The Role of Cloud Computing and Artificial Intelligence Technologies on Cost Management in Smart Manufacturing: An Innovative Approach in Management Accounting

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Abstract. *This work investigated how artificial intelligence (AI) and cloud computing are related to cost control in smart manufacturing. It aims to show how these technologies improve manufacturing environments' decision-making and cost efficiency for better management accounting. The study thoroughly examined the literature for the qualitative research methodology. The cloud computing benefits from lowering operating costs, the use of AI in predictive maintenance, and the incorporation of these technologies into management accounting systems are only key area and trends from the thematic analysis. According to the results, offering scalable and flexible computing resources enabled companies to quickly adjust to shifting demands of the market, cloud computing greatly reduced costs. Yet, the study also emphasized the difficulties in the management of the resources, such as the possibility of inefficiencies and higher expenses due to inefficient resource distribution. Also, AI technologies enhance the efficiency and accuracy of accounting procedures, freeing up professionals for the concentration on strategic duties such as financial analysis and decision support. The report suggested that to reduce and avoid inefficiencies, businesses should carefully manage their cloud resources. For the improvement of operational efficiency and decision-making, businesses were required to include AI-driven solutions into their management accounting systems. The study also found that enterprises should give priority to implementing cloud computing and AI technologies to stay competitive in the quickly shifting smart manufacturing market. These technologies provide a substantial area for innovation in cost management.*

Keywords: Cloud Computing, Artificial Intelligence, Cost Management, Smart Manufacturing, Management Accounting.

1. INTRODUCTION

The rapidly developing smart manufacturing sector, technological advancements are radically changing traditional business practices. Among these, cloud computing and artificial intelligence (AI) are as revolutionary forces changing the concept of cost management within the framework of management accounting. Cloud computing has been essential for companies for the reduction of expenses and boost operational effectiveness because of its capacity of delivering scalable and adaptable computing resources via the internet (Liu, 2011). As cloud systems are agile and scalable, businesses are capable of quickly adapting to the changing market demands, giving them a competitive advantage in a digital economy (Voorsluys, 2011).

Despite the potential benefits of cloud computing, resource management challenges still exist. The early advantages of cloud adoption may be diminished by improper resource allocation, which could lead to performance issues or excessive costs (Dittakavi, 2021). Combining scientific workflow scheduling (SWFS) and cloud and grid computing complicates cost optimization because interdependencies among process tasks requires a coordination for avoiding inefficiencies raising expenses (Hosseinzadeh, 2020).

In addition to benefits of cloud computing, AI technologies are revolutionizing management accounting by the rise in the productivity, accuracy, and efficiency of accounting processes. The use of AI-driven solutions to automate complex procedures such as fraud detection, financial analysis, and decision support, accounting professionals currently focuses on higher-value tasks such as strategic planning and leadership (Christauskas, 2018; Vărzaru, 2022). Demirkan (2020) stated that the integrating AI with management accounting systems enhances decision-making processes and expedites the change into a data-driven methodology in managing the company finances.

When cloud computing and AI join, big progresses in cost-management techniques should be realized as smart manufacturing develops. This work explores how these technologies help management accounting and offer a fresh approach to the problems of cost control in modern productivity.

Study Problem and Questions

The progress in cloud computing and AI technologies is causing rapidly changes many industries, such as manufacturing and management accounting. Though these technologies can have a big potential for improving cost management and operational efficiency in smart manufacturing, their integration is still challenging as businesses establish a balance between the upfront charges and ongoing running expenses and the expected benefits of higher efficiency and accuracy.

In addition, since it is not clear how these technologies precisely impact cost management in the accounting, a big gap in the research currently accessible exists. This work aims at overcoming this gap by the investigation of how cloud computing and AI technologies enhance cost management in smart manufacturing environments.

The following sub questions are derived from the main questions:

1. 1.How does cloud computing affect cost control?
2. How important are accounting information systems and management control to the success of an organization?
3. How will technology influence management accounting in the future?

Study Objectives

The goal of the study is to learn more about how AI and cloud computing affect smart manufacturing cost control. The following sub-objectives make up this primary objective: Examine how cloud computing affects cost management:

1. Examine how accounting information systems and managerial control contribute to the success of organizations.

2. Examine how technology trends will affect management accounting in the future.

The Significance of the Study

This research is noteworthy for various reasons:

1. This study offers important insights into how cloud computing and AI technologies could enhance cost management procedures by examining their impact in smart manufacturing. The results might assist companies in boosting sales, cutting expenses, and optimizing operations mall of which would improve production procedures and make them more efficient and competitive.

2. By focusing on the particular effects of cloud computing and AI on cost management within the management accounting framework, the research fills a significant knowledge vacuum. By a deeper understanding of the technological advances in accounting and their implications for smart manufacturing, this study adds to the knowledge.

3. Businesses aiming at including artificial intelligence and cloud computing into their cost management systems directly get benefits from this study which offers valuable advice for decision-makers, accountants, and industry experts for their cost management by identifying the obstacles and proposing solutions for a effective integration.

2. METHODOLOGY

This work examines implications of cloud computing and AI technologies on cost management in smart industries. This is by performing a thorough literature review for the identification and synthesizing of relevant research findings.

Research Design

The work examines how cloud computing and AI could enhance cost-management strategies in smart industries by a qualitative methodology and comprehensive literature. The literature review explores how different technologies interact with cost management in manufacturing environment which is the main method for the collection and interpretation of the data.

Data Analysis

A thematic analysis of the compiled material identified important subjects and patterns related to cloud computing and artificial intelligence's effect on cost management in smart manufacturing. The information was coded for finding common themes in the data. It reduces operating costs. Also, some examples include the role of AI in predictive maintenance, and the integration of these technologies into management accounting systems. The results were then integrated for providing a comprehensive understanding of how these technologies help in the general productivity and cost management in smart manufacturing settings.

3. LITERATURE REVIEW

The Role of Cloud Computing on Cost Management

Different computer services over the internet, including networking, processing, and storage, are known as "cloud computing" (Liu, 2011). Thanks to this paradigm shift in infrastructure, both individuals and organizations can now access and use computing resources without having to own or manage the underlying hardware. Instead, other businesses also referred to as cloud service providers provide and manage these resources. The offered services fall into several broad categories, including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), all of which address different operational needs.

In the contemporary environment, cloud computing is crucial. The increasing use of digital transformation by organizations has made cloud environments' agility, adaptability, and scalability indispensable (Voorsluys, 2011). It eliminates the capital expenditures associated with building and maintaining physical infrastructures and ensures that businesses may swiftly adapt to changing market circumstances. Furthermore, analyzing huge information in real time demands computational power that cloud platforms can give due to the growth of big data, artificial intelligence (AI), and the Internet of Things (IoT) (Chieu, 2009).

Inadequate resource management in cloud environments leads to a multitude of problems. Performance issues result from inefficient resource allocation, which can cause application slowdown, outages, or in severe cases, crashes. Such interruptions could be detrimental to a business's operations, sometimes leading to a decline in sales and a damaged reputation for the company. However, waste happens when resources are used more than

they actually need to be. Although this tactic might prevent urgent operational issues, the organizations incur unnecessary costs for services.

Cloud computing's inherent scalability and flexibility could become a problem if not managed carefully. Without a comprehensive resource management plan, companies' risk being mired in an endless cycle of changes that lead to unpredictable expenses and ineffective operations. Furthermore, the early cost-saving benefits that lure organizations to the cloud may be outweighed by uncontrollably high expenses in cloud systems. In a competitive corporate environment, striking a balance between cost effectiveness and operational performance is not only a technological challenge but also essential to long-term success (Dittakavi, 2021).

Workflows are crucial to the organization of scientific applications in distributed systems. These workflows are typically defined using a Directed Acyclic Graph (DAG) (Fiore, 2013; Shrier, 2008; VanderWeele, 2007). In this architecture, each computing activity is represented as a node, and each task-to-task data or control dependency is represented by a directed edge connecting the related nodes. Because these process applications are so important, several Grid efforts have been established to fulfill this need. In addition to creating workflows on the Grid, these systems are made to execute and manage them (Dittakavi, 2021).

The proven performance of the Grid initiatives has opened new research directions. One of the key areas of research is the viability and effectiveness of adopting Cloud-based technologies to manage large-scale scientific activities. Moving to cloud systems may offer cost-effectiveness, scalability, and flexibility. Due to its inherent characteristics, the Cloud grows in importance as distributed computing advances and could potentially meet the requirements of scientific operations (Dittakavi, 2021). Cloud-based capabilities have been added to several Grid workflow management system versions in recent times. These modifications and enhancements demonstrate that Cloud systems are becoming more widely regarded as viable platforms for conducting large scientific procedures, in keeping with the evolutionary trajectory of distributed computing systems (Dittakavi, 2021).

Scientific workflow scheduling, or Scientific Workflow Scheduling (SWFS), is the process of mapping and scheduling jobs or tasks from a scientific workflow onto distributed computing resources in order to accomplish specific goals, such as limiting execution time or cost (Masdari, 2020; Wan, 2012). Scientific workflows are ordered, logical sets of computer activities designed to achieve specific scientific goals. These tasks could involve data processing, simulations, or complex analysis requiring multiple computational steps.

Due to the heterogeneity of distributed computing resources, which include varying processor types, memory capacities, and network bandwidths, SWFS aims to divide workloads among available resources as efficiently as possible. Challenges related to SWFS are handling the dynamic nature of tasks and resources, optimizing main aims, dealing with resource failures or uncertainties, and managing task dependencies (Liu, 2018; Liu, 2017). Yet, its advantages are critical for advancing scientific discoveries in many domains such as lowering turnaround times and optimizing the use of computer resources (Dittakavi, 2021).

SWFS in cloud and grid computing causes complication, in considering the workflow execution cost (Hosseinzadeh, 2020; Liu, 2017). A main challenge is the satisfaction of the demands of many users, sometimes competing with one another for limited resources in cloud or grid computing environment. This competition is caused by the need to achieve Quality of Service (QoS) requirements. These limitations make sure that the services meet specific requirements impacting the general operation cost (Dittakavi, 2021).

The cost optimization challenge is additionally complicated by the interdependencies across workflow operations in SWFS. Owing to these interdependencies, actions need to be carried out in a well-organized and coordinated way to ensure that workflows run smoothly and are completed successfully. Higher costs could be the result of any glitches or inefficiency. Another challenge is the significant communication costs associated with these interdependencies. In example, because tasks depend on one other, data transfer between different resources is necessary. Significant communications costs could arise from this data transfer, especially if it occurs frequently or includes large amount of data (Dittakavi, 2021).

The Role of Management Control and Accounting Information Systems in Organizational Success

Management control systems make sure that the organization's resources are used as efficiently as possible in order to achieve its goals. In addition to financial data, an efficient management control system utilizes control and psychological traits (Nguyen, 2017). From a primary organizational goal, the management information system collects and processes data from numerous sources to generate a range of sub-objectives. It is useful to compare the projected plan with the actual performance from several perspectives (Al-Ali, 2017). To thrive in a technologically advanced and competitive world, a business must establish a management control system to strengthen its managerial and supervisory responsibilities

(Chi, 2019; Xin, 2018). One of the many components of the management information system is the construction of the management accounting information system, which is essential to the organization's general viability, internal control framework, financial stability, and customer loyalty (Chowdhury, 2019; Ward, 2016).

Businesses have just lately begun utilizing e-commerce-based accounting information systems to obtain a competitive edge (Shajalal, 2021; Hidayat, 2020). Management accounting plays a critical role in addressing a company's operational and managerial financial demands through the responsibility center. The responsibility center ensures optimal utilization of internal accounting control systems in addition to supporting the development and execution of other beneficial internal management systems (Ghasemi, 2019). Amershi (2014) claim that management accounting significantly improves innovation management. Rodriguez-Galiano (2015) claim that management accounting systems simplify the process of figuring out how much single- and batch products will cost. Businesses are increasingly using balanced scorecards to evaluate the performance of many indicators, according to Cooper (2017).

Technological Trends Shaping the Future of Management Accounting

The joint publication "Digital Darwinism" from the Institute of Management Accounting (IMA) and the Association of Chartered Certified Accountants (ACCA) described the technology developments that potentially affect the discipline of Management Accounting (MA). Mobile technologies, artificial intelligence, digital payment and delivery methods, and virtual and augmented reality were some of these developments (ACCA/IMA, 2022). In Forbes, Chandi (2018) looked at the three major technologies that would affect MA going forward: increasing automation, BC, and CC.

According to Ionescu (2013), there are several advantages of cloud computing for accounting, such as reduced operating expenses, immediate user access to accounting documents, and simplified document creation. Digital technology can eliminate asynchronous data, expedite and increase transparency of intra- and interorganizational communication, and enhance the quality of decision-making (Chandi, 2018; Ionescu, 2013). Thanks to AI technology, accountants can now focus on higher-value duties like strategy formulation, problem-solving and analysis, and leadership. AI reduces costs and workload while increasing productivity, efficiency, and accuracy. The Alternative Investment Management Association (AIMA) will employ machine learning to generate more relevant information by providing reliable accounting data (Christauskas, 2012; Ahn, 2018; Cho, 2018).

There has been a lot of research on the technological advancements in Massachusetts over the last 10 years in particular (Arnold, 2018; Dos Santos, 2020), with a focus on the challenges of applying AI solutions. Technology is having a major impact on the role of accounting specialists, necessitating the training of a new generation of professionals with the skills necessary to operate in the increasingly virtual workplace (Schmitz, 2019). Accounting professionals have always embraced information technology advancements (28), but in order to fully realize the potential of accounting operations, a revolution involving the implementation of AIMA systems is necessary. AI-based technologies profoundly change the work and responsibility of professionals in MA, requiring the creation of new paradigms to understand these new realities (Kroon, 2021).

Accounting professional associations have developed competence frameworks that incorporate the digital skills that accounting professionals will need in the future as a response to these issues (Association of Chartered Certified Accountants, 2020). All businesses' accounting operations will undergo major changes as a result of the implementation of integrated AI solutions, which will present both opportunities and disruptions (Demirkan, 2020). According to Yoon's (2020) study on the effects of adopting new information technology in the sector, accounting can only address the issues brought about by the enormous volumes and complexity of information if it combines technological advancements.

New information technologies have made it possible to automate accounting processes, which increases information security, accessibility, and transparency and eliminates the need for human interaction in certain jobs (Yüksel, 2020). Many companies have begun integrating modern MA technologies associated with the digital transformation into their decision-making information system (Yoon, 2020). Thus, MA is an essential component of an organizational information system when seen holistically (Stoica, 2021). Artificial Intelligence facilitates the computerization and automation of managerial accounting processes by increasing productivity and speeding up accounting tasks.

Accounting managers will use information from AIMA systems to do a significant amount of hybrid MA jobs, expanding the scope of skills that accountants may perform (Moll, 2019). For example, in addition to the basic understanding of accounting and management, analysis, synthesis, problem solving, and communication, technical and Information Technology (IT) skills are needed (Pan, 2016; Schmidt, 2020).

Artificial Intelligence is a technology that makes predictions based on historical or present data, improving machine learning models. AIMA technology now allows for

prediction, complex financial statement analysis, and fraud detection. AIMA technology strengthens internal controls for fraud detection while managing data analysis, decision support, and the creation and updates of accounting records. However, accountants are concerned that in managerial and financial accounting, AIMA would replace interpersonal communication. Conversely, AIMA will facilitate decision-making and enhance complex data exploration in real-time (Vărzaru, 2022).

The accounting literature has addressed the topic of implementing new information technologies, including the application of specific technologies like BC (Karajovic, 2019), BD (Al-Htaybat; 2017), AI (Marshall, 2018), or the role of specialists in MA after the implementation of technological changes (Lombardi, 2020). AIMA systems can integrate many modules, including automated data collection, budget management, cost control, flexible responsibilities center allocation, outputs management, and financial reporting (Vărzaru, 2022).

In recent decades, Abad-Segura's study on new accounting information technologies (Abad-Segura, 2020) has connected developing concepts like social media, BC, BD, and AI to new digital technologies. Burns (2019) emphasized the advantages and disadvantages of an intelligent virtual assistant manager, while Zhang (2019) addressed intelligent process automation, which combines intelligent automation by incorporating AI and other computing technologies into traditional robotic processes. Last but not least, Huang (2019) presented a methodology for automating robotic activities so that accountants and auditors might focus on tasks requiring expert judgment.

4. CONCLUSION & RECOMMENDATIONS

This paper explores how could computing and artificial intelligence (AI) are transforming cost management in the context of smart manufacturing, emphasizing the role that management accounting plays in this process. The findings indicate that combining these technologies may significantly improve the manufacturing processes' operational efficiency, precision, and cost-effectiveness. Cloud computing provides enterprises the flexibility and scalability for the reduction of capital project costs with no compromise of the robust operating requirements. Yet, AI-driven solutions enhance decision-making and facilitates complex bookkeeping tasks which free up experts for focusing on strategically significant work.

In addition, this study shows issues that, if unproperly addressed, could increases costs, including the scheduling complex scientific workflows and administrating cloud

computing resources. Furthermore, businesses constantly learn and adapt as these technologies evolve rapidly, in particular when coming to management accounting practices.

Considering all these, cloud computing and AI provide a potential method for the fundamental change in cost management in smart industry; yet, for making good on this promise, careful plans and strategic execution are needed.

Recommendations

➢ Companies are recommended designing a comprehensive strategy for integrating cloud computing and AI into their cost management programs. This strategy should have a clear resource allocation plan, tracking regular cost, and continuously evaluating the technologies' effect on operational efficacy.

➢ To fully use cloud computing and AI, businesses are required for investing in the education and training of their accounting staff. The adaption for the development technology improves their capability of making decisions and manage costs.

➢ Due to the challenges of managing resources in cloud environments, organizations are required to utilize sophisticated resource management strategies. This means using robust monitoring systems which make the most efficient utilization of resource allocation, and ensure efficiently management of workflows for preventing unnecessary costs.

➢ Since smart industry is a quickly evolving, companies are required to keep abreast of the most recent technological development. Businesses continuously conducting research will be better equipped for identifying emerging trends, navigating potential roadblocks, and staying competitive in a technologically driven market.

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GENERAL COMMENTS

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