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The benefits of Industry 4.0 on Sustainable Development and Malaysia's Vision

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Abstract. This study contributes further to the existing literature on Industry 4.0 and Sustainable Development (SD). This study reviews and summarizes the achievable goals of sustainable development in Malaysia using Industry 4.0. These achievements in utilizing Industry 4.0 relates directly to (1) maintenance, time and cost, (2) machinery stoppages and downtime, (3) inventory involving space and cost and (4) waste that has a relationship to (a) productivity, (b) quality, (c) resource use, (d) new technology and lead time market acceptance. Industry 4.0 does not relate individual by itself nor is a business discipline. Industry 4.0 can be clustered in the new in operational method, way, approach, or medium to represent in creation of a new platform to improved performance. The idea realization and formation of Industrial 4.0 emerged from the advancements and achievements of technology, communications, internet and controls. Industry 4.0 can contribute towards sustainability encouraging sustainable growth in social, environment, and economy contributing effectively towards Agenda 2030's target of people, planet, prosperity, peace, and partnership. This paper contributes towards an extensive review on Industry 4.0 in the context of sustainable development globally and in a developing country, Malaysia. Additionally, this study concludes that the new measurement of performance can benefit and should be viewed from the perspective of sustainable development's pillar of environment, social, and economy by including Industry 4.0 benefits.

1. Introduction

The Industrial Revolution is an age of improvement. It was not an age of cotton or railways [1]. The first industrial revolution started in Britain with machine introduction into production from the 18th century until the mid-19th century. The revolution started with search for new source of energy. Great Britain have nearly exhausted their limited available trees in building homes, shipping industry as this was the great era for exploration and for domestic fuels in need of cooking and for heating. The first source of fuel after wood came from surface coal which started the rush for energy source. The produced energy was harnessed improve and enhance works done manually in the agriculture and food cultivation industry with steam engines and water as a power source with focus on productivity

improvement. This is also the era where new terminology was created in the textile industry giving prominence to "factory" and "production" [2]. The British began the 19th century as the world's leading innovators and manufacturer of machines, starting with new invention that revolutionized the transport industry, i.e. steam operated locomotives and ships. The British held the world's first manufacturing equipment fair in 1851 exhibiting new inventions in communication (telegraphs), textile industry (sewing machines), agriculture (reaping machines), construction industry (steam hammers) and revolvers to confirm their position as the world' leaders. This was the beginning of the second industrial revolution from mid-19th century until the World War I period. The introduction of steel production, early electrification and early mass production that focused in the United States [3], opened the railway transportation towards new land exploration, opening innovations including in the chemical world and introduced the world to mass production. This era saw a growth in the steel, electric, and automobile industries. The second industrial revolution was fundamentally grew from the innovation in combustion and electrical powered engines and motor, start of factory and urban homes electrification, and expansion in the automotive industry infrastructure after the war [4].

The third industrial revolution dated back from the early 50s era until the late 70s era, which is also called as digital revolution. This is the era that changed analog and mechanical to digital. This third industrial revolution centered on general-purpose technology diffusion with information communication technology (ICT) combining electronics and the Internet [4]. This is the beginning to the information technology arising from massive development in computers, information, and technology related to communication [2]. The third industrial revolution shifted the labor reliance as predominant cost of production as ICT will be the key driver towards automation using robotic, controls and internet driven with technology-dependency [5]. Rifkin [6] described the five energy pillars in the third industrial revolution, starting with need arising to shift towards renewable energy source. Building micro-power plants to collect renewable energy source. New battery, energy saving and storage technology for infrastructure building industry to save energy cost. To propose Internet like technology in power/energy/electricity grid for inter-continent supply and (v) new transition phase in transport vehicles in using electric plug-in and fuel cell technology. Industry 4.0 builds from the state of art developments achieved in the third industrial revolution using application derived ICT to industry referred to as era of digitization, which includes three main components; (1) Internet of Things IoT) combined with cyber-physical systems (sensors for data collection), (2) big data advancements and powerful analytics (data analysis and immediate solution) and (3) infrastructure for communication, secure enough for heavy industries application usage [7] also known as smart factory and production.

Sustainable Development Goals (SDG) or Agenda 2030 serve as the intended foundation to transform the global economic development with the inclusion of social equality and the ecological boundary [8] needed for today and future generation. The industrial organization around the world is among the key stakeholder using Industry 4.0 advantages and values to contribute effectively to SD. Industry 4.0's research and technology is the key for sustainability achievement and industrial organizations must move forward with the shift towards changing the manufacturing paradigm with emphasis on sustainability related value creation [9]. Value creation in sustainability should include the SD pillars of economy, social, and environment but Industry 4.0 is viewed as an economic improvement tool, as such the emphasis of study should be concentrating on the environmental and social pillar [10].

1.1 German's Industry 4.0
Each Industry revolution had its own "star". The first industry revolution had mechanization. The second industrial revolution had electricity. The third industrial revolution had information technology. The fourth industrial revolution corresponds to internet of things for both manufacturing and service industry [11]. The German government's effort in 2013, which included the industry and independent research institutions, started the 'Industry 4.0' terminology. A roadmap for Industry 4.0 was published in the same year as a national strategic plan until 2020. This roadmap's had two

illustrative aims. The first was to keep German competitive and relevant in manufacturing and this effort could then bring manufacturing back.

The world acknowledges the German's as leaders in manufacturing machinery. Iwas introduced as an intelligent manufacturing concept to strategize and strengthen their manufacturing industry by way of instilling new guidelines, standards, improve productivity and reduce cost [12]. German's Industry 4.0 growth will be a challenge and affect labor, cost-sensitive industry, and other traditional manufacturing-based industries. The combination of information and communication technology with intelligent technology can result in resource use optimization, capacity efficiency enhancement, huge reduction in rejects and waste. These new manufacturing methods and machinery gives way to new paths in search of renewable raw material, use of renewable energy source and towards optimization in resources. Industry 4.0 is configured with the purpose of connecting manufacturing with resources and services using Cyber Physical Systems (CPS) and the Internet of Things (IoT) [13]. Even the service industry, logistics distribution, and after-sales services are part of Industry 4.0 giving new opportunities in personalized service provision to the users and market. Manufacturing and services moves fast forward on fast, new development, and flexibility on production in a complex environment [14].

Industry 4.0 is defined as the digital transformation involving manufacturing and technology platforms; Big Data/Analytics, (Industrial) Internet of Things using IT (Information Technology) and OT (Operational Technology), robotics, cyber security, cloud, simulation, additive manufacturing (3D), and augmented reality. In other words, Industry 4.0 is used in data capture and manufacturing processes, to connect factories, machines and people, smart manufacturing (decentralized) with self-optimizing systems, digitization of a supply chain in a cyber-physical environment (I-SCOOP, 2016).

Digital [15] defined Industry 4.0 as the digitization of manufacturing sector. It went on to say that the disruptive technologies included were (1) data and computation power, (2) artificial intelligence including analytical actions, (3) people-machine-technology interface, and (4) touch interfaces, augmented reality, and digital-to-physical. Industry 4.0's eight key value drivers are stated as (1) to achieve operational effectiveness for productivity performance, (2) strategizing as a new business model towards cross-industry networking growth targeting start-ups and innovative-based company, (3) digital transformation through digital capability building in ecosystem, data management, cyber security and systems/data creation and management.

Industry 4.0 was presented as a strategy in 2012 at Hannover Fair in Germany, 'Future Projects' of Germany's High-Technology Strategy 2020 [16]. The common terminologies used worldwide as a part of it are (1) Internet of Things, (2) Internet of services, (3) Industrial Internet, (4) Advanced manufacturing and (5) Smart factory. Industry 4.0 relates innovativeness and technology that corresponds with methods that leads towards advancements.

These advancements combines value chain from big data, information, technology, network communication, cyber-physical systems, cloud computing, modeling, virtual realization and simulation [17]. The key focus of Industry 4.0 is beyond development of cyber-physical systems, smart manufacturing, and productivity efficiency but includes energy and resource usage maximization, finding renewable alternative to energy and resource, productivity efficiency and enhancement, reducing time from innovation to market period, horizontal and vertical integration of value-added networks and end-to-end digital engineering integration across the value chain [11]. Industry 4.0 relates to involves technology and processes that need engineering, e-skills, human skills, innovation adaptation, digital knowledge, digital technologies, manufacturing technology, electronic systems, internet knowledge, and big data business [16] that it becomes a new policy that the government needs to moot as education and skills base.

Digital compass use effectively affects economic performance in manufacturing firm. The eight-value drivers that makes this achievement are through reduction in (1) asset utilization (estimated 30% to 50% machine downtime improvement), (2) inventories and holding cost (estimated 20% to 50%, cash flow improvement), (3) quality related cost (estimated 10% to 20% improvement in rejects or rework), (4) faster time-to-market faster (estimated 20% to 50% improvement in time management),

(5) service/ after-sales enhanced (estimated 105 to 40% improvement in maintenance cost savings), (6) productivity enhancement (estimated resource/process enhancement 3% to 5% improvement), (7) labor efficiency usage (estimated 45% to 55% improvement in productivity, technical professions, and automation work) and, (8) forecasting supply/demand projection (efficiency enhancement by 85% with improvement to cash flow and inventory savings [15].

In the global acknowledgement of Industry 4.0, PwC conducted a survey in 2015 involving 26 countries with more than 2,000 companies as shown in Table 1. This global survey showed a contrasting result until 2015 and expected in 2015. A huge and vast improvement in the adaptation of Industry 4.0 by sector is expected to be seen.

Table 1. Summary of Industry 4.0 by Sector, Source: PwC (2016)

Until 2015 (%)	Sector	Five Year—2020 (%)
45	Electronic	77
32	Aerospace and Defense	76
35	Industrial Manufacturing	76
32	Chemicals	76
38	Forest Products, Paper, kg	72
28	Transportation and Logistics	71
30	Engineering and Construction	69
41	Automotive	65
31	Metals	62

In general nearly 38% of respondents mentioned that the firm is in advanced levels of integration level and digitization stage and the balance 72 percent expected to reach that point by 2020. 86 % of the respondent mentioned that based on their experience, cost reduction and revenue gain was expected from advanced digitization efforts was expected to increase profitability between 20 % to 25% in the five years period [18,19]. 55 % of the respondents believed that the return on investment is within a two years period despite the high capital investment. Industry 4.0 is a futuristic global business enterprise connecting machinery, warehousing systems, manufacturing, services, and production through Cyber-Physical Systems (CPS). The smart use of Industry 4.0 will enable smart information exchange (to plan), trigger the preparation in arrangements (to organize), action with no interventions (to direct) and influence the resulting output (to control) independently [11] resulting savings in time, cost, inventory, resource and increasing efficiency and resource use.

Industry 4.0 is a terminology which works as a smart factory using digital technology systems that can network and communicate with supply, production, and goods. They include raw material, natural resource, semi-finished parts, semi assembled products, finished products, factory equipment, robotic machinery, communication and internet electronics, and people. Looking at shareholders portfolio from the Industry 4.0 perception smart factory is a shareholder with higher order artificial intelligence. A smart factory is embedded with sensors to respond to signals, programmed for self-learning and correction ability. Industry 4.0 in this 21st century can enable a firm to be part of an innovation to create 'new' product, services while enhancing cost reduction and efficiency Industry 4.0. The future concepts and new visions of factory of future development [20].

Industry 4.0 viewed from the SD pillar of environment relates to dimensions that impacts resources (people, products, materials, time, energy, cost, efficiency, waste, sanitation, and water) which can only be realized through the intelligence of cross-linking value creation. Industry 4.0 when impact industrial sustainability pillar value of environment it relates directly with social pillar also. Value in business is then created in this network as a summary from the opportunity provided in sustainable development values included manufacturing from macro and micro perspectives. While equipment, tools, human, organization, process, and product are the summary of opportunity from a micro perspective approach in sustainable production trends, virtualization and development focus that

is related to Industry 4.0 [17]. The macro sustainable values go to the greater comfort of people and mother earth today and for the future generation.

2. Industry 4.0 in Malaysia

Malaysia acknowledges the drivers of Industry 4.0 Transformation Drivers are global economic order, technology advancement, knowledge and skill, global supply chain, competitiveness, regulations, and customer behavior. The interaction capacity related to the resulting convergence of technologies is very fast with an unprecedented pace and breadth in impact creation [21]. Many industries in Malaysia are prematurely stuck at Industry 3.0 and some even at Industry 2.0 level (agricultural, village manufacturing, service, and low technology base), mainly due to the initial expensive and huge capital investment outlay (skill, automation, and IT) and availability of cheap and legal foreign workers option [22]. 70% to 80% of Malaysian industries are stuck in the cheap labor-intensive era. This shows the mentality of business shareholder's unwillingness to invest and progress with technology. Unlike the 90s era, Malaysia then was a leading industrial nation but now faces tough competition from her neighbors. Malaysia's South East Asia neighbors are scaling up the technology ladder and bridging the gaps rapidly from their past dependency on Industry 2.0 and Industry 3.0 with the latest Industry 4.0 technology, knowledge, and skill gaps. These changes have contributed towards a massive 4.1% efficiency increase annually for the last five years [23]. Information and communication technology (ICT) adoption among Malaysian SMEs are below 10% compared to developed nations like Germany and Japan which stands at 50% [24]. Changes arising from digital revolution can contribute towards production and process to uplift the industrial challenges faced by Malaysian SMEs with Industry 4.0 inclusion [25].

These are critical issues that need to be addressed and Abod [25] mentioned that they only possible through training, finance availability and management mindset change. SMEs and industries in Malaysia have no choice, either be trained and be a part of Industry 4.0 or start to lose business. It is critical for industries to remain competitive and that starts with workforce mindset. Change or be excluded. Changes bring new challenges and funds. Funds are needed to obtain the appropriate training skills and to purchase the proper hardware that can support changes. The critical external resource in the form of government support is needed by the industries to steer with accordance to the industrial needs, country policies, and global needs. Financing Industry 4.0 relates to huge capital investment starting with IT infrastructure which relates to cost barriers. Strategic inclusion of Industry 4.0 initiatives leads impact in production unit cost efficiency. Excluding Industry 4.0 distances the industry's future from excellence and deters the global competitive growth. Embracing Industry 4.0 starts with management mindset changes either to be excluded or be part of changes with economic transformation. Management needs effective management skills to integrate digitalization which begins with top management's understanding the benefits and to institutionalize the same vision with all employees within organization. Industry 4.0 is the trigger cause towards inclusive changing environment to cater the constantly changing needs and demands of global customers.

Human Resources Development Fund CEO was quoted by Pandiyan [22] that Malaysia has 15 million workers employed in the private sector with needs in training to uplift skills and multi-skilled to meet new demands in the increasing digitalization workplace. Only two million of these workers are HDRF-registered and have benefited from the training initiatives endorsed and approved for the need of the industry, which are certification-based programmes. HRDF expects to spend RM203mil for such training programmes until 2020 by including ICT adoption, big data, women empowerment, and digital talent development for the industry [22]. Industry 4.0 in manufacturing and production segment is expected to revolutionize operations which will drive cost down, benefit customers, and play a crucial role to expand market reach with new consumers ahead of competitors. Malaysia had a head start in electronics, automotive, and construction industry in this region had has the edge to implement modern and new manufacturing technology in Industry 4.0. Dependency on cheap foreign labour for semi-automated production and reluctance mind set to let go of the past is seen as the main obstacle towards change for the nation, industry, and people to acquire new technology and skills.

Industry 4.0 is no longer an option but must be included for being relevant in efficiency increase, productivity enhancement, and new market entry through digital platforms [23]. If changes ignored and excluded, short-term gains and profiteering will corner Malaysia in a vicious trap while other neighbouring nations move ahead in technology and long term growth opportunity. The other areas which expect impacts are consumers, government, governance, and society. Customers demand are only seen to continuously increasing for physical products and services but new marketing methods using technology and database service records through analytics methods adds to sales performance enhancement [26]. These are seen to establishing a background with new collaboration partnership involving innovation to create work disruption globally. New global platforms now create uncharted new business models created by talent, culture, and organizational newness bridges and rethinking traditional application methods. Efficiency, productivity, and even with customization have led to lower cost, these are the attributes of Industry 4.0 that cannot be avoided [27]. Industry 4.0 concept gather and communicates with technology establishing a new platform bridging global partnership enabling people to dialog with governments across the world, voice opinions, coordinate efforts on cross border information, and supervise of public authorities with demanding results based on real and current time data as information input. Use of information communication technology for business use ballooned from 27% in 2011 to 89% in 2016 [28].

Governments gain power through new technology application and are able to keep orderly control, understand the needs of her people and create changes accordingly, which is possible through pervasive surveillance and control of digital infrastructure [29]. Society can and will be re-shaped by Industry 4.0, either willingly or by force as changes are inevitable [23]. Industry 4.0 has the capacity to act on our interactive methods, our level of awareness and knowledge to address income inequality and gender bias. The speed and pace of Industry 4.0 adoption and use amongst rich nation will further widen the monetary gap between rich and leaving the poorer against future opportunity. Malaysia is not in a position to choose but it's now the time to embrace this technology wave or stand to be forsaken and overlooked. Government investments related to correct education systems and methods are not a choice but a must for the development of talent and skills. The young must be trained early, pushed to accept, and ready for accepting the shift towards a knowledge-based economy. Government incentive, policies, and approach must move in unity and tandem with all ministries and agencies to embrace this technological advancement for a more sustainable future. Society, regardless of age must be trained to accept changes that come with Industry 4.0 acceptance and implementation. Industry 4.0 once implemented successfully in Malaysia may reduce workforce in technology upgraded industry. There are corrective actions that need to be taken by government and the private sector to adopt appropriate counter measures needed with the anticipated disruption. Any measure must start with our education system with a focus on thinking development, creating a new culture in entrepreneurship, and talent to embrace new progressive technology charter.

The 80s' Asian tigers are Malaysia, Singapore, Korea, and Taiwan but in today's reality, Singapore, Korea and Taiwan have moved ahead in status especially towards high growth nation status. Malaysia is barely ahead of other ASEAN countries such as Indonesia, Thailand Vietnam, and Cambodia but these nations are moving ahead in leaps and bounds with their larger population base advantage and big domestic market encouraging faster economic growth [23]. Malaysian national framework on Industry 4.0 was undertaken by the Ministry of International Trade and Industry, Ministry of Science, Technology and Innovation and Ministry of Higher Education under the cabinet initiative. The Industry 4.0 High-level task force has five Technical Working Groups (TWGs) [21] comprising of (1) Digital Infrastructure and Eco-system led by Multimedia and Communication Ministry Malaysia, (2) Funding and Incentives led by the Ministry of Finance, (3) Talent and Human Capital led by the Ministry of Human Resource and Ministry of Higher Education, (4) Technology and Standards led by the Ministry of Science, Technology and Innovation and (5) SMEs led by SME Corporation, Malaysia. The industry, nation, and people must be trained and educated to look forward to an inclusive Industry 4.0 framework but a framework alone is not enough unless law on the over-

reliance of cheap labour is not addressed that will lead to resisting choice of not wanting advancement change.

3. Sustainable Development (SD)

The SD concept is defined, accepted, and used from the Brundtland Commission's report (1987). 'Sustainable Development' is defined in this report as 'the need to meet the demands and needs of present generation, but the present generation cannot compromise the need and ability of future generations to meet them themselves'. Our Common Future [30] as mentioned in Brundtland Commission report refers to the three pillars, which are economic growth, environmental protection, and social equality [31]. Conferences in sustainable development started from 1972 and continues even to date but have changed in tone, action, direction, acceptance, outcome, and politics. Issues with environmental conditions started at 1972 Stockholm conference, then moved to a shared focus on environment, social, and economy development before moving to the primary emphasis in poverty in 2000 at the Millennium Summit and now stands with the agenda 2030 with sustainable development goals (SDG).

Agenda 2030 on SDGs started on 1st January 2016 and is effective for 15 years until 2030 and is the expansion to Millennium Development Goal as outlined in Figure 1.

Figure 1. Sustainable Development Goals, Source: Hwang & Jiwon (2016)

The 2030 Agenda's core principles are Universality, Leaving no one behind, Interconnectedness and Indivisibility, Inclusiveness and Multi-Stakeholder Partnerships [32]. SDGs must relate towards dimensional contribute of people, planet, prosperity, peace or partnership. The method of contribution is through (1) People to benefit through eradication of (a) hunger, (b) poverty, (c) dignity and (d) equality in a new and healthy surrounding, (2) Planet earth needs protection from (a) degradation, (b) unsustainable consumption on use of natural depleting resources, and c) introduction to production and use of a renewable resource, (3) Prosperity for mankind through (a) prosperous surrounding and fulfilling living conditions, (b) progress in values of economy, social and technology synchronizing with surrounding, global growth, and nature, (4) Peaceful life through harmonious yet peaceful surrounding, and (5) Partnership in united global partnership formation for global progress. SDG is not an individual effort, but a united effort by individuals, society, firms, governments, cluster groups, nations and governments as humankind to combat decisively on climate change, for current and future generations [32, 33].

Malaysia follows the same concept and definition as stated in UN resolution [34]. Malaysian participation in SD is through (1) Malaysia National Development Policy for poverty eradication since 1993, (2) National Conservation Policy for environment considerations as per SD of Agenda 21, (3) Malaysia National Vision Policy for an equitable society through economic development and environmental protection as per SD requirements (d) Malaysia Vision 2020 or 'Wawasan 2020' for development through economic development without neglecting political balance, social acceptance, spiritually respect, psychological, and cultural understanding. Malaysia through these programs

managed to reduce poverty levels below 5% since 2005 [35,36]. The government leads the biggest effort in handling natural resources and environment.

In Malaysia, the public participation and awareness is very low on environmental [37]. Malaysia has placed its importance on SD since the Ninth Malaysia Plan (9MP) and ranks 38 in overall SD world ranking, second in Asia, and 9th in environmental performance index related to ecosystem protection in environmental stress for human health reduction status [38]. Malaysia adopted Agenda 2030 at the United Nations General Assembly, held in New York on 25 September 2015. Malaysia supports Agenda 2030, has agreed for global monitoring and to report Voluntary National Review (VNR) in 2017 at the world High-level Political Forum (HLPF). The VNR accounts was included in the Eleventh Malaysia Plan from 2016 until 2020 which includes National SDG Roadmap development [29] as stated in Appendix 1. Malaysia is committed and will perform her commitment to ensure Agenda 2030 is achievable.

4. Industry 4.0 and Sustainable Development

The literatures on Industry 4.0 with sustainable development inclusion are very limited. A vivid comparison from the scientific and academic perspective is blurry on its contribution. A lot has to be seen in actual contribution on the Industry 4.0 to the SD impact in short and long term [39]. Creative destruction using technology advancement portrays two sides of the coin, the first leads to the destruction of past work, skill, and older qualifications and the second leads to building of new dimension in advanced technology based job creation, new skilled qualification and service [40]. The SD paradigm in Industry 4.0 gets affected through resources (products, materials, energy, and water) perspective which impacts environmental. Industry 4.0 creates continued connectivity in product and service achievement through output efficiency enhancement involving intelligent, smart, faster, and cross-linked new value creation. Industry 4.0 is a concept that creates useful SD opportunity through industrial related smart production and efficiency creation that relates indirectly to economy and social pillar [17]. A summary of the advantages created by encapsulating the Industry 4.0 approach towards sustainable development and achievement of the 17 goals can be seen in Table 2. Though there will be more but the real derivative of benefit will be seen in time.

Table 2. Integration of Industry 4.0 and SDG Achievements

No	'Industry 4.0'	Benefits	SDGs
1	Big Data a) New service Industry	Increased positive impact or reduction in a negative impact on environmental & social issue (Smit et al., 2016).	Goal 8
2	Supply chain a) Industrial value creation	Integrate environmental thinking, connecting the efficient extraction of resource and linking created waste as a whole process model that includes input of energy and water that associates the regeneration process towards the renewal of (Man & Strandhagen, 2017; T Stock & Seliger, 2016)	Goal 6, Goal 7
3	Education, Technical and Engineering	Human relation skills with higher education in technical and engineering bring balance between social skills, science knowledge, technical, and training. Identification, competency deduction, and visualization of competency needs to new challenges with SD inclusion (Baena et al., 2017; Hecklau et al., 2016)	Goal 4, Goal 5
4	Manageme-nt and human resource development	Only qualified, highly educated and skilled employees will control technologies related to Industry 4.0. , Key to an innovative factory, thus development and training of quality and qualified Human Resources Management will be critical (Benešová & Tupa, 2017).	Goal 4, Goal 5

No	'Industry 4.0'	Benefits	SDGs
5	Driver for creating competitive advantage	Drive down costs and increase efficiencies, capability for new and huge customer base and data related from market provides a dynamic capability to remain connected with a customer base, trends, and changes (Davies et al., 2017).	Goal 8

5. Discussion and Conclusion

Industry 4.0's common words are smart sensor, Internet of things, big data, cloud-based design and manufacturing, a social product development, smart "intelligent" factory, additive manufacturing (3D printing), cyber-physical system, integrated automation, digital software development platform, industrial value chain initiatives, information technology, information and communications technologies, autonomous robots, simulation, universal system integration, cyber security, artificial intelligence, augmented reality and human-machine interface and interaction via smart phone. Industry 4.0 relates to a dimension of factory operations and product, business and customer, and technology of an organization that can go beyond 'Strategy', 'Leadership', Governance, 'Culture' and 'People'. Industry 4.0 is a stand-alone concept and can lead towards process development, quality improvements, reduction in rejects, maximization of natural resource, efficiency increase, productivity improvement, and cost reduction. Industry 4.0 gives benefit to planning, innovation, maximizing design, enhancing the value chain, and technology to create new competitive edge created with big data availability and usage. Industry 4.0 uses in industrialization, state of art infrastructure, and fostering innovation leads to development in high income growth of an economy through job creation, income increase, and social equality for a better standard of living.

A system is created and ready for exploitation with the inclusion of SD economy in the environment business for the comfort of the society today and for tomorrow. This SD economy model can show an increase with positive impacts or lead to a reduction and contribute to environmental activity while making the society happy. This leads to competitiveness in the firm and business in the long run. The current SD''s global business opportunity is in a constant growth stage creating huge opportunity to business and Industry 4.0 application.

Malaysia has taken steps in her education system in skills related to Industry 4.0 application but current manpower knowledge and skills need to undergo vigorous training and retraining including introduction of coding in school syllabus. Malaysian firms need to adopt Industry 4.0 for other reasons too besides economy which include wastage reduction or elimination and renewable energy source usage or maximization of energy use. The sets the mapping process of SDG target achievement in Malaysia's human capital development for an advanced nation, strengthening infrastructure, innovation and Industry 4.0. Malaysia needs quality skilled workers, a new dimensioned job creation, economy development growth associated with social advancement, physical connection in fast, clean, and cheap transport and availability of high-speed Internet. The future lies with enhancing competitiveness, controlling cost of business, quality consistency with growth and international competition. The key question for the immediate future remains whether Malaysia has done enough to let go of the past believes on imported "cheap" labor-based mentality.

Industry 4.0 is about firms orienting itself to customers through digital frontage using e-commerce, digital marketing, social media, and digitalizing big data through customer experience. Industry 4.0 relates to investment in automation and adopts digital platforms for business digitalization. Industry 4.0 is not only about being smartly connected to system integration or about machines but it relates to a fusion with hardware and software or beyond. The future lays with gene sequencing to nanotechnology, leap frogging from conventional to quantum calculation, and from traditional to digitized supply chain. These activity leads to an increase in efficiency and productivity. The claimed return of investment is faster return through technology convergence, and mega-trend adaptation.

Industry 4.0 application usages can contribute positively to SD. and in Malaysia has indeed taken steps towards accepting as there is no exception. Industry 4.0 can contribute to objectives of sustainable development effectively to the prevailing principles of economic, social, environment and

also Agenda 2030's specific targets of people, planet, prosperity, peace, and a partnership if there are a mindset change and investment on digitization. This study concludes that the new measurement of performance benefit should be viewed from the perspective of SD pillar of environment and social as Industry 4.0 begins from the economy perspective.

Acknowledgement

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Appendix 1

Malaysian SDG Roadmap

Item	Goals	Policy and Plan
Goal 1	To end poverty everywhere	Strategic Thrusts 3, 4 and 6, Game Changers "Embarking on Green Growth" and "Unlocking the potential of productivity" • Occupational Safety and Health Master Plan 2016–2020 • SME Master Plan 2012–2020 • Malaysia Productivity Blueprint

Item	Goals	Policy and Plan
Goal 2	To end hunger, food security, improve nutrition and promote continuity in agriculture	Strategic Thrusts 3, 4, 5 and 6, Game Changers "Translating innovation to wealth" and "Embarking on Green Growth" • National Policy on Science, Technology and Innovation (NPSTI) 2013–2020 • Strategic Information and Communications Technology (ICT) Roadmap • National E-Commerce Strategic Roadmap
Goal 3	To ensure healthy living and well-being at all age	Strategic Thrust 2 • National Strategic Plan for Non-Communicable Diseases 2010–2014 • National Strategic Plan for Tobacco Control 2015–2020 • National Strategic Plan for Communicable Diseases • National Strategic Plan Ending AIDS in Malaysia (NSPEA) 2016–2030 • The National Plan of Action for Nutrition of Malaysia III 2016–2025 (NPANM III) • National Reproductive Health Education and Social Education (PEKERTI) Policy and Action Plan • Health Human Resource Master Plan
Goal 4	To include equitable education with quality lifelong learning opportunities	Strategic Thrust 3 • Malaysian Education Blueprint 2013–2025 (MEB) • Malaysia Education Blueprint (Higher Education) 2015–2025 • National Higher Education Strategic Plan • Blueprint on Enculturation of Lifelong Learning for Malaysia 2011–2020
Goal 5	To achieve gender equality, including empowering women	Strategic Thrusts 1 and 3 and Game Changer "Uplifting B40 towards a middle-class society" • National Policy on Women 1989 • Plan of Action for the Advancement of Women 2010–2015
Goal 6	To ensure continues supply availability in water and sanitation	Strategic Thrusts 1, 4 and 5 • National Water Resource Policy (NWRP)
Goal 7	To ensure affordable, reliable and sustainable energy	Strategic Thrusts 4 and 5 • National Renewable Energy Policy and Action Plan 2009 • National Green Technology Policy 2009 • National Energy Efficiency Action Plan 2015
Goal 8	To promote sustainable economic growth with decent and legal employment	Strategic Thrusts 3, 4 and 6 and Game Changers "Embarking on Green Growth" and "Unlocking the potential of productivity" • Occupational Safety and Health Master Plan 2016–2020 • SME Master Plan 2012–2020 • Malaysia Productivity Blueprint
Goal 9	To include infrastructure, inclusive industrialization and innovation	Strategic Thrusts 3, 4, 5 and 6, Game Changers "Translating innovation to wealth" and "Embarking on Green Growth" • National Policy on Science, Technology and Innovation (NPSTI) 2013–2020 • Strategic Information and Communications Technology (ICT) Roadmap • National e-Commerce Strategic Roadmap
Goal 10	To reduce inequality among gender and country	Strategic Thrust 1 • National Policy on Children and its Plan of Action • National Child Protection Policy and its Plan of Action • National Action Plan for Persons with Disabilities 2016 to 2020 • Minimum Wage Policy
Goal 11	To make city and settlements with community safe and resilient	Strategic Thrusts 1, 2, 4 and 5 and Game Changer "Investing in competitive cities" • National Physical Plan 3 (NPP3) • National Urbanization Policy 2 (NUP2) • Competitive Cities Master Plans • National Environmental Health Action Plan • National Housing Policy (DRN) 2013 to 2017 and DNR 2.0

Item	Goals	Policy and Plan
Goal 12	To ensure responsibility in resource consumption	2018 to 2022 • Road Safety Plan of Malaysia 2014 to 2020 • National Solid Waste Management Policy Strategic Thrusts 4 and 6 and Game Changer "Embarking on Green Growth" • National Ecotourism Plan 2016–2025 • National Policy for Biological Diversity 2016–2025 • National Environmental Health Action Plan (NEHAP) • National Solid Waste Management Policy 2006 • Solid Waste and Public Cleansing Management Corporation Strategic Plan 2014–2020 • Department of National Solid Waste Management Strategic Plan 2016–2020 • Construction Industry Transformation Programme (CITP) 2016–2020
Goal 13	To act immediately on climate change impacts	Strategic Thrusts 2, 4 and 5 • National Policy on Climate Change 2009 • National Urbanization Policy 2006–2020 • National Physical Plan 3 • National Green Technology Policy 2009
Goal 14	To conserve oceans and marine life as resource	Strategic Thrust 4 and Game Changer "Embarking on Green Growth" • National Plan of Action for the Coral Triangle Initiative (NPOA-CTI) 2009 • National Policy for Biological Diversity 2016-2025 • National Oil Spill Contingency Plan (NOSCP) • National Coastal Zone Physical Plan • National Ocean Policy 2011–2020 • National Plan of Action to Prevent, Deter and Eliminate IUU Fishing • National Plan of Action for Management of Fishing Capacity in Malaysia 2014–2018
Goal 15	To use, protect and restore life on land, including nature and environment as resource	Strategic Thrust 4 and Game Changer "Embarking on Green Growth" • National Policy for Biological Diversity 2016–2025 • National Tiger Conservation Action Plans 2008–2020 • Elephant Conservation Action Plans 2013–2022 • National Forestry Policy 1992 • National Action Plan on Peatlands 2011
Goal 16	To advocate, promote, equal and accountable access to peace and justice	Strategic Thrusts 1 and 2 and Chapter 9 on "Transforming public service for productivity" • National Policy on Children and its Plan of Action • National Child Protection Policy and its Plan of Action • ASEAN Regional Plan of Action on the Elimination of Violence Against Women and Children • Plan of Action on Child Online Protection (PTCOP)
Goal 17	To pave way for friendship, implementation and partnership for goal achievement	Strategic Thrust 6 • Malaysia's foreign policies and trade policies • AEC Blueprint 2025 • ASEAN Strategic Action Plan for SME Development 2016–2025