P2P as well as P2M and vice-versa.

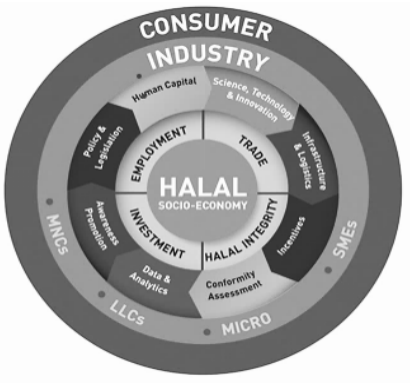

Figure 5a. Halal Ecosystem

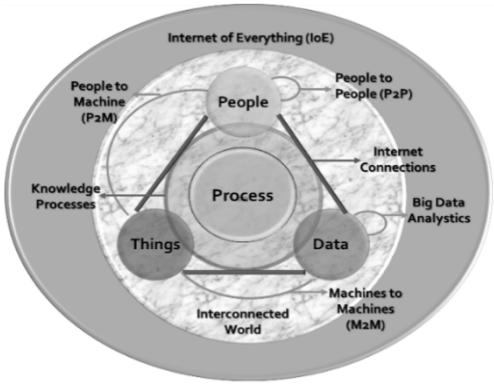

Figure 5b. IoE Ecosystem

The prevailing challenges of inconsistencies of halal regulations and transparency, differing halal certification across the globe, coupled with lack of single universal halal certifying body, can partly be resolved with the application of IoE. The interconnectedness provided in real-time, with information securely stored and made available by IoE, will greatly assist stakeholders within the halal ecosystem. Industry players will have almost immediate access to halal/ Shariah compliant resources (information, raw materials, talent, expertise, finance) and be able to make informed decisions to address current and future problems. For example, information with regards to halal compliance of the resources they need, such as halal certification verification, can easily be recovered, or information on halal export requirements of importing country is easily accessible. Actors within the halal supply chain will also have an added advantage in that timely relevant information are conveyed to them and assist them to strategise accordingly thereby avoid disrupting the supply chain; saving time and costs. Consumers and end users can also obtain accurate information of the halal product they would like to purchase as they are assured of the halal integrity of the said product, in that way effectively influencing consumers' behaviour in a positive manner. This added assurance will bode well for halal companies and assist them in increasing customer loyalty and company's brand value.

4. Conclusion and Implications

Once a disregarded sector, the halal industry is now recognized globally as one of the most competitive and fast-moving sectors in the world with much unrealized growth potential. There is also a rising appreciation internationally, that halal is aligned with SDG 8 and 12, and a new paradigm solution to global issues such as food safety, environmental awareness, economic sustainability and animal welfare.

However, the halal industry which is heavily reliant on an uninterrupted halal supply chain, is plagued by issues pertaining to preserving halal integrity throughout the supply chain and logistics management, in addition to the lack of standardised halal standard and global halal certification body. The stated challenges have continued to hamper the expansion of domestic halal industries beyond national borders.

The application of Internet of Everything (IoE) to the halal ecosystem may provide such a solution. The halal ecosystem also consists of the same elements as that of IoE which is things (devices/equipment/machines), people (industry players, governing agencies, consumers, end-users), processes (logistics, production, transactions, communications, marketing) and data (halal standards, import/export requirements, suppliers, ingredients, etc.).

The pandemic and other world crisis has not only accelerated digital transformation but revealed that all stakeholders are willing to adopt it, as it became a necessity for continued trade and transaction, seeing that it provides a means for communications, interconnectedness and accessibility. Many businesses had even resorted to investing more into transforming their business activities digitally in order to not only deliver an uninterrupted supply of product to the users but to continue remaining relevant in the industry. In fact, some business sectors (food and beverage, cosmetics, pharmaceuticals) have already implemented IoE up to a certain degree. The same can thus be used for the halal industry if it wants to continue to expand and avoid major disruptions. The capacity and capability of having IoE implemented into the halal ecosystem will be invaluable and future proof the halal industry, though much work needs to be undertaken by the various stakeholders to ensure the viability, sustainability and expansion of the halal industry.

Regardless of the future, we need to be mindful that like any other technology, including the initial humble beginnings of the Internet, IoE is yet another enabler. Though there remain numerous possibilities, options and clear value propositions, its use for business and in society in general, should take several aspects into consideration. Issues such as security, privacy, cost, and access to proper infrastructure must also be addressed to avoid stolen data and incorrect information and even identity thefts from occurring.

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