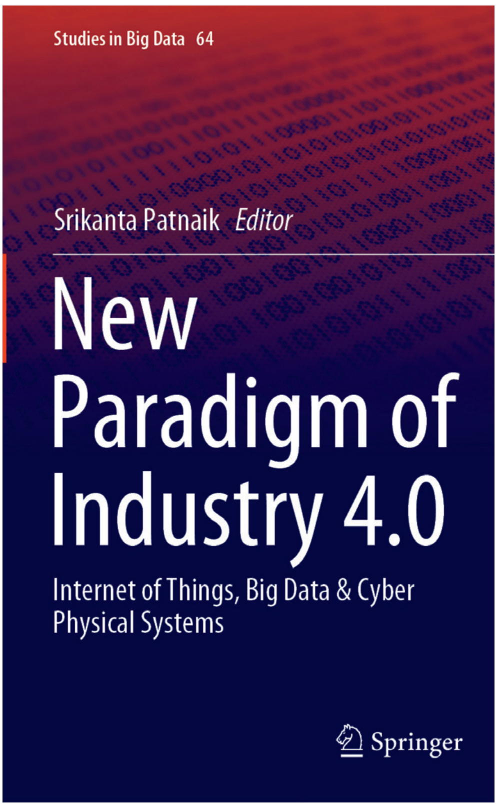
BOOK REVIEW SECTION

Patnaik, S. (ed.): New Paradigm of Industry 4.0: Internet of Things, Big Data & Cyber Physical Systems. Bhubaneswar, Springer, 2020. 180 p.

Are we going fast enough to cope? This is the most frequent question that has been asked over the companies since 2011. It was the year that has introduced the fourth industrial revolution to our lives that became one of the biggest debates among companies, politicians, scholars, and even the primary school teachers. So, are we going in the right direction to cope with this revolution in our life? This is a big question, which needs a bigger answer. However, with the uncertainty that we have in our life caused by natural disasters as well as human-made disasters, are we able to cope with this revolution in the sake of managing the unforeseen and to promote a better life for human beings? This book is an attempt to give an overview of the issues that organisations are facing in adopting Industry 4.0, now and later. For sure, it cannot answer the whole question, but discusses a wide range of Industry 4.0 related issues, future models and the development of a set of sustainable management tools to cope with this revolution to close the gap between academic investigations and actual feasibility.



The book editor, Professor Srikanta Patnaik has already written several publications in connection with the new technological revolution. The book has eight chapters, and each of them discusses a certain issue to cover some of the managerial challenges and the decision-making framework in the Industry 4.0, as well as certain areas of manufacturing and education techniques that can be adopted in the upcoming period. It also goes beyond, investigating how the new IT systems can support sustainability in firms hiring Artificial Intelligence (AI) in the manufacturing and inspection, and it discusses some technical matters of Industry 4.0 too.

Many books can promote further research on Industry 4.0. This volume is one of them, even if the topic is hard to be covered in one book. However, after reading the book I have chosen only two chapters (first and third) for a more detailed review, because these are more closely connected to Industry 4.0 in a way that has explicit relevance for those working in the field of geography, particularly in the disaster and crises management.

The first chapter discusses "one effective way to the risk factors integrating Machine Learning (ML) into Industry 4.0 applications" (p. 1). Here is a direct example of applying ML in Industry 4.0 to introduce geographical information systems to the decision-making process to manage natural disasters and, more broadly, to manage risks. The third chapter is related to the education gap that has been caused by Industry 4.0, where lack of training and education is one of the biggest obstacles (beyond low infrastructural development) to use Industry 4.0 applications not only in GIS and disaster management, but in many other fields as well. Another obstacle for education is scarce financial means due to which we need open-source software to teach how can deal with Industry 4.0 applications.

The first chapter considers the field of ML techniques to be integrated into the Industry 4.0 applications to manage risks as the main subject. The authors have categorised risks into four main groups: Volatility, Uncertainty, Complexity and Ambiguity

(VUCA) according to the old classifications of US Army War College from 1991. The authors also brought some information about the background of Industry 4.0 based on AI, big Data, Internet of Things (IoT), Cyber Physical Systems (CPS), Information and Communication Technology (ICT) and Radio Frequency Identification (RFID), these applications had their foundations laid during the third industrial revolution. It is interesting to note that every industrial revolution has its own sides of risks. This chapter proposes a way of managing risks using ML, taking into consideration that ML is a subset of AI. ML can be defined in a same way as any data processing. It uses algorithms that are adopted and analytically formed to train the identified and tested database. The steps of any data process are the followings: 1. data collection, 2. data pre-processing, 3. model building, 4. model training and testing, 5. performance evaluation and model prediction of desired results. ML algorithms were classified into three major groups: supervised, unsupervised and reinforcement learning. ML applied techniques have been used to manage VUCA, starting from the late 19th century not only in commercial crises management but also in natural and human-made disasters. They also classified many parameters of risks, developing algorithms for each parameter to improve ML process in risk management. Moreover, the authors started to highlight the role of some ML techniques used for managing risks that can occur within industrial platforms. This chapter also explains ML algorithms, and after each explanation, a series of recent studies gives examples for the applications of each ML type.

One such application is in food production, which is highly volatile and uncertain depending on the customer's expectations and needs. It is also affected by traffic conditions. Increasing traffic and traffic jams due to increasing number of vehicles can endanger the quality of products (e.g. dairy products), and this can lead to less customer satisfaction and financial losses. ML is a good solution for the traffic condition forecasting. It analyses the historic data of roads and gives predictions about their conditions and traffic for example on Google maps.

The second one of the ML applications is the Role of Logistic Regression. It is also supervised by ML algorithm that can be applied in the weather forecasting and in many other fields (healthcare system, voting etc.). A rich literature review about the different applications is also available here for readers.

Of the application methods, The Role of Forest (RF) is also worth mentioning. In this chapter the authors also demonstrate a well submitted literature review to provide real life examples using ML techniques. One ML method employed by Wang, Z. *et al.* (2015) was mentioned as an example for the use of ML in geographical and decision support systems for disaster management. This case was a novel approach to flood hazard risk assessment, using RF as a method and Support Vector Machine Learning (SVM) as a risk assessment comparison to solve a non-linear problem. Based on four previous floods in the Chinese Dongjiang River Basin, five thousand samples of eleven risk indicators were taken into consideration. This river is the primary water source of six highly populated and developed cities: Ganzhou, Heyuan, Huizhou, Dongguan, Guangzhou, Shenzhen and Hong Kong. However, after applying RF and SVM they were able to produce spatial distributions and assessment maps showing the place and frequency of each risk indicator. In consequence, ML techniques based on the RF classifier were able to exclude six out of eleven indicators with different importance. Taken as a whole, this was a great way to employ ML to identify risks and reduce time and efforts (Wang, Z. *et al.* 2015).

Before discussing how we can use the Industry 4.0 applications in disaster management using the big Data and IoT in GIS, it is worth to retrospect. The use of GIS in disaster and crises management has been known from 1849 when John Snow traced the source place of cholera in London (Snow, J. 1991). In the 1960s its usage started to be wide, but at that time it was only a few terabytes. However, with the extraction of social media data, crowdsource data and remote sensing data (using open-source satellites systems), not to forget higher resolutions, high definition layers, and the big number of drones and cellular phones that have been in use as well, the amount of GIS data has grown bigger than ever. European Space Agency (ESA) by itself generates tens of terabytes per day. IoT in this matter generates huge geo-coded temporal, and real-time data (Azaz, L. 2011). This means that it can be too big for too many users to download and (or to) process, therefore the solution was to link it to space using the Cloud Computing. This allows data sets to be overlaid to the algorithms of ML (Klein, L.J. *et al.* 2015). However, several software can be used to manage this kind of big Data, one of them is PAIRS Geoscope. This software can be used for Physical Analytics Integrated Data and Repository Services. It has been made to handle the complexity and size of geospatial-temporal data. This software with the use of Industry 4.0 concepts can also use other technologies like Geomesa and Geowave, which are open-sources for geospatial-temporal indexing big databases (Albrecht, C.M. *et al.* 2020). This software also allows us to be connected through the usage of IoT and historical imagery stored in it. In this way we can draw many of post disasters scenarios, to help us in the lesson (De Perez, E.C. *et al.* 2014).

Geospatial information is one of the most important information that can be used in Disaster Management (DM). big data and cloud computing have made it easier to use this information. The major elements of the DM cycle are the followings: preparedness, response, mitigation, and recovery (Thomas, D.S.K. 2018). The real-life example shows how the sensor's information was used during and after an earthquake from a ground-based sensor like the seismic sensor network operated by the U.S. Geological Survey (USGS) and The Global Seismic Sensor Network. This was used in Lombok (Indonesia) disaster where a 6.8-magnitude earthquake happened on August 5, 2018. Just hours after the disaster, the analysis of earth surface displacements was available. Using the Synthetic Aperture Radar (SAR) and the signals acquired by the European Space Agency was also an effective way to reach infrastructure analysis after disasters (Albrecht, C.M. *et al.* 2020). In the mitigation phase of the DM, evacuation, rescue and relief have to be taken immediately after the disaster to reduce its impacts (Risk Reduction). Using Big Data and Cloud Computing we can reach lots of people and houses, and also the critical infrastructure that may be affected within the area. Then this information can be directed to the first-response teams and it can help in the search and rescue operations (He, L. and Yue, P. 2019). We can also process the remote sensing images and drones quickly to be integrated into geophysical models to assess the damage (Flesch, R. 2007).

Not only in case of earthquakes, but in many other cases as well (e.g. wildfire disasters), we can use modelling that is highly dependent on geospatial temporal data to know the soil, humidity, temperature and many parameters that can determine the spread of the fire. We can also determine the right way to dispatch the response teams using these data sets, like the European Union system and the National Aeronautics and Space Administration system, which provide operational data for wildfire tracking using Landsat with resolution reaching up to 10 metres (Albrecht, C.M. *et al.* 2020). Dealing with these systems that are using the Industry 4.0 applications needs a software to code and decode programming languages. One of the most popular programming languages is Python (Klein, L.J. *et al.* 2015), which is open source with no hidden costs.

Chapter 3 discusses a very important field in the era of Industry 4.0 which is education using a low-cost open-source hands-on Industry 4.0 education software, a recommendation of Python as the ideal tool for laboratories. To cover most of Industry 4.0 skills gap that it's affecting the implementing process where the largest gap is the skills in the field of big data. This chapter went to all the hands-on ways of education to prepare the young as well as the experienced workforce. It gives examples from many countries on how they set up their laboratories, also in terms of software. We can see the Turkish-German University (Istanbul, Turkey) and Graz University (Austria) here as good examples. But they are expensive ones as well, so the author is focusing on low-cost software that can be afforded. The author describes this software as "the glue or the bridge between all the systems" (p. 39.), providing a comparison among five such kinds of software. The focus is here on Python, which is for free (open source). Taken as a whole, the chapter does not give an exact answer how to fill the gap of skills.

After summarising the book, I would say that it has ups and downs if we focus on Industry 4.0, the central topic of the book according to its title. Yet, it can be the starting point for many researches. Overall, it is a good read, but it does not give a good overview on Industry 4.0 compared to other pieces of literature. In spite of this, I would recommend this book primarily for those who are working in disaster management and who are geospatial information specialists in disaster management. The first chapter, which is a most valuable part of the book, will be very useful to them. The book can also be important for those working on filling the skill gap caused by Industry 4.0, for they can get a broader overview of relevant applications. The other parts of the book dealing with different industries (e.g. furniture, textile) and environmental issues could be more insightful if they handled Industry 4.0 as a solution to help, but not to replace, the workforce in the textile industry of India. However, these parts of the book can be useful for decision makers, who can read about many ways for improved decision making when it comes to green supply chains and the use of statistical methods to improve their decisions. The volume can also be a useful starting point to read about the fourth industrial revolution, for some chapters help the reader better understand the technical formation of Industry 4.0.

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REFERENCES

Albrecht, C.M., Elmegreen, B., Gunawan, O., Hamann, H.F., Klein, L.J., Lu, S., Mariano, F., Siebenschuh, C. and Schmude, J. 2020. Next-generation geospatial-temporal information technologies for disaster management. *IBM Journal of Research and Development* 64. (1–2): 1–12. Available at https://doi.org/10.1147/JRD.2020.2970903

Azaz, L. 2011. *The use of geographic information systems (GIS) in business*. A paper for International Conference on Humanities, Geography and Economics. Pattaya, Thailand, ICHGE'2011. 299–303.

De Perez, E.C., Monasso, F., Van Aalst, M. and Suarez, P. 2014. Science to prevent disasters. *Nature*

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Geoscience 7. (2): 78–79. Available at https://doi.org/10.1038/ngeo2081

Flesch, R. 2007. *European Manual for In-Situ Assessment of Important Existing Structures.* LESSLOSS Report No. 2007/02. Pavia, Italy, Istituto Universitario di Studi Superiori.

He, L. and Yue, P. 2019. *A cloud-enabled geospatial Big Data platform for disaster information services.* Paper for Geoscience and Remote Sensing (IGARSS), IEEE International Symposium 2019. Yokohama, Japan. Available at https://doi.org/10.1109/IGARSS.2019.8898893

Klein, L.J., Marianno, F.J., Albrecht, C.M., Freitag, M., Lu, S., Hinds, N. and Hamann, H.F. 2015. *PAIRS*: *A scalable geo-spatial data analytics platform.* Paper for the IEEE International Conference on Big Data, 2015. Santa Clara, USA. Available at https://doi.org/10.1109/bigData.2015.7363884

Snow, J. 1991. On the mode of communication of cholera, 1855. *Salud Publica de Mexico* 33. (2): 194–201.

Thomas, D.S.K. 2018. The role of geographic information science & technology in disaster management. In *Handbook of Disaster Research*. Eds.: Rodríguez, H., Donner, W. and Trainer, J.E., Cham, Springer. Available at https://doi.org/10.1007/978-3-319-63254-4_16

Wang, Z., Lai, C., Chen, X., Yang, B., Zhao, S. and Bai, X. 2015. Flood hazard risk assessment model based on random forest. *Journal of Hydrology* 527. 1130–1141. Available at https://doi.org/10.1016/j.jhydrol.2015.06.008