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Integration of Cloud Solutions into Business Processes: Application and Prospects in the Manufacturing Sector

Abstract

The application of cloud technologies in the manufacturing sector is nowadays considered a strategic and essential factor for gaining competitive advantage. In this context, the functional benefits offered by cloud solutions to manufacturing enterprises, their areas of application, and the main technological and management challenges encountered during the integration process are systematically analyzed. At the same time, the development prospects of cloud-based technologies and the new opportunities they create in the manufacturing industry are widely discussed from a scientific perspective.

Keywords: *cloud technologies, manufacturing sector, cloud-based manufacturing, competitive advantage, technological integration, future prospects*

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Bulud Həllərinin Biznes Proseslərinə İnteqrasiyası: İstehsal Sektorunda Tətbiq və Perspektivlər

Xülasə

İstehsal sektorunda bulud texnologiyalarının tətbiqi bu gün rəqabət üstünlüyü əldə etmək üçün strateji və vacib amil hesab olunur. Bu kontekstdə bulud həllərinin istehsal müəssisələri üçün təklif etdiyi funksional üstünlüklər, onların tətbiq sahələri, inteqrasiya prosesində qarşıya çıxan əsas texnoloji və idarəetmə problemləri sistemli şəkildə təhlil edilir. Eyni zamanda, bulud əsaslı texnologiyaların inkişaf perspektivləri və onların istehsal sənayesində yaratdığı yeni imkanlar elmi baxımdan geniş müzakirə olunur.

Açar sözlər: *bulud texnologiyaları, istehsal sektoru, bulud əsaslı istehsal, rəqabət üstünlüyü, texnoloji inteqrasiya, gələcək perspektivlər*

Introduction

In the modern era, global competition and rapid changes in market dynamics necessitate the application of innovative technologies in the manufacturing sector. In this regard, cloud technologies have become a source of strategic advantage by creating new opportunities for obtaining, storing and processing information, providing enterprises with flexibility, scalability and resource optimization. The main features of cloud technologies create conditions for more flexible and efficient management of business processes. The application of cloud-based solutions in the manufacturing sector allows enterprises to manage production capacity more effectively, reduce costs and accelerate the launch of innovative products to the market. Especially for small and medium-sized enterprises (SMEs), cloud technologies create conditions for using high-tech opportunities without requiring large capital investments. However, the integration of cloud technologies in the manufacturing sector requires not only technological transformation, but also organizational changes and the implementation of new management models. Issues such as security, data confidentiality and technical infrastructure compatibility during the integration process require special attention. In this regard, the application of cloud technologies in the manufacturing sector is of great importance in terms of increasing the flexibility of enterprises, optimizing costs and accelerating the launch of innovative products to the market. However, for the effective application of these technologies, it is necessary to find a way to solve issues such as restructuring existing production processes, security and data protection. In connection with the above factors, it is considered important to examine the possibilities and limitations of using cloud-based solutions in manufacturing enterprises, determine future

development directions and propose appropriate technological models to achieve sustainable competitive advantage.

Research

The Basics of Cloud Solutions and the Need for Integration. Cloud technologies create new opportunities for obtaining, storing and processing information. These technologies, which provide access to services mainly over the Internet, create conditions for more accessible and efficient use of resources for a wide audience, from individual users to large enterprises.

Cloud services are usually organized according to three main models:

- Infrastructure as a Service (IaaS)
- Platform as a service (PaaS)
- Software as a service (SaaS).

These models make it easier for manufacturing companies to use technical resources, reduce capital costs and increase operational agility.

One of the main advantages of cloud solutions is that they provide access to data from anywhere and at any time (Marston, Li, Bandyopadhyay, Zhang, Ghalsasi, 2011). That is, you can view, edit or share your data, regardless of where you are physically located and what time of day it is, as long as you have an internet connection to obtain information. This feature allows the manufacturing sector to ensure real-time data flow, accelerate decision-making and more optimal resource management. At the same time, cloud services provide users with a scalable infrastructure under variable workload conditions, which is a great advantage for manufacturing companies in seasonal or demand-driven production increases. We can explain this with a simple example. A manufacturing company called "X" LLC receives 1,000 product orders on normal days. However, on the eve of the holiday, for example, during Novruz or New Year, the number of orders increases to 5,000 per day. If this company had purchased its own server, it would have had to purchase very large and expensive equipment for this increase, which would have been idle during the rest of the year. But when using cloud services, the company simply rents this additional capacity during the holidays, and then reduces its use (Sultan, 2011; Wang, Törngren, Onori, 2015). Thus, it both saves money and can speed up its work when needed. In general, cloud services ensure that the factory has easy access to "increasing and decreasing" technical resources when needed.

The need to integrate cloud technologies in the manufacturing sector is justified by several main factors. First, in the context of global competition, the need to quickly adapt to market demands and establish flexible production models is increasing.

Second, maintaining and managing traditional infrastructure requires high financial and resource costs, which cloud technologies significantly reduce this burden. Third, it is important for companies to base their technological platforms on more flexible and adaptive systems in order to meet the requirements of digital transformation and accelerate the innovation cycle.

Modern manufacturing companies, such as industrial giants such as General Electric (GE), are already using "cloud-based predictive analytics" systems. GE is using cloud technologies to enable real-time monitoring of manufacturing equipment and predictive maintenance operations reduces equipment failures and optimizes costs. As another example, Siemens has introduced an industrial cloud platform called "MindSphere". Through this platform, data collected from various production lines is processed and the efficiency of production processes is increased through analytical services. In Azerbaijan, leading manufacturing enterprises such as Azersun Holding are taking important steps towards increasing operational efficiency and optimizing resource management by migrating their ERP systems and data management solutions to cloud-based models. SOCAR Polymer and other manufacturing enterprises mainly use reliable industrial-level platforms such as Microsoft Azure and Amazon Web Services (AWS). These platforms provide real-time data flow, high security, scalable infrastructure and advanced analytics capabilities, accelerating the digital transformation processes of enterprises.

As a requirement of this approach, for the successful integration of cloud solutions, organizations must reconsider their information technology strategies and pay special attention to security, privacy and compliance issues. The integration process is not limited to technical adaptation only, but also

requires a change in organizational culture, adaptation of the workforce to new technologies and the implementation of new management models (Gubbi, Buyya, Marusic, Palaniswami, 2013; Xu, 2012). As a result, the effective implementation of cloud technologies in manufacturing enterprises acts as an important component of digital transformation and has become a strategic necessity to increase the competitiveness of enterprises.

Application of Cloud Technologies in the Manufacturing Sector. The concept of Cloud Manufacturing (CM) involves the distribution of resources and production capabilities over the Internet and their provision as a service. This concept, unlike traditional manufacturing systems, offers a scalable, shared and service-oriented production model. The Cloud Manufacturing concept allows enterprises to manage production processes in a more flexible and optimized manner. As an integral part of this model, it emphasizes materials, equipment and production processes managed over cloud platforms.

One of the most important examples of the application of cloud technologies in the field of production is smart factories (Smart Factories). In these factories, equipment equipped with sensors collect data via IoT (Internet of Things), and this data is transmitted to the cloud environment and processed. For example, the technical condition of the equipment is monitored in real time, possible failures are identified in advance, and thus sustainable production is ensured. Cloud and IoT integration expands production automation and remote control capabilities.

For Small and Medium Enterprises (SMEs), cloud technologies play a particularly important role. Since these enterprises usually do not have high-tech infrastructure and large investments, cloud-based services allow them to use technological resources at low cost. These include SaaS (Software as a Service), PaaS (Platform as a Service) and IaaS (Infrastructure as a Service) models that enable SMEs to be more competitive and implement innovations more quickly (AWS for Manufacturing. n.d.; Buyya, Vecchiola, Selvi, 2013).

In addition, technologies such as artificial intelligence (AI) and big data are also integrated into cloud platforms, making production processes more intelligent and predictable. For example, analyzing large amounts of data collected in the production area on the cloud strengthens the decision-making mechanisms of enterprises, increases inventory management and flexibility in the supply chain. In addition, while the integration process in enterprises is traditionally carried out on local servers, in cloud-based systems this process can be carried out in an automated and more flexible format with the support of artificial intelligence (Mell, Grance, 2011). As a result, the application of cloud technologies to the manufacturing sector contributes to both increasing productivity and accelerating digital transformation.

Prospects and Future Development Directions of Cloud Technologies. In terms of integration trends, the synthesis of edge computing and cloud technologies is rapidly becoming relevant. Edge computing provides processing of data locally (at the point of production), without transferring it to central servers. We can explain this in a simple way by the fact that recently both on-site (i.e., in the factory itself) and over the Internet have been used together. The so-called “edge computing” method allows processing data on the spot, without sending it to remote servers. This, in turn, speeds up decision-making in real time and minimizes the response time of systems. In the future, the parallel application of edge and cloud systems will create “hybrid models” that will strengthen both data flow control and data security.

Cloud technologies also lead to the formation of new business models. Experts in this field note that “smart products” and service-based models (product-as-a-service) allow manufacturers to not only produce products, but also offer additional services (predictive maintenance, operational analysis, etc.). These changes provide a more personalized approach to the customer and sustainable revenue models (Armbrust, 2010). Cloud-based technologies also create serious opportunities in the direction of automation and personalized production (mass customization). Artificial intelligence and big data analysis are processed on cloud platforms, enabling enterprises to produce products according to individual customer requirements. In terms of research and innovation directions, cloud security and open platform integration are considered priority areas. The risks associated with storing data in the cloud, including leakage, privacy violations and legal regulation issues, have become the

main focus of future research. At the same time, work continues on standardized APIs and open systems so that different production platforms can operate efficiently and in a unified cloud environment. The future development of cloud technologies in the field of production opens up new opportunities not only technologically, but also strategically and organizationally. This transformation requires enterprises to be open to innovation and adaptive to technological changes.

Conclusion

In conclusion, the application of cloud technologies in the manufacturing sector allows enterprises to operate more flexibly, economically and digitally. Through these technologies, enterprises can benefit from real-time data processing, process automation and scalable services. However, special attention should be paid to issues such as security, legal frameworks and personnel training during integration. In the future, further integration of cloud technologies with artificial intelligence and edge computing will enable faster data processing and immediate decision-making.

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