Guest editorial

A big data analytics approach to quality, reliability and risk management

Nowadays, everything around us produces Big Data (BD). The digital process and the social media exchange provide it, while the communication and sensor systems transmit it. The development of smartphones and mobile devices increased the amount of it. Thus, multiple sources provide BD at an alarming velocity, volume and variety. Due to this, it is necessary to adopt optimal processing power, analytic capabilities and skills, in order to extract meaningful value from them (Janssen *et al.*, 2017).

BD has rapidly moved to be a mainstream activity in the organisations, changing the way people within organisations work together. The culture in which business and IT leaders have to join forces to achieve value from all data is changing. Tapping into large-scale, fast-moving and complex streams of data sets has the potential to transform the way organisations take their decisions. On the other hand, increasing demand for insights requires a new approach for defining tools and practices. In the current competitive business and industrial environment, top management has to be fully knowledgeable about new thinking, techniques and developments in the field.

According to Zhang *et al.* (2017), the emerging advanced technologies related to the identification process, wireless sensors, radio frequency identification, communication technologies and information network technologies, have created the new era of the Internet of Things (IoT). Subsequently, Zhang *et al.* (2017) asserted that IoT offers an IT infrastructure to assist the information interchange of "things and processes" in a real-time and reliable manner. Thus, data represent the connecting bridge between cyber and physical world. However, as suggested by Berti-Équille (2007), it is important to highlight that a significant amount of data is not relevant if their quality is not taken into consideration in the analysis. In fact, the impact of low data quality on the results validity and interpretations of BD processes leads to the conclusion that every designed approach have to ensure data quality and accuracy. Many studies show techniques to evaluate the data quality in the world of IoT, as summarised by Karkouch *et al.* (2016). Moreover, the different nature and relevance of the available data require a particular attention in terms of security and privacy, for most application domains such as personal, home, government, enterprise and industry domain (Ouaddah *et al.*, 2017). Nevertheless, according to Wu *et al.* (2017), this enormous set of data and the continuous improvement of the information technology highlight the difficulties to manage properly the available information. However, there is the consciousness of the increasing relevance of this new approach in the activities management. In fact, in the last few years, BD and IoT have been rapidly gaining ground in many sectors.

Zhao *et al.* (2017) adopted the BD approach for developing a multi-objective optimisation model in the green supply chain management (SCM) and, in particular, for minimising the inherent risk caused by hazardous materials. The BD approach defined the guidelines for data acquisition within the entire considered supply chain (SC) and for the data quality control. For these reasons, Lillrank (2003) elaborated standard definitions of quality and suggested guidelines for methodology development. In particular, he postulated the distinction between information-as-artefacts and information-as-deliverables. Furthermore, he highlighted the need to improve the integration of BD science in the SCM sector. Gunasekaran *et al.* (2017) underlined the relevance of BD for achieving business value and firm performance to be used jointly with a predictive analysis. Their study answered some research questions regarding the relation between BD and top management commitment, supply chain connectivity and information sharing. They pointed out that the application of BD approach in the SCM is

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positively related to the information exchange and the SC connectivity, finally asserting that BD can help to face critical challenges of predictive analytics referring to data capture, storage, transfer and sharing. Banica and Hagiu (2016) showed how, nowadays, even though each company has its own information system (which delivers sales reports, graphics, statistics and forecasts) and an internet platform for communicating with its customers, many relevant data could be obtained through the social networks. In fact, the information technologies development has produced rapid changes in the relationships between companies and their customers. More and more, pre-sale and post-sale relations take advantage from the use of internet platforms for replying more quickly to the end customer needs. This kind of information, directly connected to customer needs, gives another type of perception of the company. It could also increase the competitiveness in the target field improving the "creative industry", by the participation of potential consumers in style design, and in defining utility, quality and comfort for new products. It is indeed necessary, for a company, to investigate what factors are relevant from a customer's point of view for improving its own products. For this reason, Melián Alzola and Padrón Robaina (2010) addressed their study on this line, trying to investigate the reasons why people use the internet. On these grounds, Conde-Clemente *et al.* (2017) implemented the paradigm of "Linguistic descriptions of complex phenomena" (Trivino and Sugeno, 2013). Specifically, they proposed an approach for better understanding the knowledge representation and the human perception of some issues. Of the same mind were Hopp and Vargo (2017) that used information reported on social media platforms for understanding the relationship between negative political advertising and political incivility on Twitter. Their theoretical model used data collected from over 140,000 individual Twitter users located in 206 designated market areas. Moreover, Li *et al.* (2016) developed a BD approach to predict online e-marketplace performances, analysing data extracted from a popular e-commerce. Indeed, according to Shardanand and Maes (1995), essentially, social information filtering automates the "word-of-mouth" recommendations process.

BD can find a breeding ground also referring to product and process quality. According to Lee *et al.* (2014), product quality sector can offer much comprehension on machine condition through backward reasoning algorithms, using BD as the outcome of the manufacturing process. Specifically, BD can provide feedback for system management, usable to improve production scheduling. Moreover, it is necessary to underline that BD techniques can go together with the entire lifecycle of the product (Li *et al.*, 2015). In fact, following the Industry 4.0 principles, the combined use of BD and IoT methods provides practices for monitoring products' quality and equipment health, allowing the prediction of the machinery lifecycle. In particular, machine health prediction decreases the machine downtime, and the prognostics information supports the ERP system in the manufacturing management optimisation, maintenance scheduling, ensuring machine safety and optimising the cost of system operation and maintenance (Meeker and Hong, 2014).

BD approach is increasing its relevance also in the risk management sector. Walker and Strathie (2016) presented some proofs of concept demonstrations for showing that long-standing ergonomics methods can be driven by BD and succeed in providing insight into human performance in an innovative way, in terms of transport safety risks. They used BD, collected from on-train data recorders, for addressing the most critical strategic risks currently faced by rail operators and authorities worldwide. Their relevant result highlighted that the connection between psychological knowledge, ergonomics methods and BD generates an important new framework for driving a new awareness. One of the most relevant requirements for BD application is the close cooperation between stakeholders, in order to build necessary infrastructures, to maintain data integrity and eliminate patient privacy concerns. Concerning the risk management, BD approach allows to define relationships among the several risk factors, as suggested by Bevilacqua *et al.* (2008), and

also identifying hidden relations among them (Bevilacqua *et al.*, 2018). Bevilacqua and Ciarapica (2018) developed a conceptual model, based on BD Analytics tools, to integrate human factor in a refinery risk management system. The proposed method, taking into consideration a wide set of objective and predictive variables, shows new cause-effect correlations in refinery processes never described previously, highlighting possible adverse events and supporting decision-making in these areas. Moreover, the data suitability is the starting point for modelling tools for the classification and the prediction of occupational injury risks (Persona *et al.*, 2006).

All the mentioned studies and the others founded in literature highlight the enormous potentiality of BD approach in quality, reliability and risk management. However, it is necessary to develop and improve new analytic methods to obtain more significant results.

The data acquisition, storage and management are the main steps for each analysed approaches, with particular attention to the data quality. The development of new acquisition systems and data mining methodologies are fundamental. The information derived from them can help managers in many decision-making processes. New system modelling approaches and statistical process controls have to consider the increasing of the available information without losing their specificity. Every single datum could contain a different type of information depending on the user point of view. The researchers are called to identify the modality to achieve an accurate result usable in all the aspects of quality, reliability and risk management: from the managers training to innovations in processing and production, to raise standards of product quality following the information technology improvements and the growing relevance of IoT paradigms.

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Further reading

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Giovanni Mazzuto, PhD in Industrial Plants at the Politecnical University of Marche, graduated in 2010 in Engineering of the Industrial Automation at the University of Ancona. His research activities mainly deal with environmental analysis of process plants and maintenance management, analysis of the behaviour of the supply chain, project management and product development. He is Author of several papers that have been published on international journals (*International Journal of Production Research*, *Journal of Loss Prevention in the Process Industries*, *International Journal of Business Performance and Supply Chain Modelling*, *International Journal for RF Technologies: Research and Applications*) and conference proceedings.

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