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INDUSTRIAL REVOLUTION 4.0: RISKS, SUSTAINABILITY, AND IMPLICATIONS FOR OIC STATES

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*Riaz Ansary***

Abstract: This paper reviews the potential risks of the fourth industrial revolution and how sustainable development goals align with those risks and any benefits. This paper adopts a qualitative research method using content analysis of video and textual materials. This research finds that the increased complexity of IR4.0 carries greater risks but offers greater benefits to humanity. Sustainability is going to be positively affected by the greater use of smart interconnected technologies. However, the fabric of human society will undergo a tremendous change that will often lead to unwanted consequences. Many risks can be anticipated and addressed by designing systems, including financial and economic, that are inherently robust and adaptable. States must acknowledge the risks associated with new technologies and complex systems, such as artificial intelligence, and devise strategies to help deal with and anticipate those risks. This paper identifies the risks and benefits of the Fourth Industrial Revolution, implications for sustainability, and proposes a *maqasid*-based approach to IR4.0 related policy in OIC countries. This paper is intended for researchers in the area of public policy, OIC, Islamic economics and for policymakers interested in adopting the *maqasid* framework.

Keywords: Industrial Revolution 4.0, Sustainable Developments Goals, complex systems, risks, artificial intelligence, *maqasid al-shari'ah*.

Introduction

Humanity as a whole is currently enjoying unprecedented levels of abundance in food and water, safe housing, as well as enhanced communication and information technology. However, these blessings are still not available to hundreds of millions of people on our planet today. Sustainable development goals were designed to be universal in their outreach. Since conditions are not the same all over the globe, the risks faced by different societies and communities differ greatly. This paper is written with the conditions of general prosperity and abundance in mind. The Fourth Industrial Revolution (IR4.0) is presently taking

place exactly in these conditions, which are unlikely to deteriorate in the next several decades unless natural disasters and pandemics bring humanity to the edge of annihilation.

Circumstances today, as always, have uncertainties and risks arising therefrom. These are mainly due to our inability to correctly predict the future despite all the modern tools available. Historically, humanity tends to develop in waves, whereby bad times (negative) are followed by good times (positive), and so on. This process is gradual; despite humanity's best efforts to maintain order, disorder always sets in due to a multitude of factors. However, efforts to keep social order via laws, rules, regulations, and norms, slow down the process of disorder in societies. The natural world, on the other hand, operates at a different level, and it has its own order, which for us may seem chaotic and senseless. The law of nature is based on diversity, which brings about prosperity.

Therefore, it is imperative for humanity, especially the scientific community and government bodies, to continuously assess uncertainties and risks, and take necessary measures to minimise negative outcomes. The unstoppable proliferation of information and communication technologies under the so-called IR 4.0 produces a great deal of uncertainty and uneasiness about the future, and, consequently, calls for greater understanding of the potential risks and their effects upon society in general and sustainable development in particular.

The WEF Global Risk Report 2020¹ places environmental disasters at the top of the list with regard to likelihood and/or impact. Issues like extreme weather, natural disasters, biodiversity loss, and other such crises are the result of human activities that increase CO₂ emissions into the atmosphere, causing the greenhouse effect and leading to raised temperature and negative changes in biodiversity, climate, agriculture, and so on. The report also acknowledges that rapid advances in information and communication technologies (ICT) are changing the fabric of human society whereby the markets for jobs, goods, and services are also undergoing a rapid change.

Therefore, this paper aims to critically analyse the risks of IR4.0 and see how sustainable development goals are affected by those often obscure and opaque risks. It offers the possibility of assessing the risks of IR4.0 using an assessment tool and matrix, and proposes an ethical framework for future sustainable development.

Characteristics of the IR4.0

The coronavirus pandemic (COVID-19) that we are experiencing today is having far-reaching effects, especially on businesses, whole economies, as well as

political consequences for some ruling elites. However, a year on from when the virus was first detected in November 2019 in Wuhan, China,² we are seeing that this pandemic has not changed the fundamental architecture of our societies and economies. In other words, even though we are witnessing significant changes in human behaviours and interactions, we have yet to see a global systemic effect whereby whole countries and societies are uprooted, national borders redrawn, governance structures broken down, and world economies tipped into uncontrollable crises. On the contrary, humans have quickly adapted to the pandemic and are learning to live with social distancing, working from home, and home-schooling. Moreover, many countries are trying to go back to normal amid the ongoing pandemic, albeit with extreme caution. In general, the existing global as well as local governance architectures have not been greatly affected.

Risk events, especially epidemics and natural disasters due to human activity, are not “black swan” events. They cannot be discounted as random and unlikely to happen, for doing so would lead to a lack of oversight and preparedness by the authorities. Most recorded crises, especially economic, financial, and natural, are the result of human endeavours conducted without proper governance and understanding of consequences. One of these fields of human endeavour is technology, which if not properly supervised, managed, and regulated, will sooner or later result in some form of crisis. Consequently, as IR4.0 continues to develop, its risks will also continue to grow. So, countries need to think ahead and realise how potentially hazardous such growth may be for humanity.

Historically, significant changes in human production activities are likened to revolutions because they brought about systemic changes. According to Schwab,³ the first Industrial Revolution (IR) happened between c.1760 and 1840 and was characterised by the invention of the steam engine, railroads, and the mechanisation of production. The second IR happened between the middle of the nineteenth and the greater part of the twentieth century and was spurred on by the invention of electricity and the assembly line. The third IR was due to digitisation, including the invention of semiconductors, computers, and the internet (from the 1960s to the beginning of the twenty-first century). And now we are at the beginning of IR4.0, characterised by greater access to digital technologies, greater internet connectivity through the ‘Internet of Things’ (IoT), and the reduction in costs of production and need for human labour.

Yvanovich states three main challenges presented by IR4.0, namely: cybersecurity, lack of qualified and experienced specialists, and shrinkage in the job market.⁴ By contrast, the main opportunity is the increased use of data that can be turned into actionable insights. To be considered part of IR4.0, he continues, a system (manufacturing or service sectors) must include the following elements:

- Machines, devices, sensors, and people that can communicate with ease.
- Ability to provide actionable insights and promote information transparency.
- Ability to provide technical assistance when needed, during problem-solving processes, or when the situation is too dangerous for humans.
- Machine learning algorithms to enable decentralised decision-making, becoming as autonomous as possible.

According to Stockwell, IR4.0 has the following components: (1) data generated by instruments, devices, sensors and software, which needs to be stored, analysed, and acted upon; (2) constant interconnectedness via IoT platforms; (3) inclusiveness or ubiquity, whereby data, generated by various devices and brought together via IoT, provides a better user experience through algorithms using predictive analytics; and (4) making increasingly intelligent decisions based on machine learning, artificial intelligence, and predictive analytics.⁵

Before going into the risks presented by IR4.0, let us see the characteristics of the social, economic, and technological environment dominated by interconnected technologies (compiled from various sources and personal observation):

1. Increased connectivity between devices, equipment, buildings, vehicles, and humans.
2. The exponential increase of data through intelligent systems via sensors.
3. Disruption to established business models, especially financial services, manufacturing, and distribution.
4. More automation in production and service processes.
5. Lower costs of production, leading to “zero marginal cost production”.
6. Real-time autonomous and intelligent decision making.
7. Smart manufacturing, marketing, and services.
8. Non-linear integration (vertical-horizontal axis integration).
9. Increased complexity of all systems.
10. Greater man-machine collaboration.
11. Greater collaboration between sciences (natural and social), technology, and engineering.
12. Increased uncertainty and unpredictability of complex systems.

Most of the elements above are quite positive and point towards more efficiency and effectiveness of production, management, and communications. Below are some of the benefits of the new interconnectedness:

1. Greater access to education and knowledge.
2. Cheaper products and services.
3. Greater efficiency in resource management and production.
4. Better designed products.
5. Cheaper energy.
6. Faster and more efficient innovation processes.

However, one worrisome characteristic of IR4.0 is the increased complexity of all known systems, including financial, manufacturing, travel, communications, business and others. Anything that is not well-understood bears more uncertainty and risk. The complexity of life, dominated by ever-developing technologies, especially Artificial Intelligence (AI), may have the following risks, many of which are already a reality:

1. Loss of jobs due to automation.
2. Greater security and privacy risks.
3. Design flaws of highly connected systems leading to disasters or other unwanted consequences.
4. The proliferation of fake and post-truth messages in social and mass media.
5. Low predictability of complex systems, especially those built by AI.
6. Greater potential for fraud, hacking, spying, or remote manipulation of infrastructure software (e.g. electric grids, nuclear power plant management software, flight control tower operations, hospital/university/government records, etc.).
7. Psychological dependency on technologies, especially in entertainment (games, movies, shows, music, etc.).
8. Easy access to potentially dangerous ideas, news, arms, plans, drawings, etc. (e.g. drawings of 3D-printed guns).
9. Unpredictable algorithms created solely by machines via AI, machine learning, and big data analytics (e.g. high-frequency trading software).

IR4.0 Risk Assessment

The risks emanating from IR4.0 can be classified as man-made and machine-made. The majority of risks tend to be man-made. In other words, they are the result of human intervention at the level of innovation, production, or execution. Machine-made risks are not as evident but not less dangerous due to their unpredictable nature, especially with regards to AI, which is allowed to create its own intelligence via the deep learning techniques of big data. Despite the apparent usefulness of individual smart technologies, their potential collective risks are not well understood. Moreover, as we are in the initial stages of an ICT-led industrial revolution, one can only imagine what effects technology will have on human society and nature in the remaining part of the 21st century and beyond (if we survive the natural disasters that happen with increasing intensity).

Risk is complex. While it can be practical to categorise risk so that responsibility can be delegated to different organisations, institutions, or individuals, risk management must not be “departmentalised”. Complexity challenges the problem-solving model of separating issues into singularly defined parts and solving for the symptoms. It is imperative that our understanding of risk is developed without resorting to reductive measures that isolate and remove from context, and ignore systemic characteristics. This applies as much to our institutional arrangements for risk governance as it does to community organisation, research endeavours, or policy formulation.⁶

Risk management requires that risk-takers be mindful of potential negative outcomes and their intensity or severity. Risk, as defined by the International Standards Organisation, is the “effect of uncertainty on objectives”.⁷ Assessment of risks is a deliberate procedure that involves a conscious effort to visualise and quantify actual and potential risks involved in a given activity. ISO defines this as the “overall process risk identification, risk analysis, and risk evaluation”.

Diagram 1: Risk assessment elements and purposes

Hence, risk assessment is a systematic process aimed at finding the sources of factors that may prevent the achievement of certain objectives and dealing with them effectively. According to the ISO 31000:2018,⁸ at the identification step one would assess tangible and intangible sources of risk; threats and opportunities; vulnerabilities and capabilities; changes in context; nature and value of assets and resources; limitations of knowledge and reliability of information; consequences and their impacts; and the biases, assumptions, and beliefs of those involved. The risk analysis step considers: the likelihood of events and consequences; nature and magnitude of consequences; complexity and connectivity; time-related factors and volatility; efficiency of effective controls; and sensitivity and confidence levels. Lastly, the risk evaluation step helps to: make the decision to do nothing or to consider risk treatment options; undertake further analysis to better understand the risk; maintain existing controls; or reconsider objectives. This process would, in the end, help reach a decision to avoid the risk, remove it altogether, minimise it, change the likelihood or consequences, or share/retain it.

To give a simple example, one can visualise the negative effects of driving a modern car on a modern busy road without the seat belt fastened. In case of an accident, not using the seat belt results in a much higher chance of fatality. This can be quantified, visualised, and assessed in terms of probability and severity. Likewise, the elements of IR4.0 can be assessed by using some form of risk assessment. However, it may not be possible, in our opinion, to assess the risks of the whole IR4.0 because it is a system consisting of techniques, companies, people, industries, projects, and many other elements scattered across the globe. On the other hand, it is possible to assess and manage risks associated with a particular technology or a project. Therefore, this paper is going to deal with only one type of technology, which is at the heart of IR4.0: Artificial Intelligence (AI). In the next few pages, the concept of AI will be defined with some examples of available and future technologies, risks associated with AI will be presented, and a preliminary assessment will be made using the technique of “Preliminary Risk Analysis” (PRA). There are many other detailed tools (e.g. Failure Modes and Effects Analysis, Fault Tree Analysis, Scenario Analysis, etc.) that could be used for this task, but we chose PRA due to its simplicity. Thereafter, the paper will analyse how these risks affect sustainable development goals.

Artificial Intelligence

To start analysing AI risks, it is important to define the term and present examples. Firstly, Artificial Intelligence (AI) is simply a man-made smart machine that is capable of making decisions independently. According to the European Commission, AI is:

software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal...

As a scientific discipline, AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), machine reasoning (which includes planning, scheduling, knowledge representation and reasoning, search, and optimisation), and robotics (which includes control, perception, sensors, and actuators, as well as the integration of all other techniques into cyber-physical systems).⁹

As the field of AI is not new (it has been around since the mid-twentieth century), the definition of what constitutes artificial intelligence has changed over time. Classical AI, first promoted by computer and cognitive scientists, emphasised the ability of a machine to compute and solve complex mathematical problems given input from the environment, also known as the information processing view. It was viewed as an input/output machine, which is hardly intelligent compared to live agents. The more recent idea of AI is that of an autonomous agent that can interact with the real world and survive on its own due to emergent behaviour. Emergent behaviour is a type of behaviour that is not programmed directly by a human programmer.¹⁰ Emergence is a property of complex systems, which may be described as “the whole is greater than the sum of its parts.” So, AI is a complex system comprising hardware and software that can collect data from the environment, process it, make decisions, and act on them without interference from its designer.

It was in Seoul in March 2016 that real AI is said to have been born, when the world champion in the board game Go, Lee Sedol, took on Google’s AlphaGo and lost four out of five games. AlphaGo was a computer program designed to learn the game and come up with its own strategy via deep learning.¹¹ AlphaGo differed from IBM’s Deep Blue (which beat Garry Kasparov at chess in 1997) in its capacity to learn and make its own strategy and not just compute possible moves and counter moves. The commercial implications of AI, that can analyse vast amounts of data and come up with unique solutions are enormous. On the one hand, it can create positive solutions to real-world problems in manufacturing and services, but on the other hand, it can be used to control populations via total surveillance, increase inequality and threaten democracy.

However, AlphaGo was domain-specific AI, which means that it was designed to learn and do only one thing – play a board game. This kind of AI is already used extensively by all Internet giants, such as Google, Facebook, Amazon, Apple, and so on. These systems are mainly software programmes designed to acquire huge amounts of data, process them to find patterns, learn from them to form new knowledge, and make appropriate decisions. They are used in finance, insurance, smart weapons systems, medicine, weather prediction, nuclear power simulations, and even for policing and surveillance. AI-enabled surveillance systems are becoming more and more sophisticated and are used by cities to control traffic and crime, and by some states to control their citizens via systems that are able to recognise millions of faces, car registration numbers, cars, other vehicles, and so on. China is the leader in this area today, where state sponsorship of AI-based applied research has seen gigantic amounts of data produced by millions of users every day. Kai-Foo Lee, a Chinese billionaire and technology investor, said: “In the age of AI, where data is the new oil, China is the new Saudi Arabia”.¹² However, these are all domain-specific artificial systems that are quite limited in nature even though they may be used to perform a variety of tasks.

Another upcoming trend in AI is Artificial General Intelligence (AGI). These systems can “...respond to a variety of previously unspecified situations, no matter how novel they are or unprepared the AI is for the task. Such an AI could...learn, create its own knowledge, make its own decisions, and simulate the human brain”.¹³ In other words, AGI would be characterised by its ability to function autonomously, interact with the environment, learn from it, and develop the capability to survive. Also, it would probably have some form or shape, such as a human-like robot (e.g. humanoid robots Sophia or Asimo). Even though such AI systems do not exist at the current time, efforts are underway to create these kinds of entities/robots. Baum surveyed 45 AGI research and development projects in 30 countries, which clearly show the interest among scientific as well as business and investment circles in advancing this technology.¹⁴ Major countries involved in this kind of R&D are the USA, China, Japan, UK, France, Russia, Israel, Switzerland, and a few other Western and Asian countries. However, most developed or developing countries have at least some form of academic and governmental interest in advancing AI-related technologies. This can also be judged from the number of vacancies announced for PhD and post-doctoral positions at universities around the world. For example, a quick job search for academic positions related to AI returned the following results:

- Global Academy Jobs (<https://www.globalacademyjobs.com>) – 486 jobs;

- TheUniJobs (<https://www.timeshighereducation.com/unijobs/>) – 114 results;
- jobs.ac.uk (<https://www.jobs.ac.uk/search>) – 102 jobs;
- Academic Positions (<https://academicpositions.com/find-jobs>) – 106 positions.¹⁵

Likewise, jobs in non-academic applied AI R&D are growing rapidly as well. These are related to AI proper, machine learning (ML), natural language processing (NLP), computer vision (CV), data engineering, and data analytics.

Risks Assessment of AI

To assess the risks associated with AI as part of IR4.0, we will use the Preliminary Risk Assessment method, as previously mentioned. To do so, the authors will have to make some assumptions with regards to the presence, likelihood, and severity of the risks under evaluation. This paper will only touch upon the six most worrisome risks, as listed below.¹⁶

	What could go wrong	Potential impact?	How might the hazard occur?	What is the likelihood on scale 1-5? (L)	How significant is the impact on scale 1-5? (S)	Calculate (LxS)	What might help control or mitigate the hazard?
1	Self-conscious, uncontrollable AGI	War on humans	Self-preservation algorithm	At present-1 In future-3	At present-1 In future-5	At present-1 In future-15	Control over research and development of AI, appropriate government regulations, ethical guidelines accepted by industries
2	Total control over populations by dictators or corporations	Threat to democracy, enslavement	AI-enabled surveillance systems	5	5	25	Strict international control over usage of AI-enabled surveillance technologies

3	Replacement of humans in manufacturing / agriculture / services industries	Loss of jobs and livelihood	More efficient robots	5	3	15	Government regulations that enable humans to upgrade skills, encourage creativity, or introduce universal basic income.
4	Industrial catastrophes	Loss of life	Flaws in design	3	5	15	Enable open-source R&D to detect flaws/errors in code. Have some form of ethical guidelines for R&D firms/ institutions.
5	Hacking/ malicious takeover of important assets via electronic means	Loss of wealth, shut-down of important utility services	Exploiting weaknesses in AI, Internet-connected technologies	5	4	20	More robust control/regulation/ audit of AI-built Internet-connected systems. Better ICT security infrastructure
6	Flawed algorithms in AI-enabled weapons systems	Loss of life of non-combatants	Bias in algorithms targeting certain kinds of individuals by robotic weapons	4	5	20	Some form of international treaty banning weapons that target specific segments of populations based on race, religion, ethnicity

Table 1: Preliminary Assessment of AI Risks

The results of Table I above are entered below into a matrix to give a better visualisation of potential risks and their severity. To do that, we use the risk score to place the hazards into appropriate cells in Table II. For Hazard No.1, we use the future occurrence score. Also, scores for Hazards No. 1 and 4 are the same, so they are placed in the same cell in the matrix. The last, Hazard No. 6, may be the most severe in its impact upon unsuspecting populations in certain areas where major military powers operate. In addition, all human-built machines are imperfect and maybe exploited either by other humans or by self-evolving AI.

Severity						
Likelihood		Insignificant 1	Marginal 2	Moderate 3	Critical 4	Extreme 5
	Certain 5			Replacement of humans in jobs	Malicious takeover of assets	Total control over populations
	Likely 4					Flawed AI-enabled weapons
	Possible 3					Self-conscious, uncontrollable AGI, Industrial catastrophes
	Unlikely 2					
	Highly unlikely 1					

Legend: Low | Moderate | High | Extreme

Table 2: Risk Assessment Matrix

The risks associated with AI assessed above are all in the extreme zone, which means they are all significant with regards to their effects on humans. Some of them have not occurred yet (No.1, 4, and 5) but their potential risk in the future is quite high. Risk No. 2 is a reality today as many governments seek to control their populations via security cameras coupled with face-recognition and other bio-surveillance technologies. This way they may easily identify citizens on the streets and use some form of punishment for unwanted behaviour, as being done by China presently.¹⁷ Total surveillance is already possible via smartphones. It is done by commercial entities who collect data from their users. Data generated by phone users is mostly monetised by large corporations, who commodify it for advertisers to precisely target consumers. This is what is called “surveillance capitalism” by Shoshana Zuboff, a professor at Harvard Business School. According to Zuboff, “the term surveillance capitalism is not an arbitrary term. Why surveillance? Because it must be operations that are engineered as undetectable, indecipherable, cloaked in rhetoric that aims to misdirect, obfuscate, and just downright bamboozle all of us all the time”.¹⁸ She further stated that users think that they have some control over what personal

information they provide to corporations such as Google, Facebook, Apple, or Amazon. Instead, she says, "...what's really happening is that personal information we provide is the least important part of the information that they collect about us."¹⁹ These corporations use what is called "residual data" – digital footprints that we leave as we use the Internet. Initially thought of as waste material, companies like Google soon realised that this data carries rich predictive information about our online and offline behaviour. These companies collect data to improve their service by analysing patterns of human behaviour. Zuboff calls this data "behavioural surplus" and it is used to predict human behaviour not only online, but offline as well.

Hence, the wealth of data produced by millions of interconnected devices, along with positive effects, has a huge potential for misuse, abuse, or errors leading to unwanted events, some of which may be catastrophic. Many dangerous technologies were produced in the twentieth century, such as nuclear energy, biological and chemical weapons, genetically modified organisms, toxic pesticides and herbicides, and so on, which continue to threaten human civilisation today in the twenty-first century. IR4.0 and its backbone, artificial intelligence, is designed, promoted, and built by humans, who are weak, biased, and subjective, having limited insight into the long-term effects of their own inventions, ideas, and products. Therefore, to ensure the continuity and safety of IR4.0, it must be well regulated, especially with regards to the ethics of AI.

Ethics and AI

Ethics is a branch of philosophy interested in differentiating right from wrong. Ethics tends to be subjective because the evaluation of morality is based on values, which are not entirely universal. Previous industrial revolutions were based mostly on commercial considerations without evaluating the value of a capitalistic enterprise. Today, as humanity is at the threshold of another leap in technological advancement, new industrial capabilities are set to transform whole societies in terms of employment, wealth creation and distribution, and ultimately well-being, which is one of the major points of sustainable development promoted by the UN. However, it is essential to recognise that in this new paradigm, "operations, decisions, and choices previously left to humans are increasingly delegated to algorithms,"²⁰ which gather, organise, and interpret data, and make decisions based on rules set by either humans or machines. Algorithms are invariably value-laden and, therefore, processes and technologies using them are inherently biased and may have unintended consequences. Thus, ethical concerns are of particular importance for IR4.0.

Humankind is at the threshold of an age filled with uncertainty with regards to technology-intensive futures. Consequently, academics have come up with a new research subject: machine ethics. This field is concerned with understanding and implementing ways of giving machines (computers or robots) such ethical principles that will help them autonomously resolve ethical dilemmas encountered during their operation. As AI expands in complexity, capability, and outreach, it will begin to function across different environments, interacting with humans and other machines. Ethical issues will inevitably arise that we humans will expect such machines to handle appropriately, attempting not to harm anyone or to minimise harm as much as possible. At that time, machines will have to operate as ‘autonomous moral agents’, as humans already do. Hence, as these technologies are rising in importance and capabilities, it is imperative that their designers put ethics in the design process itself. Additionally, authorities (local, national, and international) must have the ability to regulate the industries that have a great impact on society. Therefore, as Nassim Taleb states: “Policymakers have a responsibility to avoid catastrophic harm for society as a whole; the focus is on the aggregate, not at the level of single individuals, and on global-systemic, not idiosyncratic, harm”.²¹

To facilitate the future of ethical AI, the European Commission has come up with guidelines for building trustworthy machines, which must contain three essential elements:

(1) it should be lawful, complying with all applicable laws and regulations; (2) it should be ethical, ensuring adherence to ethical principles and values; and (3) it should be robust, both from a technical and social perspective since, even with good intentions, AI systems can cause unintentional harm. Each component in itself is necessary but not sufficient for the achievement of Trustworthy AI. Ideally, all three components work in harmony and overlap in their operation. If, in practice, tensions arise between these components, society should endeavour to align them.²²

Lastly, to operationalise ethical imperatives in the design process, there needs to be greater supervision on the personal/individual level as well as corporate and government levels. As this is not the focus of this paper, we will not go into further detail about how it might be done. Nevertheless, when it comes to Muslims as religious agents living in a secular economic world dominated by AI, they must not stay away from contributing to these developments. They must take an active part in identifying and implementing universal ethical principles in regional and international AI initiatives. Hence, there must be greater public

debate and education about these issues, especially for school children, who will most probably live in a more complex environment of technological advancement.

IR4.0 and SDGs: Effects, Economics, and Complexity

This paper argues that sustainable development goals will be positively affected by IR4.0. The main reason is the “greening” of manufacturing, transportation, and services sectors, as technology decreases the need for fossil fuels, which will also lessen the emissions of carbon dioxide and other toxic gases into the atmosphere. However, before a more detailed analysis of the effects of IR4.0 on SDGs, let us recapitulate the UN’s sustainable development goals and targets with special reference to modern technologies.

On 25 September 2015, the United Nations General Assembly adopted resolution A/70/L.1 titled “Transforming Our World: The 2030 Agenda for Sustainable Development.”²³ This resolution’s main agenda was ending poverty and hunger through the collaborative effort of all UN member-states. It set out plans to “ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social, and technological progress occurs in harmony with nature.”²⁴ Paragraph 3 of the Introduction states:

We resolve, between now and 2030, to end poverty and hunger everywhere; to combat inequalities within and among countries; to build peaceful, just and inclusive societies; to protect human rights and promote gender equality and the empowerment of women and girls; and to ensure the lasting protection of the planet and its natural resources. We resolve also to create conditions for sustainable, inclusive and sustained economic growth, shared prosperity and decent work for all, taking into account different levels of national development and capacities.²⁵

It’s a very ambitious plan that today, ten years before the target date, seems an impossible task to accomplish. However, reduction of poverty and hunger is possible, especially in the environment of IR4.0, a fact acknowledged indirectly by the Agenda.

Sustainability simply means a type of production and consumption that does not deplete valuable resources to the point of inability to regenerate. Every living being has the right to share the planet’s resources equitably. Every living thing deserves a liveable environment. As human beings develop new manufacturing

capabilities through IR4.0 technologies that do not deplete natural resources, the world will achieve sustainability. The authors are therefore optimistic that technologies, coupled with better governance, efficiency, and cooperation, will help achieve the sustainable development goals of poverty reduction, ending hunger, and providing better opportunities for education and business.

Consequently, IR4.0, characterised by automation, interconnected devices, AI, and greater energy and production efficiency, will directly affect the goals of poverty reduction (goal No. 1), ending hunger (goal No. 2), promoting wellbeing (goal No. 3), ensuring quality and equitable education (goal No. 4), ensuring access to clean water and sanitation (goal No. 6), ensuring access to sustainable energy (goal No. 7), promoting sustainable economy and work (goal No. 8), building sustainable and resilient infrastructure, industrialisation and innovation (goal No. 9), reducing inequality (goal No. 10), making human settlements safer and more sustainable (goal No.11), and ensuring sustainable production and consumption (goal No.12). However, this can only be achieved through greater cooperation between all stakeholders, such as governments, international multilateral organisations, educational institutions, businesses (especially small and medium enterprises), and civil society. Greater cooperation is needed because there is a danger of a handful of corporations seizing most of the resources and technologies, creating an even greater inequality and wealth gap.

To ensure sustainability goals are achievable, it is necessary to stay within certain limits of production and consumption whereby natural resources are not depleted irreversibly. Many ideas have been put forward to promote sustainability. One that is particularly appealing and suitable for the world is by Kate Raworth, a senior research associate at Oxford University and a professor at Amsterdam University of Applied Science. She is the author of *Doughnut Economics*,²⁶ in which she proposes that, to achieve sustainability and meet twenty-first century challenges, humans need to live within the means of the planet. In other words, humans have to change their economic focus from permanent growth to shared wellbeing within the means that our planet can maintain. Describing her “doughnut” she writes:

...in essence it is a pair of concentric rings. Below the inner ring – the social foundation – lie critical human deprivations such as hunger and illiteracy. Beyond the outer ring – the ecological ceiling – lies critical planetary degradation such as climate change and biodiversity loss. Between those two rings is the Doughnut itself, the space in which we can meet the needs of all within the means of the planet.²⁷

Below is the “Doughnut” chart introduced by Raworth. The inner zone of the doughnut is the liveable space for all that is regenerative and sustainable. If we overshoot the outer ring, we will end up ruining nature and causing major climate change, biodiversity loss, all sorts of pollution, and other disasters that will render the planet unliveable. On the other hand, if we fall short of the economic development necessary for a decent living, we end up causing hunger, poverty, illiteracy, corruption, and other economic problems. It is obvious that overproduction and overconsumption bring humanity towards environmental problems while lack of investment into equitable economic development causes misery to populations in terms of hunger and poverty.

Figure 1: Doughnut economics chart

(source: <https://www.kateraworth.com/doughnut/>)

When looking at Figure 1, one is likely to understand it better from a complex systems perspective. The term “complex systems” refers to a set of interdependent systems that interact with and affect each other. Hence, human over-activity, in terms of production and consumption, negatively affects the natural systems of climate, flora, and fauna, as well as natural resources. Human under-activity, due to climatic, political, or economic conditions, leads to low production and consumption, which may translate into miseries like unemployment, loss of wealth and dignity, etc.

As far as IR4.0 is concerned, innovation in technological solutions will end human and environmental problems. However, not all solutions are necessary

and good. All technologies can be divided into four categories: (1) necessary; (2) auxiliary; (3) non-essential; and (4) dangerous (there could be variations of these categories as well). Accidentally, this categorisation coincides with the classification of benefits under the shariah, namely (1) essentials (*daruriyat*), (2) the complementary (*hajiyyat*), and (3) embellishments (*tahsiniyyat*).²⁸ The following is a chart depicting these technologies on the sustainability-progress scale.

Figure 2: Scale of technologies under IR4.0 (authors’ own)

Even though the placement of circles is arbitrary, the authors think it generally represents how we may view technologies, solutions, and even industries on a scale of sustainability and progress. Necessary technologies represent such hardware, software, methods, and systems that economic progress depends upon. These include agriculture, manufacturing, transportation, communication, and waste management technologies. Auxiliary technologies help humans to operate, maintain, or enhance the necessary technologies. They are not used directly in the production processes, but without them the first category cannot be maintained. The third category, non-essential technologies, are the ones that humanity can exist without, but they make life more interesting, beautiful, and fulfilling. Lastly, dangerous technologies are those that have a high probability of ruining any progress that humans have achieved so far. Often, they go hand-in-hand with or even initiate technological progress, such as nuclear, chemical, biological, or AI technologies. However, they can be easily misused or abused to harm

certain individuals, states, countries, groups of people, or nature. Therefore, it is important to realise where various technologies stand in relation to sustainable development, and promote such categories that are harmless (necessary, auxiliary, or even non-essential) and discontinue, minimise, or regulate the production of dangerous ones. Also, given the fact that some IR4.0 technologies are not well understood (e.g. Artificial Intelligence), it makes sense to monitor or regulate them closely to avoid the risks previously mentioned above.

Implications for OIC States

Walter Scheidel, in his book *The Great Leveler*, paints a very bleak picture of economic inequality and ways of reducing it. According to him, economic inequality was successfully reduced in the past by only four mechanisms: state collapse, pandemics, mass mobilisation wars, and transformative revolutions. All of these significantly reduced populations and the wealth gap.²⁹ Scheidel was quite sceptical about other means of inequality reduction, such as education, technology, economic development, and democracy. While his analysis is mostly correct, it excludes faith-based societies, such as the Islamic caliphates under certain rulers. It is also possible to frame Islamic ideology under “transformative revolutions” whereby pre-modern Islamic societies achieved greater equality following the universal and egalitarian message of Islam, which was revolutionary for many societies at the time. The history of Muslim societies is full of examples of God-conscious rulers applying just policies that reduce inequality without having to rely on mass depopulations due to wars, epidemics or revolutions.³⁰ Modern policymakers can take cues from the past to form policies based on universal values to achieve greater economic justice, reduce poverty and raise the sustainability of economic activities, including under IR4.0.

Another danger to sustainability and IR4.0 is what Phillips calls “Global Power Elites”, who control the flow of capital.³¹ He identifies a number of transnational firms that control over US\$40 trillion in assets but are run by just 199 people. These elites form institutions, influence laws, and control armed forces to protect themselves and their investments. With continued shrinkage of margins, the elites are looking for more ways to move capital around the world with speculative aims, promote their agenda by influencing governments to privatise public assets, and cause wars in countries that resist their agenda. In this environment, it is extremely difficult to be positive about the future of humanity unless popular resistance grows and governments of non-aligned countries (such as the OIC, NAM, ASEAN, AU, and other regional unions) cooperate in resisting transnational corporations and the institutions they have formed.

In this globalised world enhanced by IR4.0, states included within the Organization for Islamic Cooperation³² (OIC) have a better chance to cooperate among themselves and with the rest of the world to achieve sustainability and contribute to a zero-waste circular “doughnut” economy. The coronavirus pandemic, and the financial crisis twelve years ago, have shown that the world has become deeply interconnected. Crises, natural or economic, are increasing in intensity, exposing the vulnerabilities of countries despite economic development levels. How states will fare in these crises depends on local preparedness to make difficult decisions, and also on economic discipline and global cooperation to assist one another.

Given the nature of modern uncertainties and risks, the authorities and leaders of OIC states must realise how complex the world has become. To start offering local solutions, they should understand the complex systemic nature of our economic, political, educational, cultural, industrial, and technological environment. Our natural world is under persistent attack from human industrial activity. That became particularly evident during the quarantines implemented all over the world due to the COVID-19 pandemic, which led to a significant reduction in pollution. Many methods of production are outdated and often outright dangerous. Sustainability cannot be achieved using nineteenth and twentieth century methods. It must be based on renewable energy sources with production processes that cater for recycling, re-use, or use of sustainable materials.

Additionally, to promote sustainability within IR4.0, OIC states should use a powerful theoretical framework within which they can shape all important legislation, policies, guidelines, and practices. This framework should be the *maqasid al-shari‘ah* (higher purposes of the shariah). This framework allows the designing of laws, rules, policies, and guidelines that are ethical, people-centred, and environment-friendly. According to Kamali, “*maqasid* are goals and purposes that look to the future and permit innovative approaches...”³³ He also advises Muslim leaders “to take the *maqasid* as a basis of justification for legislative and judicial reforms.”³⁴ This framework is powerful because it is based on the wisdom (*hikmah*) of the Law-giver (*Shari‘*) and is designed to help people realise what is good and beneficial (*masalih*) and ward-off what is evil and harmful (*mafasid*).³⁵ Hence, through this framework, states can produce future-oriented policies and inculcate a *maqasid*-based culture in education and economic activity, provided, of course, that such *maqasid* are followed first by the authorities themselves, then by the elite, academia, and business community. Then the rest of society will follow, creating a common culture of sustainability, responsibility, and care. However, this framework can be applied only through a thorough contemplation of the fundamental principles of the

Qur'an and Sunnah by those who work on and introduce public policies with the aim of effecting "reform and improvement or *islah*."³⁶ Thus, the framework of *maqasid al-shari'ah*, as suggested by Jasser Auda, ought to be recognised as a systems philosophy and operationalised as a methodology for policy making in the spheres of technology, science, and education.³⁷

Figure 3: IR4.0 Governance Maqasid Framework (author's own)

Indeed, the shift to sustainable development models requires difficult changes in the philosophy of production, governance, education, and consumption. Such a shift can only be achieved by understanding and internalising the urgency of change by members of society at the local level. Therefore, sustainability is possible through urgent collaborative efforts on the part of governments, civil society, and the business community. Religious leaders have the important task of understanding all those complexities, problems and solutions, and advising their followers accordingly. The Qur'anic message about the risks and consequences of negative human activity (e.g. Al-Qur'an, 2:155, 5:64, 7:74, 30:41) must be emphasised, re-interpreted, and taught at schools and universities. Putting aside differences and hostilities, intra-OIC cooperation must be enhanced in terms of health, economics, technology, education, and defence. Additionally, in these troubling times, the OIC states ought to champion the prophetic ethics of cooperation, brotherhood, and assistance.

Conclusion

This paper discussed the idea that the Fourth Industrial Revolution offers technological tools and a means to achieve the UN's sustainable development goals. However, risks associated with these modern technologies must be studied, identified, and addressed if they are to have any long-term positive effect. There are many methods of risk assessment, all of which are designed to analyse individual risks, their source, their likelihood, and severity of impact. This paper used the Preliminary Risk Assessment tool to analyse some current and future risks of Artificial Intelligence. It has been demonstrated that the assessed risks are all quite severe and must therefore be either stopped completely or subjected to strict regulation. The paper has shown that AI is the area that needs the greatest attention in terms of ethical design and control. Nevertheless, the paper agrees with the notion that IR4.0 and Artificial Intelligence are a viable means to increase human wellbeing, enhance economic development through greater efficiency in production and service delivery, create better solutions to environmental problems, and so on. In order to deliver positive change, AI must be human-centric. Producers must ensure that such technologies never harm human beings, either intentionally or unintentionally, that they follow and do not infringe upon any existing laws and ethical norms, and that they are robust from a technical and social perspective. To effectively address risks from various perspectives, there must be a sufficient diversity of stakeholders when deciding what path AI should take today and in the future. The issue of sustainability in an environment dominated by IR4.0 has to be addressed as well.

The result of SDG implementation at national levels is expected to create economies that are resilient and sustainable, which corresponds to the idea of a circular economy, described as “an industrial system that is restorative or regenerative by intention and design”.³⁸ This is also consistent with the idea of “*doughnut* economics” described above. Hence, the economics discipline, especially Islamic economics, must shift its focus from economic efficiency, productivity, and growth to justice, fairness, and rights.³⁹

More research and applied work will have to be done by scientists from various disciplines in an integrated manner. Muslim social scientists, natural scientists, engineers, educators, designers, and business people must take an active part in these developments under the guidance of *maqasid al-shari'ah*. We now propose the following actionable recommendations for policymakers:

- Develop a national strategy to deal with Artificial Intelligence.
- Cooperate with international stakeholders in regulating the AI industry

from the perspective of ethics and sustainability.

- Introduce appropriate legislation at the local level when regulating the production, purpose, and use of AI.
- Governments should encourage more interdisciplinary research and education on the newest technologies and their sustainability effects.
- Adopt a *maqasid*-based framework for policy development.

Notes

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