Information Technology in Organisations and Societies

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Information Technology in Organisations and Societies: Multidisciplinary Perspectives from AI to Technostress

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INVESTOR IN PEOPLE

Dedication

To my parents, who have taught me to be kind.
Zach W. Y. Lee

Tommy would like to dedicate this book to master Minho.
Tommy K. H. Chan

For everyone, may you be blessed with good health and happiness.
Christy M. K. Cheung

To all who have interest in learning about the impacts of information technology on our work and life.

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Preface

Information technology (IT) use is typically regarded as a positive phenomenon that generates desirable outcomes. However, the negative consequences of IT use have been increasingly witnessed in recent years. For instance, individual users may experience 'technostress' from personal social media use and IT use in the workplace, and organisations may experience losses in productivity and assets due to employees' failure to comply with information security policies. Thus, researchers have called for further investigation into the negative and positive effects of IT use.

This book, *Information Technology in Organisations and Societies: Multidisciplinary Perspectives from AI to Technostress*, contains multidisciplinary research on the positive and negative aspects of IT use at both the individual and organisational levels, and covers emerging phenomena and topics ranging from artificial intelligence (AI), augmented reality, and organisational transformation to technostress. The book endeavours to provide contrasting views on the positive aspects and outcomes of digitisation and on the potential harms induced or exacerbated by advanced IT. The book also presents innovative discussions on strengthening the benefits of IT use and mitigating its drawbacks.

The studies in this book examine the implications of IT along a continuum from the organisations to the individual. The book starts with chapters on examining the implications of IT specific to the organisational context, and includes studies on the implications of AI for organisations, the organisational transformation framework for data-driven decision-making, and the relationships between technostress and employees' non-compliance with information security policies. Later chapters address the implications of IT in relation to organisations as well as individual users and consumers, with studies that develop an integrative framework for cognitive absorption, examine technostress in the workplace through sociological mechanisms, and explore the impacts of augmented reality on experiential marketing. The final chapters examine the impacts of IT specifically at the individual level, including an examination of the relationship between self-disclosure on social networking sites (SNSs) and well-being, and a literature review on social media stress. The diversity of the studies is also manifested geographically, with contributors from institutions and organisations across Africa, Asia, Europe, and America; methodologically, by using case study, design science, interview, literature review, and survey approaches; and theoretically, with theories ranging from organisational transformation frameworks, sociological mechanisms, the person–artifact–task model, the stimulus–organism–response model, and the hyperpersonal communication model, to the transactional model of stress arising from the use of SNSs.

The book represents a collective effort not only to consolidate studies on emerging issues and phenomena related to the positive and negative aspects of IT use but also to prescribe future research avenues in connected research domains. The book adds to the growing body of knowledge on the multifaceted nature and outcomes of IT use. It is particularly relevant and appealing to academics and researchers working on IT use research, and should serve them well as a handy reference to the field.

The first chapter of the book, by Madhav Sharma and David Biros, presents an overview of the implications of AI for organisations through a discussion of the core components of AI, the organisational goals that could be achieved with AI, the various types of AI, and their interrelationships. The authors also cover the unintended consequences and vulnerabilities of using AI systems in an organisational setting. The chapter offers a balanced discussion of the benefits and drawbacks of AI systems, and concludes with recommendations for organisations on the development and implementation of AI.

The second chapter, by Hanlie Smuts and Alet Smith, presents an organisational transformation framework for data-driven decision-making (OTxDD) based on a collaboration between humans and machines. The authors use the design science research approach to develop the OTxDD framework, which consists of four major enablers (data analytics, data management, data platform, and data-driven organisation ethos) and twelve sub-enablers, together with an organisational measurement tool. Organisations can use the OTxDD framework and the measurement tool to create a transformation path to data-driven decision-making, applying insights from both knowledge workers and intelligent machines.

While the adoption and diffusion of advanced IT can enhance individual and organisational performance, there are some negative aspects, such as technostress and information security threats. In the third chapter, Forough Nasirpouri Shadbad and David Biros propose a conceptual model to explain the relationships between technostress and employees' non-compliance with information security policies, suggesting that a higher level of perceived technostress is associated with a higher likelihood of employees violating such policies. Measures to reduce technostress and mitigate organisational security threats are discussed.

The fourth chapter, by Raluca Stana and Hanne Westh Nicolajsen, examines IT-related technostress in the workplace using sociological mechanisms. Having identified a lack of investigation of the social environment in which technostress arises, the authors examine technostress in the workplace through the sociological lens of obligation. They use an embedded case study in Denmark to examine political materials and interview employees from multiple organisations. The findings suggest that technostress may be socially constructed, and the authors suggest that a future research direction could be to view technostress as a societal responsibility.

With the growing interest in the uses of hedonic technologies and the gamification of system design, the concept of cognitive absorption, a holistic experience arising from technology use, has become increasingly important in explaining IT usage behaviours at both the organisational and the individual levels. The fifth chapter, by Christy M. K. Cheung, Dimple R. Thadani, and Zach W. Y. Lee, proposes an integrative framework of cognitive absorption in technology use that summarises the antecedents and consequences of cognitive absorption. The framework offers a foundation for future theory building and provides system developers with practical insights into the design of next-generation hedonic and immersive technologies.

The sixth chapter, by Xuewei Yang, continues with an examination of a particular emerging immersive technology, augmented reality, in the context of experiential marketing. Drawing on the stimulus–organism–response model, the author proposes and tests a research model that explains the effects of augmented reality media characteristics on consumers' value perceptions, and how these influence their purchase intentions. The findings show that augmented reality media characteristics positively influence consumers' utilitarian and hedonic value perceptions. The study provides marketers with insights into implementing digital transformation strategies and augmented reality applications in marketing practices.

The proliferation of SNSs has changed how we communicate, network, and socialise with others. The seventh chapter, by Tommy K. H. Chan, explores how social anxiety influences self-disclosure on SNSs and its effect on well-being. Drawing on the hyperpersonal communication model, the author advances a research model to explain how social anxiety leads to self-disclosure on SNSs. The author also hypothesises that online disinhibition has a positive moderating effect on the relationship between social anxiety and self-disclosure. This study enhances our understanding of the self-disclosure patterns of socially anxious individuals on SNSs, providing practitioners and educators with insights into how intimate relationships and a higher level of social interaction with others can be fostered.

Research on the positive and negative implications of IT across organisations and individuals has gained momentum, and the broad reach of this edited book contributes to the movement. We hope that both researchers and practitioners will enjoy reading the book and will derive new insights that inform their future research and practice. We thank the contributors and the publisher for making this book possible.

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Lastly, we would like to express our gratitude to Emerald Publishing and their editorial team for producing and publishing this book. This book would not have been possible without their support.

Zach W. Y. Lee
Tommy K. H. Chan
Christy M. K. Cheung

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Chapter 1

AI and Its Implications for Organisations

Madhav Sharma and David Biros

Abstract

The nature of technologies that are recognised as Artificial Intelligence (AI) has continually changed over time to be something more advanced than other technologies. Despite the fluidity of understanding of AI, the most common theme that has stuck with AI is 'human-like decision making'. Advancements in processing power, coupled with big data technologies, gave rise to highly accurate prediction algorithms. Analytical techniques which use multi-layered neural networks such as machine learning and deep learning have emerged as the drivers of these AI-based applications. Due to easy access and growing information workforce, these algorithms are extensively used in a plethora of industries ranging from healthcare, transportation, finance, legal systems, to even military. AI-tools have the potential to transform industries and societies through automation. Conversely, the undesirable or negative consequences of AI-tools have harmed their respective organisations in social, financial and legal spheres. As the use of these algorithms propagates in the industry, the AI-based decisions have the potential to affect large portions of the population, sometimes involving vulnerable groups in society. This chapter presents an overview of AI's use in organisations by discussing the following: first, it discusses the core components of AI. Second, the chapter discusses common goals organisations can achieve with AI. Third, it examines different types of AI. Fourth, it discusses unintended consequences that may take place in organisations due to the use of AI. Fifth, it discusses vulnerabilities that may arise from AI systems. Lastly, this chapter offers some recommendations for industries to consider regarding the development and implementation of AI systems.

Keywords: Artificial intelligence; analytics-based prediction; machine learning; deep learning; computer vision; natural language processing

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Introduction

For over 100 years, the Artificial Intelligence (AI) umbrella has extended to include the most advanced technologies of each time period. Research in AI has been scattered across disciplines with a few common threads of understanding (Stone et al., 2016). According to Oxford Reference, which aggregated definitions from AI across 11 notable sources across disciplines, AI is defined as 'the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages' (Oxford, 2020). The largest contributor to research in AI has been computer science which has investigated technical advancement and validity of these systems. Recently, with widespread adoption, applied sciences such as information systems also have shown interest in this area with respect to business analytics and cybersecurity. Table 1.1 lists other definitions of AI appearing across disciplines of computer science and business.

Table 1.1. Definitions of AI.

Discipline	Authors	Definition
Computer Science	Nilsson (2014)	'Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment'
	Simon (1995)	'A branch of computer science that studies the properties of intelligence by synthesizing intelligence'
	Oxford (2020)	'The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages'
Management Information Systems	Rai et al. (2019)	'Machines performing the cognitive functions typically associated with humans, including perceiving, reasoning, learning, interacting, etc.'
Marketing	Shankar (2018)	'Programs, algorithms, systems, and machines that demonstrate intelligence'
	Syam and Sharma (2018)	'Involves machines mimicking intelligent human behavior'

Despite the fluidity of understanding of AI, the most common theme that has stuck with AI is 'human-like decision making' (Simon, 1995). Advancements in processing power of graphical processing units (GPUs), big data technologies-enabled highly accurate prediction algorithms and robotics have brought AI closer to human-like decision making and actions. Many machines can now perform (and sometimes even outperform) the cognitive functions typically associated with humans, including perceiving, reasoning, learning and interacting (Rai, 2020).

The current state of AI involves highly accurate predictive algorithms and automation of processes to some degree (Sharma & Biros, 2020). This makes AI cover a multitude of technologies across industries. Some prevalent trends include medical recommendation algorithms, consumer recommendation algorithms, dynamic pricing in travel sites, automatic targeted ad-engines, resume-parsing and hiring algorithms, just-walk out automated storefronts, translators, and self-driving vehicles, which are examples of some pervasive AI systems (Brynjolfsson, Hui, & Liu, 2019; Brynjolfsson & Mitchell, 2017; Brynjolfsson, Rock, & Syverson, 2018). With a notable projected market value of $3.9 trillion by 2022 (Columbus, 2019) and a growing knowledge workforce (Miller & Hughes, 2017), these applications are approaching the status of general-purpose technologies which have the potential to significantly alter the economic and social structure of the society (Brynjolfsson et al., 2018). This is evidenced by tech-giants such as Google, Facebook and Apple which leveraged AI systems to gain prominence (Rayport, Kelley, & Schwalb, 2018). Yet, there have been instances of AI failures that have caused financial, social and legal harm to parties associated with the implementation of AI (Biros et al., 2019). Additionally, AI systems' potential to partially or fully replace human workforce directly affects organisational structures and processes (Brynjolfsson et al., 2018).

This chapter provides a deeper understanding of AI and related technologies and their use in organisations. First, we discuss the components of AI and how they interact with each other. Second, we explore common goals and objectives organisations can fulfil with AI systems. Then, we examine the different types of AI systems and their implications on organisations. Fourth, we discuss potential vulnerabilities of AI systems and possible unintended consequences. The chapter ends with some recommendations for organisations that use AI currently or intend to adopt it in the future.

Components of AI

For organisational contexts, AI systems are technological tools that generate value by increasing the scale of efficiency or use by introducing automatic prediction-based decisions and autonomous responses. Currently, AI encompasses technologies that combine analytics and automation, such as machine learning (ML), deep learning, natural language processing (NLP) and computer vision (Stone et al., 2016). Table 1.2 details the definitions of each of these technologies. Two common components in all AI systems are analytics-based prediction and automation. Both of them have varying degrees of interaction in AI systems.

Table 1.2. Definitions of AI Components.

Technology	Description
Machine Learning	'Machine learning is the study of computer algorithms that allow computer programs to automatically improve through experience' (Mitchell, 1997)
Deep Learning	'A class of machine learning techniques that exploit many layers of non-linear information processing for supervised or unsupervised feature extraction and transformation, and for pattern analysis and classification' (Deng & Yu, 2014)
Reinforcement learning	'A framework that shifts the focus of machine learning from pattern recognition to experience-driven sequential decision-making' (Stone et al., 2016)
AutoML	'Machine learning where data cleaning, feature engineering, algorithm selection, hyperparameter tuning, as well as most other steps are done automatically' (Larsen, 2018)
Internet of Things (IoT)	'Connectivity of physical objects equipped with sensors and actuators to the internet via data communication technologies' (Oberländer, Röglinger, Rosemann, & Kees, 2018)
Robotics	'Concerned with how to train a robot to interact with the world around it in generalizable and predictable ways, how to facilitate manipulation of objects in interactive environments, and how to interact with people' (Stone et al., 2016)
Computer vision	'Computer Vision has a dual goal. From the biological science point of view, computer vision aims to come up with computational models of the human visual system. From the engineering point of view, computer vision aims to build autonomous systems which could perform some of the tasks which the human visual system can perform (and even surpass it in many cases)' (Huang, 1996)
NLP	'Computers understand, interpret and manipulate human language' (SAS, 2020)

Analytics-based Prediction

Evolving from decision support systems (DSSs) in the 1980s, business intelligence in the 1990s, business analytics in 2000s to big data in 2010s, data-driven decision making has been a fundamental part of organisations (Sharda, Delen, & Turban, 2016). Analytics-based systems (DSSs, expert systems) have added value to organisations over time by informing their users about data-driven insights and improving their decision making.

The analytics-based prediction component of AI is led by ML which involves the use of algorithms that learn to make decisions directly from data rather than having their decisions programmed by a human. Recently, the most notable of these is neural networks (Mitchell, 1997). There are three paradigms in ML: supervised, unsupervised and reinforcement learning. Supervised learning is the learning function that maps inputs to outputs according to labelled training data (examples of input–output pairs) (Russell & Norvig, 2010). Unsupervised learning is a learning function that detects patterns in data with no pre-existing labelled data (Locatello et al., 2019). In reinforcement learning, a machine or a software agent interacts with its environment (by producing decisions) and learns by trial and error (Kaelbling, Littman, & Moore, 1996).

Deep learning is a subset of ML that exploits the use of dense multi-layered neural networks for pattern analysis (Deng & Yu, 2014). Where ML almost always requires structured data, deep learning uses multiple layers of neural network to extract higher-level features from raw unstructured data. Together, a combination of these technologies generates models based on existing data which inform future decision making.

Automation

The decisions are then converted to cognitive actions using robotics and the Internet of Things (IoT) components. Robotics automate the processes using cognitive elements. IoT uses sensors and actuators to both collect data from environments and produce actions. Together these technologies automate many repetitive, data-intensive tasks. The most pervasive of which is human language understanding using NLP and automated labelling of images and videos using computer vision. NLP is used in a wide array of automatic response systems or chatbots and conversational systems. Notable examples include Apple's Siri, Amazon's Alexa, and Google assistant systems. Computer vision is widely used in medical diagnosis, autonomous vehicles, and automated storefronts like Amazon Go. ML and deep learning enable machines to learn how to make predictions based on the data they are provided, leading to capabilities like being able to interpret natural language and identify objects in images. The machines can then be programmed to make informed decisions resulting in AI technologies such as chatbots, AI assistants, and automated storefronts. IoT and robotics components provide AI technologies with avenues of data collection and physical agency to conduct their functions. For example, autonomous cars couple computer vision (based on trained ML algorithms) and robotics. Fig. 1.1 shows the relationship between different technologies and their interactions, forming AI systems.

Goals

To develop and implement AI systems, an organisation needs three resources: reliable data, technology and data science labour. The advent of personal apps, ubiquitous IoT and social media has increased typical organisations' data collection capabilities to a great extent. With open-source algorithms and affordable

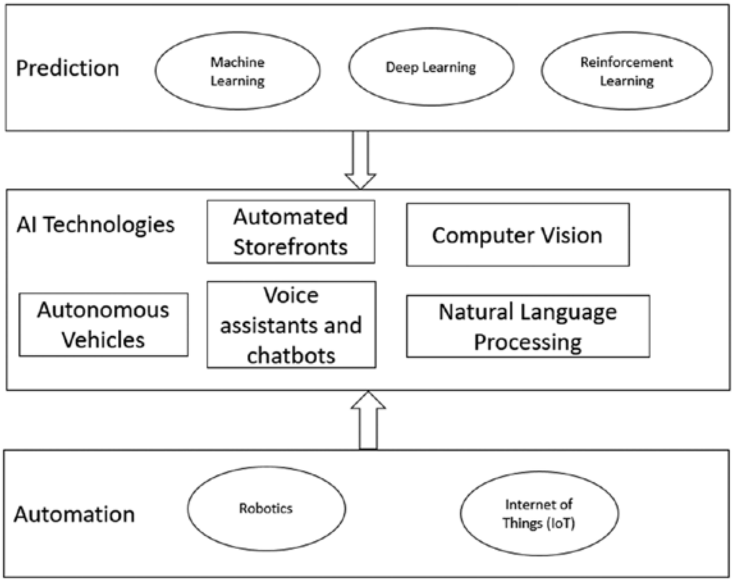

Fig. 1.1. AI Technologies.

access to high-performance GPUs, the technology to develop and implement an AI system is within reach of organisations across all tiers and sizes (Brynjolfsson et al., 2018). The data science labour force has grown substantially in the past decade to meet the high demand. With all three resources in reach, all tiers of organisations (small, medium and big) can develop and implement AI systems to add value to their enterprise. AI can add value to organisations by meeting one or more of the following objectives.

Standardisation

Some organisations use AI systems to develop and implement technical standards and set criteria to eliminate variance arising from human judgement. Typically, these are weak AI systems or hybrid systems with AI as an expert. They enable the organisations to make dispassionate data-driven decisions which make their decision-making processes more uniform. This may promote fairness and make it easier for the organisation to choose without favouritism. Another example of standardisation, NASA's use of AI system to evaluate potential planets. AI algorithm trained on NASA's Kepler telescope was able to identify 50 new exoplanets (planets outside our solar system) from historical NASA data (Yeung, 2020). Examples of this goal for AI include evaluations of teachers in schooling systems and credit card approval apps (Wilson & Daugherty, 2018). Using AI to evaluate teachers across a school district or state, or evaluating credit card applications of customers across the country ensures that all entities are rated based on the same variables without any individual bias.

Personalisation

Personalisation of products and services by predicting consumer behaviour was a prominent theme in organisation's use of IT in its initial years (Fan & Poole, 2006). Transaction processing systems with loyalty programs gave organisations access to data that can predict purchase habits of users. Scholars investigated consumers' willingness to trade their privacy for customised products that suited their needs (Awad & Krishnan, 2006). As IT became ubiquitous decades later, use of browser cookies, search histories and social media data enables organisations to have more data points to track consumer behaviour. This access to data points about consumers increased exponentially with the widespread adoption of IoT such as smart speakers, virtual assistants, and wearable devices. Consumer-driven organisations push to appeal to their clientele by tailoring their products and services towards specific individuals using available data (Wilson & Daugherty, 2018). With AI systems' ability to process large amounts of data quickly and generate recommendations, it can add value to these consumer-driven companies. Examples of use of AI in personalising products and services can be seen across industries ranging from retail, fitness, social media and entertainment. Notable illustrations include success of personalised fitness equipment and programs from Peloton, Apple, Mirror and others (Koetsier, 2020). Amazon's product recommendation algorithm processes data about the consumer from various sources such as shopping history, browsing history, and inquiries from conversational assistant to send targeted advertisements to individuals. Similarly, Netflix's algorithm is trained for specific users and recommends movies they may like.

Reducing Human Involvement

AI can be used by organisations to reduce human efforts in repetitive tasks. Fully or partially autonomous systems eliminate or reduce the need for humans to do tasks that can be easily automated increasing efficiency and adding value to the organisations. With a reduction in human effort, human error can also be reduced or taken out of the equation as exemplified by the use of autonomous vehicles. In the case of fully autonomous systems used internally by the organisation, AI systems replace human employees for certain tasks that AI can perform. Unlike humans, AI systems do not need to take breaks or change shifts leading to AI systems' use in storefronts and related places remarkably increase efficiency (Brynjolfsson et al., 2018). For example, a 30-year veteran driver who tested a self-driving truck said that the AI system could scan the road for a longer distance and react over 15 times faster than human drivers (CBS, 2020).

Maximising Use

Machine and deep learning-based predictive analytics is capable of processing large amounts of input data in a short time. The automation elements of AI make these systems capable of generating considerable amounts of output as well. Combining these attributes, AI systems can resolve many operational bottlenecks which can lead to increased use of their products and services by their users in terms of frequency and time of use. This goal can be coupled with personalisation and reducing human involvement to make systems which increase the frequency and time of a product or service's use for consumers (Makridakis, 2017; Wilson & Daugherty, 2018). Use of AI systems to fulfil this objective has led to vital changes in organisational structure. Industry leaders such as Apple, Microsoft and Google, where once were known for their (hardware and software) landmark products are now venturing into more service-oriented structures (Gurman, 2019). Examples of AI systems being used in industry include AI-enabled virtual assistants used for customer care that can handle a higher volume of customers than human customer care associates at a lower cost. Heavy use of recommendation algorithms by social media sites such as YouTube and Facebook to increase engagement on their platforms is also an example of use of AI by organisations for this goal (Kumar, Rajan, Venkatesan, & Lecinski, 2019).

Signal Innovation

AI systems encompass buzz words and trending technologies. Organisations' emphasis on new technologies has proven to have positive reactions from the stock market and media (Hayes, Hunton, & Reck, 2001; Steelman, Havakhor, Sabherwal, & Sabherwal, 2019). Top management of some organisations opt for the use of AI systems in order to appear more innovative than their peers and gain legitimacy as per the institutional theory (DiMaggio & Powell, 1983; Jensen, Kjærgaard, & Svejvig, 2009). Evidence of these objectives can be seen in both big and small organisations. Success stories of AI systems creating value for organisations may also motivate organisations to develop and implement AI systems that do not fit their direct business needs. For example, IBM developed strong AI (Watson) without a pre-set market segment (Strickland, 2019). AI systems like these may not yield profits but are successful in positively reflecting organisations' research and development capabilities. Use of AI to signal innovation is more prominent in small to medium-sized enterprises. Many start-ups market themselves based on their AI prowess to attract investors. It was found that 40% of European start-ups that use AI in their description did not have any AI-related product or service (Vincent, 2019). In pursuit of one or a more of these goals, organisations may choose to design and implement AI systems. There are different types of AI systems that fit different problems organisations may aim to address. In the following section, we discuss different types of AI.

Types of AI

We have discussed components of AI systems and goals that can be achieved with their aid. We have talked about AI in general terms, but AI systems are of different types (as shown in Fig. 1.2). They can be classified based on task orientation and agency. Task orientation refers to the range of tasks an AI can perform (Searle, 1980). Agency of technology refers to the degree of control of AI system has in performing its functions (Sundar, 2020). These classifications