

Machine Learning Methods as Components of Existing Business Models

Johannes Kriebel and Andreas Pfingsten

Topic of this special issue

Artificial intelligence and machine learning are currently among the most relevant topics to consider when analyzing and adjusting business models. Artificial intelligence is commonly described as machines performing cognitive functions, including perception, prediction, and decision making. Machine learning describes flexible methods for identifying patterns in large data sets that are useful in improving perceptions, predictions, and decisions.

Current interest in artificial intelligence and machine learning is driven primarily by increases in available data, computing power, and algorithms to process this data (Kraus et al., 2020). One of the many advantages of these technologies is conveniently and automatically handling unstructured data, including text and images, which are common data sources for businesses. Multiple industry studies show a substantial increase of machine learning technology use in firms, which is expected to lead to significant revenue growth from software, hardware, and machine learning solutions and services from suppliers (International Data Group, 2021). Furthermore, firms deploying artificial intelligence are expected to see reduced costs and increased revenues in their own operations (Balakrishnan et al., 2020; Candelon et al., 2020). The augmented use is particularly fueled by spectacular successes presented to the general public, such as IBM's Watson, Google's AlphaGo, or self-driving cars. Strategic plans for artificial intelligence formulated by major governments and industry leaders further emphasize that this is not just a short-term trend but is here to stay.

Company artificial intelligence use calls for technical solutions to some extent, but artificial intelligence integration into existing business models and processes requires solutions from business research. Pivotal issues to be addressed include how machine learning can create business value (Chen et al., 2012; Grover et al., 2018), how collaboration patterns change in the wake of new technologies (Schilling, 2015), how artificial intelligence influences innovation (Wu et al., 2019; Wu et al., 2020), and how to choose between machine learning augmentation or automation of human work (Raisch/Krakowski 2020). Although these are fundamental questions, business research has not extensively investigated these issues in the past, from our perception. Yet, the field has begun to more comprehensively address these questions from multiple business discipline perspectives.

Content

We are grateful for the opportunity to edit *Die Unternehmung's* special issue, "Machine Learning Methods as Components of Existing Business Models." The 2019 call for papers mainly addressed the question of changes to business models due to machine learning, which machine learning business applications we already see working in organizations, and what to expect in the near future. Because these questions may be addressed from multiple perspectives, our call for papers encouraged contributions from multiple disciplines, allowing for diverse perceptions and contributions. Varying viewpoints accompanied a variety of qualitative and quantitative methods. Machine learning in business applications is a rapidly developing topic driven both by university researchers and skilled practitioners. Therefore, submissions from academia and various professional groups were happily received, and those delivering the most relevant insights on the understanding of machine learning were selected. Next, we will provide a short description of how these special issue contributions expand our knowledge of machine learning in a business context.

Machine learning and business model innovation

The contribution by Dennis Renee Metzler, Nicole Neuss, and Jan Muntermann, "*Artificial Intelligence and Business Model Innovation in Incumbent Firms: A Cross-Industry Case Study*," is the most general assessment in the special issue. Addressing how artificial intelligence changes business models of incumbent firms, the authors conducted expert interviews with executives from several industries and analyzed corporate disclosures, which were coded to address what changed in the business model elements. Although most business model elements can be generally affected by artificial intelligence in some way, particularly prevalent changes include use of artificial intelligence for automation and efficiency purposes (e.g., robotic process automation). Another common application discussed included developing artificial intelligence-based or artificial intelligence-supported products and services such as smart sensors or recommendation systems. Furthermore, artificial intelligence requires firms to establish related resources, including IT infrastructure or research units. To cope with challenges posed by artificial intelligence, companies often form new alliances or obtain collaborative partners. In some cases, businesses manage to increase customer communication via artificial intelligence or acquire new artificial intelligence-related revenue streams.

Following Metzler et al.'s general assessment, subsequently selected contributions offer a closer examination of machine learning impacts of various business function contexts.

Machine learning in intelligent document processing

Tomasz Janasz, Peter Mortensen, Christian Reisswig, Tobias Weller, Maximilian Herrmann, Ivona Crnoja, and Johannes Höhe's "*Advancements in ML-enabled Intelligent Document Processing and How to Overcome Adoption Challenges in Enterprises*" particularly addresses the use of machine learning for intelligent document processing. As demonstrated by the authors, this use of artificial intelligence offers widespread applications for multiple business functions and represents significant impact on organizational efficiency. The article discusses potential uses and the respective technologies in detail, providing the reader with a solid understanding of possible opportunities. The authors

also conducted expert interviews to understand critical success factors, including how technology implementation shapes collaborations within and between organizations. Technology implementation requires collaborations of multiple internal and external stakeholders to share knowledge and create business value. The authors discuss various strategy guideline steps, including identification of business value and use of innovation strategy. On an organizational level, value is maximized by establishing an innovative culture and observing data security governance standards. Technology requirements regarding data quality and continual machine learning must be satisfied. Finally, artificial intelligence must be easily understood and seamlessly integrated into daily business processes for all stakeholders, without the need for technology training.

Machine learning in marketing

Two papers selected for this issue focus on machine learning applications in marketing, a business discipline that adopted data mining and machine learning techniques relatively early. Gioia Volkmar, Sven Reinecke, and Peter Mathias Fischer's "*Künstliche Intelligenz im Marketing: Möglichkeiten und Herausforderungen*" addresses opportunities and challenges related to machine learning in marketing based on expert interviews with 39 experts from research, technology, and management fields. Opportunities focused on efficiency, objectivity, quality, and customer satisfaction. This is for example related to the analysis of large data sets, improved response to customer expectations, development of recommender systems, customization support, automatic customer contact, and complaint management. The authors further identify several marketing functions that could be improved by machine learning use. Primary challenges include missing implementation strategies, cultural and ethical issues, and availability of knowledge, data, and data security measures. For example, firms may perform short-term activities creating applications without adequately defining the business value, obtaining acceptance by employees and management, or addressing general problems.

In the next contribution, "*Predictive Modeling in Marketing: Ensemble Methods for Response Modeling*," Gabriela Werb and Martin Schmidberger investigated machine learning methods to predict cross-buying for bank products and services. The authors examined how well ensemble methods predict the probability of a large German service provider's customers with existing accounts to open a checking account. Ensemble methods combine multiple instances of machine learning models to achieve better predictions. Cross-buying behavior is an important problem in marketing. The predictions based on ensemble methods were quite successful compared to more traditional approaches. This study was further unique in its intensive use of explainable artificial intelligence technologies. Machine learning techniques are often considered "black box" models due to predictions that are often difficult to trace. Explainable artificial intelligence techniques demystify this "black box" and encourage acceptance of these prediction techniques. The article applies a wide variety of methods to better understand why ensemble methods offer more exact predictions.

Machine learning in finance

The final two contributions assess the use of machine learning in finance and both focus on robo advisory solutions, a type of financial technology that provides automated asset

management services via online applications. In their article “*Robo Advisory Customer Groups: Who Requires Advice?*”, Justus Blaschke and Johannes Kriebel¹ analyzed robo advisory service processes related risk elicitation. Prior literature has discussed the trade-offs between extensive risk elicitation and increased revenue due to more customers opening an account. Although one may expect customer interest in extensive advice, prior literature argues that clients avoid long questionnaires. This study used ensemble methods to identify customers interested in more extensive risk elicitation services, assisting robo advisory services with adapting questionnaires to user expectations. Furthermore, use of explainable artificial intelligence techniques assessed which customer characteristics are most informative of demand for advice. Users’ financial education, age, income, assets, and investment amounts proved to be the most informative characteristics.

While Blaschke and Kriebel focused on risk elicitation, Marcus Becker, Mikhail Beketov, and Manuel Wittke examined the central functions of robo advisory services from a general perspective in “*Machine Learning in Automated Asset Management Processes 4.1*.” These primary functions were identified as asset universe selection, investor profile identification, asset allocation, monitoring and rebalancing, performance review, and reporting. The authors analyzed which functions could be conducted or improved by machine learning and examined a wide range of robo advisory service business models on the current extent of the services’ machine learning use. Particular emphasis was placed on the usefulness of textual information for machine learning solutions in robo advisory services. Machine learning solutions are more prevalent in functions directly related to asset selection and identification, and less frequently used for investor profile identification.

Conclusion

The use of machine learning for business applications offers compelling prospects for the future. We believe that, besides technical questions, artificial intelligence represents a fascinating business topic. This special issue of *Die Unternehmung* provides an improved understanding of business challenges and opportunities. Authors analyze relevant issues from various perspectives and provide helpful insight that will hopefully be enlightening for researchers and practitioners alike.

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1 AP: Since JK is co-editor of this issue, it is important to note that he never had any access to the names of the reviewers of his contribution.

References

- Balakrishnan, Tara; Chui, Michael; Hall, Bryce; Henke, Nicolaus (2020): The State of AI in 2020. Edited by McKinsey & Company. Available online at <https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/global-survey-the-state-of-ai-in-2020>, checked on 4/29/2021.
- Candelon, François; Reichert, Tom; Duranton, Sylvain; Rodolphe, Charme di Carlo; Stokol, Georgie (2020): Deploying AI to Maximize Revenue. Edited by BCG Henderson Institute. Available online at <https://www.bcg.com/de-de/publications/2020/deploying-ai-artificial-intelligence-to-maximize-revenue>, checked on 4/29/2021.
- Chen, Hsinchun; Chiang, Roger H. L.; Storey, Veda C. (2012): Business Intelligence and Analytics: From Big Data to Big Impact. In *MIS Quarterly* 36 (4), pp. 1165–1188. DOI: 10.2307/41703503.
- Grover, Varun; Chiang, Roger H.L.; Liang, Ting-Peng; Zhang, Dongsong (2018): Creating Strategic Business Value from Big Data Analytics: A Research Framework. In *Journal of Management Information Systems* 35 (2), pp. 388–423. DOI: 10.1080/07421222.2018.1451951.
- International Data Group (2021): IDC Forecasts Improved Growth for Global AI Market in 2021. Available online at <https://www.idc.com/getdoc.jsp?containerId=prUS47482321>, checked on 4/29/2021.
- Kraus, Mathias; Feuerriegel, Stefan; Oztekin, Asil (2020): Deep Learning in Business Analytics and Operations Research: Models, Applications and Managerial Implications. In *European Journal of Operational Research* 281 (3), pp. 628–641. DOI: 10.1016/j.ejor.2019.09.018.
- Raisch, Sebastian; Krakowski, Sebastian (2020): Artificial Intelligence and Management: The Automation-Augmentation Paradox. In *Academy of Management Review*. DOI: 10.5465/2018.0072. (forthcoming)
- Schilling, Melissa A. (2015): Technology Shocks, Technological Collaboration, and Innovation Outcomes. In *Organization Science* 26 (3), pp. 668–686. DOI: 10.1287/orsc.2015.0970.
- Wu, Lynn; Hitt, Lorin; Lou, Bowen (2020): Data Analytics, Innovation, and Firm Productivity. In *Management Science* 66 (5), pp. 2017–2039. DOI: 10.1287/mnsc.2018.3281.
- Wu, Lynn; Lou, Bowen; Hitt, Lorin (2019): Data Analytics Supports Decentralized Innovation. In *Management Science* 65 (10), pp. 4863–4877. DOI: 10.1287/mnsc.2019.3344.

Johannes Kriebel, Dr., ist akademischer Rat am Institut für Kreditwesen der WWU Münster.

Anschrift: Institut für Kreditwesen, WWU Münster, Universitätsstr. 14–16, 48143 Münster, Tel.: +49 (0) 251/8322-692, E-Mail: johannes.kriebel@wiwi.uni-muenster.de

Andreas Pfingsten, Dr., ist Professor für BWL und Direktor des Instituts für Kreditwesen der WWU Münster.

Anschrift: Institut für Kreditwesen, WWU Münster, Universitätsstr. 14–16, 48143 Münster, Tel.: +49 (0) 251/8322-881, E-Mail: andreas.pfingsten@wiwi.uni-muenster.de