ОБЩЕСТВЕНИ КОМУНИКАЦИИ И ИНФОРМАЦИОННИ НАУКИ
PUBLIC COMMUNICATIONS AND INFORMATION SCIENCES

TOOL AND PROCESS IN INFORMATION MANAGEMENT IN THE INDUSTRIAL CONTEXT

Maximilian Renke
University of Library Studies and Information Technologies
https://doi.org/10.70300/ZNRR4086

Abstract: *This paper examines the interplay between technological tools, such as Internet of Things (IoT) devices and Enterprise Resource Planning (ERP) systems, and structured processes in optimizing information management within industrial contexts. It argues that while these tools enable real-time data collection, analysis, and automation, their efficacy is amplified when integrated within defined processes that ensure data consistency, security, and regulatory compliance. By reviewing existing literature, this study identifies the comparative roles, benefits, and limitations of ICT tools and structured workflows, providing insights into how these components collectively enhance operational efficiency, data integrity, and decision-making capabilities in industrial settings.*

Through a systematic literature review, the paper identifies best practices and highlights recurring challenges in ICT tool integration, such as high implementation costs, training requirements, and compatibility with existing workflows. The findings underscore that a balanced approach, where tools operate within standardized processes, is essential for effective information management in the industrial context. This alignment supports predictive maintenance, resource optimization, and overall adaptability, enabling organizations to meet Industry 4.0 goals and respond to dynamic market demands.
Keywords: *Information Management, ICT, IoT, ERP, Industry 4.0*

INTRODUCTION

Concerning Information Management in the industrial context, tools and processes are essential components that drive operational efficiency, data consistency, and informed decision-making. Tools in this context refer to systems Enterprise Resource Planning (ERP) platforms and applications such as like the Internet of Things (IoT), which facilitate real-time data collection, analysis, and automation within industrial workflows (Ahmetoglu, Che Cob & Ali, 2023). These tools allow organizations to capture, store, and manipulate data to optimize resource allocation, monitor production, and predict maintenance needs, making them invaluable for data-driven operations (Xu, He & Li, 2014). However, while these tools provide the technological means for efficient data handling, they require defined processes to be effective.

Processes from Information Management in the industrial context encompass the structured workflows, protocols, and standards that govern how data is entered, stored, shared, and used within an organization. They ensure that data management practices are consistent, compliant, and secure, forming a framework that enables reliable information flow across departments and external partners. Processes thus act as the organizational backbone, ensuring that tools operate in a standardized and legally compliant environment that aligns with organizational goals. Without such structured processes, even the most advanced tools may lead to inconsistent data handling and inefficiencies, potentially compromising data integrity and regulatory compliance (Abramovici & Filos 2011).

This paper explores the interplay between tools and processes, asking the guiding question: How can a balanced integration of tools and processes optimize information management in industrial contexts? By examining the comparative roles, benefits, and limitations of tools like IoT and ERP systems

and the structured processes that govern them, this study seeks to provide practical insights for industrial managers. Through a systematic review of existing literature, it will highlight best practices for achieving efficiency, compliance, and adaptability in managing industrial data.

RESEARCH METHODOLOGY

The research methodology for this paper follows a systematic literature review approach, focusing on evaluating and synthesizing existing academic research and industry reports relevant to ICT integration within industrial processes. A systematic literature review enables a structured analysis of secondary sources, allowing for a detailed understanding of how technologies such as IoT and ERP impact industrial efficiency, adaptability, and data management. This method involves collecting, assessing, and synthesizing findings from reputable sources to create an overview of current knowledge, identifying trends, gaps, and established practices in industrial information management.

By examining multiple studies and industry reports, this methodology provides an understanding of the field of ICT integration in the industrial context, drawing insights from diverse perspectives and contexts. This approach is particularly valuable for identifying recurring patterns and challenges, such as high implementation costs, training needs, and data governance issues, which are critical for understanding both the strengths and limitations of ICT integration. The systematic nature of this review ensures that findings are not based on isolated studies but are representative of broader, validated trends across the industry, supporting the results presented in this study on the integration of ICT tools and processes.

RESULTS

In the following, the integration of ICT tools like IoT and ERP within structured industrial processes is explored, highlighting their role in enhancing efficiency, decision-making, and adaptability. When aligned with defined workflows, such tools provide real-time data access across areas such as asset management and predictive maintenance, enabling proactive and data-driven decisions.

While ICT integration offers significant operational benefits, the results also address challenges such as high initial costs, training demands, and compatibility with existing workflows. These barriers can affect technology adoption and necessitate careful planning. By examining both the strengths and obstacles of ICT and ERP integration, this chapter provides a comprehensive view of how structured processes and advanced tools support efficiency and adaptability in the industrial sector.

INTEGRATION OF TOOLS INTO PROCESSES

In industrial information management, integrating tools such as IoT and ERP within structured processes is essential for enhancing operational effectiveness. Research shows that when IoT systems are linked with ERP platforms, they provide real-time data across operations, allowing managers to make proactive, data-driven decisions that optimize resources and reduce downtime (Ahmetoglu, Che Cob & Ali 2023). This connection enhances visibility in areas such as asset management and predictive maintenance, which are crucial for streamlined operations in manufacturing contexts (Wijesinghe, Nanayakkara, Pathirana, Wickramarachchi & Fernando 2024).

Despite the advantages of these tools, research also emphasizes the necessity of defined processes to manage the large volumes of data generated by IoT. Structured processes within ERP frameworks help ensure data privacy and security, establishing protocols that manage data transmission and storage effectively. This structure minimizes risks related to potential data breaches or inconsistencies, ensuring that data is handled securely and consistently across various departments (Ahmetoglu, Che Cob & Ali 2023).

Moreover, aligning IoT and ERP tools with structured processes supports Industry 4.0 goals, allowing organizations to benefit from predictive analytics and automation. By embedding IoT data within ERP workflows, organizations can improve productivity, lower costs, and increase flexibility, all of which are critical in today's competitive industrial landscape. This alignment positions organizations to respond to operational demands while maintaining efficiency (Wijesinghe, Nanayakkara, Pathirana, Wickramarachchi & Fernando 2024).

Research highlights that integrating IoT with ERP systems enhances efficiency in industrial settings

by enabling real-time data collection from equipment and processes, thereby supporting faster and more informed decision-making. This real-time visibility allows companies to adjust operations dynamically in response to live data, optimizing resources and reducing downtime, which is particularly critical in manufacturing environments (Wijesinghe, Nanayakkara, Pathirana, Wickramarachchi & Fernando 2024). Without defined workflows to structure the use of this data, however, inconsistencies may arise, reducing the effectiveness of the insights generated and potentially causing operational delays (Janiesch et al. 2020).

Structured processes also establish crucial data governance protocols, addressing security and compliance needs in handling the extensive information generated by IoT devices. Defined procedures help manage data privacy risks, ensure regulatory compliance, and maintain the consistency and reliability of the information, which strengthens the foundation for effective information management (Wijesinghe, Nanayakkara, Pathirana, Wickramarachchi & Fernando 2024). When structured processes are absent, there is a higher likelihood of data inaccuracies, potentially leading to misinformed decisions that can disrupt production workflows (Janiesch et al. 2020).

Finally, clear processes enable the scalability of IoT in combination with ERP systems, allowing organizations to expand their benefits as they grow. For example, structured workflows within ERP systems can automate responses to data from IoT sensors, such as triggering maintenance schedules when equipment data indicates a potential issue. This capability not only reduces manual intervention but also enables predictive maintenance, supporting long-term operational sustainability and helping organizations adapt to future demands (Wijesinghe, Nanayakkara, Pathirana, Wickramarachchi & Fernando 2024).

INCREASING EFFICIENCY AND COMPLIANCE

Integrating Information and Communication Technology (ICT) and ERP systems into industrial operations has been shown to significantly enhance efficiency by automating data flows and providing real-time data access. This integration streamlines processes such as inventory management, order processing, and production scheduling, reducing manual intervention and minimizing errors. For instance, Ahmetoglu et al. (2023) demonstrated that IoT-enabled ERP systems facilitate seamless data exchange between machinery and management systems, leading to optimized resource utilization and improved operational efficiency (Ahmetoglu, Che Cob & Ali 2023).

The automation provided by ICT and ERP systems also plays a crucial role in decision-making by reducing lead times. Real-time data access allows managers to monitor production processes continuously and identify bottlenecks or inefficiencies promptly. This capability enables swift corrective actions, minimizing downtime and enhancing overall productivity. Real-time monitoring through integrated ERP systems allows for immediate adjustments in production schedules, aligning output with demand fluctuations and reducing the risk of overproduction or stockouts (Wijesinghe, Nanayakkara, Pathirana, Wickramarachchi & Fernando 2024).

Moreover, the adaptability of ICT and ERP systems supports rapid adjustments to changes in production needs. In dynamic industrial environments, the ability to respond quickly to market demands or supply chain disruptions is vital. Integrated systems provide the flexibility to modify production plans, reallocate resources, and adjust workflows efficiently. Janiesch et al. (2020) emphasized that the integration of IoT data into ERP systems enhances the responsiveness of manufacturing processes, enabling companies to maintain competitiveness in volatile markets (Janiesch et al. 2020).

Structured processes are essential for information management in the industrial context, as they ensure consistent data utilization across operations and provide a framework for information handling. By implementing standardized procedures for data entry, processing, and retrieval, organizations can reduce the likelihood of errors and discrepancies, enhancing data integrity and reliability. This consistency is crucial for reporting and informed decision-making, as it ensures that all stakeholders have access to coherent information (Davenport & Prusak 1998).

In supply chain contexts, ICT tools enhance operational flexibility by enabling real-time data sharing and communication among partners; however, structured processes are fundamental for ensuring data privacy and accuracy. Standardized procedures govern how data is collected, stored, and shared, prevent-

ing unauthorized access and reducing data breaches. These processes incorporate validation checks that ensure shared data is accurate and up to date, which is essential for coordinated activities such as inventory management and order fulfillment (Christopher & Lee 2004). A report by the European Union Agency for Cybersecurity emphasizes that robust processes in ICT supply chains are critical for maintaining data integrity, thereby fostering trust among partners (enisia 2015).

Furthermore, adherence to standardized processes supports compliance with regulatory requirements related to data handling and privacy. Many industries are subject to regulations mandating specific practices to protect sensitive information, and standardized processes help organizations meet these legal obligations, reducing the risk of penalties and reputational damage. Structured processes provide traceability, making audits and compliance checks more straightforward and allowing organizations to demonstrate adherence to both industry and legal requirements. Additionally, standardized processes improve information quality by promoting data accuracy and consistency, which is key to regulatory compliance. These processes reduce risks related to data privacy and allow organizations to maintain a high level of accountability, further supporting compliance efforts (Kahn, Strong & Wang 2002). For example, the National Institute of Standards and Technology (NIST, 2015) highlights that process-driven approaches in ICT supply chains enhance security and ensure compliance with regulatory standards (Boyens, Paulsen, Feldman & Witte 2015).

ENHANCING INDUSTRIAL ADAPTABILITY

The integration of ICT tools, such as IoT and ERP systems, significantly enhances adaptability in industrial operations by facilitating real-time data collection and analysis. Xu, He, and Li (2014) describe how IoT applications in industrial environments enable continuous monitoring of equipment and production processes, allowing organizations to respond swiftly to changes in market demand or operational disruptions. This capability is particularly valuable in supply chains, where real-time insights support more agile decision-making, ensuring that operations remain aligned with changing conditions (Xu, He & Li 2014).

However, the effectiveness of ICT tools is greatly enhanced when they are embedded within a structured process framework. Streltsova et al. (2019) argue that standardized processes are essential for data integrity, as they provide consistent protocols for data collection, storage, and retrieval. These processes reduce the risk of data discrepancies and errors, creating a reliable foundation for information management within industrial enterprises. By following a standardized approach to data handling, organizations can leverage ICT tools more effectively, ensuring that the insights gained from real-time data collection translate into coherent and actionable decisions (Streltsova, Borodin, Yakovenko & Sokira 2019).

Standardized processes also facilitate the deployment of ICT tools across various industrial sectors by aligning these technologies with specific operational requirements and regulatory standards. Abramovici and Filos (2011) highlight the importance of standardized processes in integrating ICT tools such as Intelligent Manufacturing Systems, internationally, as these frameworks support consistency and compliance across different regions and sectors. This alignment with regulatory standards ensures quality control and reduces the likelihood of disruptions caused by inconsistent data handling practices, making ICT tools more adaptable and beneficial for global industrial applications (Abramovici & Filos 2011).

In supply chain management, the adaptability of IoT-based systems enables reconfiguration in response to changing demands. However, as Li and Liu (2019) explain, structured processes are essential for managing the extensive data flows generated by these tools, ensuring that information remains accurate and secure throughout the supply chain. Standardized processes in data handling provide a foundation for trust among supply chain partners, as they guarantee data accuracy, privacy, and compliance with regulatory standards. This structured approach supports efficient collaboration and enables organizations to capitalize on the flexibility offered by ICT tools in dynamic industrial environments (Li & Liu 2019).

INTEGRATION CHALLENGES OF ICT TOOLS

Integrating ICT tools into industrial settings introduces challenges, particularly related to costs, training, and compatibility. High initial investment costs can be prohibitive for organizations, especially in

competitive or cost-sensitive sectors, which may limit the adoption of technologies like IoT and ERP systems. Pilat (2004) emphasizes that while ICT has economic benefits, the financial demands associated with its implementation often require organizations to have robust financial strategies, deterring smaller organizations from full adoption due to limited resources. Additionally, the specialized nature of these technologies necessitates comprehensive training for employees, which adds further expense and time demands, creating a potential barrier to adoption (Pilat 2004).

Process compatibility is another notable challenge. Many industries have established workflows that are not designed to seamlessly integrate with modern ICT tools. Cresswell, Worth, and Sheikh (2011) discuss in a health care centered view, how adapting existing processes to accommodate new technology often requires extensive restructuring, which can disrupt established operational routines. This misalignment may result in partial utilization of the technology's capabilities, as existing processes may not support the advanced functionalities of ICT tools. Consequently, organizations might face inefficiencies or reduced technology benefits if significant process adjustments are not implemented to align with the new tools (Cresswell, Worth & Sheikh 2011).

Integrating ICT tools like IoT and ERP systems into supply chains enhances efficiency and responsiveness but introduces privacy and security challenges due to extensive data sharing across multiple platforms and organizations. While these technologies facilitate real-time data flow and operational improvements, they also create vulnerabilities, as data often between different entities, increasing the risk of unauthorized access and data breaches. Such breaches could compromise sensitive information and result in financial and reputational damage. To mitigate these risks, robust data governance frameworks that establish standardized security protocols across collaborative networks should be considered. These frameworks ensure that consistent security measures are applied across all supply chain partners, which is essential for maintaining data integrity and building trust among stakeholders (Barakat, Alam, Chowdhury & Miraz 2020).

To address these challenges, establishing standardized data governance processes is essential. Smith and Alexander (2022) argue that consistent data governance practices can significantly enhance data integrity, reduce inconsistencies, and ensure compliance with regulatory requirements. Standardized governance protocols provide organizations with structured guidelines for data handling, storage, and access, ensuring that ICT tools operate securely within collaborative networks. This standardization not only builds trust among partners but also facilitates efficient information flow, enhancing the effectiveness of ICT integration across industries (Smith & Alexander 2022).

FINDINGS AND DISCUSSION

In the following, the comparative roles of ICT tools, such as IoT and ERP systems, and structured processes in achieving effective information management within industrial contexts are explored. While both elements are essential, each offers distinct contributions that support different aspects of operational efficiency and data management. ICT tools enable real-time data collection, automation, and responsiveness, which are critical for enhancing productivity and facilitating data-driven decisions. However, as the findings reveal, the effectiveness of these tools is significantly enhanced when embedded within structured processes that ensure data consistency, security, and regulatory compliance. This comparison highlights the need for a balanced approach, where tools and processes work in harmony to optimize information management in industrial settings.

COMPARATIV FINDINGS

In comparing the effectiveness of tools, such as IoT and ERP systems, and structured processes in information management in the industrial context, the literature emphasizes the importance of both elements, each serving distinct but complementary roles. Tools like IoT and ERP systems enable real-time data collection, automate workflows, and facilitate quick responses, thereby enhancing operational efficiency and supporting data-driven decision-making. These technologies allow for capabilities such as asset management, predictive maintenance, and seamless communication across departments. However, their effectiveness is significantly amplified when they operate within structured, standardized processes.

Without defined workflows, tools may be underutilized or lead to inconsistent data handling, reducing their overall impact on operational efficiency and reliability.

The literature suggests that while tools provide substantial operational benefits, structured processes are often the foundational element for successful information management in industrial contexts. Processes provide a framework for consistent data handling, ensuring accuracy, security, and compliance with regulatory requirements. For instance, processes within ERP systems help manage data flows, address privacy concerns, and maintain data integrity across departments. This approach enables adaptability and scalability, supporting industry standards and regulatory compliance, which are essential in heavily regulated industrial environments. Thus, while tools enable real-time operations and automation, structured processes are the backbone of effective information management, allowing tools to achieve their full potential within a secure and coherent system.

IMPLICATIONS FOR INFORMATION MANAGEMENT IN THE INDUSTRIAL CONTEXT

The findings underscore the importance of a balanced approach for industrial managers looking to integrate ICT tools like IoT and ERP systems within structured processes. While these tools enable real-time data access, enhance decision-making, and improve operational efficiency, the results show that their effectiveness is significantly amplified when aligned with defined workflows. Managers can use these insights to recognize that, although advanced tools provide powerful capabilities, structured processes are essential for consistency, security, and scalability. By prioritizing both tools and processes, managers can ensure that real-time data from IoT systems can be securely transmitted and stored within ERP frameworks, minimizing risks related to data breaches and inconsistencies. This integrated approach allows industrial organizations to benefit fully from predictive maintenance, asset management, and resource optimization, as each process is grounded in reliable and secure information management practices.

To apply these findings effectively, managers should focus on best practices gleaned from the literature, which emphasize the need to establish structured processes that govern data handling, privacy, and compliance before fully implementing ICT tools. For example, standardized data governance protocols are critical for ensuring data accuracy, security, and regulatory adherence across departments. Additionally, investing in ongoing employee training ensures that staff can operate ICT tools within the set framework, enabling consistent data utilization and reducing the likelihood of errors. The results also highlight the importance of scalability, structured workflows within ERP systems can facilitate predictive maintenance and other automated responses, supporting long-term operational sustainability as the organization grows. By adopting a flexible, process-oriented approach to ICT integration, managers can create a resilient information management system that aligns with Industry 4.0 goals, adapts to dynamic market demands, and supports continuous operational improvement.

CONCLUSION

This paper has highlighted the comparative roles of ICT tools, such as IoT and ERP systems, and structured processes in achieving effective information management within industrial contexts. The findings reveal that while tools provide crucial capabilities for real-time data collection, automation, and responsiveness, their impact is enhanced when embedded within structured workflows. Structured processes ensure data consistency, security, and compliance, providing a reliable foundation that maximizes the effectiveness of these technologies. Ultimately, tools and processes serve distinct yet complementary functions; tools enhance operational efficiency and decision-making, while structured processes maintain data integrity, regulatory compliance, and scalability.

For industry practitioners, these insights emphasize the need for a balanced approach that integrates both tools and processes to optimize information management. To implement this balance effectively, managers are advised to establish standardized data governance protocols and ensure that ICT tools are aligned with regulatory requirements and organizational workflows. Additionally, continuous training for employees on data handling practices and ICT tool usage is essential for reducing errors and maintaining consistent data utilization across departments. Best practices from the literature suggest that setting up scalable workflows within ERP systems and regularly updating data governance protocols can support

predictive maintenance, resource optimization, and overall operational resilience.

In closing, the integration of both tools and structured processes is critical for building a robust and adaptive information management system within industrial settings. As the field continues to evolve, advancements in Industry 4.0 and data-driven technologies will likely create new opportunities and challenges for industrial information management. By fostering a balanced and adaptable approach, industrial organizations can ensure that they are equipped to leverage future technological developments, driving continuous improvement and maintaining a competitive edge.

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ИНСТРУМЕНТИ И ПРОЦЕСИ В УПРАВЛЕНИЕТО НА ИНФОРМАЦИЯТА В ИНДУСТРИАЛНИЯ КОНТЕКСТ

Резюме: *В статията се разглежда взаимодействието между технологичните инструменти, като например устройствата на интернет на нещата (IoT) и системите за планиране на ресурсите на предприятието (ERP), и структурираните процеси при оптимизиране на управлението на информацията в индустриален контекст. Твърди се, че макар тези инструменти да дават възможност за събиране, анализ и автоматизация на данни в реално време, тяхната ефикасност се засилва, когато са интегрирани в рамките на определени процеси, които осигуряват*

последователност, сигурност и съответствие с нормативните изисквания. Като прави преглед на съществуващата литература, настоящото изследване идентифицира сравнителните роли, ползите и ограниченията на ИКТ инструментите и структурираните работни процеси, предоставяйки информация за това как тези компоненти колективно повишават оперативната ефективност, целостта на данните и възможностите за вземане на решения в индустриални условия. Чрез систематичен преглед на литературата документът идентифицира най-добрите практики и подчертава повтарящите се предизвикателства при интегрирането на ИКТ инструменти, като например високите разходи за внедряване, изискванията за обучение и съвместимостта със съществуващите работни процеси. Това съгласуване подпомага прогнозната поддръжка, оптимизацията на ресурсите и цялостната адаптивност, което позволява на организациите да постигнат целите на Индустрия 4.0 и да отговорят на динамичните изисквания на пазара.
Ключови думи: *управление на информацията, ИКТ, IoT, ERP, Индустрия 4.0*

Максимилиан Ренке
Университет по библиотекознание и информационни технологии
E-mail: maximilian.renke@gmail.com