ARTIFICIAL INTELLIGENCE TECHNOLOGY AND BUSINESS MODEL INNOVATION: A CASE FROM THE MANUFACTURING INDUSTRY

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ABSTRACT

This study addresses the challenges manufacturing industry leaders face in incorporating AI technologies into their corporate plans. It delves into various methods for applying AI paradigms to develop innovative business platforms and environments within the manufacturing sector. By analyzing case studies and evaluating AI-based business models, the research explores the transformative potential of AI adoption, shedding light on its economic and societal impacts. The study emphasizes the importance of integrating AI into existing goods and service infrastructures, leveraging modern company structures and procedures as guides for the integration process. Data collection involved an open-ended questionnaire administered to European businesses, with participation from CEOs, operations managers, senior managers, service managers, and operation managers, totaling 50 individuals selected based on their expertise in integrating AI models into operational practices. The findings underscore the necessity for firms to strike a balance between technology and value, emphasizing the linkage between technical applications and potential customer values. Moreover, the study highlights the role of digitalization, including AI technology, in empowering organizational leaders to better promote products and services while identifying potential customer groups. By contributing to the body of knowledge on AI commercial frameworks in the manufacturing industry, this research enriches understanding and offers practical insights for driving innovation and growth through AI integration.

Keywords: Artificial Intelligence (AI) Technology, Business Model Innovation, Value Creation, Value Delivery, Digitalisation, Manufacturing

INTRODUCTION

Artificial intelligence (AI) is defined as the technology principally employed for designing intelligent machines to improve the quality and determine the foresight factors of an entity (Adner & Kapoor, 2010; Anandarajan, 2002). The proliferation of AI technologies produces the prospect of enabling radical changes in existing products, services, innovation processes, and the nature of business activities in the industrial ecosystems to embrace the further development and innovation of contemporary business models. Moreover, AI is considered as the enabling technology to be incorporated into the networks of products and systems before subsequently offering highly beneficial services generated from the value chain process to consumers (Cenamor, Sjödin, & Parida, 2017). As such, the integration process of AI technology with business solutions is generally defined by the key elements of contemporary business models and practices (Chalmers, MacKenzie, & Carter, 2021). Examples of AI incorporation include major innovative enterprises, such as Airbnb, Ola, Uber, Flipkart, e-Bay, Amazon, and Mantra, as well as other enterprises which have incorporated the AI as the state-of-the-art business model (Fountaine et al., 2019; Mishra & Triptahi, 2019, 2020a, 2020b). Consequently, significant impacts on the innovation of the conventional business model through the shift towards digital platforms have been observed from the proliferation of AI technologies (Arnold & Scheutz, 2018) after various traditional businesses have been exposed to embryonic and rapidly advancing technology.

Past studies were discovered to provide higher levels of focus on understanding the AI than

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on identifying the challenges associated with the implementation and transformation of conventional business models (Adner & Kapoor, 2010; Lee, Suh, Roy, & Baucus, 2019). Although a majority of researchers scrutinised the important aspects of implementing AI technologies to further develop business management strategies (T. H. Davenport & Ronanki, 2018; Reim, Åström, & Eriksson, 2020), a scarcity was observed in the holistic comprehension of AI adoption and application processes to revolutionise business models with innovative ideas and activities in the existing ecosystems. This study aims to examine the impacts of employing AI technologies in business management strategies from the perspective of industrial ecosystems and to fill the existing literature gap by synthesising current knowledge before developing a research agenda for knowledge advancement.

THEORETICAL BACKGROUND

The AI Business Model Innovations

Previous studies have discussed the employment and deployment strategies of AI technologies for business management and activities (Dwivedi et al., 2020; Tong, Jia, Luo, & Fang, 2021). The study authors also investigated relevant research works that suggested potential ideas of business model innovation to increase the growth of various manufacturing organisations (Dwivedi et al., 2020; Gauthier, Bastianutti, & Haggège, 2018). In accordance with this, recent studies suggested that AI could be viewed as an enabling tool for allowing paradigm shift and inventive idea generation to improve and modernise traditional operational practises, which would be extremely helpful to the managers of an organisation (Malik, Tripathi, Kar, & Gupta, 2022). Similarly, pertinent research works also indicated that AI technology would generate profound positive impacts on improving business practices and strategic planning activities by establishing higher levels of interactions and communications between corporate members (Lee et al., 2019). Nevertheless, difficulties have been noticed due to the higher data ambiguity degree when establishing the business paradigm changes due to the quick technology advancements (Gaines-Ross, 2016; Lee et al., 2019).

The adoption of AI has a transformative influence on current business operations along with their ecosystems, as highlighted in numerous literatures. As per the study of James Manyika et al. (2018) exhibits that AI improved the efficiency by automating routine tasks and decision making procedures, that maximises growth. It also assists the businesses by making data-driven decisions, connecting the power of big data. In light of the study by Michael Jordan (2018) focuses on the significance of AI in personalisation, citing its capability to offer tailored product sugegstions and marketing startegies,thereby results in improving customer experiences. These personalised techniques could lead to enhanced customer loyalty and involvement (Iansiti & Lakhani, 2020).

Brynjolfsson & Mcafee (2017) focuses on the competitive advantage where early AI adopters obtain through innovation, which enables them to stay ahead of the industry competitors. AI also affects ecosystems, that motivates collaborations with AI vendors, data providers, and other stakeholders. Additionally, the adoption of AI necessitates an emphasis on regulatory and ethical considerations for addressing the concerns with regards to data privacy, fairness, and responsibility. At last, in terms of sustainability, AI could optimise the use of resourcee and minimise environment effect that contributes to sustainable business practices (Yudkowsky, 2016). Thus, AI adoption represents a complex shift of business operations and ecosystems, that unlocks new probabilities while needing careful management for navigating the challenges.

Value Creation with AI Models for Business Strategies

The process of value creation predominantly concentrates on developing innovative products based on customer requirements and delivering quality products to the customers by relevant organisations (Nikolaev and Petrova, 2021). Moreover, AI is also perceived as an innovative digital

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technology utilised to construct original products with advanced services (Toshiya & Nariaki, 2020). Specifically, past research posited that products created by digital technologies were corresponding to the requirements and perspectives of consumers (Silva et al., 2021; Yeboah-Boateng & Nwolley, 2020). Therefore, leading enterprises are highly encouraged to collaborate due to the possession of systematic methodologies in distinguishing the customer requirements from multiple access points of contemporary market knowledge and understanding (Dremel, Wulf, Herterich, Waizmann, & Brenner, 2017).

Mochizuki (2019) primarily focused on studying the AI application techniques to meet customer requirements and found innovative linkages between customer segments that might be useful in helping the manufacturing firms develop a higher degree of customisation for customers. On the other hand, it was revealed by (Wodecki, Wodecki, & Harrison, 2019) that AI-integrated business practises enabled corporate incumbents to create successful communication channels with buyers and offer high-quality goods as a result of improved production effectiveness (Rusthollkarhu & Aarikka-Stenroos, 2019). To gain knowledge of consumers' requirements, preferences, and demographics, multiple access gateways of consumer information could be integrated with AI technologies (Ryssel, Ritter, & Gemünden, 2004).

Value Delivery and Business Model Innovation with AI Technologies

Previous research has demonstrated that organisational leaders are better able to market goods and services while identifying possible client groups from the manufacturing process' digitisation, including the deployment of AI technology (Schilling & Seuring, 2021). Häußermann and Lütge (2021) advise organisations to take on greater levels of accountability in acquiring pertinent information and abilities from developing technologies, especially the Internet of Things (IoT), before implementing them to particular resources in order to gain these advantages (Hess, Matt, Benlian, & Wiesböck, 2016).

According to Rusthollkarhu and Aarikka-Stenroos (2019), AI-integrated business practises also enable organisational incumbents to build successful mass customer channels of communication and deliver high-quality products owing to improved efficiency in manufacturing. Utilising AI technology may provide businesses with a variety of advantages, including lower transaction costs and adaptive market requirements. Thus, before implementing developing technologies, like IoT, to particular resources, organisations must maintain greater levels of accountability in acquiring pertinent expertise and abilities.

MATERIALS AND METHODS

Research Approach and Case Selection

The data presented in this paper came from the examination of several case studies involving large businesses, the assessment of business models that use AI, and the advantages that organisations have when utilising AI technology to create novel corporate models. Case studies allow multiple observations of complex organisational processes and new insights into theoretically novel phenomena, including AI development and deployment (Edmondson & McManus, 2007). In order to help mobilise insights on various real-time operations and produce special discoveries that are important in deeply comprehending existing AI models, case studies take advantage of the common technique when building the advertising area of manufacturing technologies.

The unit of analyses that has been selected for this research are the artifacts as the selection of case study has been made that is adopted from different books, journals, articles, and magazines. The purpose of highlighting the unit of analyses is that this approach leads to different analyses, validity, and accuracy in qualitative research (Gustafsson, 2017). It was an inference that case study would provide us with better answers to the drivers and source of volume resilience, survey research would

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permit us to understand the connection of these variables to managerial perceptions regarding the firm's performance. Therefore, the use of secondary data enabled us to obtain statistical conclusion validity in testing the connection among volume flexibility and actual performances of the organisation. Similarly, the evidence based on various cases could be considered more vigorous and convincing, because the intention in the study of various cases is to coincide the findings of different cases and of course this would permit towards adding validity to the proposed theory (Yin, 2014). According to Gustafsson (2017), in the study of multiple cases, the logic entails acquiring similarities and differences among the cases to be studies and each case could be at least explained partially, because not all the cases within a group should necessarily be carried out exactly in similar way, where some of the cases might include particular objectives and be carried out less intensively than others.

Apart from it, the other argument regarding the absence of clarity of the unit of analysis is whether the case study invovled is holistic or embedded. As per Yin (2014), a case study might entail more than one unit of analysis if the interest of the research is placed in one or more other subunits that is entitiled in the reference entity. In this regard, this study will talk about the embedded case studies. Rather, if the study only implies the worldwide or entire organisational nature, community or process that interests it is in the holistic design. The major principle for opting one of the other design is the degree of focus that should be acquired within the case of AI technology to develop innovative corporate models. In other words, the differences among these designs is relied on the phenomenon to be studied and the knowledge interests that prevails over them, that is more holistic and more focused.

Data Congregation and Investigation

Data was gathered from European firms using an open-ended questionnaire for the assessment, which was based on the organisations' individual business approach management and regulations. The unit evaluation was carried out at the organisational level, including chief executive officers (CEOs), operations managers, senior managers, service managers, and operation managers. This paper included a greater percentage of senior members and managers. A total of 50 interviewees were chosen for the interview based on their experience integrating AI models to present-day business procedures. Prior to the interviews, participants were chosen using a snowball sampling technique, and their existing engagement with the use of AI systems for company managerial approaches was confirmed (Teece, 2017). Since the deployment of AI-based business models strongly requires the formation of complicated linkages throughout many organisational components, participants were questioned throughout the interview about their functional responsibilities within the company. In terms of data collection, authors don't affirm that the interview data was returned to the respondents for the clarification of quotation along with providing confirmation for data accuracy and minimise the interpretation error and rectifying similar actions pattern of the cases (Beverland & Lindergreen, 2010; Barletta, 2017). Moreover, the interview was collected over telephone from chief executive officers (CEOs), operations managers, senior managers, service managers, and operation managers selected from European firms. Data was scheduled based on the participants time and activties in order to gather relevant information and insights regarding AI systems and models for determining the complicated associations throughout the organisational components. Correspondingly, the respondents were also interviewed for the positions of research and development managers, business organisers, service managers and production managers (Wilson, Daugherty, & Bianzino, 2017) to attain a clear understanding of all cases and positions held in the organisation.

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Table 1
CASE RESPONDENTS

Organisation symbol	Revenue in Euro/ Employees	AI-based Business Models	Position of Respondents
A	10 million/13,000	Aerospace management solutions incorporated with the AI model	Chief technical officer (CTO),
			R&D manager,
			service manager
B	13 million/6,100	AI solutions for the automotive industry	Operation manager,
			senior managers,
			service manager, vice president
C	19 million/17,000	It offers an autonomous solution based on the AI models	CEO, digital marketing manager,
			service manager,
			sales managers
D	730,000/2,400	Mining optimisation	CEO, business marketing manager, autonomous manager, sales manager,
			IT lead
E	450,000/1,800	Information communication technologies development	CTO, operation manager, business development manager

Source: Developed by the author

Given the above table 1, it can be claimed that during the interviewing process, respondents provided their responses with the open-ended questions as a guide in introducing the following themes: (1) What are the important practices of the AI-based business model?; (2) how can we scale the AI business model?; and (3) how is the ecosystem involved in the AI development and deployment processes? A more thorough examination of the case studies was possible since the right questions were put forward to explain issues and gather more data. Each interview lasted 45 to 90 minutes and may be done in person or by means of a conference call electronically. This depth of data could be valuable, particularly while studying intricate pehnomenon. The use of this method of both in person interviews and electronic conferences provides resilience in data collection, accomodating the preferences and participants geographical locations. acquired data was then analysed and triangulated by cross-referencing various replies in all of the interview transcripts (Ehret & Wirtz, 2017) The investigators of the research also looked at project records, public resources, corporate reports, and agreements that allowed empirical triangulation. To improve the validity, openness, and repeatability of the results, a case study procedure and databases were developed. There are certain limitations to consider where time investment needed for interviews lasts 45 to 90 minutes is significant both for the interviewees and the researchers. This could be a restricting aspect while considering the number of interviews that could be conducted within a given timeframe and might be practical for large-scale studies. In addition, this approach rely on various data sources and empirical triangulation is resource-intensive. Another concern is the potential launch of subjectivity during the process of interview. Open-ended interviews could result in varied interpretations of responses among distinct researchers that could launch biasness into the analysis. Therefore, it is necessary to observe that case study findings may be context specific, that onstraint the generalisability to wider populace. While the described approach is well-suited for in-depth exploration of specific cases that provides insights that could be applied broadly.

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Data Analyses

The research utilised an interpretive methodology following Clark et al. (2010), employing a thematic approach to identify patterns and links within large, complex data sets. Raw data (interview transcripts) were reviewed multiple times to establish first-order code categories using words, phrases, terms, and labels conveyed by each respondent. The established first-order code categories were examined to reveal potential connections or patterns, allowing for second-order themes to emerge as distinct ideas. The study authors referred to existing research insights and secondary sources such as internal documents, presentations, and newspapers Skalozub, Horiachkin, & Klymenko (2022) to develop and refine the emerging themes. Through a comparison of different cases, the data structure was refined and a research model was developed to understand the role of AI technologies in the value creation process and their application in business models. The research findings were validated by three successful incumbents of selected enterprises (Roskladka and Baiev, 2021). The links between the study's aggregate parameters, themes, and classifications were eventually hypothesised. With the goal to build creative business models before generating possible values, first-order categories and second-order themes were disclosed, and this led to the development of theoretical collective factors for AI-driven business model advances. Overall, the interpretive methodology and thematic approach allowed for a comprehensive analysis of the data, providing insights into the complex relationship between AI and business models. In analysing the data no software was used to encode interview analysis because of restricted resources, a small dataset or a preference for manual control over the process. In addition, there are certain researchers that prioritises to maintain the confidentiality and security of sesitive interview data, where none of the doftware might guarantee. Not involving external experts in model validation could be due to distinct reasons which entail budget constraints, time limitations, difficulty in finding qualified practitioners, or a preference to depend on internal expertise. Though, external experts could provide valuable insights, improve model credibility, and rectify potential pitfalls that make their contribution a recommended practice in research methodology, as suggested by Yin (2014).

Findings

Based on the key models of value creation, delivery, and capture developed by AI, the research discovered that successful businesses utilised business models that used AI to increase their worldwide networks and revenues. The concepts encourage improvisation in company practise while doing proper management tasks. Overall, the study made the case that businesses might create and use cutting-edge business models that embrace the fundamentals of AI.

AI-enabled Business Management and Functionalities

The current study found that when incorporating AI applications into the current corporate development paradigm, there are a new set of problems that must be overcome, such as bridging cross-domain knowledge to produce precise, significant, and transferrable models. Organisations must define AI in terms of value generation, delivery, and capturing in order to identify the benefits received from its adoption in fostering the expansion of certain business activities, as reported by one respondent: *"We did a thorough revision on our daily operations such as day-to-day maintainace of aerospace equipment, which was previously done via manual labour, but with the adoption of AI, this task can be done autonomously. This has helped us to recognise new usage and applications of AI in operational efficiency - (CEO of Company C)."*

AI models enhance monitoring and control processes in manufacturing, increase forecasting capacity, and provide an overview of organisational performance. Preventive maintenance schemes and monitoring dashboards also employ AI technologies for improved profit gains, reduced breakdowns, and reduced human resources in back-end control activities: *"AI is very helpful in*

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preventing any default in the system. This is associated with the help of other technologies, like IoT and Big data, as it is now easier to predict the future of the system through analysing the data (Business development manager of Company E).”

Other benefits related to the execution of optimisation models include increased flexibility in customer operations and elevated profit growth.

“I’m totally convinced that using AI is leading to better operational performance and lower cost. This is due to automatic tasks performed by AI. This all leads to the shorter time of achieving the task (Operation manager of Company B).”

It is exhibited through the above findings that AI-enabled business management in the aerospace industry has escorted in transformative fucntionalities and benefits. Through an inclusive overhaul of daily operations, AI has automated the tasks that earlier was relied on manual labor. This entails the maintenance of the equipment, that could be managed autonomously. This automation not only enhances operational effectiveness but also unveils novel avenues for the application of AI technology in the sector. In addition, the synergy among AI and other technologies for instance IoT sensors and big data analytics enabling predictive maintenance. This proactive method helps in preventing system defaults and interruptions by forseeing potential problems. It participates in minimised downtime and improved reliability in aerospace systems. The impact of AI enlarges cost minimisation and operational performance improvement (Agarwall, Das & Swain, 2022). By automating various tasks, AI reduces manual effort and quickens task completion, ultimately leads to more effective operations. This not only enhances the entire performance of aerospace systems but also results in saving the cost. The shorter task completion times, facilitated by AI’s automation, participated to more streamlined and cost efficient operations within the sector.

The findings acquired from the participants contributed towards providing valuable insights into the multifaceted influence of AI adoption in business management and operations. Overall it is recognised that AI’s ability to automate the tasks, as indicated in the manufacturing sector case, not only improves growth but also tends towards saving the cost (Garetti & Taisch, 2012). However, it is essential to observe that the automation success is relied on selecting careful tasks and continuous integration. In addition, the synergy among AI and complementary technologies such as IoT and big data for prognostic maintenance is a repetitive subject. This technique helps in the prevention of system failures by forseeing potential problems and enhancing the system reliability. These findings exhibited that the power of data analysis and proactive maintenance leads to minimised downtime and ensuring continuous system performance.

Furthermore, the connection among the adoption of AI and cost minimisation is a continuous observation. The tasks automation is shown to significantly minimise the operational costs, whereas the speed of completing the task, facilitated by AI tends towards more effective operations (Tschang & Almirall, 2021). Thus, it is authoritative to weigh these advantages against the upfront costs along with the ongoing maintenance expenses linked with AI integration. Additionally, the ability of AI is to assess extensive datasets enabling towards data-driven startegic decisions, that provides the businesses a competitive advantage and improving the experiences of the customers. This data-driven approach is critical at the time where data is a valubale asset. At last, the findings underlines potential challenges. They acknowledge that the integration of AI could be resource-intensive, that needs skilled workforce and launch subjectivity in the analysis of data, particularly when human interviews are involved. Moreover, the context-specific nature of the case studies reminds of the effect of AI that may vary across the industries and firms.

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DISCUSSION AND CONTRIBUTIONS

Theoretical Contributions

According to research by Bharadwaj et al. (2013), the adoption of AI models has beneficial economic and societal consequences when used to solve a variety of issues. However, organisational incumbents have difficulties when implementing AI technology for cutting-edge business models (Malik et al., 2022; Skalozub, Horiachkin, & Klymenko, 2022). The purpose of this study was to shed light on the best practises for implementing AI models into business management and practises, notably in digital marketing, for manufacturing organisations. The results indicate that AI technologies can lead to corporate growth and development and have a substantial influence on business models (Kiel et al., 2017; Adner, 2017; Brock & von Wangenheim, 2019; Thomas Davenport, Guha, Grewal, & Bressgott, 2020; Shrestha, Ben-Menahem, & von Krogh, 2019). However, existing literature provides limited explanations regarding contemporary challenges in applying AI technologies to respective business models (Brock & von Wangenheim, 2019; Thomas Davenport et al., 2020). To address this knowledge gap, this study provides in-depth analysis and presents a detailed understanding of AI implementation in current business models of manufacturing firms.

The results of this study advance the establishment of AI-driven business model inventiveness, adding to the body of knowledge on AI, online advertising, and networking. Considering the facts illustrated in table 1, the suggested framework emphasises the fundamentals of value generation, delivery, capture, and ecosystem integration-based AI business models and offers a suggested method for business transformations resulting from AI-based model innovation. The study emphasises the importance of a single AI methodology for business growth and development and encourages future research to focus on the development and implementation of AI-based models for the next generation of digital marketing. To fully comprehend the procedures and interactions involved in creating and putting into use AI-based model innovations and ecosystems, the study additionally suggests additional study and evaluation. In summary, this study offers insightful information for manufacturing companies seeking to implement intermediate development and innovation of AI-driven business models in digital marketing, as well as integrating AI models into their company management and practises.

Managerial Contributions

The current study highlights the positive reasons for developing an AI-driven business model, including innovative business solutions, optimised utilisation of resources, control and monitoring activities, and business forecasting. However, there are several challenges in understanding, developing, and implementing an AI-based model at the organisational level. Organisational incumbents are recommended to consider the dimensionality of AI systems to improve the chains of model innovation and strategy development (Petrova et al., 2022). Possessing the necessary expertise to carry out the procedures of reconfiguration and building of an AI business model with controllable attributes makes the improvement possible. As it is associated with three distinct aspects of AI conversion, including capabilities, principles, and ecological systems, which are advantageous for linking both micro and macro aspects at the organisational scale, AI technology may be seen as the most suitable solution to encourage business expansion and progress. In specific context, the findings discovered valuable insights for companies to progressively and comprehensively execute AI applications in generating robust organisational growth while acting as a source of competitive agility.

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Limitations and Future Direction

Multiple constraints on the research show the need for more investigation. First and foremost, the study's focus is on identifying the creation and use of innovative business models to promote progress in the manufacturing industry. The findings' generalisation, especially with reference to the creation and use of AI BMI throughout other sectors, cannot be evaluated without further research. Therefore, more research would be beneficial to broaden or modify the study's conclusions in diverse fields of industry.

Secondly, the study's focus is to identify the implementation and incorporation of AI in existing business ecosystems. Thus, future research is recommended to examine in detail the cooperation and interaction of different AI models to generate business model innovation by extending the current framework into related business models such as digital governance, digital coordination with partners, and various AI growth models. This will help in investigating the future of AI in boosting business growth and coordination. The article is just the beginning of the journey to deepen understanding, promote development, and incorporate AI into actual business practices.

CONCLUSION

The current study aims to examine AI implementation methods of organisations to innovate existing business models and develop original products and services with AI-enabled business solutions. Accordingly, two separate reviews were conducted to discover the AI innovation type employed in reconfiguring current business models and ecosystem development with AI solutions. Moreover, a dynamic model was presented to distinguish the relationship between micro and macro elements of an organisation. On the other hand, this research work also examined three major processes of AI models, namely value creation, value delivery, and value capturing. The reviews revealed that AI models did not interrupt the major operations of an organisation, but assisted in applying innovative business models to advance organisational development and growth. Simultaneously, the incumbents of manufacturing organisations provided innovative AI solutions based on the collaboration of different ecosystems. Thus, the study authors concluded that AI could be deemed one of the most pertinent models to develop an innovative business model and produce enhanced solutions for existing ecosystems.

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