Editorial

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Data driven decision support

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The aim of this special issue is to present current research on data driven decision support. Recently, many discussions about data driven approaches can be found in both the scientific as well as in the practitioner literature. Under the umbrella of the term “big data”, the ability to extract, prepare, store and analyse very large, diverse, near or real-time data sets is expected to change our views on data and the way how business operates [1]. According to the EU Data Market study, the number of data workers could almost double by the year 2020, the overall data market could get to 111 billion Euro in 2020 and the economic impacts produced by the adoption of data-driven innovations could rise to 4.7 % of GDP in 2020 [3].

The major driver for this is the ability to process more as well as more diverse data in near or even real time which enables to process data not yet analysed or even to collect more data. The latter is heavily boosted by the growing availability of cheap sensors and increased connectivity. As a result, as much as 90 % of the data have been created in the last couple of years [2]. This together creates many new application areas in the context of data driven technologies.

The analysis of data is intertwined with the idea of decision support [4]. Thereby, the aim of decision support is to provide the decision maker with a better information basis for decision, not to automate the decision process itself [5]. Decision support and decision support systems are not new. Such systems are designed to help decision makers in utilizing data and models to solve problems to improve the decision quality [6]. But the way we approach data and how we process data changed a lot. Statistics is more and more complemented by artificial intelligence to discover unknown relationships [7]. Such algorithms are especially suited to analyse time series data which are very relevant for decision support in organiza-

tional business processes. Unsupervised algorithms can be applied to detect completely new phenomena and supervised algorithms allow taking existing knowledge into account [8].

In contrast to previous hypes on artificial intelligence, powerful hardware and advanced distributed computing capabilities allow a broad and easy application. Further, open source libraries such as Tensor Flow initiated by the Google brain team, reduce the barrier for implementing software. Additional global players heavily invested and have already products on the market, e.g. IBM Watson, Sony Cogtai or Google Allo. Even in industry, commercial applications of artificial intelligence to provide data driven decision support can be found, e.g. Bosch power tool initiative or KUKA LBR-iiwa.

Data driven decision support focusses on the analysis and representation of historical data. In this regard, visual analytics focusses on the suitable representation of big data and especially on the visualization of data streams to support decision making by combining automatic analysis methods with human background knowledge and intuition [9]. Knowledge discovery promises to “discover knowledge that no one has discovered before” by applying algorithms [10]. The result are typically models which can be used for the automatic classification of situations. However, in addition to analyse the past, a key goal of data driven decision support is to make suitable and reliable predictions.

Data driven decision support changes the interaction between humans and machines, but does not replace human deciders. New algorithms and approaches will automate processes, but also allow to think about completely new tasks. In this regard we reframe the use of decision support as augmentation, human work can flourish and accomplish what has never been possible before [11]. This special issue consists of five papers exploring new and demanding tasks for data driven decision support. The papers focus on different application domains, e.g. health care, security and auditing, task forces and trading, focus on the representation of historical data, on knowledge discovery or on predictive models by applying new artificial intelligence approaches and algorithms. In the following, I will highlight the contributions of each paper:

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Paper 1 from Hayn et al. investigate requirements for data driven decision support in the context of health care. The authors focused on predictive models based on machine learning algorithms to analyse clinical data and to identify patterns in clinical data. Within this research the authors identified healthcare specific requirements for data driven decision support which are an important foundation for future research on data driven decision support in healthcare settings.

Paper 2 from Eigner and Bodendorf also focuses on a healthcare setting and deals with the readmission prediction in hospitals. For this purpose, multiple cross-validated classification models are implemented and compared in the context of patient discharge management. In addition to the visualization of the data, the prototype also has a predictive component. Within this paper the architecture of prototype and its prediction models are in the key focus.

Paper 3: Brunner et al. focusses on IT security auditing and specifically on the verification of security controls. The data driven decision support is intended to support company internal as well as external auditors in examining the suitability of security controls. For this purpose, a data-driven audit data management and analytics prototype was developed and evaluated.

Paper 4: Lacic et al. focus on trading situations and specifically on car import planning. The authors developed a prototype and tested four different forecasting models in a series of experiments. The results are evaluated in the context of a case study and they show relevant influence parameters for this decision problem.

Paper 5: Köfler et al. focus on the management of task forces and specifically on security forces at open air music festivals. The authors implemented a prototype providing decision support for the security forces command center. The prototype was evaluated in a case study and design implications and requirements are identified in expert interviews, group discussions and observations.

All papers nicely show that larger data sets can be computed and analysed in smarter ways. This automates tasks of human deciders so that they have more time to tackle more advanced problems [7]. But humans do not only have more time for more advanced problems, also challenging decision problems become now accessible by new technologies. Hence, the future challenge of data driven decision support will be to discover new and promising application areas instead of automatizing existing decision problems. Further, employees need to be trained in applying artificial intelligence approaches and

especially in how to assess the quality of the recommendations. Finally, sharing large data sets across organisational boundaries also bears the risk of revealing critical information or knowledge. Hence, approaches are needed to clearly show which information or knowledge can be extracted from a given data set.

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References

1. McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D. J., and Barton, D. "Big data: the management revolution." *Harv. Bus. Rev.* 90, no. 10 (2012):60–68.
2. IDC. European Data Market Study SMART – Final Report (2017), https://sites.google.com/a/open-evidence.com/download/repository/SMART20130063_Final%20Report_030417_2.pdf?attredirects=0&d=1.
3. Al-Jarrah, O. Y., Yoo, P. D., Muhaidat, S., Karagiannidis, G. K., and Taha, K. "Efficient machine learning for big data: a review." *Big Data Res.* 2, no. 3 (2015):87–93.
4. Provost, F., and Fawcett, T. "Data science and its relationship to big data and data-driven decision making." *Big Data* 1, no. 1 (2013):51–59.
5. Alter, S. "A work system view of DSS in its fourth decade." *Decis. Support Syst.* 38, no. 3 (2004):319–327.
6. Turban, E. *Decision Support and Expert Systems: Management Support Systems*. Prentice Hall PTR (1993).
7. Chen, X. W., and Lin, X. "Big data deep learning: challenges and perspectives." *IEEE Access* 2 (2014):514–525.
8. Najafabadi, M. M., Villanustre, F., Khoshgoftaar, T. M., Seliya, N., Wald, R., and Muharemagic, E. "Deep learning applications and challenges in big data analytics." *J. Big Data* 2 no. 1 (2015):1.
9. Keim, D. A., Mansmann, F., Schneidewind, J., Thomas, J., and Ziegler, H. "Visual analytics: scope and challenges." In: *Visual Data Mining*, Springer, Berlin, Heidelberg, 2008, pp. 76–90.
10. Fan, W., and Bifet, A. "Mining big data: current status, and forecast to the future." *ACM SIGKDD Explor. Newsl.* 14, no. 2 (2013):1–5.
11. Davenport, T. H., and Kirby, J. "Beyond automation." *Harv. Bus. Rev.* 93, no. 6 (2015):59–65.

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