

HUMAN VERSUS MACHINE INTELLIGENCE
STAYING RELEVANT IN THE UPCOMING ARTIFICIAL
INTELLIGENCE ERA

NARAYANAN N KULATHU RAMAIYER

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Universiti Malaysia Sarawak
Kota Samarahan

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Preface

Machine intelligence is a promising area of study. It cannot, however, be treated as a standalone or in isolation. It must be linked to human decision-making capacity as machine intelligence has grown mainly by modelling or imitating human intelligence. This book explores various facets of human and machine intelligence together with the ecosystem where they co-exist.

There was a need to introduce the Theory of Inventive Problem Solving (TRIZ) and its immense capacity for solving complex problems. Though TRIZ is normally used as a problem-solving tool, its powers as a knowledge representation, storytelling and vision formulation tool has been demonstrated throughout this book.

This work addresses the pressing issues of our time along with a method of alleviating them. It provides a platform to shed insights on ways to discover innovative solutions for policy makers, decision makers and strategists. The author's diverse range of academic pursuits has been connected to formulate a convergent point of focus and to produce an assimilative map that recombines the multi-dimensional knowledge in a coherent manner.

The challenge presented in the formulation of this work was complex: It needed to inform people on how to be prepared for the unpredictable and unknown future that lies ahead. Such preparation requires employing an artificial intelligence perspective to the indigenous knowledge perception and importantly, it needed to include human values and ethical considerations.

The work has been written in a way that makes it easy to read and then help as many people as possible to ride the waves of change. It starts with leading questions that assist in charting a roadmap for transformation. It will serve as a guide for academics working on a broad range of areas such as Information and Communication Technology for Development (ICT4D) research, intelligent systems, eLearning as well as all others who care about mankind's future.

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MALAYSIA

We must be willing to get rid of the life we've planned, so as to have the life that is waiting for us.

—Joseph Campbell

Intelligence confers the power of discrimination between right and wrong. The wavering intelligence of man that has lost its one-pointedness and purity is responsible for all the conflicts prevalent today.

—Sathya Sai Baba

Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid.

—Albert Einstein

The world is endless, the universe inexhaustible, and the human brain will never be threatened with unemployment.

—Genrich Altshuler

There is a need to instil strong innovation as a birth right.

—Victor Fey

Rainforests hold answers to questions we have not yet asked.

—Mark Plotkin

Emerging Global Challenges: The Challenges are REAL

We live in an era where our lifestyle is influenced extensively by large-scale global developments. Even if one is fully unaware of these developments, their lives become transformed in one way or another. As the convergent forces of advancement (with technology) unifies people across the globe, they then face the danger of allowing emerging trends to dictate lifestyles and in shaping a new reality. The era is referred to as the Artificial Intelligence (AI) era, as this core technology is powering its way into the minds of people, institutions, organisations, and society. We will firstly contextualise historical developments that are unique to our times, and one that has led to the situation we find ourselves in today.

1.1 Industrial Revolution and the Forces of Change

The Industrial Revolution (IR) started in Europe, around two hundred and fifty years ago as an effort to advance humanity through the invention of machines such as the steam engine. The IR has since evolved to become a continuum of four waves of advancement as shown in Table 1.1.

Table 1.1: The Evolution of Industrial Revolution as a Continuum

Development	IR 1.0	IR 2.0	IR 3.0	IR 4.0
Enabler	Water and Steam	Electricity	Electronics and IT	Networked Communities, Internet of Things
Focus	Mechanised Manufacturing	Mass-Production	Automation of Manufacturing	Cyber-physical Systems

More recently, the fourth wave of the industrial revolution, IR 4.0, has been in the limelight. This fourth wave is now paving the way for large-scale automation and digitisation efforts at a global stage. It is therefore being promoted as the way to drive an economy, as the response to the challenging circumstances that we face today. The term IR 4.0 itself was firstly coined in Germany as a government initiative to spur the economy through automation of the manufacturing industry in 2011.

The key enablers for IR 4.0 are networked communities and their potential to inter-network devices which support innumerable potential applications. The pillars of IR 4.0 include: Internet of Things (IoT), Augmented Reality, Big Data Analytics, Cyber Physical Systems, and Cyber Security. These pillars are all technology driven and strategically designed as a means of advancement through the automation of all manufacturing activities. Manufacturing here is no longer restricted to physical products; it now also implicitly includes knowledge, learning management, talent development, innovation drives and everything else we do.

The expanding scope of the Internet of Everything [Evans, 2012] propels, exploits and amasses all man-machine efforts as part of resultant Cyber-Physical Systems. Cyber-Physical Systems here refer to virtual systems

embedded in the real-world with a purpose of augmenting human capacity. The technology pillars then characterise a collection of integrated technologies with the capability of digitising every aspect of our lives.

Although the aim of the book is not to go into the details of IR 4.0 technologies, it touches on key aspects relating to the changing-facets-of-intelligence.

In an emerging AI era, the full power-model of IR 4.0 implementations can be observed in leading corporations such as Siemens and General Electrics. As an illustration of these powers, Siemens has a smart factory that can process 10,000 materials from 250 suppliers simultaneously to produce 950 products [Hessman, 2013]. With such sophisticated high precision production facilities, the power to orchestrate control over massive-scale global resources with 100% traceability becomes a reality.

Advanced analytics are being used here to foster better decision-making in supporting sophisticated smart factories by exploiting the predictive powers of digital technologies. The term Bigdata is used here to animate the dynamic aspects of the sheer data volume, the lightning speed in which it is produced, and the diversity of data forms that are processed.

AI supports smart factories by helping manufacturers predict demand patterns and to further allocate resources far more accurately. Factory employees, augmented by digital systems, work alongside collaborative robots or *cobots* together with other wearable gadgets to enable greater levels of interaction with such systems [Hobbs, 2018].

Without a full picture of where we are headed or having a clear guided pathway, it will be tough to fully gain benefits from the revolutionary advancements that are taking place. Therefore, there is a need to fully realise the implications of the Industrial Revolution as a continuum, rather than treating it merely as an isolated event in time [Abdul Razak, 2018].

IR 4.0 involves the evolving flow of superstructures [Abdul Razak, 2018] (as seen in Figure 1.1) where the key components of manufacturing, knowledge and automation become much more closely knit.

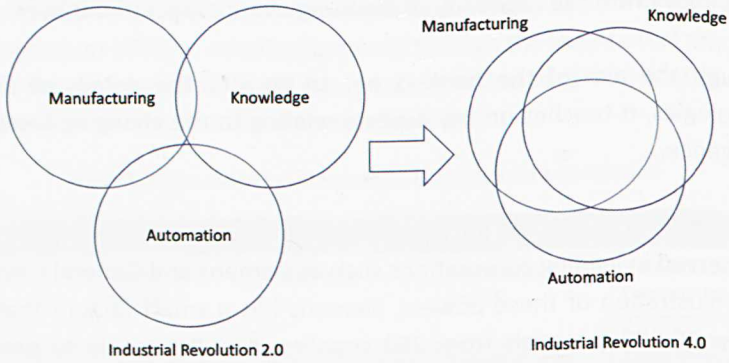


Figure 1.1: Superstructure Changes Relating to Industrial Revolution [Adopted from Abdul Razak (2018)]

1.2 Need for Effective Value Creation from IR 4.0

IR 4.0 tends to put pressure on under-developed countries, requiring a fast catch-up in terms of bridging vast knowledge and physical gaps. For example, places that do not even have electricity are at times required to make a technological leap with little or unclear guidance to what firstly needs to be done.

A Forced approach for mechanisation will not be adequate. The situation becomes worse when a clear roadmap is not available, leading at times to highly technological solutions being applied to unmatching tasks without due consideration.

The report by Deloitte highlights that there are companies that have invested time and resources in IR 4.0 initiatives but had to settle merely for IR 2.0 outcomes ¹ (of digitisation). Reasons for this include a lack of readiness to harness the changes associated with IR 4.0 and not having a

¹ Based on a survey by Deloitte Global to measure business and government readiness for the diffusion of "Industry 4.0." The survey polled 1,600 C-level executives across 19 countries. Though 87% were optimistic about the value and transformational power of IR 4.0, only 14% considered themselves to be fully ready.

strong business case for investing in the advanced technology. Figure 1.2 contrasts the aspects of an IR 4.0 smart factory as opposed to an IR 2.0 mechanised factory².

As can be seen here, an IR 4.0 factory performs advanced functions such as systems automation, employing collaborative intelligence capabilities through data driven control. These features are, however, inadequately addressed in previous IR models. Adopting the IR 4.0 progression comes with a high price of being subjected to a high level of dehumanising factors. Without due consideration of humanising factors, numerous challenges are anticipated. An elaborate discussion on the humanising factors will be presented in Chapter 2.

The same considerations are needed with respect to empowering disruptive business models powered by IR 4.0 technologies that are now becoming commonplace. As an example, Uber and Grab have already disrupted the hired vehicle industry. Not considering the sentiments of various stakeholders and other contextual parameters early can potentially lead to various social problems.

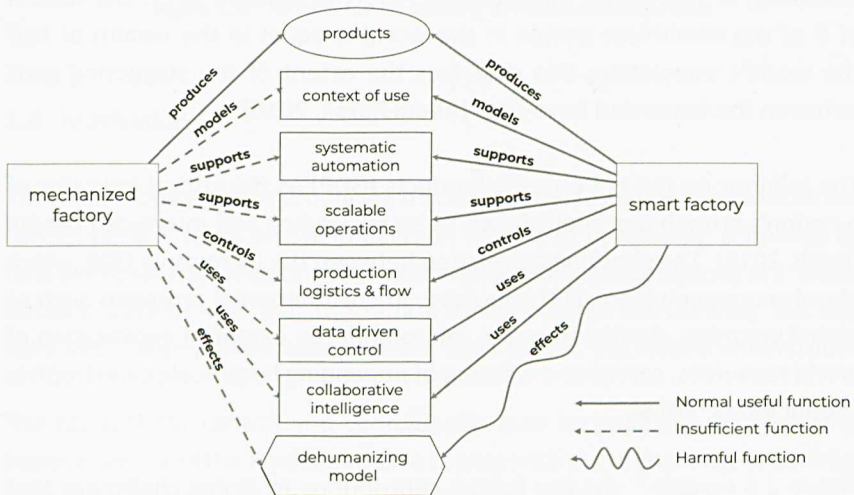


Figure 1.2: Contrasting Evolutionary Features of a Smart Factory

² TRIZ based models are used throughout to illustrate concepts visually. Function model has been used here as a problem modelling tool to distinguish IR 4.0 from the previous developments. Function analysis as a TRIZ tool will be described in Section 4.2.1

IR 4.0 driven business cases have tremendous potentials in bringing about game changing Industrial Transformation. There is, however, a need to align the purpose of investing in IR 4.0, which should not be solely aimed at catching up on mechanization. This cannot be undertaken without due consideration of contextual parameters.

1.3 AI-Age and Coordinated Control

Industrial revolution initiatives support mankind through mechanisation, electrification, connected empowerment and the digitization of human endeavours. Despite the inherent benefits that have widely been described, there are concerns that cannot be overlooked.

Marginalisation happens through normative measures of equity and wealth sharing being used to drive development efforts. We therefore find the disparities between the haves and have-nots growing at a mind-boggling scale.

According to the Oxfam International report in January 2017, the wealth of 8 of the wealthiest people in the world is equal to the wealth of half the world's population; this describes the extent of the staggering gaps between the haves and have-nots [Abdul Razak, 2018].

The reliance on Gross Domestic Products (GDP) as the critical indicator of a nation's growth has been shown to be misleading and misguided [Abdul Razak, 2018]. The shocking correlation between the increase in GDP, which closely corresponds to: 1) the increase in environmental problems such as global warming, decline in moral values and, the extent of exploitation of world resources, serves as a warning of impending large-scale catastrophes [Abdul Razak, 2018].

Figure 1.3 reveals ³ the key factors contributing to global challenges that are threatening the future of mankind. The key factors include: 1) the extent of technological control that the emerging superpowers have gained

³ The Cause and Effect Chain Analysis (CECA) model is employed here to visualise these contributing factors. CECA is a TRIZ tool that will be described in Section 4.2.2

2) The over exploitation of physical resources and the lack of check-and-balance leading to large-scale marginalisation and 3) the extent of exploitation the vulnerable lot have been subjected to. Aspects of control relating to the superpowers will be discussed in Chapter 2. This book, however, will address the key concern of technology itself becoming a threat, particularly in its extensive dehumanisation capabilities. Section 2.7 will elaborate on this aspect. The concern here mainly relates to the unchecked advancements in lethal networked intelligence posing life-threatening risks.

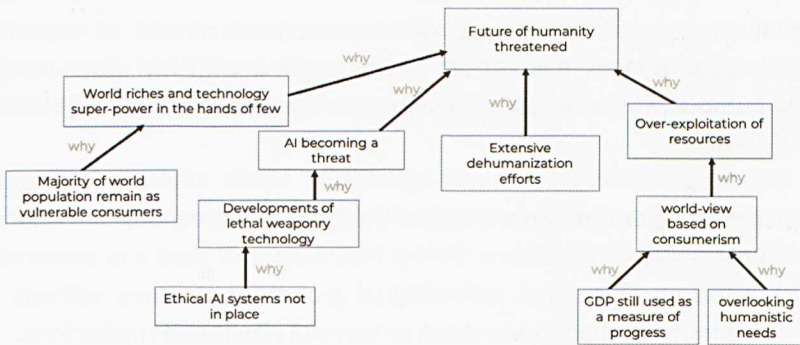


Figure 1.3: The Uncertainty Relating to Future Developments

1.4 Motivation

The main motivation for producing this book came from the need to address contemporary issues and help decision makers in developing countries to deal with challenges relating to the emerging Artificial Intelligence era. What became obvious was that the radical developments surrounding this era have been largely overlooked and to a large extent, not clearly understood.

The capacity for control and coordination over technologies by emerging superpowers and the inadequacies in coping with these challenges required a major paradigm shift for policy makers.

The talks by Professor Dzulkifli Abdul Razak, the current Vice-Chancellor of Universiti Islam Antarabangsa, and his book [Abdul Razak, 2018] have been instrumental in shaping my thoughts regarding the largely overlooked

human dimension of the industrial revolution. The full extent of dangers of IR 4.0 has been described thoroughly in [Abdul Razak, 2018].

While I was writing this book, I also came across a New York Times bestseller on AI superpowers by Kai-Fu Lee [Lee 2018]. This book has clearly expounded the explosive surge of interest in AI-implementations, particularly in contrasting developments in Silicon Valley with that of China. His account on the reality and scale of AI-induced job displacements has been shocking, even for me.

The illustration of the dangers of unconstrained control of the data mining super-powers [Lee, 2018] is well aligned with my past writings [Kulathuramaiyer, Balke, 2006] [Kulathuramaiyer, Maurer, 2009] [Maurer, et al, 2007].

We see challenges through any one of the following directions:

1. The unconstrained technological growth and abuses without proper mechanisms to check on harmful effects and implications.
2. Abuse of power by the emerging super-powers who suddenly find themselves with tremendous powers.
3. Malicious technology centric attacks on human targets.
4. Dehumanised civilisation due to an education system that demeans human intelligence.
5. Large-scale job displacements that lead to radical measures by marginalised groups.

It is therefore not surprising that Stephen Hawking points out that, the full developments of AI [Cellan-Jones, 2014] can be seen to threaten human civilisation and even foreseeably lead to an end to human society itself.

1.5 Flow of the Book

Having described the background and highlighting the global challenges, Chapter 2 will present the emerging coordinated global control. It is based on the three decades of exploration by the author and attempts to understand human intelligence as part of the extensive efforts to design intelligent machine capabilities.

As we will discuss in Chapter 3, the need to build upon grass root innovation cannot be overlooked in this effort. The connection between innovation pathways as efforts in unlocking indigenous knowledge and wisdom is subsequently highlighted. We will then introduce a systematic innovation pathway in Chapter 4 to provide answers to the many questions raised here.

Chapter 5 presents viable knowledge-based representation models to address these concerns. It will then highlight a people-centric, values-based alternative as a basis for sustainable growth and balanced future scenarios.

Emerging Coordinated Global Control: Are We Ready to Become Slaves?

This chapter looks at the extensive research undertaken by the author over the past 30 years, examining scenarios of control, coordination and dominance relating to both human and machine intelligence. It takes on a grounded standpoint of IR 4.0 by first reviewing key developments surrounding AI.

According to a techno-centric worldview, Human Intelligence is expected to soon be surpassed by computational powers. The validity and likelihood of such propositions will be discussed in this chapter. As these developments will be closely tied to control and coordination in a global knowledge era, a unifying view of human machine intelligence model will be defined. First the background developments that have led us in this direction will also be presented here.