Integration of automated information systems and architectural solutions in industrial enterprises

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Abstract. The global aluminum industry faces challenges like price fluctuations and environmental regulations. To overcome these, it must adopt Automated Information Systems (AIS) to streamline data handling and improve decision-making. However, AIS implementation requires system integration, workforce training, and robust security measures. In summary, AIS adoption is crucial for the aluminum industry's efficiency and sustainability in a changing global landscape.

1 Introduction

The aluminum industry is a key segment of the global economy, providing raw materials and semi-finished products to a wide range of industries, from aviation and automotive manufacturing to packaging production and construction. Since the late 19th century, when the electrolysis method was discovered, aluminum has become a fundamental material for many industries. However, like many other sectors, the aluminum industry faces challenges such as increased competition, strict environmental standards, and the need for production optimization.

Today, with the growth in global demand for aluminum, the industry faces new issues, such as raw material price instability, tightening environmental requirements, and the need to improve energy efficiency. For example, raw material price instability leads to difficulties in predicting market trends and optimizing production plans. However, manual management and monitoring of production processes limit companies' ability to adapt to rapidly changing market conditions.

To address these problems, the aluminum industry must actively adopt the latest technologies and automated management systems that provide precise monitoring and optimization of production processes [1]. The application of automation and modern information technologies can improve demand forecasting, reduce costs, and make production more adaptable and flexible in the face of a changing market.

An Automated Information System (AIS) is a complex of software and hardware designed for collecting, storing, processing, and transmitting information within an
organization. It contributes to reducing manual labor, minimizing the risk of human errors, and increasing the productivity and quality of decision-making.

In this context, the implementation of Automated Information Systems (AIS) is not only an opportunity but also an urgent necessity. AIS provides centralized and automated monitoring, management, and real-time data analysis. They help reduce energy consumption costs, optimize raw material usage, and minimize production losses. Thanks to modern technology and analytics, AIS can predict potential problems and offer effective solutions.

The implementation of AIS (Automated Information Systems) is an important and strategically significant initiative that requires close collaboration among all stakeholders and deep technical knowledge. This process covers many aspects of modern business, including finance, resource management, logistics, marketing, as well as various aspects of production and management. Effective AIS implementation enhances the efficiency of the enterprise, makes it more competitive, and aligns it with modern environmental standards.

The implementation of AIS in the aluminum industry is undoubtedly a strategically important step in ensuring more efficient and competitive operations. However, it also comes with a range of serious challenges that may hinder the successful adoption of the technology.

One major issue is the integration of the existing systems with the new one. The compatibility of the different software and hardware used in the production chain must be considered [2, 3]. Additionally, the system must be able to handle large amounts of data in real-time, ensuring accuracy and reliability.

Another challenge is the training of personnel to use the new system [4, 5]. The workforce must be trained to understand the new technology and how to use it effectively. This is particularly important as the system will be used to monitor and control critical production processes.

Finally, there is the issue of security. The system must be designed with robust security features to protect sensitive data and prevent unauthorized access. This is especially important in an industry where intellectual property is a valuable asset and theft can have severe consequences.

In conclusion, the implementation of an automated information system in the aluminum industry is a complex process that requires careful planning, integration, training, and security measures [6]. Despite the challenges, the benefits of such a system are significant, including increased efficiency, accuracy, and competitiveness.

2 Organizational phase

The implementation of an automated information system for the aluminum industry can provide significant benefits in terms of efficiency, productivity, and competitiveness. However, it is important to follow a structured approach, which includes requirements analysis, business process identification, architecture design, application development, database creation, functionality testing, module integration, system installation, monitoring and analysis, as well as ongoing updates and improvements.

The first stage in implementing an automated information system for the aluminum industry is organization requirements analysis. This analysis involves identifying key business processes and developing ways to automate them to enhance efficiency and productivity. It is also important to consider the organization’s specific needs during the analysis process, including compliance with regulatory requirements and data security.

Following the requirements analysis, the next step is to identify the business processes that need automation. It is crucial to identify various tasks and actions performed manually and plan for their automation through the new system. To ensure precise implementation in the new system, it is also essential to thoroughly document the business processes.
Architecture design is a critical step in the implementation of an automated information system for the aluminum industry. The architecture should be designed considering the organization's specific needs, including scalability, reliability, and security [6]. The design should also take into account various system components, such as hardware, software, and network infrastructure [7].

Application development involves creating software that will automate the identified business processes. The application should be designed to be user-friendly and intuitive, with clear instructions and prompts to assist users through each stage of the process. The application should also be flexible, allowing for changes and updates as needed.

Creating a database is another important step in implementing an automated information system. The database should be designed to store all relevant data related to the automated business processes. It should also be designed to be scalable, allowing for the addition of new data as needed [9].

After developing the application and database, it is crucial to test their functionality to ensure they meet the organization's requirements. Testing should be conducted in a controlled environment with a focus on identifying any system errors [10]. User acceptance testing should also be included to ensure that the system is intuitive and easy to use.

Module integration involves combining all the different components of the system into a unified whole. This includes integrating the application with the database, as well as any other modules or systems used by the organization. Integration should be carried out in a controlled environment to ensure it does not disrupt current operations.

Once all components are integrated, it's time to install the system. Installation should be performed by qualified professionals with experience working with similar systems. Installation should also occur in a controlled environment to avoid disruption to current operations.

After installation, it is essential to monitor and analyze the system's performance to ensure it meets the organization's requirements. Monitoring should include regular performance checks and user feedback, with a focus on identifying areas where improvements can be made to further optimize operations and enhance productivity [11].

Finally, it is crucial to continually update and improve the system to ensure it remains current and effective over time. This includes updating software components and making changes to business processes as needed. Continuous improvement should be an ongoing process involving all stakeholders in the organization. All processes and steps can be viewed in Figure 1.

![Fig. 1. Processes and phases of information system implementation](image-url)
2.1 Concept

The model for the life cycle of an automated information system developed for the aluminum industry is a critical component in ensuring the successful implementation and operation of the system [12]. This model encompasses various stages that are essential for the development, deployment, and maintenance of the system, while also considering the specific requirements and challenges of the aluminum industry.

The first stage in the life cycle model is the requirements gathering phase [13]. This involves identifying and documenting the specific needs and objectives of the automated information system within the context of the aluminum industry. This includes understanding the various processes and operations involved in the industry, as well as the key stakeholders and their requirements.

Once the requirements have been gathered, the next stage is the system design phase. This involves creating a detailed design that outlines the structure, functionality, and interfaces of the automated information system [14]. The design should take into account the unique characteristics of the aluminum industry, such as the need for data integration with other systems, real-time monitoring capabilities, and compliance with industry standards and regulations.

After the system design has been finalized, the development phase begins. This involves coding and programming the various components of the automated information system, as well as integrating it with existing systems and databases. The development process should follow industry best practices and standards to ensure the quality and reliability of the system.

Once the system has been developed, it undergoes a rigorous testing phase. This involves conducting various tests to validate the functionality, performance, and reliability of the system. Testing should include both functional testing, which ensures that the system meets the specified requirements, as well as non-functional testing, which evaluates factors such as security, scalability, and usability [15].

After successful testing, the system is ready for deployment. This involves installing and configuring the system in the production environment, as well as training end-users on how to use and maintain the system. Deployment should be carefully planned and executed to minimize disruption to ongoing operations in the aluminum industry.

Once the system is deployed, it enters the maintenance phase. This phase involves monitoring the system's performance, addressing any issues or bugs that arise, and making necessary updates and enhancements to ensure its continued effectiveness. Maintenance activities should be carried out in accordance with industry best practices to maximize system uptime and minimize downtime.

Throughout the entire life cycle of the automated information system, it is important to have a robust project management framework in place. This includes defining clear project objectives, establishing a timeline and budget, assigning roles and responsibilities, and regularly monitoring and reviewing progress. Effective project management is crucial for ensuring that the system is delivered on time, within budget, and meets the needs of the aluminum industry [16, 17].

2.2 Hardware architecture

The aluminum industry is a complex and highly specialized sector that requires sophisticated and efficient automated information systems to ensure seamless operations. The hardware architecture of such systems plays a crucial role in meeting the industry's unique needs [18].

The hardware architecture of an automated information system for the aluminum industry consists of several key components, including servers, data storage devices, network infrastructure, and client devices.
Servers, which form the backbone of the automated information system, must be high-performance machines capable of processing large volumes of real-time data. They are responsible for data storage, data processing, running applications, and managing user access. Servers in the aluminum industry are typically configured as clusters to ensure high availability and reliability. They must be equipped with high-speed processors, large memory capacities, and fast data storage devices. Additionally, their design should include redundancy to guarantee system reliability even in the event of hardware failures. Servers are also equipped with backup power sources and cooling systems to ensure uninterrupted operation.

In addition to servers, the architecture must include network infrastructure capable of handling the substantial data traffic generated by the system. This includes high-speed switches, routers, and other network equipment that can provide high bandwidth for applications used in the aluminum industry.

Furthermore, the network infrastructure must be designed with high reliability and security in mind. It's important to use redundant network connections to ensure uninterrupted system operation in case of failures. Implementing firewalls and intrusion detection systems is also crucial to protect data and the network from threats. This helps create a modern and reliable network infrastructure capable of efficiently supporting automated processes in the aluminum industry while maintaining system performance.

The architecture should be designed with scalability in mind, allowing for easy addition of additional servers and network equipment as the needs of the aluminum industry grow. This provides flexibility and the ability to expand the system in line with evolving requirements.

Memory storage devices, in turn, must be highly scalable and fault-tolerant, considering the large volumes of data generated in the industry daily [19]. They should also have backup and recovery mechanisms in place to ensure data protection. This comprehensive approach to architecture and storage devices will provide a reliable and scalable infrastructure for the aluminum industry, capable of effectively handling data processing and storage needs [20].

Finally, client devices are used by users to access the automated information system. In the aluminum industry, client devices can include desktop computers, laptops, tablets, and mobile devices. These devices should be configured to provide secure access to the system and offer a user-friendly interface. Client devices can also be equipped with specialized software for data analysis and visualization. You can view the hardware architecture of this system in Figure 2.

![AIS hardware architecture](image)
3 Technical implementation

Given the complexity of the structure and numerous industry branches located in different cities, the implementation strategy must be carefully planned to minimize costs while ensuring maximum efficiency.

The recommended implementation strategy is a phased approach. This approach involves the gradual implementation of the system, starting with the most critical areas and gradually expanding to other areas. In the initial stage, the focus should be on the head office, followed by the largest branches, and then gradually moving on to smaller branches [21].

To successfully launch the initial stage of the process, it is necessary to meticulously and comprehensively go through a thorough equipment inspection phase to identify potential issues and incompatibilities [22]. This stage is critically important as it helps prevent future problems and failures while optimizing the overall system performance [23].

Conducting this inspection involves analyzing the technical condition of each piece of equipment, identifying potential risks, and detecting possible conflicts in the operation of various components.

After completing the inspection, a plan of action should be developed to address the identified issues and ensure compatibility among all system elements [24].

Once all technical equipment issues are resolved, the next step is the installation and configuration of servers and infrastructure. Initially, we install operating systems on the servers and then proceed with the installation and configuration of server applications such as web servers, databases, mail servers, and other necessary software for the proper functioning of the infrastructure.

Afterward, it is essential to secure the system against threats and breaches. Configuring firewalls, installing antivirus software, setting up monitoring systems, and regularly updating are crucial aspects of ensuring server security.

Then, we move on to network configuration, including IP address configuration, router installation, creating virtual networks, and, if necessary, load balancing configuration.

One key aspect of implementation is integrating the new system with the existing one [25]. This can be a challenging task, but it is critical for ensuring the organization's seamless operation. Attention should be paid to data compatibility, network settings, and access to ensure everything functions harmoniously.

The phased approach has several advantages. Firstly, it allows for gradual implementation that can be easily managed and controlled, reducing the risk of system failure due to inadequate planning or implementation. Secondly, it enables the company to prioritize its resources, focusing on critical areas first to ensure that the most important processes are automated initially. Thirdly, it allows the company to test and evaluate the system's effectiveness in real-time, making adjustments as needed.

The main drawback of the phased approach is that its full implementation may take more time. This can result in a longer period before the company fully realizes the benefits of automation. Additionally, it may be more challenging to maintain consistency across all branches if automation is implemented gradually [26].

In conclusion, it should be emphasized that the choice of an implementation strategy for automated systems within an organization is a pivotal moment that requires careful consideration.

Ultimately, the successful implementation of automation requires a skillful balance between speed and reliability. Companies must thoroughly assess their needs, resources, and readiness for change in order to select the best implementation strategy that will enable them to achieve maximum efficiency and long-term sustainability.
4 Conclusion

The implementation of an automated information system in the aluminum industry has been a topic of great interest and importance. This work has delved into the various processes and stages involved in the integration of a ready-made application, as well as the model of its life cycle and the hardware architecture of the application [27].

The application of an automated information system in the aluminum industry has proven to be a game-changer. It has streamlined processes and increased efficiency, resulting in a significant reduction in production costs. The integration of such a system requires careful planning and execution to ensure its success [27].

The first step in the implementation of an automated information system is the identification of the specific needs of the aluminum industry. This involves assessing the current processes and identifying areas that require improvement. Once these needs have been identified, the next step is to select a suitable application that meets these requirements [28].

The integration process involves several stages, including installation, configuration, testing, and deployment. Each stage requires careful attention to detail to ensure that the application functions as expected. The testing phase is particularly crucial, as it allows for the identification and resolution of any issues before the application goes live [29].

The life cycle model of the automated information system plays a crucial role in its successful implementation. The model outlines the various stages involved in the development, deployment, and maintenance of the application. It provides a framework for managing the application's life cycle, ensuring that it remains relevant and useful over time [27].

The hardware architecture of the application is another critical factor that must be considered during its implementation. The hardware must be capable of supporting the application's requirements, including its processing power, storage capacity, and network connectivity [30].

In conclusion, the implementation of an automated information system in the aluminum industry is a complex process that requires careful planning and execution. However, the benefits of such a system are significant and can result in increased efficiency and reduced production costs. By following a structured approach to implementation, organizations can successfully integrate these systems into their operations and reap their rewards.

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