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Ethical problems of Industry 4.0

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Introduction

The advancements in software technology and data science are enabling Industry 4.0, the Fourth Industrial Revolution, in other word, the Industrial Internet of Things, while the first three industrial revolutions have brought about immense change as known, the impact of Industry 4.0 will be much wider and far greater, especially regarding the easily overlooked ethical and moral aspects. Widening wealth gaps between countries and among classes of people within countries, a potential growing unemployment rate, data privacy and accessibility issues, and the treatment of intelligent agents (e.g., military robots) present new and complex ethical and moral dilemmas.

In this essay, I will point out Industry 4.0 ethical and moral predicaments from the perspective of different business and technical forces. I will discuss ethical and moral issues related to data privacy, system accessibility, cybersecurity, the future of work, and the future of humanity.

The attendance of this study pays to the ethical challenges of the last phase of industrial development. Its characteristic promises many benefits, however, as it turns out, opens as well as new questions and problems, these includes the implications of a particular technological enthusiasm that its multifunctionality, in several respects, crowding out value orientation of the company.

The context of the last industrial revolution is flying on a wave of modernism, which has delivered many promises that remain unfulfilled, even though many have provided, on the other hand, new problems have arisen in the field of social, legal, environmental, and personal meaning of life and general malaise. Although, I do not want to defend the technological development, I must consider social and ethical implications of technological vision and economic optimism, because both are linked.

The solutions to current issues of ethical responsibility and even global issues will be a task of the current generation and future generations. Their answers and solutions, however, are burdened by the instability of our society that digitization and robotics itself cannot resolve.

In the counterpart, the Industry 4.0 penetrates the market with the support of politicians, accompanied by prioritizing technology and letting down the social and human consequences. The status 4.0 industry is dangerously jumping ahead of the business and management ethics of the 21st Century.

The aim of this essay is to discuss various challenges and ethical, moral considerations from different perspectives and tending to give technical designers/ developers a better understanding and appreciation of the ethical and moral challenges Industry 4.0 presents.

The origins of Ethics

Ethics derived from philosophy or religion do not easily fit into the world of technology. The world of science has its share and attempts; however, humans find it difficult to develop virtues for their own conduct, let alone building relevant virtues into new technologies.

It is undebatable that the fourth industrial revolution (4IR) and Ethics in Fourth Industrial Revolution changing how people work, live, and communicate with each other. Almost every aspect of human life has been impacted by 4IR. The building blocks of 4IR have proved to be powerful agents of change.

Consequently, 4IR has a significant potential of changing the things people value and the way they value them. New digital technologies have changed how people access education, information and social media has given a voice to many people, as well as online shopping and delivery services have revolutionised the retail experience. Progresses in biomedical technology have led to healthier and longer lives, however, 4IR has its negative sides.

Therefore, people must think of how technology can change them and most importantly, there is an urgent need for people to realise that justice, respect, and fairness must remain the cornerstone of humanity and people must embrace an ethical strength at every level of technological development to accurately map the moral foundation of future generations.

Only ethics can ensure humanity and hence critical ethical issues that must be enhanced to support the changes the world is experiencing with the 4IR. One of the critical ethical issue concerns employment as previously mentioned (unemployment rate). Artificial intelligence has unleashed new levels of productivity and transformed jobs, human labour has been replaced by automation to the detriment of workers with less education and fewer skills.

Therefore, there is an immense need for business organisations and governments to address the changing needs of work. Issues of training, talent development and career reinvention need to be discussed to guarantee and ensure that technology does not significantly affect people's jobs. Moreover, another critical ethical issue is equality. 4IR and Ethics in Fourth

Industrial Revolution has improved and developed income levels and the quality of life for people. Unlikely, the economic benefits of 4IR are focused on just a small group of people, in consequence, increasing inequality.

Therefore, there is a pressing need to ensure and guarantee that technologists embrace a higher commitment to a more inclusive development and equitable growth for all people. Furthermore, the benefits of new technologies must be evenly distributed across all demographic groups.

For a better clarification, privacy and trust are other critical ethical issues that must be addressed. Technology has broadened the scope of surveillance and impacted privacy, personal information is increasingly tracked to deliver intelligent and personalised services while simultaneously, disrupting privacy, while the technologies of 4IR are neutral, they are increasingly used in ways that deteriorate trust.

Therefore, there is also an urgent need to address these issues and confirm high levels of trust and privacy today and in the future. The technologies of 4IR and Ethics in Fourth Industrial Revolution are redefining humanity and how people engage and commit with one another and their planet. While putting the emphasis on the potential impact of technology in changing people's lives, there is a need to establish ethical guardrails that would keep the technologies on track for the benefit of humanity.

Particularly, people must address the impact of technology in relation to the issues of equality, employment, privacy, and trust. People must intentionally develop positive values into new technologies.

Industry 4.0

Industry 4.0 initiatives can influence whole business system via transforming the means and ways the products are designed, produced, delivered, and discarded. Industry 4.0 is relatively novel boosting nations. However, the adoption of Industry 4.0 initiatives is not so easy due to existence of many challenges.

Firstly, Industry 4.0 collectively refers to a wide range of concepts, including cyber-physical systems (CPSs), the Internet of Things (IoT), artificial intelligence (AI), cloud computing, smart manufacturing, decentralized self-organization, and advanced analysis techniques. It concentrates primarily on the establishment of smart factories, smart products, and smart

services embedded on the internet of things (IoT), and the conversion of established factories into smart manufacturing environments. Industry 4.0 allows for continuous interaction and information exchange among humans, between humans and machines, and between the machines themselves. In 2013, it is predicted that more than 75 billion objects will connect to the Internet of Things by 2020 (Morgan Stanley). New, flexible business models that enable personalized and digital products and services will need big amounts of high-quality data soon. Highly automated and even autonomous machine tools and robots will be widely available. By 2025, the rate of automation (division of labour as share of hours spent) will be 52%, a sharp contrast to the 2018 rate of 29%.

In fact, unless there is a creation of new industries not yet present, the number of workers will likely decrease, new and remaining jobs may require more knowledge than current ones and may also demand new skill sets.

Thus, this will require retraining and retooling of existing workers. In consequence, the education paradigm will have to be reengineered. Moreover, with Industry 4.0, the organization will be more decentralized rather than centralized, which not only leads to management complexity but also challenges existing management theories and practices.

Therefore, Industry 4.0´s opportunities and benefits can be seen in more efficiently used resources, more personalized customer service, and easier to use and more cost-efficient upgraded equipment. More intelligent agents in CPSs will release humans from laborious tasks, allowing people to dedicate time to more meaningful work, however, we cannot overlook the challenges and risks Industry 4.0 presents. The main challenges revolve around technological, organizational, strategic, legal, ethical, and moral issues.

My focus in this essay is on the ethical and moral issues that have a far received little attention.

Ethics is a complex and complicated concept, which I find it hard to define in detail. Generally, ethics refer to the moral principles that govern behaviour, and the study of ethics entails what constitutes ideal conduct in several and various situations. Ethics affect both individuals and society. A highly ethical society and a highly ethical individual can commonly promote ethics, establishing a good symbiosis. In a society with high ethical

values, an individual with low ethical values may benefit in the short term, however in the long term, society will obviously reject that individual. If the individual has high ethical values but the society has low ethical values, it will be challenging for the individual to survive in this society; if the individual is influential, the societal ethics may improve over the long term.

The worst situation is when both society and the individual have low ethical values. Therefore, to study ethical issues is to evaluate and examine the moral aspects of conduct and the actions deemed morally acceptable and accessible. Some scholars believe that classic ethical principles should be used to deal with new technology, which, as an example, should not bring any harm to users. However, others argue that new dimensions of ethical issues, such as the responsibility of machines, should be considered and included in the discussion.

For instance, the contribution of intelligent agents in manufacturing enables some tasks to proceed without human participation but the question is if an agent makes the wrong decision and causes severe damage, is the agent completely responsible or the designers of the intelligent agent?

For a better understanding, I will try to give some analysis of potential ethical issues in Industry 4.0 from different perspectives.

Ethical forces

The ethical forces of Industry 4.0 apply their influence over different stages in value chain activities from design, development, and production to application. Tracing the ethical responsibility and decision making of each stakeholder associated with value chain activities is very important and poses a major challenge. Artificial Intelligence (AI) and autonomous systems make the tracing of ethical responsibility more pressing because some of those functions may be performed without human intervention.

Therefore, a lack of ethical and moral standards in those autonomous agents and decision-making software is a problem, and a lack of experience and guidance in formulating ethical and moral standards in Industry 4.0 compound the problem.

In general, the difference between Industry 4.0 and previous industrialization comes from the wide application of CPSs, which connect the physical and virtual worlds and realize

real-time information interaction among different stakeholders.

Back in time, industrial revolutions technology supplemented and replaced the limited physical strength and speed of humans. In Industry 4.0, advanced technology can supplement and replace human´s limited cognitive processing space/scope, along with speed. This is simultaneously both exciting and scaring.

Humans are not the strongest in the animal kingdom, however our cognitive superiority has enabled our dominance as a species on this planet. If our cognitive superiority is challenged, the future of humanity is ambiguous. The use of the word force to describe any agent that may interact with CPSs and can take responsibility.

Based on the roles each force plays, we can classify the forces into technical-oriented and business-oriented forces. Next, I will discuss the responsibilities of the various forces in promoting an Industry 4.0 that subscribes to high ethical and moral values.

In today´s competitive business environment, ethical issues arise frequently, and business partners may not respect contracts, or competitors may attempt to steal business secrets. With Industry 4.0, the situation becomes much more complex.

Considering the trend to personalized production, which benefits individuals who receive personalized services and achieving them, however, involves big data, data science, AI, machine learning, and automation. This raises complex and complicated organizational and social issues. For example, the adoption of more autonomous systems and automation will likely lower the employment rate, damaging human motivation, well-being, and livelihoods.

Nowadays, in the new business models, intelligent agents and autonomous systems will affect employment. Laborious and repetitive jobs will be restructured or even eliminated. The structure of the jobs may also change significantly, and new jobs will be created, but specialized knowledge and more complex skill sets will likely be needed. To adapt to the new working environment, major transformation in education as well as on the job retraining will be mandatory. The main concern is those groups of workers who will be left behind by Industry 4.0.

Moving to the responsibility of each technical force stakeholder should be clear and transparent. Each stakeholder must maintain the highest ethical standards to prevent risky behaviors and harmful consequences. For instance, the failure of safety-critical systems may lead to a loss of human life and other catastrophic consequences. It is important that

designers and developers acknowledge the ethical implications of the high-tech products or services that they design and build. The rapid development of computing technology, however, has resulted in policy vacuums. When different technologies from different companies are integrated, it can be hard to assign responsibility. Unsure responsibility may weaken the designer´s sense of responsibility, but it is legitimate that all products are designed to be safe. Designers and developers should be held responsible for safety-related accidents that are a result of ignoring safety considerations in the design and development of new technology.

The process of addressing ethical issues is a continuous one; ethical policies associated with computing technology should evolve as technology advances. Although, rapid advances in technology make it harder to study ethical issues and establish ethical standards and policies particular to a technology, general guidelines and policies can be developed and boosted as a basis for a framework for ethical assessment in Industry 4.0.

In the other side, users should be aware of the impact of their decisions. As an example, police officers (users) deploying autonomous drones to destroy drug plantations must assess the environmental impact to avoid starting a forest fire.

Additionally, users should be well trained to work with CPSs and other intelligent agents; otherwise, users working with new intelligent devices may be exposed to a potentially risky environment without a full understanding of the technology. New and unexpected behavior resulting from new technology will increase the risk of error and wrong decisions. Almost all computer and smart devices are now Internet and Social media enabled.

On the one hand, this provides convenience and accessibility for the users. On the other hand, this exposes many computers and devices to cyberattack because of user carelessness or unfamiliarity with cyberthreats. Many organizations currently have obligatory cybersecurity training, which was not required five or ten years ago. Some high-security government agencies have even cut off access to the Internet in the workplace.

In many cases, users are not fully aware of the interactions that take place in current smart environments, such as the Internet of Things. This lack of user awareness can aggravate the ethical and moral issues of Industry 4.0.

Ethical issues in Industry 4.0

New technology, data and systems are crucial in Industry 4.0 and taking a good advantage of them can benefit human society and enhance people´s lives. However, it is easy to overlook the potential ethical and moral impacts when using technology.

In this part, I will discuss the potential ethical issues in Industry 4.0 which are basically related to data and systems. Data has an important role in Industry 4.0. It is collected from the human environment and analyzed to drive a new economy and new business models, increase profits, and boost services. Industry 4.0 related technology generates, stores, and uses highly sensitive data, which needs adequate security and privacy on a global scale. Ownership of the data requires to be clarified as well.

It is challenging to formulate standards to stimulate data sharing and yet provide suitable and appropriate protection. There is consistently a tradeoff between creating smart services and maintaining privacy. For instance, to provide personalized customer service, as much knowledge about the person as possible should be collected, in turn, increases the risk to privacy. As proved by recent data breaches, information is increasingly exposed to hacking, resulting in information security and privacy issues.

For instance, data privacy is extremely important in the context of healthcare and social media, which contain sensitive private records. In fact, the Facebook-Cambridge Analytica data scandal and many other data breaches expose the urgency of building a protection system for private data and information without a clear ethical and moral guidelines and policies, the management of collected personal information can be challenging.

Moreover, accessibility, as an ethical principle that refers to whether systems, products, and services are convenient for all people, including the elderly, the handicapped, and the disabled while taking into high consideration the complexity of new technology and high-tech products, as well as the aging populations of some countries, the accessibility of new technology will directly affect human well-being. The purpose of developing technology is to benefit humans however, the consideration must be given to enhancing systems, products, and services that are accessible to all, and the benefits of advanced technology should be fairly distributed to all.

Another ethical principle that must be discussed is transparency that helps promote ethical and moral behavior. Transparency of systems can clarify responsibility and make outcomes understandable. Users can clearly understand the underlying processes the

system used to reach at an outcome and use that knowledge to make the right decisions. Without transparency, it is much easier to maliciously use and control systems. Moreover, insufficient transparency may jeopardize human trust in autonomous systems.

Furthermore, cyberattacks are geographically uncontrolled compared to physical attacks. The original designers of cyberweapons are not easy to identify, while vulnerable, weak systems are countless, including healthcare systems, transport networks, traffic light systems, and food distribution systems. Cybersecurity affects system reliability, which, in the counterpart, affects user trust in these systems. Enhanced cybersecurity and improved protection of data will reduce ethical and moral problems and complications.

Conclusion

Eventually, keeping ethics and moral values high in Industry 4.0 has become more critical and challenging than ever before. Although, there is no one-size-fits-all approach to solving ethical issues.

In this essay, I have discussed potential ethical issues from different perspectives. Only when we establish and follow ethical and moral principles from various aspects of Industry 4.0, we can achieve a society that will truly benefit from Industry 4.0. The educational system must train very well students, especially those studying computing and software engineering, in ethical principles.

The educational system must also be reengineered to educate students and workers to become more qualified in Industry 4.0, where the release of platforms and systems is much faster than we have seen, and the skill sets required are constantly changing. Graduates are expected to be work-ready and know the latest technology trends and tools.

The ability to think critically and the embracing of lifelong learning are highly important, as those who have these characteristics can adapt to the challenges of Industry 4.0 and be less subject to replacement by machines and intelligent agents.

Understanding ethical and moral issues related to Industry 4.0 is still in its infancy stage. Addressing ethical and moral issues is not a simple discussion of right or wrong or a problem solvable by a small group of people. However, formulating and improving ethical and moral principles related to Industry 4.0 are critical as I have mentioned previously. Industry 4.0 is transforming jobs, societies, and humanity. The future development of Industry 4.0 needs to be guided by sound ethical and moral principles.

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