Editorial
Rethinking Information Technologies and Information Systems—From Informing Pandemic Preparedness to Managing Business Disruptions and Endemic Responses

I. Introduction

In THE wake of the COVID-19 pandemic, the world seems to have jumped off the hinges. During the pandemics, countries needed to first take several steps to contain the spread and subsequently find solutions to exit the pandemic—these often being connected also to solutions related to information systems—which can, however, also bring important lessons for other sudden shock situations, as well as periods of endemics.

In this most recent severe sudden shock of COVID-19 [1], decisions were often made *ad hoc* based on incomplete and sometimes unreliable information. This often led to hasty decisions that were based on improvisation of the gathered data's implications. A good example is the social distance that individuals were recommended to keep while in physical proximity. Depending on the country/context, this distance has varied between 3 ft and 2 m [2], [3], [4], [5], [6] since clearly, reliably calculating the safe distance requires virologic and epidemiologic information that was not (immediately) available. There is an array of similar examples, where time and again decisions by authorities had to be taken on partial inputs.

The scientific community has recognized this gap relatively soon [7], [8]. At the forefront was the need for evidence-aware decision making [9], however, where the scientific communities can support the shift to more evidence-based policymaking [10], [11] in the public sector but also a more efficient dealing with the effects of sudden shocks, such as COVID-19, of the private sector.

It is encouraging that the COVID-19 pandemic is finally over. However, there is no guarantee that similar pandemics will not appear again in the future. In the next step, firms, policymakers, as well as individuals in the societies should be better prepared. Without doubt, the role of information technologies will be critical [12], [13].

II. Toward the Contribution of Information Systems

Rethinking the existing information systems can support bridging the gaps, as it is information systems that help decision makers by providing accurate and timely information, which can be critical for authorities to make right decisions in turbulent environments [14]. In contrast, unreliable information can result from conflicts that arise when trying to create local information systems for pandemic response within centralized healthcare systems [15]. While each of the stakeholders has relied on modern information technology during recent infectious disease outbreaks, insufficient attention has been paid to the fact that the theoretical possibilities of this technology are limited by characteristics of the health system of which the information system is but a part [16]. Connecting various information systems must be comprehensive, and only as such can it consequently lead to understanding new and more robust implications of information systems adoption, as well as provide evidence-based information to support effective and efficient decision-making process and policy changes [17]. There seems to be more value to be derived from information systems support—with advances possible in terms of system functions, technical components, or pandemic evidence compilation [15].

In line with this, we have encouraged researchers to investigate how existing information systems as sociotechnical constructs [18] consisting of interactions between people, their roles and activities they carry out, as well as their use of technology, support the mitigation of COVID-19 consequences or other external swift shocks, help exit the crisis, and inform the future crisis-related challenges. We did so while considering several issues.

During the COVID-19 pandemic, many innovative measures were proposed [19]. For instance, retailers started to go online and even adopted social media (such as WhatsApp) for their business operations [20]. The use of text analytics can hence help to enhance the corresponding online-to-offline operations [21]. A lot of manufacturers changed their normal operations to help produce personal protective equipment (PPE) under COVID-19. Popular examples including brands such as LV helped to produce masks [22]. However, how to quickly produce the right quantity of PPE with the coordination of limited supplies of resources requires the presence of versatile information systems and effective project management skills.

For governments and policymakers, saving people's lives is key during a pandemic. The risk assessment schemes for

policies, such as city lockdowns as well as the distribution of humanitarian supplies to the people in need, all require sophisticated analyses with the use of information technologies such as artificial intelligence and big data analytics [23]. Of course, governments also provide supports such as wage subsidies to individuals and firms [24]. The use of information systems becomes necessary to make the process effective and help avoid problems such as cheating.

For firms in the global supply chains, they should carefully examine how the pandemics affect their suppliers and customers [25]. The presence of information systems, especially with data analytics capability, is essential. In addition, to achieve the 3Rs (responsiveness, resilience, and restoration) [22], it is also crucial to have the right information systems in place.

In short, although COVID-19 has passed, nobody knows when another pandemic may come. Hence, it is crucial to enhance preparedness and responsiveness to the potential challenges. As a result, rethinking how digital technologies and information systems can help policymakers, firms, and individuals deal with pandemics and the associated disruptions is a very important topic. This relates to not only the right choice of information technologies but also the right applications as well as planning of the respective systems implementation (e.g., project management [26]). All these require important skills and research from engineering management.

III. This Special Issue Overview

Motivated by the significance of information technologies and other critical tools of engineering management to help firms, policymakers, and individual decision makers to deal with the pandemics, we have organized this special issue in the IEEE Transactions on Engineering Management.

Table I shows a summary of the featured papers. As we can see from Table I, most featured papers adopt the analytical modeling and quantitative empirical approaches. The topics being explored include those from the people and healthcare perspectives, as well as from the supply chain perspectives when there are disruptions during the pandemics.

IV. Concluding Remarks and Future Research

Lessons learnt from COVID-19 influenced firms and policymakers to make smarter decisions when it comes to using information technologies to deal with future pandemics. Before we conclude, in the following, we propose a few directions for future studies.

1) *City lockdown arrangements:* During a critical pandemic such as COVID-19, city lockdowns are probably one painful yet useful measure. However, there are a lot of challenges behind lockdowns, which deserve further investigation. For example, how to determine the optimal timing (when to start) and duration (when to stop) for the city lockdowns? What are the critical factors governing these decisions? All these research questions require more in-depth research. How information technologies (such as data analytics and artificial intelligence) can be used to support decision making for these important questions should also be explored in future studies.
2) *Government policies:* Under COVID-19, governments all around the world have implemented different policies and provided all kinds of supports to individuals and firms [24]. Even though a lot of studies have been conducted on government supports or policies regarding PPE such as masks, there is insufficient research on whether and how governments can support firms to make use of information technologies. This opens a new avenue for deeper investigation in the future.
3) *Derisking:* During COVID-19, we observed serious problems because of the disruptions and city lockdowns. For example, if production takes places in Country A and there are city lockdowns, then supply of the product will be at risk. Even if there are no city lockdowns, whether full productivity can still be achieved under the pandemics is unknown (e.g., lots of workers are sick), which will also lead to disruptions in production. Similarly, for the demand side, if Country B used to be a big market for a certain product, a serious pandemic there will also create the demand-side disruption. Thus, the disruption problems can appear from both the supply and demand sides. So, the concept of derisking, i.e., companies no longer relying on a sole supplier or market in the operations, arises. Derisking is a very popular topic in operations management, with information technologies playing a crucial role in its implementation. This is the well-established sense-and-respond strategy, which is supported by state-of-the-art information systems. However, the value of this type of sense-and-respond system for operations with derisking is underexplored in the literature. More studies, from exploratory qualitative studies to analytical modeling research, should be conducted in the future.
4) *Multimethod studies:* Innovation is necessary for firms and policymakers to better prepare for pandemics like COVID-19. To get more scientifically sound results, it will be good to adopt the multimethodological approach [23], [27] in conducting related research. This means that a lot of further study opportunities are present even for topics that have been examined by a single method. By combining different methods, the findings will be more convincing, and the insights will be more comprehensive. This also advances the science of the results.

We would like to express our sincere gratitude to the Editor-in-Chief, Prof. Tugrul Daim, for his kind support in merging two teams of guest editors (one team led by Tsan-Ming Choi, and one team led by Nadja Damij) and advising us during the editing of this special issue in the IEEE Transactions on Engineering Management. We are grateful for the contributions by all authors and the timely review by the reviewers.

Enjoy reading this special section![1]

TABLE I
PAPERS FEATURED IN THIS SPECIAL SECTION

Method	Title of papers
AM	Could Early Warning Combat Demand Disruption Caused By Endemics And Pandemics? Benefit And Dilemma Analysis; Managing Home Healthcare Services With Dynamic Arrivals During A Public Health Emergency; Optimal Establishments Of Massive Testing Programs To Combat Covid-19: A Perspective Of Parallel-Machine Scheduling-Location (Scheloc) Problem; Sustainable Supply Chain Finance And Supply Networks: The Role Of Artificial Intelligence; Rbotue: Rumor Blocking Considering Outbreak Threshold And User Experience
DA	Designing Predictive Models For Customer Recommendations During Covid-19 In The Airline Industry
LR	Links Between Risk Source Identification And Resilience Capability Building In Agri-Food Supply Chains: A Comprehensive Analysis; Challenges And Limitations Of Pandemic Information Systems: A Literature Review
MM	Roles Of Innovation Leadership On Using Big Data Analytics To Establish Resilient Healthcare Supply Chains To Combat The Covid-19 Pandemic: A Multi-Methodological Study
QE	Developing Techniques To Support Technological Solutions To Disinformation By Analysing Four Conspiracy Networks During Covid-19; Applications Of Industry 4.0 For Pandemic Responses And Business Continuity: A Toe-Dcv Integrated Approach; Advancing Consumer Behaviour: The Role Of Artificial Intelligence Technologies And Knowledge Sharing; Business Continuity Innovation In Disruption Time: Sociotechnical Systems, Business Analytics, Virtual Business, And Mediating Role Of Knowledge Absorptive Capacity;
QL	Activity-To-Skills Framework In The Intellectual Property Big Data Era
SM	An Approach To Optimising Kanban Board Workflow And Shortening The Project Management Plan

Methods: AM = analytical modeling (including optimization); DA: data analytics; LR: literature review; MM: multimethod; QE: quantitative empirical; QL: qualitative; SM: simulation.

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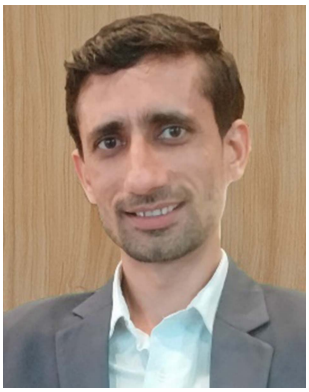

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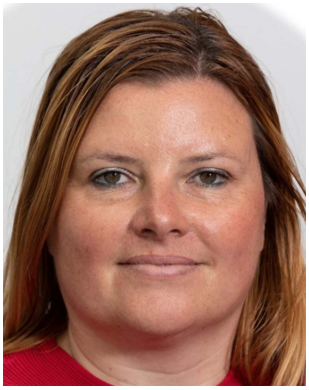

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