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Application Potentials and Knowledge Acquisition: Artificial Intelligence in Industrial Companies' Controlling Departments

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Abstract

The benefits and application potentials of artificial intelligence in controlling are widely known. Contrary to expectations, an in-depth interview study of Austrian industrial companies shows that the use of AI in controlling is only just beginning. In order to make controllers fit in this area, in-depth knowledge channels are required. In addition, several other aspects need to be considered for implementation. This paper presents the results of a qualitative pilot study from Austria on the use of artificial intelligence in the controlling departments of Austrian industrial companies.

Keywords
Artificial Intelligence, Application, Industrial Companies, Austria, Qualitative Survey

1. Introduction
Artificial intelligence (AI) is of great importance for the economy. The effects will benefit society as a whole. Business processes will be optimized, the basis for decision-making will be improved, new sources of revenue will be opened up and productivity will be enhanced. These benefits demonstrated by the EU and the assessment of the potential ensure that the position in the EU in global competition should be improved and thus AI should be increasingly promoted so that it benefits the economy and its citizens (European Parliament 2019).

AI is seen as a game changer in the corporate world which create additional value in the company (Wamba-Taguimdje et al. 2020; Plastino and Purdy 2018; Chamoni and Gluchowski 2017). For this purpose, AI covers a wide range of different technologies, such as translation programmes, chatbots or image classification. Many different methods and algorithms are now being used in the field of AI or predictive analytics such as neural networks, support vector machines, decision trees and forests, naïve bayes, linear and logistic regression, cluster analysis, k-means, k-nearest neighbour classification just to name a few (e.g. Chamoni & Gluchowski 2017; Athey & Imbens 2019).

AI can be used to optimise products or services, processes and many other areas in a company. In the business sector, a lot has happened with regard to the use of artificial intelligence (Mertens and Barbian 2019; Koropp and Treitz 2019). Machine learning algorithms have become increasingly common on the stock exchange and in banks in recent years. They are used, for example, to analyse stock market prices, valuation of real options or to identify fraud (e.g. Han & Kim 2021; Andreou et al. 2006; Bao et al. 2022).

Another area of application of AI is the use of these technologies in administration, especially in the controlling department, but also in the finance department, there are several task areas that can be processed with AI technology.

These are, for example, the automatic processing of incoming and outgoing invoices, the creation of standardized reports or the forecast for the preparation of the budget. Nevertheless, the application in the accounting and controlling area faces great challenges. Losbichler and Lehner (2021) attribute the limitation of the use of AI in this area to the vast amount of information in a complex system. Furthermore, in Europe in general, only 8% of companies on average use at least one AI technology, according to statistics published by Eurostat (2022), which are based on the national statistics of the member countries. Based on the low use of AI technologies in industrial companies, the following questions are of interest in this study:

1. What support and benefits do controllers expect from the use of AI?
2. What obstacles currently exist in controlling departments that the use is not yet widespread?
3. How is AI knowledge acquired among controllers in Austrian industrial companies?

The objective of our explorative, qualitative pilot study was to gather in-depth information about the use of artificial intelligence specifically in the controlling of industrial companies. On the one hand, our study was intended to provide an initial insight into the areas in which AI technologies are already being used in controlling at medium-sized and large, internationally active industrial companies in the German-speaking region and which specific barriers inhibit the use of AI. The second objective of our study was to provide an insight into where and how controllers obtain or would like to obtain information about the possibilities of using AI technologies in controlling and what general requirements exist for the provision of information.

The structure of the paper is as follows: This section provides an introduction to the topic. In the second section, the authors provide an overview of the literature on other studies in this area as well as information channels. The third section presents the methodology for this work, while the fourth section describes the data collection. The results follow in the fifth section. It is shown what benefits controllers expect from AI, what barriers to AI implementation currently exist in industrial companies, and how knowledge acquisition in this area occurs, as well as how information channels for knowledge acquisition should be structured. In the last section, the conclusion follows.

2. Literature Review

Despite the challenges of using AI in controlling (Losbichler and Lehner 2021), AI is nevertheless seen as a future technology in controlling (Weißenberger 2021). In their study, Holmes and Douglass (2022) surveyed accounting professionals on the impact of AI adoption and the associated risks to the accounting profession. They show that participants have positive perceptions about AI and believe that it can make work practices much more efficient by reducing repetitive tasks and eliminating risks of human error. In addition, they expect accounting curricula to change and recommend educational institutions incorporate computer literacy. Lee and Tajudeen (2020) also show in their study, in which nine organizations in Malaysia were surveyed on the use of AI-based accounting software, that the use of AI has accelerated productivity, improved efficiency, improved customer service, supported flexible work style, increased process control, and saved labor.

In particular, the automation of repetitive processes in the form of Robotic Process Automations (RPA) has a significant role to play in automating human tasks. A review of RPA with its advantages and disadvantages as well as the representation platforms is described by Sharma et al. (2022). The authors list the advantages of RPA as ranging from handling large amounts of data to reducing the need for human resources to the ability to have the system work automatically.

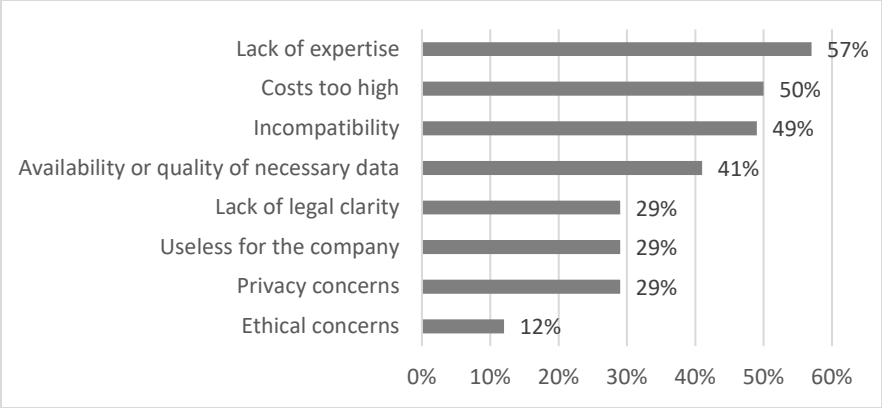

Figure 1. Reasons given by companies from Austria why AI is not yet being used, Source: Statistik Austria 2021

The survey conducted by Statistik Austria in 2021 shows that only 9 % of companies in Austria use at least one AI technology. The size of the company has a significant impact on usage. Only 7 % of small and 15 % of medium-sized companies, but 32 % of large companies use AI. The most common technologies used are text recognition and processing (e.g., text mining; 56 %) and data analytics (e.g., machine learning, deep learning; 42 %), as well as AI technologies for automating processes or steps (e.g., AI software-based robotic process automation; 29 %) and natural language recognition, processing, and generation (28 %). Companies use AI technologies primarily for organizing business processes and for marketing and sales (30 % and 29 %, respectively). 23 % of companies use AI technologies in the area of management or leadership of the company as well as in the context of production processes (22 %). Companies that do not yet use AI but would like to do so cite a lack of expertise, high costs and incompatibility as the most common reasons.

The barriers to the use of AI are manifold. In its study, the OECD (2021) cites numerous obstacles SMEs face when adopting AI solutions: lack of data culture, lack of awareness of the benefits of AI, need to retrain staff, high sunk costs for internalizing AI, need for complementary investments, little evidence and low visibility of return on investment, and reputation and legal risks.

If one relates the reasons for the non-use of AI technologies specifically to the area of controlling, then with regard to the lack of expertise, it can be pointed out that further training offers exist in the area of controlling and digitization and are currently being developed on the topic of AI for controllers. A list of training courses offered by various providers in the area of digitization can be found in Wagener (2018). In addition, a great deal of information on topics relevant to controlling can be found on the Internet (e.g. Grünbichler and Kovarova-Simecek 2018; Braun 2016), in which many topics related to digitization and AI can be found. Use cases and best practice examples represent a particularly relevant topic for the acquisition of knowledge. Although various use cases are fundamentally similar, the difficulty arises here that different methods are typically used (Vierkorn 2022).

3. Methods

An exploratory, qualitative approach was chosen as the research design. To gain a deeper understanding of the expected benefits, barriers to implementation, and knowledge acquisition, qualitative supported interviews were conducted with controllers from industrial companies. The interviews were analysed applying Qualitative Content Analysis using the web application www.QCAmap.org (cf. Fenzl and Mayring 2017, p. 333 ff.).

Specifically, the technique of inductive category formation (cf. Mayring and Fenzl 2019, p. 633 ff.) was applied to develop categories directly from the interview material along predefined content analytical rules for the following four questions of analysis: (1) current and planned areas of application of AI technologies in controlling including benefits of the use of AI; (2) barriers towards the implementation of AI in areas of controlling; (3) approaches and sources of information (potentially) used by controllers to get or stay informed about possibilities on the application of AI technologies; (4) the form of information provision expected by controllers.

The audio recordings of the interviews were transcribed in a first step using the automatic speech recognition service of MS Azure. In a second step, the initial transcripts were manually corrected and completed by matching the text material with the audio recordings. The results were discussed by the team and compared with results of other studies.

4. Data Collection

As part of the pilot study, guided interviews (cf. Mayring 2002, p. 67 ff.) were conducted with specifically selected controllers in management positions from eight industrial companies or corporate groups that have a company location or headquarters in the regions of Carinthia or Styria in Austria. The selected companies have between 150 and 4,000 employees and between four and 30 controllers at the respective location. The position of the four female and four male controllers interviewed ranged from department or site manager in controlling to chief financial officer (CFO). Interviews were conducted and recorded online between June and September 2022. Interview duration ranged from 30 to 60 minutes. The interview duration depended significantly on the prior knowledge as well as understanding of AI. The less the interviewees had previously dealt with the topic, the shorter the interview time was.

5. Results and Discussion

5.1 Results of the exploratory study

Overall, several topics were addressed in the interviews. The results from the complexes (1) use and benefits of AI technologies in controlling, (2) implementation barriers, and (3) information channels and knowledge acquisition are presented in the following.

5.1.1 Use and benefits of AI technologies in controlling department

Similar to the results from the Statistik Austria survey on the use of AI in companies (Statistik Austria 2021), the results of the qualitative content analysis of the transcripts yielded data analysis and the automation of processes or work steps to be the central current, planned or possible future areas of application of AI technologies in controlling.

With respect to the use of artificial intelligence in data analysis, the interviewed controllers referenced the area of descriptive analytics, in particular the automated calculation and visualization of economic indicators (e.g. monthly or quarterly reporting, for variance analyses, etc.) and the area of predictive analytics for forecasting economic indicators, such as cash or revenue forecasts, which are not only based on an extrapolation of the development of the indicator in the past, but can also incorporate a variety of other parameters into the forecast model. Regarding the automation of processes or work steps, the controllers primarily pointed out possibilities of AI-based robotic process automation, which can be used specifically in the digitization of document flows (e.g. capturing and posting incoming invoices), in the workflow of order processing in ERP systems (e.g. checking, completion, closing), or in inventory valuation for process optimization and increased efficiency.

The most important benefit of applying AI technologies into controlling, from the perspective of senior controllers, is the improvement of the basis for decision-making. This is achieved on the one hand by the possibilities of simplified and faster collection, interleaving and processing of a larger volume of different data from diverse sources and on the other hand by the reduction of the error-proneness of the processes of data collection and data analysis.

Another central benefit that may be achieved by or expected from the use of AI technologies in controlling is an increase in the efficiency of employees, which is accompanied by time savings for employees and a possible reduction in staff requirements. The automation of processes, repetitive activities with a lower demand level or the automated collection and processing of data will set free resources on the employee side, which may then be shifted to more productive and demanding tasks, in which the potential of AI technologies is currently still considered to be rather limited by the surveyed controllers, such as the interpretation of data, the search for causal explanations and the derivation of recommendations for action.

5.1.2 Barriers to AI implementation

According to the qualitative content analysis of the interview material, the barriers identified or expected by the controllers in the implementation of AI technologies in the controlling area can be divided into three larger sub-areas: Similar to previous quantitative surveys (Statistik Austria 2021, OECD 2021), the greatest barriers in the area of controlling are also seen at the employee level by the interviewed senior controllers. In addition to the lack of know-

how about AI technologies in the department they reported a lack of imagination for AI application possibilities and a lack of awareness for the necessity of dealing with AI technologies.

The second decisive factor hindering the successful implementation of AI technologies in controlling is the obstructive framework conditions at the organizational level. On the one hand, this refers to the lack of uniformity in the ERP system and the associated lack of data quality. On the other senior controllers advert to data protection concerns in cloud-based software solutions at the company or customer level, which could only be bridged by appropriate anonymization, which then in turn limits the functionality of AI. Both aspects have also been identified in previous studies as important barriers to the use of AI in companies (see, e.g., Statistik Austria 2021). In addition, a lack of embedding the use of AI in the overall strategy of the organization was pointed out as a barrier by the interviewees.
The third major barrier to the use of AI technologies in the area of controlling is located at the resource level and includes, firstly, a lack of time resources for dealing with AI and, secondly, a lack of time resources to drive forward the implementation of AI technologies in the area of controlling in parallel to ongoing activities. These findings are again in line with the results of the surveys of Statistik Austria (2021) and the OECD (2021) on the use of AI in companies.

5.1.3 Information channels and knowledge acquisition

Regarding the access to knowledge and information on the topic of artificial intelligence in controlling, the qualitative analysis of the interview data showed that both electronic sources and personal contacts are highly relevant for controllers when it comes to obtaining information on possible applications of AI technologies in controlling.
Among the online sources, newsletters from various controlling institutions and controlling portals on the Web are currently the main sources of information. Additionally, tutorials and webinars, which in many cases are found through a Google search, play an important role when it comes to staying informed about possibilities to apply AI in controlling.

Controller groups in social networks (e.g., XING) as well as in-house online tools for the regular exchange of experiences among colleagues build the bridge to the physical channels, where in particular the exchange with other companies and controllers who already use AI technologies is experienced as particularly interesting and helpful. In addition, contacts with external business consultants offering AI solutions, institutes at universities, and external consultants are seen as relevant source of information and knowledge channels.

In terms of the content presented in knowledge and information channels on the possible applications of AI technologies in the controlling area, use cases have the greatest potential. From the perspective of the senior controllers, the practical presentation of examples and instructions that can be easily replicated or transferred to one's own use cases, combined with an overview of possible systems and tools that are suitable for the use of AI technologies, could make a substantial contribution to the expansion and dissemination of the use of AI technologies in the controlling area. The preferred form of information preparation are video tutorials. Webinars and podcasts as well as forums are also mentioned as potentially attractive sources for the target group.

5.2 Proposed Improvements

Artificial intelligence technologies are still rather at the beginning in the controlling area of industrial companies apart from first implementations with weak AI. The implementation fails primarily due to the acceptance of the employees and the lack of knowledge about programming and the algorithms. In addition, typical problems arise in connection with data quality, various software systems and the associated interface problems, as well as high implementation costs. In order to be able to use these technologies in industrial companies and especially in the controlling area, the following recommendations can be made:

- The implementation of AI technologies in controlling requires the promotion of awareness and the provision of resources for dealing with the topic at the employee level.
- Educational institutions should offer "programming" courses to lower the inhibition threshold for AI technology.
- Providers of knowledge should publish use cases and best practices and demonstrate the cost-benefit benefits of the technology.
- Use cases for the application of AI technologies in controlling should include the specific problem and the possible methods and tools for solving it as well as their practical application.

- Use cases should be presented in the form of videos, video tutorials, or webinars, combined with a forum for exchanging experiences, so that it is easy to replicate the solutions or transfer them to one's own use cases.

In general, it can be stated that most controllers have problems with AI, as they have not had any contact with this topic to date. It is also apparent that graduates of universities with courses such as programming have a more open and receptive approach than those graduates who have to familiarize themselves with the topic for the first time.

Even though the replacement of controllers and accountants by machines is still a future scenario, Peng and Chang (2019) already provide further recommendations for the future role model of the profession when the profession is replaced by the machine. Their recommendations in this regard are continuous education, building communication skills, seamlessly connecting and living with AI, advancing informational Information capability and development of professional skills.

6. Conclusion

The results of the survey show that the benefits of artificial intelligence in controlling are seen by industrial companies, but are not yet in use or only to a limited extent. Due to their operational activities, controllers usually do not have the time to deal intensively with AI technologies. In addition, there is often a lack of acceptance at employee level to deal with new topics such as computer skills in programming. At the organizational level, there is usually a lack of data quality and resources. In order to demonstrate the potential of AI, best practice examples or use cases are best suited, which show the facts, a solution, and ideally also the benefits such as time savings. In this respect, knowledge can be acquired through various information channels. Video instructions, ideally combined with demonstrations of use cases, are very frequently mentioned in this regard.

References

Andreou, P. C., Charalambous, C. and Martzoukos, S. H., Robust Artificial Neural Networks for Pricing of European Options, *Computational Economics*, vol. 27, pp. 329-351, 2006.

Athey, S. and Imbens, G. W., Machine Learning Methods that Economists should know about, *Annual Review of Economics*, vol. 11, pp. 685-725, 2019.

Bao, Y., Hilary, G. and Ke, B., Artificial Intelligence and Fraud Detection, in: Babich, V., Birge, J. R. & Hilary, G. (eds) Innovative Technology at the Interface of Finance and Operations, *Springer Series in Supply Chain Management*, vol 11, Springer Gabler Verlag, 2022.

Braun, B., Controlling-Seiten im Netz, *Controlling & Management Review*, vol. 60 no. 1, S. 60-62, 2016.

Chamoni, P. and Gluchowski, P., Business Analytics – State of the Art, *Controlling & Management Review*, vol. 4, pp. 8-17, 2017.

European Parliament (2019), Available: https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2019)637967, Accessed on October 12, 2022.

Eurostat (2022), Use of digital technologies among EU enterprises, Available: https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/ddn-20220120-1, Accessed on September 13, 2022.

Fenzl, T. and Mayring, P., QCAmap: Eine interaktive Webapplikation für Qualitative Inhaltsanalyse, in: *Zeitschrift für Soziologie der Erziehung und Sozialisation*, vol. 37 no. 3, S. 333-340, 2017.

Grünbichler, R. and Kovarova-Simecek, M., Controlling-Informationen im Internet: Navigationsunterstützung für Controller, *CFOaktuell*, vol. 12 no. 6, pp. 246-249, 2018.

Han, J. J. and Kim, H.-J., Stock price prediction using multiple valuation methods based on artificial neural networks for KOSDAQ IPO companies. *Investment Analysts Journal*, vol. 50, no. 1, pp. 17-31, 2021.

Holmes, A. F. and Douglass, A., Artificial Intelligence: Reshaping the Accounting Profession and the Disruption to Accounting Education, *Journal of Emerging Technologies in Accounting*, vol. 19, no. 1, pp. 53-68, 2022.

Koropp, C. and Treitz, R. Performance Management mit Advanced Analytics, *Controlling & Management Review*, vol. 6, pp. 32-38, 2019.

Lee, C. S. and Tajudeen, F. P., Usage and Impact of Artificial Intelligence on Accounting: Evidence from Malaysian Organizations, *Asian Journal of Business and Accounting*, vol. 13, no. 1, pp. 213-239, 2020.

Losbichler, H. and Lehner, O. M., Limits of artificial intelligence in controlling and the ways forward: a call for future accounting research, *Journal of Applied Accounting Research*, vol. 22, no. 2, pp. 365-382, 2021.

Mayring, P. and Fenzl, T., Qualitative Inhaltsanalyse, in: Baur, N./Blasius, J. (Hrsg.): *Handbuch Methoden der empirischen Sozialforschung*, 3th edition, Wiesbaden, S. 691-706, 2022.

Mayring, P., *Einführung in die Qualitative Sozialforschung: Eine Anleitung zu qualitativem Denken*, Weinheim, 2002.

Mertens, P. and Barbian, D., Erreicht Künstliche Intelligenz auch das Controlling?, *Controlling & Management Review*, vol. 4, pp. 8-17, 2019.

OECD (2021), The Digital Transformation of SMEs, OECD Studies on SMEs and Entrepreneurship, OECD Publishing, Paris, https://doi.org/10.1787/bdb9256a-en.

Peng, Y. and Chang J. S., An Exploration on the Problems of Replacing Accounting Professions by AI in the Future, *5th International Conference on Industrial and Business Engineering (ICIBE 2019)*, Hong Kong, China, September 27-29, 2019.

Plastino, E. and Purdy, M., Game Changing value from Artificial Intelligence: eight strategies, *Strategy & Leadership*, vol. 46, no. 1, pp. 16-22, 2018.

Sharma, S., Kataria, A. and Sandhu, J. K., Applications, Tools and Technologies of Robotic Process Automation in Various Industries, *3rd International Conference on Decision Aid Sciences and Applications (DASA)*, pp. 1067-1072, Chiang Rai, Thailand, March 23-25, 2022.

Statistik Austria (2021), IKT-Einsatz in Unternehmen, Available: https://statistik.at/statistiken/forschung-innovation-digitalisierung/digitale-wirtschaft-und-gesellschaft/ikt-einsatz-in-unternehmen, Accessed on September 15, 2022.

Vierkorn, S., Keine Angst vor KI, *Controlling & Management Review*, vol. 66, no. 6, pp. 58-61, 2022.

Wagener, B., Digitale Skills ausbauen – aber wie?, *Controlling & Management Review*, vol. 62, no. 6, pp. 32-36, 2018.

Wamba-Taguimdje, S.-L., Wamba, S. F., Kamdjoug, J. R. K. and Wanko, C. E. T., Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects, *Business Process Management Journal*, vol. 26, no. 7, pp. 1893-1924, 2020.

Weißenberger, B. E., Künstliche Intelligenz als Zukunftstechnologie im Controlling, Controlling & Management Review, vol. 65 no. 2, pp. 8-17, 2021.

Biography

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