

Review

Use of Artificial Intelligence in Terms of Open Innovation Process and Management

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Abstract: Organizations see open innovation as important to their future growth strategy. The increasing interest in artificial intelligence has led to a heightened interest in its potential applications in many industries. Many firms invest heavily in artificial intelligence intending to innovate their business models, though managers often lack understanding when trying to implement artificial intelligence in their operations. The data was retrieved from the Scopus database and was analyzed using the R Bibliometrix Biblioshiny and VOSviewer software. The aim of the article is to indicate the consistency in the formation of open innovation processes while applying artificial intelligence and to provide the profile of perspectives on artificial intelligence adoption in innovation management. This paper provides a deeper perception of artificial intelligence and how it can be used to drive open innovation processes and business model innovation within the use of artificial intelligence in open innovation processes and artificial intelligence in the management of open innovation. The authors discuss how recent advances in artificial intelligence have created new opportunities for increased external collaboration. The study found that the rise of artificial intelligence as a key technology for promoting openness and collaboration has ushered in a new era of achievable open innovation. Our presented findings suggest the sequence of open innovation processes powered by artificial intelligence and insights into the artificial intelligence application to innovation management.

Keywords: open innovation; artificial intelligence; management



Citation: Kuzior, A.; Sira, M.; Brożek, P. Use of Artificial Intelligence in Terms of Open Innovation Process and Management. *Sustainability* **2023**, *15*, 7205. <https://doi.org/10.3390/su15097205>

Academic Editors: Donghyeop Shin and Hun Park

Received: 25 March 2023

Revised: 21 April 2023

Accepted: 24 April 2023

Published: 26 April 2023



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1. Introduction

A large amount of academic and business literature has emerged around open innovation as it has become an important tool for growth.

Open innovation has become a key driver of revenue growth and business performance. A study “Open the door to open” conducted by the IBM Corporation innovation found that organizations that embrace open innovation had a 59% higher revenue growth rate than those that do not [1]. Furthermore, open innovators who had strong engagement with different groups had a 58% revenue growth rate compared to organizations that only pursue open innovation. Ryszko and Szafraniec [2] present the results of bibliometric analyses merging business models and open innovation. The research identifies practical solutions to digital transformation, including those based on artificial intelligence, as one area that demands further progressive research. The process of digitizing individual countries and regions is necessary to build an innovative knowledge-based economy [3].

Advancing artificial intelligence systems impacts management significantly. The opportunities presented by artificial intelligence are some of the most important that technology has to offer, as they have the potential to add great value and give a competitive advantage [4–6]. The new scientific concept of depicting multidimensional social and public processes in the form of artificial intelligence and cognitive models and connections

continues to develop [7]. Baden-Fuller and Haefliger [8] emphasize the close relationship between technology and business performance, arguing that the business model is the key link between the two. The findings of Haftor et al. [9] suggest that business model innovations require novel uses of digital technologies to enable new activities to be incorporated into existing business models. The study conducted by Böttcher et al. contributes to understanding how different business models emerge and how firms create digital business model innovations [10]. Companies often use new technologies to achieve their own goals, such as strengthening resistance to competition, increasing innovation, and reducing costs [11–14].

The purpose of the paper is to investigate the research streams of artificial intelligence and digital transformation to provide a deeper understanding of how companies can transform their business processes with artificial intelligence and use artificial intelligence technologies to manage open innovation. Our insights will be presented in a sequence of steps on how artificial intelligence can provide a better understanding of transforming businesses through artificial intelligence implementation. The authors examine the effect of artificial intelligence on open innovation processes and the management of open innovation.

2. Materials and Methods

This research has been conducted as a systematic literature review, using search engines, for example, Scopus, to identify current research. To find relevant articles, we have used combinations of the following keywords: open innovation, artificial intelligence, business model innovation, and digital transformation.

The process of conducting a literature review using the Scopus search engine and the berrypicking method has been combined to gradually increase knowledge within the field. This berrypicking method is suited for the literature review due to the lack of published articles in quality journals [15,16]. In terms of the mentioned framework, the result of the search process is not simply the set of documents retrieved by the final query, but rather the documents, references, and information gathered throughout the process. The primary limitation of this study is that its data was sourced from Scopus. To bolster the validity of future research on this topic, it is recommended that future studies make use of data from a variety of sources. The primary reason to choose Scopus as the source of bibliometric records for this study is its extensive abstract and citation database of peer-reviewed literature, covering a wide range of disciplines.

Sorting steps have been used to ensure that the collected articles contained high-quality information that is relevant to the research purpose: an analysis of the title and abstract of the articles, looking for keywords and relevant information; screening the articles based on factors such as journal quality, publish date, and the number of citations, and reading the full article to determine if it was relevant to the literature review.

To obtain an overview of open innovation and artificial intelligence literature some techniques of bibliometric analysis have been applied. Scopus as an online bibliographic database has been chosen for the analysis. Search query words have been identified and the search query has been formulated as follows (((TITLE-ABS-KEY ("open innovat*") OR TITLE-ABS-KEY ("open innovat* process*") OR TITLE-ABS-KEY ("innovat* management*")) AND TITLE-ABS-KEY ("artificial intelligence") AND (TITLE-ABS-KEY ("business model*") OR TITLE-ABS-KEY ("open business model*")))). As a result, the final research sample of 23 documents has been obtained. Biblioshiny, a web interface of the Bibliometrix package of R-studio [17], and VOSviewer (1.6.19) [18] have been used to perform analyses. The keywords have been then subjected to a network analysis in the VOSviewer program. Tools such as Tree-Field Plot and Thematic Map processed by Biblioshiny have been applied to obtain multiple results in graphs.

3. Results

Torkkeli et al. considered openness as a relative term, meaning that a high score on the openness scale may not necessarily indicate that a company is constantly seeking

out or willing to exchange knowledge within a market [19]. Open innovation posits that organizations can benefit from both internal and external sources of innovation and should utilize both internal and external channels to bring these innovations to market. The ability of a company to exploit external knowledge is a key factor in its innovative capabilities.

Open innovation has become a popular concept in business, as companies look for new ways to organize their innovation processes. Open innovation is not a silver bullet, but it is an important part of traditional innovation approaches, and it can speed up collective learning and value creation [20]. Technology development business models and intellectual property strategy are among the ways to manage open innovation [21].

Policymakers and firm practitioners value the ability to identify and collaborate with external knowledge sources and the eco-innovative characteristics of enterprises. The adoption of open innovation into eco-innovation forms an open innovation mode that stipulates green management practices. The interrelation of open innovation and eco-innovation, as well as the interconnection of green management practices, applied to open innovation and eco-innovation determine the possibility to achieve and improve open eco-innovation [22–24].

Researchers investigate how advanced technologies can be implemented within an organization using the perceptron model to improve decision-making processes [25]. The artificial intelligence-human sequential decision-making model is of particular interest to entrepreneurial firms as it can be used to optimize open innovation strategies for sourcing and selecting innovation ideas. This approach is advantageous as it shifts the “cost of problem-solving from generating solutions to evaluating and selecting solutions” [26]. It is important to consider the requirements of the artificial intelligence technologies’ application to build the decision-making models on the directions and benchmark parameters of the organization’s development [27].

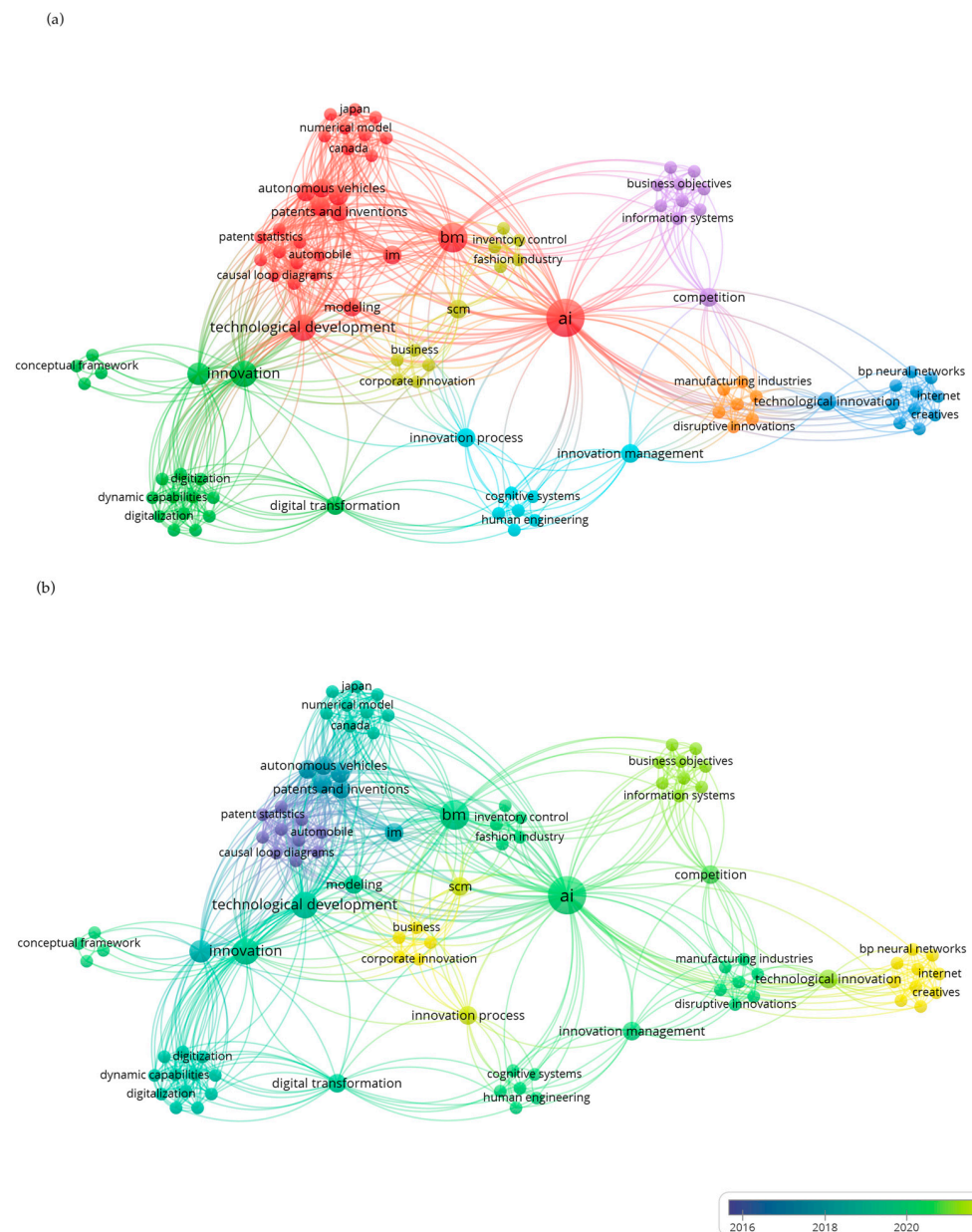
When organizations adopt open innovation, they not only face increased customer satisfaction but also a rise in the development of new products and services, as well as employee productivity. Open innovation is not just one way of doing things; combining it with other approaches can make it even more powerful. For example, organizations that use open innovation along with strong product and services innovation, traditional research and development, or business model innovation see much greater growth than those who just use open innovation alone.

The results of the network analysis of the indexed keywords in the exported data are presented in Figure 1a,b.

The authors distinguish 95 indexed keywords. Indexed keywords have been preferred to the authors’ keywords as they consider synonyms, variant spellings, and plurals. The thesaurus file has been used to perform data cleaning. The analysis has singled out the existence of seven clusters representing the most significant research sub-areas. The clusters include the following keywords, which were the most important considering the total link strength:

- Red cluster: artificial intelligence, business model, technological development, autonomous vehicles, commerce, intelligent robots, open innovation, patents and inventions, modelling, and information management;
- Green cluster: innovation, business development, and digital transformation;
- Blue cluster: technological innovation;
- Yellow cluster: supply chain management;
- Violet cluster: competition;
- Turquoise cluster: innovation process, innovation management;
- Orange cluster: business model innovation.

Though the keywords “artificial intelligence” and “open innovation” belong to the red cluster, they have different indicators. “Artificial intelligence” has eight occurrences and total link strength of 119 while “open innovations” has two occurrences and 42 total link strength. From key-words in the red cluster above, the keyword “open innovation” is



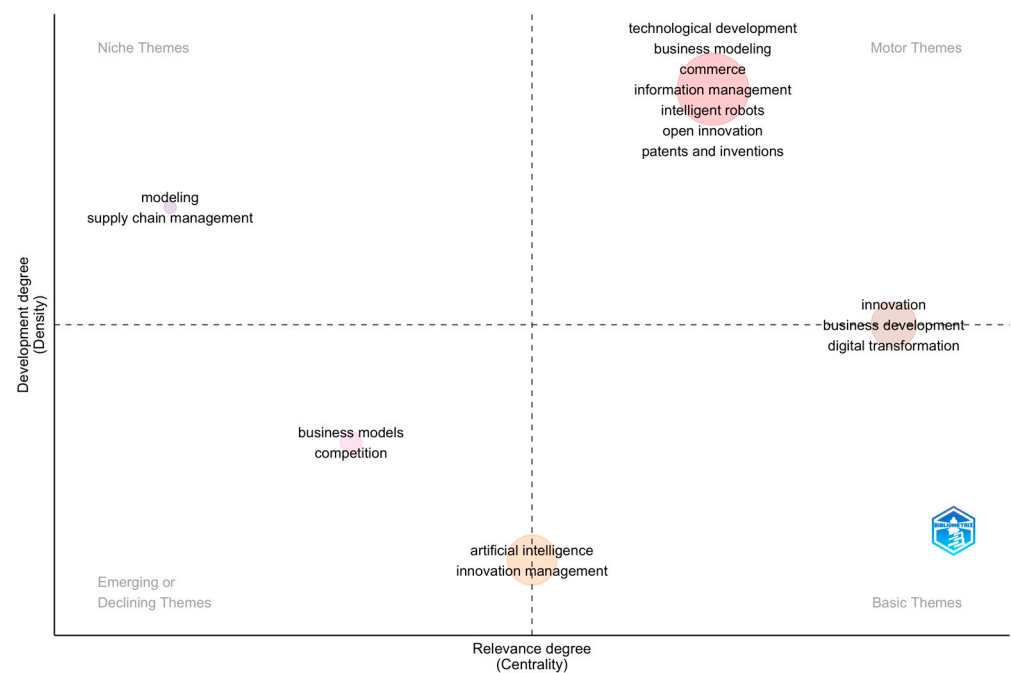


Figure 2. Thematic maps for analyzed data retrieved with the R Bibliometrix Biblioshiny.

The analysis results identified seven motor research themes. They are technological development, business modelling, commerce, information management, intelligent robots, open innovation, and patents and innovations. Two have been classed as niche themes: modelling and supply chain management. Two of them have been emerging or declining themes: business models and competition. Such themes as artificial intelligence and innovation management have been located at the intersection of emerging or declining themes while innovation, business development, and digital transformation have been positioned on a cross of motor and basic themes. Research themes such as business modelling, intelligent robots, and open innovation have appeared.

3.1. An Open Operating Model

Successful open innovation does not happen randomly. It requires a lot of work with different groups to enable open innovation.

Open innovation is a new and different way of doing innovation, one that relies on the collective intelligence and expertise of employees, partners, vendors, and customers to create new growth opportunities. Innovation is key, and the best way to foster innovation is to create an appealing experience for all participants that is based on network effects, which in turn lead to the creation of value [20]. Therefore, a platform that allows for the convergence of expertise and ideas, collaboration among participating organizations, and the co-creation of value with customers should be the focus of any co-innovation efforts. The study of Marques et al. [28] provides insights into the types of cooperation that are most important for different ways that organizations can innovate. Managers can use these findings to make better innovation decisions and choose the best partners for their innovative processes. In terms of public policy, the results of this study can help governments develop more effective policies that improve and boost the interactions essential for the innovation process, as well as improving relations that have not previously been beneficial, thus strengthening the national innovation system.

Creation of an open technology foundation for open innovation as one of the steps to advance your open innovation capabilities includes the application of exponential technologies such as artificial intelligence that can help accelerate and improve the innovation process, providing deeper insights into the development of new solutions and approaches.

The shift to an innovation ecosystem model is based on the increasing digitalization of society and economy, which began with the digitization of various elements, data, and processes [29,30]. Open innovation ecosystems are networks of organizations that work together to create new products, services, or applications. These ecosystems are defined by their openness, which allows organizations to tap into a variety of resources to achieve their goals. Models are used to effectively coordinate the activities of the various organizations in the ecosystem. Open innovation depends on ecosystems to create opportunities for value creation within and across value chains. This means that there is a strong relationship between the digital technologies used to support innovation activities and the innovation model adopted by companies. In other words, digital technologies are the foundation of the modern innovation ecosystem.

It is important to have a flexible business model when implementing open innovation so that it can adapt to the process of transforming technology or knowledge into commercial success. Creating an optimal business model involves selecting the right external partners to help reduce costs and risks. Open innovation is a way for organizations to tap into external knowledge sources to improve profits and build competitive advantage.

The business model is the vehicle for technology creation as well as value creation and capture from technology. The business model may be transformed during the innovation process, which is referred to as business model innovation [31,32]. This dialectic relationship is supported by the information and communication technologies which increase the range of imaginable business models [33].

The open innovation model is a way for organizations to improve their innovative potential by sharing knowledge across company boundaries. Open business models imply a new approach to Intellectual Property management; companies must bypass defensive reactions and consider intellectual property as a strategic asset, allowing interaction with their environment [34]. Business angels and venture capitalists can play an important role in the open innovation process by providing not only funding but also competencies and networks to entrepreneurs.

3.2. Artificial Intelligence in Open Innovation

Artificial intelligence plays a key role in driving innovation by providing insights and accelerating the discovery process. Artificial intelligence enables ecosystems to harness the power of data provided through a hybrid cloud to generate actionable insights [35]. This makes artificial intelligence essential for next-generation innovation formulation and initiatives.

The pandemic has forced many companies to rethink and accelerate their digital transformation efforts. More and more organizations have successfully accelerated digital transformations due to COVID-19 [36]. Organizations that integrate digital transformation with open innovation saw results dramatically exceeding others. Open innovation and digital technologies are becoming more intertwined.

Technologies that allow for exponential growth, such as artificial intelligence and the Internet of Things, improve our ability to capture and make sense of large quantities of data. This, in turn, supports accelerated discovery and innovation. Therefore, artificial intelligence has a high potential for driving innovation in the nearest future. Artificial intelligence powers open innovation as it applies to learning algorithms to discern patterns, accelerate discovery and augment collective intelligence.

Open technologies help promote open innovation by making it easier to create new value from existing business relationships. The recent emergence of exponential technologies and the acceleration of digitization have created an urgent need for organizations to embrace open innovation. This is due to the rising expectations of stakeholders.

Theoretical concepts regarding the use of artificial intelligence as a catalyst for business transformation have resulted in four key insights [37]. These concepts relate to research within artificial intelligence, digital transformation, and business ecosystems. Consequently, the key takeaways are that organizations need to: (1) understand artificial intelligence

and the organizational capabilities needed for digital transformation; (2) understand the current business model, the potential for transformation, and the role of the business ecosystem; (3) develop and refine the capabilities needed to implement artificial intelligence; and (4) reach organizational acceptance and develop internal competencies. Artificial intelligence can quickly analyze large amounts of data and identify patterns that could be difficult for humans to find. For example, an AI program can scan public information to find a start-up that has filed a patent for an innovation that could be relevant to a specific problem. Artificial intelligence technologies usually reflect insight generation from complex data, image recognition and video analytics, language processing, text, and audio analytics.

Open innovation will take on a new meaning with the advent of artificial intelligence. this technology will allow companies to combine internal data with open data from the internet to find the best ideas suggested by the algorithm. This will move away from traditional crowd-sourcing methods and towards a more informed and effective use of artificial intelligence to scan for innovations on the web. Start-ups and inventors who have a large digital footprint will be accessed for information on solutions to the company's problems.

Promoting external development is one of the key strategies to bring artificial intelligence into the development sector [38,39]. Since many organizations lack the internal resources and expertise to develop new artificial intelligence innovations, it will be crucial for them to leverage external resources and expertise through collaboration. Here, the paradigm of "open innovation" can be a cost-effective way to develop new solutions and bring them into established organizations. To do this, organizations should connect with various stakeholders, including start-ups, non-governmental organizations, and academic institutions. Such collaborations can utilize the respective skillsets of stakeholders to their advantage: development organizations can focus on their unique domain knowledge while external collaborators bring expertise for developing and implementing artificial intelligence solutions. From the other point of view, it is also the opportunity to form great data amounts to teach artificial intelligence-driven technologies.

The role of artificial intelligence can be considered from two points of view: artificial intelligence in open innovation processes and artificial intelligence in the management of open innovation.

To develop artificial intelligence capabilities and innovate business models to scale artificial intelligence in digital servitization to focus on data pipelines, algorithm development, and artificial intelligence democratization [40]. To develop these capabilities on a larger scale, businesses need to innovate their models by focusing on agile customer co-creation, data-driven delivery operations, and scalable ecosystem integration.

The open innovation process, supported by artificial intelligence is provided as a four-step procedure: (1) specify the problem statement, (2) develop a search algorithm, (3) consider the matches and elaborate, (4) search for innovators and integrate, and (5) to adapt incentive mechanisms and metrics to balance risk and reward.

The model of open innovation with artificial intelligence is successful because it allows executives to identify the results of problems, for example declining revenues, and the artificial intelligence then helps to find the root causes for these issues. They can lack an understanding of what the key problem of their innovation strategy is. For example, by accessing data from customer service chatbots, it may be possible to discover that some customers report problems immediately after receiving a product, which points to an issue with the shipping process.

After understanding the problem that innovation needs to focus on, artificial intelligence-powered technologies will now search for packaging solutions across industries. It will search for ideas receive great online feedback and are used by competitors.

Technologies acquire to learn from the organization's preferences and implied knowledge over time to create better matches in future. Therefore, open innovation practitioners are in need to teach the system.

The step after identifying potential matches is to contact innovation firms and evaluate how to cooperate or integrate the innovation into the client's process.

Open innovation will have implications for how to drive and measure success, as well as the approach to risk and reward and intellectual capital. To succeed with open innovation, it is necessary to reassess many of the assumptions that have underpinned innovation efforts to date and adjust the systems for encouraging and rewarding fresh thinking. It is also important to ensure those incentive mechanisms are geared towards positive innovation dynamics for long-term value rather than short-termism and transactional benefits.

Artificial-intelligence-based innovation management is reliant on both technical and organizational aspects [41–43]. These dimensions may deserve special focus, as they may determine how quickly and effectively an organization can shift to artificial intelligence-based innovation management. Procedures that enable open innovation are as follows [44]. Open innovation teams that are independent and work within the traditional company configuration are a popular choice. These teams typically include people from the supply chain management and legal departments. To enable the open innovation team to work more freely, one company suggested separating the team's budget and management from that of the technology officer. Another important step towards an open approach to innovation is choosing the appropriate structure. Additionally, establishing some infrastructure and tools to support open innovation is important. For example, some companies introduced intelligence-gathering systems to keep up with new developments. Others established corporate venture capital functions to invest in start-ups of potential strategic value.

Yams et al. [45] demonstrated the need for two different experimentation stages: first, an initial artificial intelligence adoption level that strengthens an organization's capacity for optimization and incremental innovation (from foundational to operational stages); and following that, one where organizations reach inquiring and integrated artificial intelligence maturity levels that drive more radical or disruptive innovation. To systematically support the integration of artificial intelligence into innovation management systems and increase an organization's capability for radical innovation, the authors introduced the artificial intelligence Innovation Maturity Index framework. Open innovation plays an important role in upgrading and changing the knowledge distribution of an organization, thereby increasing its knowledge entropy. The entropy of knowledge within an organization reflects the likelihood of that knowledge being distributed evenly among individuals within the organization at a given moment in time [46]. Although it is the tendency to think of organizational knowledge as a cohesive whole, it is composed of the individual knowledge of the people within the organization, which leads to a certain distribution of knowledge at any given moment [46]. This, in turn, enhances the innovation process.

The development of artificial intelligence causes a need to investigate its potential as a tool for open innovation. Though it is difficult to reject the role of artificial intelligence there are still advantages and disadvantages in which artificial intelligence can contribute to open innovation [47,48]. The pros are an open-source approach provides motivation and inspiration for artificial intelligence algorithms developers to come up with innovative features much faster than commercial vendors; crowdsourcing is a useful tool for promoting innovation in resource-intensive industries that are highly competitive, such as those that rely heavily on artificial intelligence. While the cons include the risks associated with open-source artificial intelligence products are similar to those associated with any other open-source product; it is difficult to train an artificial intelligence model to the required level of accuracy without extensive computing power and the necessary datasets. In order the open-source movement has been beneficial for many industries, it is vital to be adapted to work for products that are driven by artificial intelligence.

4. Discussion

As artificial intelligence increasingly automates repetitive and data-heavy tasks in many industries and sectors, the role of open innovation practitioners will shift from hunting and matching to focusing more on the integration part of the work. This will require human-to-human interactions, discussions, and negotiations to successfully bring outside ideas into large enterprises. Furthermore, while considering the role of humans in the

integration of artificial intelligence it is important to focus on enhancing human ability rather than replacing it [49]. There is also a purpose to investigate the current state of AI's capabilities, to better understand how it can help or hinder innovators during the innovation process [50]. Another important issue is the focus on entrepreneurial learning and its role in the entrepreneurial process, particularly within digital entrepreneurship [51]. Issues regarding the ethical side of innovation are also important [52,53]. Therefore, researchers aim to give an exhaustive overview and analysis of the field of AI ethics [54–58]. According to the Belmont Report, the academic society use respect for persons, beneficence, and justice as the main principles to guide ethics [59]. For instance, besides the Recommendation on the Ethics of Artificial Intelligence, UNESCO suggests both various stakeholders and other parties involved in developing or using artificial intelligence technologies stay involved in the ethical part of technology adoption [60]. The harmonization of legal regulation and business practice will shape its future practice as well. The European Union is taking the global lead in legislating principles around data rights, algorithmic accountability, and online platforms, forcing businesses and legislators elsewhere to either comply with its rules or become more proactive in shaping the agenda [61]. Therefore, such documents as the Ethics Guidelines for Trustworthy Artificial Intelligence [62], Policy and Investment Recommendations for Trustworthy Artificial Intelligence [63], Assessment List for Trustworthy Artificial Intelligence (ALTAI) for self-assessment [64], and Sectoral Considerations on Policy and Investment Recommendations for Trustworthy Artificial Intelligence [65] management worth considering. The ethical implications and moral questions that arise from the development and implementation of artificial intelligence technologies are examined while the guidelines and frameworks are reviewed [66]. The potential dangers of artificial intelligence and the possibilities to help people use technologies safely are among other concerns. Therefore, frameworks and other sets of rules require a focus on protecting people's rights and safety when AI is used. These rules focus on the importance of respecting people's fundamental rights and safety [67].

In many industries and sectors, artificial intelligence takes over tasks that are repetitive and data heavy [68,69]. In terms of open innovation, this means that the scanning, searching and matching part of the work can be replaced by robots [70]. What is more, artificial intelligence analyses what is available on the internet. This will help companies find the best ideas by combining their own data and open data. Executives can achieve improvement of innovation at organization by artificial intelligence integration into the open innovation strategy of big firms, which will allow for better innovation [40,71]. Assessment of all the internal data of organization gives possibility to understand the problems. Further, artificial intelligence program scans for innovations on the web and look at start-ups and inventors who have a large digital footprint, patent databases, and scientific publications for information on solutions for its problems.

Implementing artificial intelligence requires new structures and processes, which can be challenging. Artificial intelligence algorithms are limited to solving specific types of problems and require training data. The complexity of artificial intelligence algorithms can be manageable for small projects but becomes increasingly difficult to address as artificial intelligence systems become more interconnected. Skilled staff and investment in training are required to apply artificial intelligence successfully. Despite these complexities, companies that invest in digital technologies tend to reap superior value from artificial intelligence.

Beyond universities and their students that have the potential to be drivers of societal change in terms of open innovation [72], the role of technologies and their link to open innovation is still being explored [73]. There are some significant challenges associated with adopting an ecosystem-driven, platform-based open model of innovation. These include issues around privacy, value appropriation, intellectual property management, and contract design and safeguarding. As more talent breaks out into the open and new models of engagement evolve, there is a need for superior ways of managing contracts, data, privacy, ideas, rewards, and emotions.

Blockchain technology with its distributed ledger technology has the potential to support the pursuit of open innovation [74]. Cross-industry groups are partnering to enable businesses, public sector organizations, and citizens to interact with each other more securely. Another key part of the strategy is to meet network participants where they are, regardless of their technology choices. Various areas of technology are embedded. There are ways that blockchain can make innovation ecosystems more robust, dynamic, and, as a result, more antifragile. The aspect of blockchain that is relevant to management is the seeker-solver relationship. A seeker is typically a large corporation that wants to solve a complex problem, and the solver could be a single person. Another application of blockchain is in managing intellectual property. Intellectual property is often evolving in nature and developed in a participatory approach, but everyone wants to profit from it. Blockchain can help close the innovation loop by enabling value appropriation so that everyone receives a fair share of the outcome.

The areas of artificial intelligence and blockchain technology implementation are numerous. Energy management, land management, supply chain management, energy cloud management, healthcare, tourism, and decision-making are only a few of them though they prove that blockchain technology is used as a tool to support the spread of open innovations. The necessity for the development of alternative energy technologies is attributable to sustaining competitiveness in approach to environmental protection and management, enhancing efficiency as well as achieving the Sustainable Development Goals [75–79]. For instance, a blockchain-based community energy trading framework is proposed using IOTA as the distributed ledger [80]. As a result, that will make it easier for people to trade energy with each other. The efficient and seamless integration of advanced digital technologies is an important factor in the emerging transition of the energy sector to a lower-carbon system [81]. Blockchain plays a vital role in the evolution of the Internet of Energy market, as distributed renewable resources and smart grid networks are deployed and used [82]. Both blockchain and artificial intelligence can help increase energy efficiency [83]. Blockchain and artificial intelligence help to mitigate energy cloud management with security and privacy issues [84]. The strategic implementation of resource-saving technologies within organizations show to provide long-term economic benefits [85]. Blockchain technology embedded in land management caught interest and growth in both technical and land-governance directions [86]. A blockchain-based supply chain is another example worth considering [87]. Artificial intelligence is used to increase decision-making efficiency and quality by improving individuals' decision strategies. Though questions about transparency and fairness are still crucial and are still subject to investigate [88]. The potential benefits of combining human and artificial intelligence in organizational decision-making receive a lot of attention [89–91]. Artificial intelligence has a transformative effect on tourism as well as creating new opportunities in the tourism sector [92].

4.1. Benefits and Challenges of Artificial Intelligence across the Open Innovation Process

The advantages and disadvantages of artificial intelligence implementation can be considered through the stages of open innovation [93].

4.1.1. The Define Stage

Artificial intelligence can predict customer purchase behavior, affecting the demand for centralized and decentralized activities and staffing issues regarding skill shortages. Further research is needed to determine the most effective way to train employees to use cognitive technologies to glean insights from data [94]. Two main recommendations on if international governance of artificial intelligence can be effective if it remains fragmented, or if there is a need for a centralized international organization for AI are as follows [95]. The success of a centralized regime will depend on its design. A well-designed regime covering a set of coherent issues could be beneficial but locking in an inadequate structure may be worse than fragmentation. For now, fragmentation is likely to persist. This should

be closely monitored to see if it is self-organizing or simply inadequate. Digital innovations are continually and rapidly altering the demand for skills in the future beyond today's talent shortages [96]. As artificial intelligence increasingly automates low-value-added tasks, a skills gap will open up between young professionals and older workers, favoring those with experience [97]. To adapt to this changing landscape, businesses should focus on agile skills development to meet the needs of their workforce. Since employees perceive obstacles to the use of open innovation platforms and/or networks differently managers need to consider this point [98]. However, managers should also take into account factors affecting innovation adoption and organizational culture factors in terms of their impact on innovation adoption [99]. Social support can help encourage innovation since it helps develop skills and attributes needed for creativity [100]. However, municipal authorities should do their best to provide organizational and resource support for further innovation adoption [101]. As AI technology has become more advanced, it has begun to play a role in more and more important decision-making processes. Business intelligence is a key tool in the process of effective decision-making, planning, and achieving better results [102]. To ensure that these decisions are trustworthy and free from bias, it is necessary to take active measures to reduce the potential risks that bias can pose [103].

4.1.2. The Design Stage

Artificial intelligence can be used to predict demand, streamline the innovation process, and reduce costs. The ability of artificial intelligence to predict failures and enable planned interventions can help reduce downtime and operating costs while improving production yield [104]. By creating virtual prototypes and comparing their performance, artificial intelligence can help identify the most efficient and cost-effective design. However, artificial intelligence algorithms can become complex when trying to address multiple systems that are built on one another. Artificial intelligence can only solve one problem at a time. The power of AI algorithms has led some experts to label AI as sentient [105]. Any corruption, tampering, bias, or discrimination can have major implications for organizations, human life and society. Any ethical company that cares about its reputation will treat its customers and prospective customers fairly [106].

4.1.3. The Validate Stage

Using machine learning to improve the customer experience by engaging customers in their customer journeys, local product development, customization, enhanced marketing, and sales promotion ROI can require skilled staff and investment in training, depending on the size of the organization. Companies in all industries are increasingly focused on personalization as a key element of their business strategies [107]. Competitive advantage will soon be determined by a company's ability to collect and analyze large amounts of data on individual customers, as well as its use of artificial intelligence to understand and improve the customer experience. The important role of AI-based personalization in collecting, categorizing, analyzing, and utilizing data generated from previous customer interactions means it is crucial to understand AI-based personalization applications and their implications for customer experience throughout the journey from purchase to post-purchase [108]. In addition to investing in AI technologies, a successful transition to an AI-driven economy requires investing in complementary, intangible assets such as data, skills, and organizational capital [109].

Artificial intelligence is defined as pioneering technology and method that can improve the accuracy and efficiency of regulatory interpretation, compliance management, and reporting [110]. The use of artificial intelligence in research and development can help speed up the innovation process. Open innovation tends to be the way to be innovative because it allows for collaboration between different people and organizations. This means that more ideas can be generated, and better solutions can be found for problems. In terms of artificial intelligence, the following points need to be considered: (1) the ways humans think about culture, organization, and processes in the age of artificial intelligence need to

be re-evaluated; (2) the means by which artificial intelligence can help improve the success of research and development projects; (3) the adoption of artificial intelligence to gain benefits and achieve best practices of open innovation [111].

5. Conclusions

The increasing technological advancements and progress in artificial intelligence research have led to a wider range of industries and organizations taking an interest in the technology's potential applications. However, there is still a lack of understanding of how to properly implement artificial intelligence applications. This can limit the potential business gains that can be made. This paper seeks to increase understanding of artificial intelligence implementation by reviewing research within open innovation, artificial intelligence, business model innovation, and digital transformation. The authors identified the paper's step-by-step scheme of the open innovation process driven by artificial intelligence. The authors also highlighted several perceptions of artificial intelligence adoption concerning innovation management.

Paying attention to the fact that artificial intelligence is a disruptive technology makes it difficult to reject the benefits of its application. The paper mentioned four key insights of the use of artificial intelligence as a catalyst for business transformation, and takeaways connected with them; it explained how the open innovation process supported by artificial intelligence can provide the understating of how artificial intelligence can contribute to open innovation.

Author Contributions: Conceptualization, A.K., M.S. and P.B.; methodology, A.K., M.S. and P.B.; software, A.K., M.S. and P.B.; validation, A.K., M.S. and P.B.; formal analysis, A.K., M.S. and P.B.; investigation, A.K., M.S. and P.B.; resources, A.K., M.S. and P.B.; writing—original draft preparation, A.K., M.S. and P.B.; writing—review and editing, A.K., M.S. and P.B.; visualization, A.K., M.S. and P.B.; supervision, A.K.; project administration, A.K.; funding acquisition, A.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Silesian University of Technology, grant number 13/020/BK_23/0081.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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