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Comprehensive analysis, research agenda, and framework on artificial management and innovation management

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Abstract: Businesses' approaches to managing innovation are changing as a result of artificial intelligence (AI). Given the rapid advancement of technology and the replacement of human organization, AI may require management to reevaluate an organization's entire innovation process. In light of this, we study and research the implications for future innovation management. Using concepts from the Carnegie School and the company's behavioral theory, an investigation is made relating to the implications of AI technology and machine learning-based AI systems for innovation management. We propose a paradigm that demonstrates the extent to which AI can replace humans as well as the considerations to take into account when switching to a company that specializes in digital innovation. We conclude our study by making predictions about potential future research areas. According to various worldwide sources, one of the most recent areas of educational technology is artificial intelligence in education (AIEd). Despite the fact that it has been there for close to 30 years, educators are still unaware of how to use it for pedagogical reasons on a bigger scale or how it might meaningfully affect teaching and learning in higher education. The failure to integrate AI into HR operations, however, could prove to be a grave sin, preventing businesses from expanding and surviving in a future where advanced technologies and computers are the norm. This is because human resources is not typically associated with this emerging technology. The global workforce is in danger, as AI and sophisticated self-learning computers are removing human influence or involvement from every aspect.

Keywords: Artificial Intelligence (AI), Innovation Management, Machine learning, Information Processing, Augmented Intelligence, Robotics

Introduction:

There has been a boom in academic interest in the idea that artificial intelligence (AI) and machine learning can displace humans, take over job positions, and alter current organizational procedures. The key idea is that AI can outperform human specialists in terms of quality, efficiency, and results given specific limits in information processing.We can wonder if AI might contribute to one of the most crucial processes determining a company's long-term survival and competitive advantage - innovation - given that it can do traditional "human" activities in organizations. It may seem far-fetched at first to think that firms should and should employ AI and machine learning for innovation. After all, invention has historically been viewed as a domain for humans due to humans' "unique" propensity to innovate. There are various compelling reasons for organizations to integrate AI into their innovation processes, despite the limitations of AI when compared to humans. Among the exogenous factors to the innovation process include the fact that innovation managers must deal with highly dynamic and changing surroundings, increasingly competitive global marketplaces, competing technologies, and drastically shifting political landscapes. The amount of information available has also grown tremendously and is still growing. These advancements show that information is the cornerstone of competitiveness and an organization's capacity for problem-solving. More significantly, cost increases across numerous industries are exacerbating the negative effects of innovation's riskiness. In other words, the price of every new innovation has been rising with time. While Moore's Law has caused the transistor density on integrated circuits to expand exponentially, this development has required ever greater efforts from firms like Intel. Drug development procedures in the pharmaceutical sector follow a similar pattern. This means that by integrating AI and machine learning, the way innovation is organized needs to be challenged because of their cost benefits in information processing. Therefore, finding ways to integrate AI and machine learning into businesses' innovation processes ought to spark the interest of innovation managers. On the one hand, this might make it easier for businesses to adapt to their environment's increased levels of competition and manage the data that is being generated there. Contrarily, using AI to support the innovation process could offer genuine benefits to firms by reducing both the risk and the expense of innovation. Today, a company's ability to reinvent itself through exploratory ventures depends critically on human-organized innovation management. AI has the potential to help people in ways that humans are unable to. Artificial intelligence (AI) has been projected to significantly affect organizations' innovation processes in the future by academics as well as practitioners. The idea that AI might one day be

applied in innovative settings is further supported by the quick growth of AI and machine learning, which portends important and fascinating changes to come. We still have a limited knowledge of how AI might be innovatively constrained. The use of artificial intelligence (AI) and machine learning for creativity and innovation is very different from the well-established fields where traditional management has been replaced by AI. Our study responds to calls to reduce the role of humans in the innovation process and offers a framework for understanding how AI might be employed for inventive goals. We accomplish this by expanding on the main tenets and significant consequences of the behavioral theory of the company. Developing AI applications in higher education has new ethical concerns and risks, despite the huge benefits that AI may offer to enhance teaching and learning. Administrators may be tempted to substitute more lucrative automated AI solutions for instruction during times of budget constraints. Professors, teaching assistants, student counselors, and administrative staff could be worried that chat bots, expert systems, and intelligent tutors will replace them. AI has the ability to enhance learning analytics capabilities, but these systems need a ton of data, including sensitive information about teachers and students, which presents severe privacy and data protection concerns. The Analysis & Policy Observatory issued a discussion paper in April 2019 to design an AI ethics framework for Australia, and other organizations, like the Institute for Ethical AI in Education in the UK, have recently been founded to develop a framework for ethical AI governance in education. Although computer science and engineering are at the foundation of the artificial intelligence (AI) area, other disciplines including philosophy, cognitive science, neurology, and economics have also had a significant impact. Due to the interdisciplinary character of the discipline, there is disagreement among AI researchers over what constitutes AI – and intelligence in general – in general. When it comes to the use of AI-based tools and services in higher education, Hinojo-Lucena, Aznar-Daz, Cáceres-Reche, and Romero-Rodriguez note that "this technology [AI] is already being introduced in the field of higher education, although many teachers are unaware of its scope and, above all, of what it consists of" (p. 1). To carry out our examination of artificial intelligence in higher education, it is required to define several terms. We'll examine concepts of AI in education as well as the components and procedures that AI applications in higher education might include before going on to the systematic analysis of the literature.

Business model resilience is the ability of an organization to uphold the business logic that underpins the creation and delivery of value. Enterprise business models are continually being tested by profound economic, social, technological, and environmental changes that are occurring with an unparalleled pace and scale in modern business life. It is challenging for businesses to continue replicating their successful business models due to the trade tensions and rivalry between the major powers as well as the uncertainty of economic oversight. The global COVID-19 epidemic presents ongoing challenges to the hotel, tourism, retail, transportation, and manufacturing sectors' ability to operate sustainably. Information technology (IT) developments like big data, the Internet of Things (IoT), and artificial intelligence (AI) will also provide new business models that have the potential to quickly and completely replace conventional company models. The idea of disruption, which has always been present in business operations, has gained more attention in the modern day. The development of the resilience of business models in a variety of domains, such as competition, value, and innovation, has been severely challenged by the high frequency and multiform disruptions from the economy, society, technology, and environment. Developing and improving the resilience of business models has become an unavoidable concern in enterprise AI transformation due to interruptions from numerous sources and numerous features.

Information systems (IS) and business units can create value together through the methodical and efficient use of IT service management (ITSM) [7]. It appears that ITSM is a potent instrument for increasing business model resilience. However, in their ongoing efforts to increase their investments in information technology, the majority of businesses have underestimated the degree of disruption that will be brought about by changes in business practices and technological advancements. In addition, only 8% of businesses are able to implement enterprise AI transformation in line with the established strategies and procedures for preserving profitable business models. Traditional IT service management seems helpless in the face of disruptive events with high intensity and multiple dimensions. IT services must be able to adapt to shifting environments, maintain their capacity to provide value quickly, and adhere to strict stability and resilience standards [9]. AI-enabled ITSM (AITSM), which demonstrates the features of augmented analytics, decoupling, platformization, and recombination, is quickly becoming the standard ITSM solution as a result of the vast development and profound application of AI. Enterprises must start figuring out how to reactivate the potential of AITSM to shape the resilience of business models and satisfy survival needs in complex and ever-changing settings. Empowerment from AI has introduced new life and challenges to ITSM capabilities.

Major objectives of the present study:

1. To study the behavioral theory of the firm and information processing in the digitized organization
2. To know the information processing aspects in the innovation process

3. To understand the potential AI application areas in the innovation process
4. To study the AI readiness levels for developing the digitized organization
5. To understand the information processing capability levels in terms of exploiting, expanding and exploring

Information processing and behavioral theory of the firm in the digitized organization

In organizations, information processing is a critical component of innovation.The process of decision making, which necessitates information processing by managers involved in the innovation process, is a central activity in innovation management.The role of management in information processing is to choose the data, knowledge, and other information that will be used in the process.The information must then be processed, which entails gathering and analyzing data, knowledge, and information.Finally, once the data has been processed, management must make decisions the obligation to make decisions. The way information is processed in organisations is rapidly changing with the introduction of machine learning – a type of AI that allows machines to 'learn' from data and experience without being explicitly programmed (Samuel, 1959).AI systems can support or, in some cases, take over all of the above stages of organizational information processing.Indeed, certain characteristics of the modern digitized organisation have a significant impact on how information is processed in organisations.

Interestingly, today's organisations are changing in such a way that it is becoming more difficult for management to obtain and analyse certain types of data.

Information processing in the digitized organization

Machine learning and computerized knowledge constitute a strong basis upon which the newly created digital organization is built. This indicates that a significant portion of procedures are automated using algorithms. Some authors contend that this should be an organizational cornerstone and that businesses should view digital capabilities as their core competencies (Lenka et al., 2017). These interactions with customers and suppliers enable the storing of information and knowledge. As a result, more information and knowledge are kept in electronic form without the help of humans. The social system of the organization loses significance when the computerized organization takes center stage.

As a result, executives and directors in charge of innovation management and decision-making are less effective, possibly due to acting outside of the relevant information flow as well as human limits. Given that it is expected that those managers who do have access to this information are a small subset of the managerial pool, many managers may have quantitatively and qualitatively less information than they did prior to the computerized organization and technological advancements in the workplace. These conditions call for a paradigm of innovation management that integrates AI focused on innovation and machine learning of computerized data and processes. It is possible to anticipate that as AI and machine learning develop, the function of innovation management will also alter. In order to find and pick opportunities and determine what the business's potential next competitive edge might be, human innovation management will therefore be needed to work in tandem with AI and machine learning algorithms.

Information processing in the innovation process

To better understand how AI may assist organizations with innovation, we need to take a closer look at how information is handled. The recognition, discovery, creation, and generation of innovative ideas, opportunities, and solutions; the development or exploitation of a variety of ideas, opportunities, and solutions; and finally, the evaluation and selection of one or more of these ideas, opportunities, and solutions. These three stages make up the innovation process, which is the focus of innovation management. Since we are interested in figuring out where and how AI may be utilized to support human decision making in the innovation process, we will concentrate on the first two stages of the innovation process, namely concept generation and idea development. We think that the function of innovation management will evolve as electronic services and automation are more extensively adopted and as organizations become more digital. As in the past, there are two unique obstacles that innovation managers must overcome when trying to identify or develop new opportunities and concepts.The majority of solutions' new thrust will be somewhat gradual because they rely so largely on preexisting information. To come up with a more original and creative idea or opportunity, managers will need to broaden their search outside their current knowledge domains and into new, experimental fields. The more managers are able to process a large amount of information on potential solution approaches and opportunities, the better they should be able to narrow the set of potential solutions to the most promising ones and identify truly exciting opportunities, even though access in increasingly digitized organizations may be limited. Furthermore, managers should be able to think of more original ideas and spot more chances because AI enables them to go beyond their current knowledge set. It will be tough to substitute human interaction. Any system

powered by artificial intelligence that attempts to support management in these endeavors must be able to overcome the same challenges that human managers deal with when implementing new ideas.

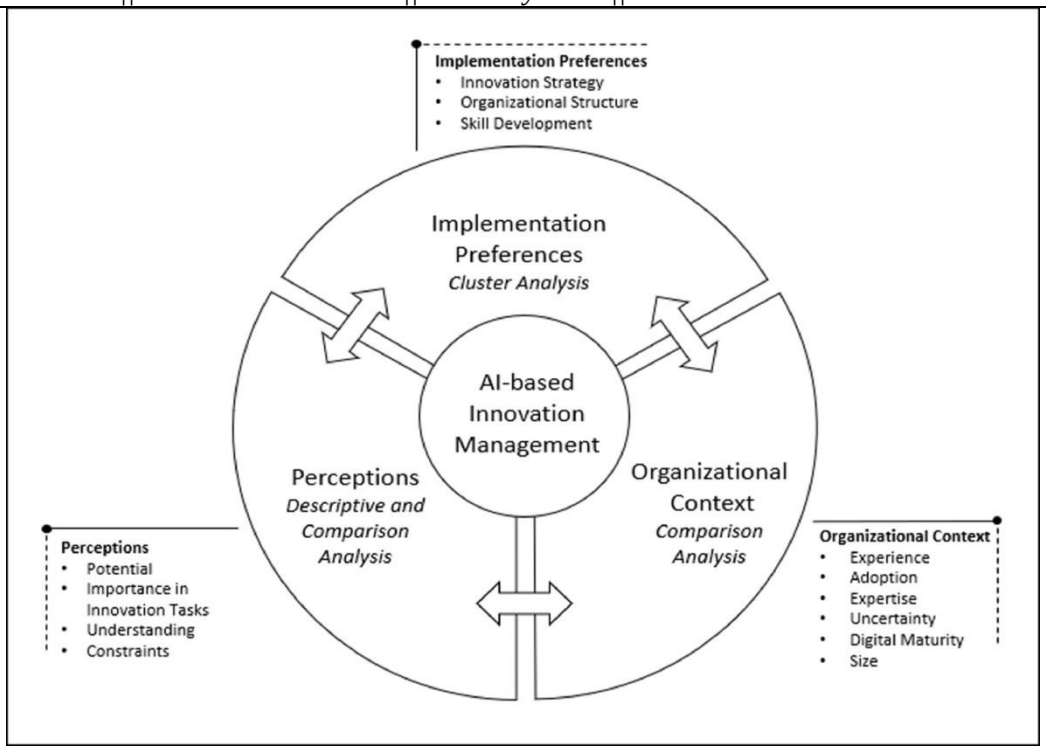
Potential AI application areas in the innovation process

By integrating the obstacles that both people and AI systems must overcome in the innovation process with the crucial tasks of idea generation and development that must be carried out, we can create a framework of potentially inventive AI application areas inside the innovation process. To fully realize AI's potential, we must first determine the areas in innovation management where AI can supplement or even replace human decision-making. Theoretically, there are four ways to support human decision making: (1) developing ideas by getting around information processing limitations; (2) generating ideas by getting around information processing limitations; (3) developing ideas by getting around local search routines; and (4) generating ideas by getting around local search routines. The limitations of human information processing are successfully overcome by modern AI systems in the domain of idea and opportunity development.

Deep neural networks are currently widely employed in AI systems because they need and can process massive volumes of data. This feature reveals a wide range of AI systems that can help people come up with ideas, possibilities, and solution methods by processing a lot more data than a human can handle and identifying promising areas for research.These technologies are already providing significant economic value to businesses.Improved conditions for innovation are strongly linked to this development.In the field of materials discovery, AI systems can be used in a variety of ways.AI can be used to optimize battery components and solar cells, for example, or to accelerate the discovery of new catalysts.To find these new materials, machine learning-based methods are used to predict the most promising materials to test, significantly speeding up the innovation process.Of course, there are some intriguing AI applications in pharmaceutical research and development.

AI readiness levels for developing the digitized organization

The problem space that needs to be solved can be equated with the first dimension, which specifies the activities involved in the innovation process (concept development and idea production). According to an information processing viewpoint on the innovation process, the "problem space" is the internal representation of the work environment employed by the subject, whether the subject is a human manager or an AI system. An information processing system can either decide to include additional data, information, and/or knowledge, redefining the problem space and allowing for the generation of new ideas and solutions, or it can decide to maintain its current definition of the problem space. The latter option would entail simply developing a new idea or solution based on the problem space. Consider the first choice as exploiting an already-existing problem space, and the second as investigating a problem space that has been redefined, is still evolving, or is brand-new. It is possible to change the solution space for innovation by altering the second dimension, which represents the challenges to be overcome in the invention process (information processing limitations and ineffective or local search). The solution space specification need not be altered in order to overcome information processing limitations; rather, this barrier to innovation simply shows that the solution space can be searched more effectively and faster. In other words, when information processing limitations are removed, the solution space is utilized more effectively and efficiently. However, it is vital to explore the solution space in order to uncover more esoteric and original solutions in order to get past ineffective and local search methods. To appreciate the extent to which contemporary AI systems can support people in the invention process, it's critical to comprehend some of their major technological properties. Particularly, the majority of AI systems created today have two fundamental traits with human capabilities.To begin with, the vast majority of modern AI systems are taught by human AI specialists who work with subject matter experts to draw on their existing body of knowledge. As a result, it follows that these AI systems should attempt a more complete search of a known, related knowledge base. In other words, the majority of systems have a restricted capacity to explore the issue area. Second, the learning process is optimized for a particular objective function by modern AI systems (Good fellow et al., 2016). This objective function is specified by the human AI researchers who are developing and training the system. These objective functions are frequently sparse as well since human researchers calibrating the systems are unable to know all possible aims, which prevent them from producing an optimal objective function. As a result, humans often define the solution space for AI applications, and existing AI systems have a limited capacity to explore the solution space on their own. As a result, we can determine a variety of "information processing capability levels" for AI systems, which show how plausible it is for AI systems to replace and enhance human decision-making. They can be divided into three capacity categories based on the types of information processing skills they exhibit.



Above image showing AI Based innovation management

Information processing capability levels in terms of exploiting, expanding and exploring

Information processing capability level 1 of the AI system suggests that it can help human innovation managers analyze far more data and knowledge than they could independently. At this level of capacity, AI systems will mainly be able to support rather than completely replace people in the innovation process because they are processing more information but not fully taking over the entire process. These AI systems can therefore help humans get above cognitive information processing constraints that restrict them from carefully considering massive amounts of data and paying attention to a variety of data sources. Well-designed AI systems can manage far more data and interpret a range of data sources. When an AI system has level 2 information processing capabilities, it can either increase the innovation process by producing fresh concepts and opportunities or circumvent local search conventions to locate more distant answers. At this level of competency, AI systems are still working with human innovation managers. These technologies are very effective in helping managers in two different ways. The ability of an AI system to analyze information at level 3 shows that it is capable of exploring novel avenues for innovation. These AI technologies can support and even partially replace human innovation managers by accomplishing more complex and challenging duties in the innovation process. When information processing power reaches the "exploring" stage, artificial intelligence (AI) systems are able to produce and create original, creative ideas. Due to their more sophisticated information processing capabilities, these AI systems can investigate both new methods of identifying problems (exploring the problem space) and new approaches to solving problems (exploring the solution space). As a result, we may anticipate that level 3 information processing capable AI systems will be able to take over a larger portion of the duties formerly handled by human innovation managers. The state of the art is still far from enabling the development of such AI systems, though, as there have been few early excursions into this kind of AI system.

Conclusion:

Last but not least, there are some problems where technology meets those in charge of putting it into practice. For instance, the level of human involvement necessary might be a barrier to the adoption of AI systems in commercial settings. Although AI solutions are made to automate workflows, it is uncommon for a whole set of connected tasks to be entirely automated. Furthermore, the algorithm(s) selected by the people who implement the system frequently have a significant impact on the problem area that AI systems can explore. The solution space can be constrained by human under specification of solutions. Sparse reward functions in sandbox reinforcement learning applications frequently cause the algorithm to solve problems in an extremely "creative" manner; the machine effectively ends up manipulating the system. Questionable generative design solutions might also result from inadequate human specifications. Results that are too "new" and not rigorous

enough can be largely useless. Human intervention is therefore necessary; however this could result in process inefficiencies.However, depending on the circumstance, human intervention may be advantageous. Determining when to forego human help and when to welcome it is consequently one of the trickiest tasks. Furthermore, in order for people to make the best judgments possible based on machine output, the AI system must provide actionable information. The question of AI system trust is another problem at the nexus of humans and technology. By shedding light on the application of artificial intelligence (AI) and machine learning algorithms in the future organization of innovation, our study expands the body of knowledge in the field of innovation management. Our research identifies instances in which organizational innovation can already benefit from the deployment of AI systems, such as when the development of new technologies is primarily constrained by data processing issues. For instance, anomaly detection-based AI systems might be helpful for businesses searching for new prospects while grappling with information processing limitations. We conclude by highlighting recent developments in AI algorithms that demonstrate the technology's ability to address some of the more challenging problems in innovation management. Examples include overcoming local search and coming up with brand-new concepts. We're eager to observe how new advances in AI technology provide fresh opportunities and broaden the fields in which AI can support creativity management.

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