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Congratulation!

Edmond

Hajrizi, Rector of UBT and Chair of IC – BTI 2023

Content

Blockchain for Open Information Governance: A New Era of Data Sharing

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Abstract. A new era of open information governance and data sharing has been launched by blockchain technology. Its decentralized and immutable ledger transforms information management. This paper explores the transformative potential of blockchain in transforming the way information is governed, accessed, and shared in both the public and private sectors. Blockchain's decentralized and im-mutable ledger provides a secure and transparent platform for data management and exchange, eliminating the need for intermediaries and significantly reducing the risk of data tampering, thus enhancing data integrity. With the help of this advanced technology, people and businesses can better manage their data while maintaining security and privacy. The paper explores current blockchain use cases in various sectors, including healthcare, finance, education, and supply chain management. It highlights the advantages of using blockchain technology, including increased stakeholder trust, less administrative paperwork, and improved information traceability. The study also discusses and acknowledges the challenges and considerations that need to be considered while deploying block-chains for open information governance. Scalability issues, legal frameworks, and interoperability standards are a few of these. In conclusion, this paper outlines how blockchain technology is transforming information governance by promoting openness, reliability, accessibility, and transparency. Blockchain is a paradigm shift in data management and sharing that enables a more transparent and collaborative environment for the exchange of information across industries.

Keywords: Blockchain, Open Data, Open Information, Data Sharing, Immutable Ledger.

Introduction

The rapid advancement of blockchain technology in recent years has led to a new phase in the field of open information governance and data sharing. This innovative technology has the potential to significantly alter the way we store, access, and share information across a wide range of businesses and multiple industries. It is characterized by its decentralized and immutable ledger system. Blockchain could enhance and alter the current methods of data management by enhancing security, transparency, and data integrity, while also reducing the need for intermediaries. The integration of blockchain and information governance is a significant step that has the potential to enhance data security, foster stakeholder confidence, and simplify administrative procedures. Governments and businesses worldwide acknowledge the potential of blockchain technology for boosting business efficiency and creating new market opportunities [1]. However, it's essential to recognize that harnessing these advantages will inevitably come with challenges. The classification of governance challenges is based on a structured framework that encompasses diverse levels, including infrastructure, application, institution, country, as well as distinct phases [2]. This paper explores the potential of blockchain technology within the context of information governance. The pragmatic use of blockchain technology in multiple sectors [3], including supply chain management [4], healthcare, banking, finance [5] [6], voting [7] and education [8], will be examined. This examination aims to clarify the impact of this innovative technology on the implementation of data governance practices. The analysis will examine numerous advantages associated with the adoption of blockchain technology, demonstrating its capacity to facilitate the establishment of a more efficient, accountable, and responsive operational environment. The ability of blockchain technology to enhance stakeholder confidence is one of its key benefits. As stated in the paper [9], Blockchain technology establishes trust in blockchain-based systems through rules derived from mathematical principles and cryptographic protocols. The immutability of records and the decentralized structure of the blockchain provide more confidence in the information being accessed. Stakeholders, whether they are individuals, businesses, or institutions, can interact and access data with greater confidence knowing that it has not been compromised and has not taken any unlawful actions. This newly discovered trust permeates all transactions and transactions conducted within the blockchain network, promoting a more secure and secure information governance structure. The adoption of blockchain technology also results in significant administrative cost reduction [10]. Blockchain reduces the need for extensive documentation and manual inquiries by reducing the role of intermediaries and automating operations. This is not only reducing the number of transactions, but also reducing

the administrative burden that comes with it. Therefore, businesses can allocate resources more effectively, shifting resources away from time-consuming administrative activities and towards innovation and growth. Additionally, blockchain technology also enhances information traceability. The immutable ledger that records all transactions and interactions within the blockchain network can be easily tracked. In situations where data origin and history are prioritized, such as supply chain management, enhancing traceability is essential. It provides accurate and transparent information on product origin and pathways. However, the numerous difficulties that arise with implementing and using blockchain technology must be acknowledged, even though its apparent advantages are apparent. Scaling presents a significant challenge, particularly as blockchain networks increase and increase the number of transactions [11]. Scalability is a crucial issue when blockchain networks expand their capabilities. It is a constant challenge to ensure that the blockchain network can handle the demand without compromising efficiency and security, and innovative approaches are essential. Additionally, it is essential to develop strong legal frameworks and modify regulations and regulations to examine the unique characteristics of blockchain technology. This involves addressing concerns regarding data privacy, accountability, and the legality of smart contracts. A legal framework that balances innovation and protection is a challenging task that requires careful consideration. The importance of developing interoperability standards is also considerable. Blockchain must be integrated effectively with existing systems and networks to achieve its full potential in open information governance. Collaboration between standardization organizations and stakeholders is essential for the multidimensional task of establishing interoperability standards. By promoting openness, reliability, accessibility, and transparency across industries, blockchain technology is an essential tool for transforming information governance. Due to its potential to transform data sharing and management, it can result in a more open and collaborative environment. This promotes the smooth exchange of information, particularly in an era where open data governance is the norm.

State of the Art in Blockchain Technology and Open information

Blockchain technology has emerged as a transformative force, transforming various industries by offering decentralized, secure, and transparent systems for data management and exchange. This section aims to provide a comprehensive overview of the current state of blockchain technology and its connection with open information.

Blockchain Technology

Blockchain is the most promising technology for the future generation of interaction systems and has garnered widespread attention from numerous industry sectors as well as the academic community. It has been acknowledged by scholars and practitioners alike that it could transform existing business models and economic structures [12]. Blockchain is a distributed ledger technology that enables secure and transparent record-keeping across a network of computers. It utilizes cryptographic techniques to ensure data integrity, immutability, and consensus mechanisms that enable reliable transactions. Blockchain refers to digital information (blocks) kept in databases (chains); thus, it is somewhat like a chain of blocks, but not in the sense that these terms are typically used [13]. Block is a group or collection of data or records recorded in a ledger within a specific period. Chain refers to a database of these blocks, which is maintained as a list that is accessible to all participants or members. Alternatively, it is a hash that links one block to another, cryptographically intertwining them to establish mathematical trust between them. Figure 1 illustrates the concept of blockchain in a figurative manner, illustrating data in each block of the chain.

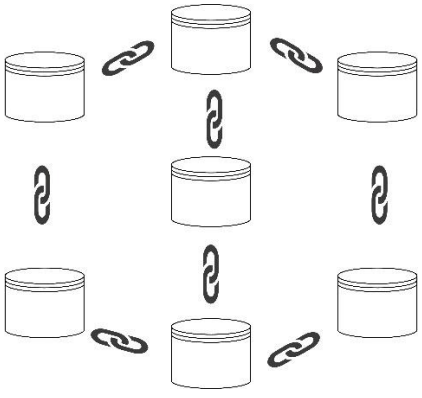

Fig. 1. A figurative representation of the blockchain concept.

Blockchain is a decentralized framework for executing data transactions, indicating the necessity for a trusted intermediary to authenticate these transactions. In contrast, blockchain

constitutes a distributed technology or database shared among participants, primarily utilized to log electronic transactions. Owing to the distributed architecture of blockchain, the potential for an individual, device, or entity to compromise the entire ledger of all participants is exceedingly improbable, thereby establishing heightened security measures against cyber-attacks [14]. The initial blockchain-based system was created in 2008 by a collective entity known as Satoshi Nakamoto [15], with its initial application being the implementation of Bitcoin. In essence, blockchain operates as an open-source distributed ledger or data system, where an updated version of records remains accessible to all involved entities. Additionally, each node within the system has a comprehensive record of all transactions ever recorded on the blockchain. Cryptographically linking or chaining blocks establishes a sequence of blocks. This process involves the creation and interlinking of blocks, wherein each block verifies the integrity of the preceding block in a sequential manner, extending back to the initial block, often referred to as the Genesis block [16]. The assurance of the block's integrity and the data encapsulated within it is achieved through digital signatures [17].

The current state of blockchain technology is a major step towards a more transparent, secure, and decentralized future. As technology continues to evolve, addressing scalability, regulatory, and interoperability challenges will be crucial in achieving its full potential for open information governance and beyond. In an environment where information stands as an asset and where data security and sharing are crucial, blockchain technology has significantly influenced the development of information governance.

Blockchain Technology for Open information Governance

Blockchain is a technology that is designed to securely store and verify transactions in a secure and tamper-proof manner, independent of central authorities. Blockchain Technology presents significant potential for transforming various institutions, both non-governmental and governmental alike, across several key domains. These domains encompass cryptocurrencies, electronic voting, the sharing economy, smart contracts, financial and healthcare services, tourism, logistics, and water sustainability [18]. In the realm of information governance, blockchain has a significant potential to alter the way data is stored, accessed, and shared. A series of studies and articles have examined this issue, encompassing the advantages and challenges of implementing blockchain in the field of information. Blockchain-based data sharing and distribution frameworks of digital assets have been proposed [19]. Many research efforts have emphasized that blockchain can enhance data security and integrity. One such endeavor involves the implementation of the Merkle tree-based auditing method, using the Merkle tree root to verify data integrity [20]. This significantly enhances computational efficiency and storage capabilities, indicating a significant improvement in data verification and preservation. Blockchain technology, as previously mentioned, utilizes applications not only in information exchange, but also across various sectors requiring secure data transfer. Certain industries possess a greater sensitivity to data privacy and confidentiality, thus necessitating a more careful and rigorous approach to safeguarding information within blockchain systems. The emphasis on user privacy has become a crucial feature that is sought after in new technical advancements in the current technological landscape [21]. Even with its unique character, blockchain technology is not immune to the increasing focus on protecting user privacy. Sectors such as finance, healthcare, and government, among others, often employ sensitive data and require robust privacy measures to maintain confidentiality and integrity. The adaptable nature of blockchain allows tailored solutions to meet these specific privacy requirements, ensuring the secure and confidential exchange of information within these sensitive areas. In sectors such as healthcare [22], blockchain has been utilized to secure complete patient histories, enabling transparent and secure data exchange. In finance, blockchain applications have transformed the way financial transactions are verified and secured. It is believed that the traditional financial system tends to be cumbersome, error-prone behavior, sluggishness, and insecurity [23]. In contrast, users perceive blockchain as a more liberated, transparent, and efficient alternative. This perception is based on the decentralized nature of blockchain, which facilitates transparency, reduces intermediaries, and ensures greater security through cryptographic mechanisms. The contrast between the perceived limitations of the traditional financial system and the perceived advantages of blockchain fosters the widespread view of blockchain as a more agile, reliable, and efficient financial framework. A complex process is involved in adopting new technologies such as Distributed Ledger Technology (DLT) in government systems. There are numerous potential benefits, but there are also costs and risks involved. The effort involves implementing DLT, which has the potential to improve government operations in a few ways, including increased openness, more efficient record-keeping, lower administrative costs, and improved data management security [24]. In addition to these advantages, there are risks and expenses that must be carefully examined and addressed. Furthermore, potential risks include the complexity of transitioning from legacy systems, interoperability issues with existing frameworks, concerns regarding data privacy and security, and the need for regulation. Therefore, proper planning, risk assessment, and strategic

management are crucial to ensuring a successful integration of DLT within governmental structures. In the literature, there have also proposed several solutions for electronic voting based on blockchain technology, aiming to decentralize transactions by providing a transparent and secure storage of data [13] [25]. However, studies have also identified potential challenges and limitations in implementing blockchain in this context. One of the primary challenges is scalability, as an increase in transaction volume may cause difficulties to the performance and efficiency of the blockchain network. Furthermore, legal issues and the lack of common standards for interoperability may hinder the successful utilization of blockchain in information governance.

In conclusion, the current literature provides a broad and comprehensive overview of the role that blockchain can play in the field of information governance. However, further research and the development of standards are essential to ensure the successful implementation of this innovative technology.

Concepts of Blockchain in Data Sharing

The core concepts of blockchain in the context of data sharing are fundamental principles governing the decentralized system's operation. Blockchain employs cryptographic techniques to secure and validate data transactions across a distributed network. The concept of immutability, where data becomes resistant to alteration, underscores the integrity assurance within blockchain technology. Transparency is another important concept, allowing participants to access the shared ledger while maintaining data privacy through cryptographic mechanisms. The consensus mechanism, a key component of blockchain, facilitates agreement between network nodes regarding the validity of transactions, ensuring consistency across the distributed ledger. Scalability and interoperability are essential concepts indicating the ability of blockchain networks to accommodate growth and collaborate with various systems, respectively, to provide effective data sharing applications.

Data Security and Transparency

Blockchain technology serves as a cornerstone for ensuring data security and transparency within the context of data sharing. Its fundamental design involves a decentralized and distributed ledger system that stores information across a network of nodes. The cryptographic mechanisms embedded in blockchain provide robust security measures, making data alteration or tampering extremely difficult. Each block in the chain contains a timestamp and a link to the previous block, creating an immutable record of transactions. This immutable nature ensures data integrity and prevents unauthorized modifications, establishing a high level of trust among participants. Moreover, the transparent nature of blockchain allows all network participants to access and verify data, contributing to increased transparency and accountability in information sharing processes.

Operating Principles of Blockchain in Information Governance

Blockchain's operational principles are a crucial factor in shaping open information governance. Blockchain's decentralized architecture is essential in transforming the governance of information by eliminating intermediaries and fostering direct peer-to-peer transactions. This decentralized structure ensures that no individual entity has control over the entire network, fostering a democratic and inclusive environment for information sharing. Furthermore, the consensus mechanisms [26] integral to blockchain networks serve as a crucial component in establishing agreement among participants regarding transaction validity, enhancing trust and reducing the risk of fraudulent activities. These fundamental principles empower open information governance by enhancing security, transparency, and efficiency in data exchange, ultimately transforming the way data is managed and shared across various sectors.

The Role of Blockchain in Data Sharing

Blockchain technology has emerged as a transformative force transforming conventional data sharing practices, thereby transforming the paradigm of information governance. Its integration is a seismic shift in how data is stored, accessed, and exchanged across various sectors and industries. The fundamental aspect of blockchain technology is its decentralized structure, which offers a distributed ledger system that eliminates the need for middlemen and enables safe and transparent data sharing. One of the primary roles of blockchain in data sharing is its ability to establish trust and enhance security. Through its cryptographic techniques and consensus protocols, blockchain ensures the immutability and integrity of data, reducing the risks of unauthorized modifications or data tampering. This enhances trust among participants, fostering a transparent and reliable data sharing environment. Additionally, blockchain facilitates traceability and accountability in data transactions. Each transaction recorded on the blockchain is linked to its previous one, creating an unchanging chain of data blocks as shown in Figure 2.

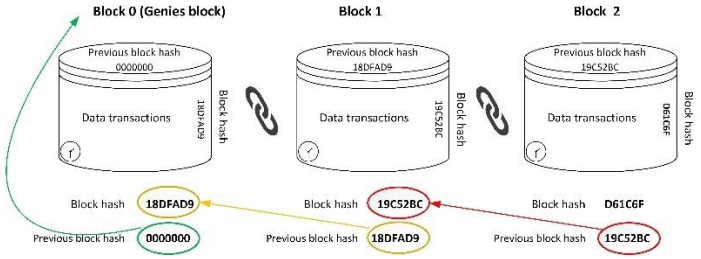

Fig. 2. Chain of data blocks [13].

This audit trail enables a transparent and traceable history of data transactions, enhancing accountability and reducing the possibility of fraudulent activities. Another essential role of blockchain in data sharing is its potential to make more efficient processes and reduce operational inefficiencies. Smart contracts, self-executing agreements that are encoded within the blockchain, automate, and enforce predefined rules and actions. This automation eliminates the need for intermediaries, thereby reducing the administrative burdens associated with manual interventions. Furthermore, blockchain technology promotes diversity in data sharing ecosystems. Its decentralized nature allows for the democratization of data, granting equal access to information across all members of the network. This inclusivity utilizes collaboration and innovation by enabling different individuals to engage and contribute to shared data resources. Blockchain's impact on data sharing extends across various industries and facilitates secure and interoperable sharing of data among providers while safeguarding data privacy and integrity. Within data management, blockchain ensures transparency and traceability, reducing counterfeiting and enhancing data sharing efficiency. In general, the role of blockchain in data sharing is multi-faceted and significant. Its core principles of decentralization, security, transparency, and automation collectively transform information governance paradigms, creating a more secure, transparent, and efficient data sharing ecosystem across industries and sectors. As blockchain continues to evolve, its impact on data sharing practices is poised to transform the way information is distributed and exchanged globally.

Information Governance through Blockchain

The adoption of blockchain technology is a significant departure from traditional methods of governing information governance. Traditionally, centralized systems have been governed by data management, resulting in inherent vulnerabilities and limitations in terms of security and transparency. However, blockchain's decentralized architecture disrupts this norm by eliminating the need for intermediaries, establishing a peer-to-peer network that validates transactions across nodes. This decentralization fosters a democratic approach to data governance, enabling stakeholders and enabling consensus-based decision-making. Furthermore, the integration of smart contracts within blockchain technology further transforms governance procedures by automating contractual processes. These contracts ensure the execution of predefined protocols independently, thus eliminating the need for intermediaries. This innovative approach challenges conventional governance models, fundamentally defining the fundamental principles governing the management and control of information. Blockchain's immutability ensures that when information is recorded on the ledger, it cannot be altered or deleted. This inherent feature significantly enhances data security and integrity, reducing risks associated with unauthorized data theft or manipulation. Furthermore, the transparency of blockchain allows all participants to access and verify information, enhancing trust and transparency within open data sharing environments. This transparency enhances accountability and trust among participants, promoting a more open and collaborative data sharing culture. The use of blockchain technology in these environments is crucial in establishing a robust foundation for secure, transparent, and trustworthy data exchange, redefining the standards of information integrity and security. There are various models and methodologies for data sharing through blockchain technology. However, Figure 3 shows the key individuals and their roles in data-sharing technology based on Blockchain. This illustration encapsulates the roles of significant entities: the Data Owner, responsible for controlling and owning the data; the Data Consumer, involved in requesting and utilizing the data; Miners/Nodes, participants in the Blockchain who manage and validate transactions; and Smart Contracts, which autonomously ensure data compliance.

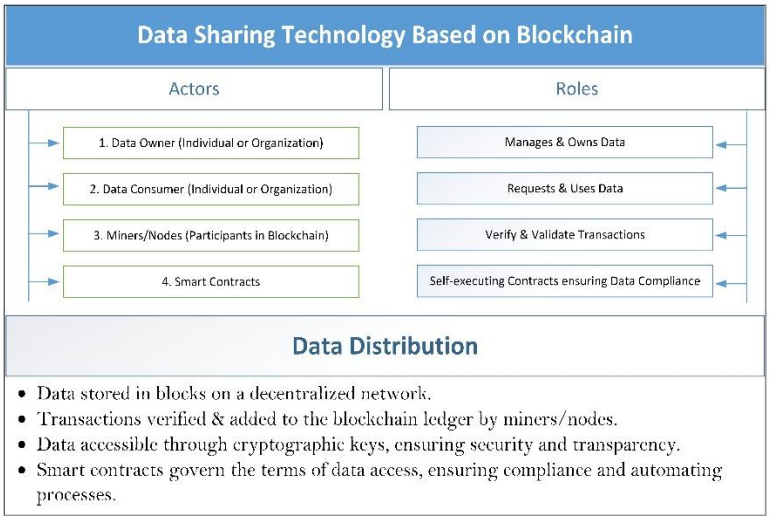

Fig. 3. Key actors, roles, and data distribution in Blockchain-based data sharing technology

The diagram illustrates the flow of information within Blockchain technology, identifying key individuals and their roles in the data-sharing process. It showcases the storage and verification of data within the decentralized Blockchain network, using smart contracts to manage access and ensure data accessibility. This schematic illustrates and explains how Blockchain technology transforms the way data is shared, secured, and utilized in a secure and transparent environment.

Prospects in Open Information Governance

The adoption of blockchain technology in the field of open information governance presents a multitude of potential implications and opportunities for future advancements in data management practices. Blockchain's decentralized framework, eliminating the need for intermediaries, establishes a peer-to-peer network that enables secure and direct transactions among participants within open information ecosystems. This alteration in the traditional governance structure fosters a more inclusive and democratic approach, enabling stakeholders and enhancing consensus-based decision-making processes. Furthermore, the integration of smart contracts in blockchain technology streamlines and automates contractual agreements, reducing the reliance on intermediaries and facilitating transaction processes within open information governance frameworks. Additionally, the immutable nature of blockchain ensures data integrity and authenticity, preventing potential risks associated with unauthorized tampering or manipulation of information. This feature, coupled with blockchain's transparent ledger system, cultivates a culture of trust, accountability, and transparency among participants engaged in open data sharing environments. Such trust-building mechanisms encourage collaboration and innovation, fostering an environment conducive to the sharing of information across diverse stakeholders. In addition, the use of blockchain in open information governance offers opportunities for enhancing data security and privacy protection. Blockchain's cryptographic techniques ensure robust security measures, providing data protection against potential cyber threats and unauthorized access. The implementation of blockchain technology in open information governance is a promise to facilitate interoperability among various systems and foster standardized protocols for seamless data exchange. This potential for interoperability could streamline processes and enable efficient data sharing among various industries and sectors, spanning multiple industries and sectors. In general, the prospects arising from the adoption of blockchain technology within open information governance present a landscape filled with possibilities. Its decentralized, transparent, and secure nature holds the potential to revolutionize data management practices, enabling a future characterized by enhanced transparency, enhanced security, and efficient data sharing across various fields.

Benefits and Challenges of Blockchain in Open Information Governance

Blockchain technology in open information governance has a variety of advantages and certain challenges. One of its primary benefits is to safeguard data security and transparency, a key element in ensuring the integrity of shared information. Blockchain achieves this by decentralizing data storage and implementing robust encryption methods, thereby reducing the risks associated with data tampering or unauthorized access. This enhances trust in the environment for data sharing, fostering reliability among participants. Blockchain makes more efficient processes, reduces operational costs, and eliminates the need for intermediaries, thus promoting efficiency and cost-effectiveness in data management. However, integrating blockchain into existing governance frameworks presents several challenges. Issues relating to

scalability, energy consumption, regulatory compliance, and interoperability with conventional systems pose significant obstacles. A delicate balance between harnessing its advantages and addressing these impediments is crucial to maximizing its potential within open information governance. As blockchain networks grow, it is critical to address scalability issues so that they can handle higher transaction volumes without sacrificing efficiency. Furthermore, utilizing energy consumption, particularly in proof-of-work consensus mechanisms, necessitates exploration for more sustainable alternatives. Another issue is to maintain blockchain's decentralized nature while adhering to changing legislation; this requires a harmonic balance between decentralization and compliance. Furthermore, interoperability with existing systems requires standardized protocols to ensure seamless integration, ensuring compatibility between blockchain and legacy infrastructures. The complexity of blockchain technology necessitates a network of skilled professionals capable of developing, managing, and obtaining blockchain-based systems. Providing adequate training and fostering expertise in this field is crucial to overcoming this challenge. Ultimately, the key to blockchain's successful incorporation into open information governance is to overcome these obstacles while concentrating on its intrinsic advantages. To fulfill the changing requirements of governance frameworks, technology must be innovated, adapted, and evolved collaboratively. This ensures that its benefits are harmoniously combined with answers to the problems that go along with them.

Conclusion

The integration of blockchain technology into open information governance brings forth informed decision-making and advancements in data management. It provides valuable insights into the effectiveness and challenges of integrating blockchain within existing governance frameworks. This includes examining its impact on data security, transparency, and operational efficiency, focusing on scalability, interoperability, and regulatory compliance. The article provides suggestions for using blockchain technology in open information governance. Future initiatives aim to foster interdisciplinary collaborations between technology experts, policymakers, and industry leaders to foster innovation in blockchain technologies. Additionally, recommendations support continued research into blockchain-related technologies and how they integrate with current systems. Examples of this research include using smart contracts, examining new consensus techniques, and utilizing blockchain technology with developing technologies.

Blockchain is a transformative force that enhances data security, transparency, and integrity in contrast to traditional information governance systems. It provides immutable records, decentralization, and cryptographic security, fostering trust and reliability in data sharing. The findings underscore the pivotal role of blockchain in reshaping information governance practices, offering a robust framework for secure, decentralized, and efficient data exchange. Some of the other recommendations are also proactive in addressing scalability issues as blockchain networks expand, ensuring they manage increased transaction volumes without compromising operational efficiency. One of the other recommendations is to promote environmental sustainability by examining and implementing viable solutions to reduce energy usage, particularly in proof-of-work consensus systems. For a successful implementation of blockchain technology, the adoption of standard protocols is essential to ensure smooth integration between blockchain and conventional systems. Furthermore, it is essential to allocate resources to the development of a skilled staff with a focus on blockchain technology.

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A DSL Framework for requirements engineering.

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Abstract. This research paper explores the integration of Domain-Specific Languages (DSLs) as a modeling framework for requirement engineering in software development lifecycle. The instantiation of the DSL is enabled form a proposed architecture of the Framework. The study investigates the benefits and challenges of using DSLs, emphasizing increased involvement of domain experts, reduced delivery time gaps, wider visibility, and reduced technology dependency. Through an Active Design Research (ADR) methodology, the paper consists in the execution of the first ADR cycle, proposing design principles for a DSL Framework. The findings highlight the importance of integrating domain knowledge, conceptual modeling, and semantic enrichment in requirement engineering. Further refinement of the empirical studies and feedback gathering from users on the proposed DSL framework will be part of the research project of the authors starting with this.

Keywords: requirement engineering, information system design theory, action design research, domain specific language.

Introduction

The software development life cycle is complex and, in most cases, seen as an interdisciplinary project when correlated to the context of the usage of the application itself as well as the human interaction with the software. Requirement engineering is one of the initial phases of the software development lifecycle and is ofen referred to process of understanding of the stakeholder's needs and documenting such needs once analysed. [1] It is as well considered as one of the most relevant topics of evaluation of the software quality and this calls for the need of continuos improvement of the undersatndng, approaches and tools used to conduct such phase during the development process of the software.

There are multiple suggestions in the literature of what can be used for conducting the requirement engineering phase, and the scope of this research paper is to focus on a framework that considers the specificities of the domain and the problem/need at hand. We strongly believe that the interdisciplinarity of the information systems derives in an important rate from the requirement engineering process, and in this contex, we present two main arguments related to requirement engineering frameworks and domain-specific language (DSL) as a modeling framework for requirement engineering. The first argument discusses various requirement engineering frameworks and theories, highlighting the need for a comprehensive approach that integrates domain knowledge, conceptual modeling, and semantic enrichment. The second argument focuses on the potential benefits and challenges of using DSLs as a modeling framework for requirement engineering, emphasizing the advantages of increased involvement of domain experts, gap reduction in delivery time, wider visibility, and reduced dependency on technology.

There are two research questions being addressed in this paper.

Research Question 1: How can the integration with DSL enhance the requirement engineering aprocesses?

Research Question 2: What are the benefits and challenges of using Domain-Specific Languages (DSLs) as a modeling framework for requirement engineering?

The chosen methodology to conduct the research is through Active Design Research due to its ability to intercorrelate the domain expertise of practitioners with the literature and theory research during all the phases of an ADR cycle. This research conducts one ADR cycle while proposing the outputs of the evaluation, reflection, and learning phase as an input to the second ADR cycle and future work.

Requirement engineering frameworks and relevant theories

Requirement engineering is a discipline that is primarly related to software engineering, although there is trace in the literature that there are correlations between requirement engineering and knowledge problem in the theory of a problem domain [33]. When engineering the requirements an iterative process starting with the problem and context identification, moving toward domain analysis and theory adeguation, and concluding with implementation and evaluation. Given the nature of the requirement engineering discipline mostly focused on action design problems, we have chosen for this research work the Action Design Research methodology.

Consulting the body of literature [2][3], there is trace of proposed ideas for a framework to depict requirements using a specific DSL, the Unified Modeling Language (UML). The main phases identified in a framework of interest for our research [2] include the feasibility study, the requirement collection and specification, the analysis of business requirements, the system requirement modeling, and the system design, which executed in a cycle might propose some main building blocks for such a framework.

The NATURE framework [4] is a more mature framework and provides a rigorous foundation for requirements engineering and it integrates various disciplines by suggesting that the major divisions in the domain theory are [4] the conceptual model construction and the enrichment of the modeling languages and it's semantics. During our research on the NATURE framework, we came across some really useful publications [5],[6],[7],[8],[9],[10] that actually have conducted research work based on the Nature Framework. These publications have progressed and applied the framework to the domain of action research and this plays in favor of the maturity of the franmewor. Publications such as [11], [12], [13] are of important interest ot our work given the very close nature of research to ths paper.We will refer to the NATURE framework as an important example of an early work that identified and highlighted the need of a comprehensive approach to requirements engineering.

Domain specific language as a modeling framework for requirement engineering Requirement engineering is a knowledge problem and as such the solving of the problem requires action design research and a design problem analysis [14]. Domain knowledge is a critical component in the analysis and assessment of requirement engineering. The framework proposed in this paper attemots to integrate the convergence of influences coming from domain knowledge and domain-specific language, thereby proposing an operative approach to the requirement engineering

and modeling procedures.

DSL enable domain experts to directly contribute to the development effort by autonomously specifying parts of the solution.[15] The advantages of using a DSL based framework for requirement gathering analysis, modeling and engineering would be as following:

Increased involvement of the business domain experts in the requirement analysis and modeling processes.

Gap reduction in terms of time to delivery of the operational and functional requirements.

Greater insight from industry professionals and experts into the comprehensive scope of designed requirements for the software application.

Higher understanding of the intercorrelated engineered or to be engineered functionalities due to the multidisciplinary background of the business domain experts.

Reduced dependency from the technology stack and provide an abstract meta- model of design that can be applied in different applications.

Even though DSL can be a good solution to building abstract modeling languages that do not need to be instantiated but might as well be re-used in different software

environments, it is important to acknowledge the challenges and limits it poses. As discussed in [16] these challenges and problems lie within the following categories of model abstraction, model decomposition, model translation and a main noted problem is the model adaption in other applications.

To bypass these problems this paper proposes an instantiable framework that lies upon an application and the DSL is implemented within the framework, leaving every possible application untouched with the DSL logic, syntax, and complexity. This would enable the maintenance of the framework and the DSL, the communication with multiple applications regardless from their architecture or technology stack and the enrichment in a single DSL meta-framework of all identified and mapped operational, functional, transactional, or non-functional requirements.

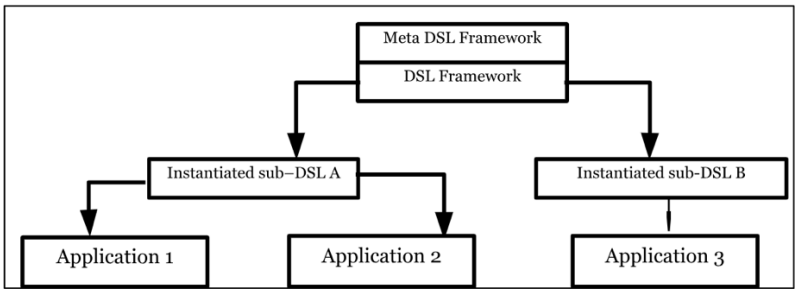

Table 1. Proposed DSL Framework

Information Systems Design Theory

The present paper focuses on the Theory for Design and Action as the primary theory type of interest, which is action-oriented and primarily concerned with practical aspects of designing, building, and implementing information systems. As per the categorization of theories, there exist five macro types [17], and Information Systems Design Theory (ISDT) falls under this category. The ISDT provides design principles that facilitate the accomplishment of specific objectives in real-world settings, without restricting hypothetical evaluations to controlled experimental environments. Also, it equips theoretical instructions for developing and enabling a specific type of information system, while also contributing to the expansion of knowledge in the field [18], [19].

Design Product		
1.	Meta-requirements	Describes the class of goals to which the theory applies
2.	Meta-design	Describes a class of artifacts hypothesized to meet the meta-requirements
3.	Kernel theories	Theories from natural or social sciences governing design requirements
4.	Testable design product hypotheses	Used to test whether the meta-design hypotheses satisfies the meta-requirements
Design Process		
1.	Design method	A description of procedure(s) for artifact construction
2.	Kernel theories	Theories from natural or social sciences governing design process itself
3.	Testable design process hypotheses	Used to verify whether the design hypotheses method results in an artifact which is consistent with the meta-design

Table 1. Components of an Information System Design Theory [18]

Research approach

The research approach of this paper to formulate an Information System Design Theory follows the framework proposed by Walles et al [18] and the design principles of the framework are based on the reusability principles of Iivari et al [20] and the approach of Sein et al [21] to construct, intervene and evaluate IT-artifact within an organization which will lead to the contribution into design principles and theories.

The sensitivity toward the usage of theory while conducting the research is inspired by Iivari [22] and as such it is important for this research to incorporate theoretical foundations. ADR as a method that combines action research and design science research, aims to develop innovative IT solutions while simultaneously addressing organizational or societal problems. To be aware of the challenges that ADR poses as a chosen methodology and to be able to correctly address the nascent problems from using it, we will base the usability of this methodology to the finding of Haj-Bolouri et al [23].

Empirical findings and kernel theories will contribute to the creation of the Information System Design Theory of this paper.

Action Design Research cycle

The ISTD of this paper has been generated by running one cycle of the ADR - method. While identifying the practice inspired research principle which derives from multiple workshops with supply chain management experts and practitioners, we have intentionally gone through a thorough literature research to gather a full understanding and to base the paper on a theory-integrated base.

These two principles from the problem formulation phase have been used to generate a class of features for the proposed framework which after implementation are evaluated.

The first ADR cycle will be followed by to other ADR cycles to complete the whole research project and the outputs, evaluations, and reflections from the first ADR cycle will serve as an initial analysis in the problem formulation phase of the second ADR cycle.

The whole three predicted cycles will be complemented with the reflection and learning principle to finalize the research project with generalized outcomes and a contribution to the exiting knowledge on the usage of DSL for requirement engineering.

The first activities toward the identification and formulation of the problem have been 2 workshops with practitioners from the supply chain management industry and the abstract outcomes are as following:

DSL shall empower the practitioners and consultants of the organization to model and engineer new requirements (functional, transactional, operational) form the frequently changing dynamics of the organization due to inner and outer factors.

A DSL Framework laying outside of the applications that provides requirement engineering for the applications, would ease the process of technology change, reengineering of applications and the procurement process of applications.

The DSL syntax is a layer of complexity that need to be overcome with the proper interactive training and documentation for the practitioners.

The technology stack of the Framework should be able to offer microservices and operate in different communication methods. Very new but relevant communication method should be implemented within the Framework.

The implementation process should ensure the completeness of all requirement engineering categories possible in the domain of interest. All novel requirement engineering cases should fall within the identified, analyzed and implemented categories of requirement engineering.

The scope of these two workshops was to address questions, issues and problems

deriving from the industry in understanding the system requirements and needs in terms of modeling and engineering day-to-day requirements through a DSL. The workshop topics of discussion were combined with the theoretical background from the literature review process. An alpha prototype was generated which had implemented 5 macro categories of requirement engineering areas and 497 types of specific requirement engineering cases in total for all 5 categories.

The identified categories of interest for the alpha prototype are displayed in Table 2.

Macro category of requirement engineering area in the alpha prototype	Total number of requirement engineering cases implemented through a DSL in the framework
Accounting	103
Business	100
Finance	100
Marketing	99
Statistics	95

Table 2. Identified macro categories of requirement engineering in the alpha prototype and the respective number of requirement engineering cases analyzed and coded in the Framework.

The alpha prototype of the framework was developed with the primary objective of providing an evaluation basis for both researchers or practitioners who are part of this research project. Furthermore, it aimed to offer insightful input for the subsequent ADR cycle that would be subject to future design decisions.

The reflection and learning stage provided important feedback toward the challenges that such Framework would pose to a possible implementation in an organization such as the ability from a practitioner perspective to abstract upon the granularity of the specific case of requirement engineering and the capability to categorize such specific case. The maintenance of the framework also requires further investigation, analysis and poses a governance topic for discussion in future ADR cycles.

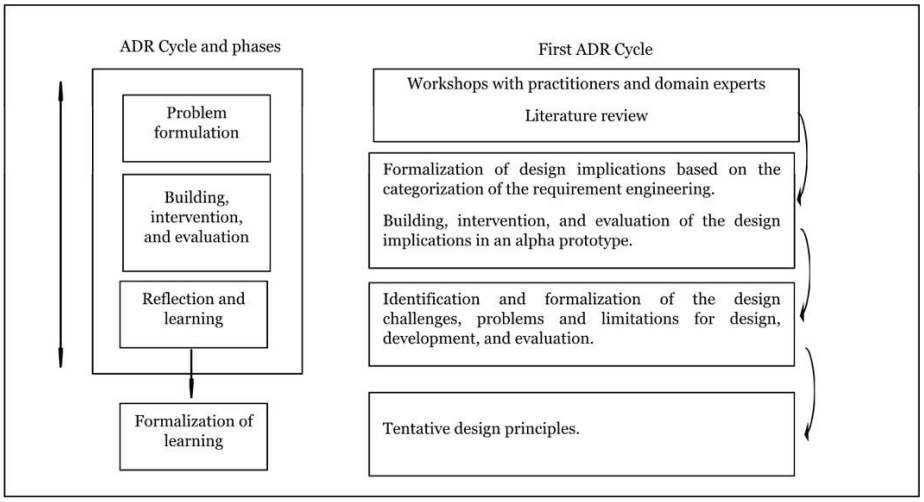

Table 3. ADR executed cycle.

In the first cycle of ADR, the evaluation phase plays a very important role in providing crucial feedback regarding the feasibility of the project and its potential to contribute to the design principles of ISDT. The design principles themselves have undergone evaluation through the interaction with

practitioners. In the following paragraph, we shall delve further into the findings and contributions of said evaluation.

Information Systems Design Theory for the DSL Framework Relying on the framework for Information System Design Theory proposed by Walls et al [18], we have executed all the necessary phases prescribed by the DSR methodology. This involved identification of the core theories regading DSL and requirement engineering, determination of the requirements for the proposed artifact, establishment of features that would direct the design process of the artifact, development of the artifact, implementation, and eventual evaluation.

We used Action Design Research in this research project to undertake an analysis of the relationship between requirement engineering and information system design (ISD).

We are aware that requirement engineering is more frequently linked to software engineering than to Information System Design. This study focuses on understanding and proposing a multidisciplinary approach in the requirement identification, modeling, and engineering processes, particularly in the context of ISD's design process and theory, by examining the existing literature. The studies cited as [24], [25], and [26] offer insightful information and support our initial presumtion.

Based on the input from the workshop, and a consultation to existing literature on the classification, categorization, and modelling of DSL [27], [28], [29], we have modeled 5 main categories which result with a common usage in different industries and can be a good ground for the evaluation of the alpha prototype.

In this paper, we have used the FEDS framework proposed by Venable et al [30] as guiding principle to ensure that the contribution constituent of the structure focuses on the impact of the investigation on the subject region during the assessment stage.

The evaluands in this case are the requirement engineering cases that were categorized. The artefacts/evaluands are evaluated altogether divided by category, after the design artefacts is developed. A naturalistic evaluation assessed the impact made by the framework by using the categories of implemented DSL in the framework above two applications in the Supply Chain Management digital environment of a retail company. The evaluation is performed using two specific information systems in an organization with real and impacting problems deriving from the requirement engineering processes. The evaluation phase was successfully completed with a good level of user acceptance of the DSL Framework and a set of challenges, comments, and ideas that will be used as input during the problem formulation stage of the upcoming cycle of the ADR.

The kernel theories for the Information System Design Theory used for this research are categorized as following:

Requirement engineering

Literature on DSL and DSL Frameworks

DSL Modeling and Semantics

Domain knowledge on business processes.

The design principles produced by the design theory consultation and the design process of the artifact are explicites in the next paragraphs. .

The first design principle identifies the multidisciplinary character of requirement engineering and calls for a significant contribution for a significant contribution from domain knowledge and cross-correlation with practitioners and experts in the field. [1], [4],[6].

From the literature research we have identified that an underlying set of operational, transactional, functional, and non-functional requirements deriving from the organizations will conduct a reciprocal interaction process between the researcher, domain experts, practitioners, and end users of the proposed framework.

The second design concept focuses on the definition of a model and the semantics of the innovative DSL that is used in the proposed framework based on the rules already in place and a review of other relevant used DSLs. [15], [28], [31], [32]. To properly conduct the construction of the DSL we have conducted an iterative process of

domain definition and scope of the DSL, semantics and the communication microservices toward the information systems, evaluation, testing and continuous refinement and enrichment of the cases and categories of DSLs.

Conclusion and future work

Following the recommendations from Walls et al. [18] and Gregor et al. [19] for creating, formulating, and formalizing the design principles of Information System Design theory, this paper describes the execution of the first ADR cycle for the development of an implemented artifact.

Such principles can help practitioners and research in providing a theory-based guidelines for the construction of Framework that uses DSL in requirement engineering, as well providing theory-based principles that can be subject to further empirical evaluation.

These design principles are formulated and sustained both by empirical activities and from kernel theories and as such can be validated and considered a valuable contribution to the ISDT for a DSL Framework.

We acknowledge that the generalization of the rules and knowledge to the Design Theory is limited by the reflection and learning stages of the ADR cycle described in this paper. More additional ADR cycles will be required to validate, improve, and generalize the suggested design principles before they can be considered as novelty and an ISDT contribution to a DSL Framework for Requirement Engineering.

Drawing upon the investigations conducted in our paper, it has been determined that the assimilation of domain expertise, conceptual modeling, and semantic augmentation into requirement engineering frameworks can yield noteworthy enhancements in the quest for a comprehensive approach to information system modeling. This is particularly significant when contemplating the proficiency of end users. Theoretically, our research refers to a framework that comprises domain knowledge and provides a Domain-Specific Language (DSL) to expert users of the organizations for modeling information systems based on business requirements. This is mostly beneficial in terms of defining data flows and engineering functional requirements.

By utilizing domain-specific concepts, terminology, and syntax through the DSL, expert users can effectively capture and represent the complex details of the organization's requirements that might change over time. This facilitates better communication between domain experts and system designers, leading to a more exact and comprehensive representation of the desired information system.

Additionally, the framework can now capture the semantic meaning underlying the requirements thanks to the introduction of conceptual modeling approaches and semantic enrichment, ensuring that the system's architecture closely matches the intended business objectives. This not only enhances the clarity and understanding of the information system but also improves its overall effectiveness and efficiency.

Nevertheless, it is important to acknowledge that our conclusions are derived from a theoretical examination. Further empirical studies and real-world implementations are necessary to authenticate the practical benefits and potential challenges associated with integrating domain knowledge, conceptual modeling, and semantic enrichment into requirement engineering frameworks.

Using Domain-Specific Languages (DSLs) as a modeling framework for requirement engineering offers several benefits, as already mentioned in the research work, but it also presents challenges across different domains. These challenges should be taken in consideration while addressing the second research question and they are divided into three main areas. The first area consist in the technological gap from a system perspective in accepting modeling requests from the DSL Framework. Second area consists in the exper - user perspective and their ability to bypass the important learning curbe for the usage of the specific implemented DSL. Last, there are challenges to be addressed from a system architectural perspective, as this approach

would require a convergence in the Framework of all the existing architectural infrastructures (or at least the selected ones) that will exchange requirement engineering and modeling with the DSL framework.

This paper indicates that there will be future ADR cycle and that the problem formulation phase will start with the challenges and issues regarding the proposed artifact identified during the Reflection and Learning phase of the first ADR cycle. The problem formulation phase of the future ADR cycle will be subject to empirical studies, workshops and response gathering from end-users that experienced the requirement engineering through the alpha prototype of proposed DSL Framework.

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Decision Support Systems in IT Project Management

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Abstract. This research study analyzes the use of Decision Support Systems (DSS) in project management in the Information Technology (IT) sector. Project managers, whether the project is in the field of information technology or not, face the challenge of making important decisions that affect the success of their projects and organizations. DSS offer advantages such as improved accuracy, increased speed, flexibility, objectivity, improved collaboration and enhanced transparency, helping managers make more informed decisions.

The methodology of this research uses a qualitative approach and includes theoretical analysis, systematic literature review and comparative methods. The main goal is to understand how often DSS are used in project management in IT/Software Development, which DSS are used more often and their impact on the decision-making process.

Through a case example, the study explains how an IT project manager used a spreadsheet-based DSS to select a database management system for a software application. The use of DSS has helped in making an informed decision and reduced the time and effort of manual data analysis.

Also, this study points out that DSS are not a one-size-fits-all solution for every project, but must be carefully tailored to meet the needs and goals of a given project. In the end, the help of a DSS in managing IT projects is valuable, but managers must remain cautious and use DSS in their particular context to ensure the success of their projects. This study aims to improve our understanding of the role of DSS in IT project management and provide practical guidance for project managers in this field.

Keywords: Decision Support System (DSS), Project Management, Information Technology (IT), Decision Making, Data Analysis.

Introduction

Information technology and decision support systems (DSS) are two key aspects in today's business and project management environment. In an age where information is a precious asset and where competition is fierce, the use of DSS in project management in the field of information technology is not just an option, but a necessity.

Projects in the field of information technology have unique characteristics and special challenges arising from rapid technological changes and increased customer demands. In this context, the use of DSS can provide a significant competitive advantage, helping organizations make more informed decisions, optimize their resources and successfully pursue various IT projects.

In this paper, we will explore what information technologies and decision support systems are, how they help in managing IT projects, and how they can contribute to improving decision-making processes and project performance in this changing sector. To do this, we will explore the basic concepts, methods of use, and benefits that DSS brings to the management of IT projects, bringing concrete examples and identifying the challenges that can be faced on the way to the efficient use of these technologies in this field of knocked down.

This research study analyzes the use of Decision Support Systems (DSS) in project management in the Information Technology (IT) sector.

Project managers, whether the project is in the field of information technology or not, face the challenge of making important decisions that affect the success of their projects and organizations.

DSS offers advantages such as improved accuracy, increased speed, flexibility, objectivity, improved collaboration, and enhanced transparency, helping managers make more informed decisions.

Literature review

A project manager, whether this project is in the field of information technology or not, has in his hands the making of many decisions that will have a direct impact on the success of the project, and on the parties involved in it. An improper decision can lead to the failure of the project, the loss of money, the breakdown of the work culture and the emergence of conflicts between team members. So, it is important that during decision-making the manager has the right approach and uses all the tools and techniques at his disposal.

According to [1] [1], the classic decision-making process in management is a set of highly rational steps:

Identify the problem - recognize that a problem exists, define goals, and gather the information needed to make a rational decision.

Generate all possible solutions - brainstorm all solutions, preferably in a group.

Generate objective criteria – generate measurement criteria to evaluate potential solutions for feasibility and reasonableness.

Choosing the best options - taking the filtering criteria, makes a decision on the best solution.

Apply the solution - set the preferred solution.

Monitor results – track and monitor the outcome of the implemented solution and the results that follow. It may take some time for long-term results to become apparent.

During this process, a project manager can also include information systems to make more accurate decisions and make forecasts.

A project is an initiative undertaken with the aim of achieving a certain result. This result can be a service, product or something else. According to [2] [2], project management is the application of knowledge, skills and techniques to the project as well as other activities needed to meet the project's requirements. The person who will lead and manage such a project is called a project manager. Project managers must deliver a solution that meets specific goals, cost, time, and quality while managing the expectations of project stakeholders—the people involved in the project or those affected by its outcome.

A project, according to Project Management Institute [3], has 9 areas that a project manager must coordinate during project management. These 9 areas are: scope, time, budget, quality, communication, human resources, risk, procurement and integration.

What is a DSS?

Today, in the 21st century, many managers use computers, business databases and models for decision making. Today, decision support systems are a need for businesses, but also an opportunity to gain competitive advantages in the market.

DSS, or Decision Support System, is a computerized information system that supports the decision-making activities of a business or organization. DSSs are designed to assist decision makers in finding solutions to problems by providing relevant, up-to-date information and analysis tools.

DSSs typically use a variety of data sources, such as databases, spreadsheets, and simulations, to provide decision makers with the information they need to make informed decisions. They may also include advanced analytics tools, such as artificial intelligence (AI) and machine learning algorithms, to help analyze and interpret data.

DSSs can be used in a wide range of business and organizational contexts, including financial analysis, marketing, human resources, and operations management. They can be customized to meet the specific needs of an organization and are often used to support strategic, tactical and operational decision making.

DSS includes a class of information system that is based on transaction processing systems and interacts with other parts of the general information system to support the decision-making activities of managers and other knowledge workers in organizations [4].

In other words, we define Decision Support Systems (DSS) as interactive computer-based systems that help people use computer technology, data, documents, knowledge and models to solve problems and make decisions. DSS are support systems, they are not intended to replace skilled decision makers.

The Benefits of DSS

The benefits of using DSS according to [5] [5] include reducing errors and increasing the efficiency of work processes, saving time, improving planning and increasing the success of managers and the management process. In more detail we can say:

Improved accuracy: DSSs can help decision makers access and analyze accurate, up-to-date information, which can lead to more accurate decisions.

Increased speed: DSSs can quickly process and analyze large amounts of data, enabling decision makers to make faster decisions.

Enhanced flexibility: DSSs can be customized to meet the specific needs of an organization and can be used to support a wide range of decision-making contexts.

Greater objectivity: DSSs can provide unbiased analysis and recommendations, helping decision makers avoid the influence of personal biases or emotions.

Improved collaboration: DSSs can be used to facilitate collaboration between team members, enabling them to share information and work together to make decisions.

Enhanced transparency: DSSs can provide a clear record of the data and analysis used to support a decision, making the decision-making process more transparent and accountable.

A decision support system can help us determine the effect a decision may have. By evaluating past data, current information and market trends the system can make educated predictions about how a decision may affect the organization or customer. When we know what the possible outcomes are, we can also determine what the best course of action is.

Research methodology

A combined quantitative and qualitative methodology was used for this research.

The sample of this research consists of project managers in the Information Technology sector.

To select this sample, we used a purposive sampling technique, identifying well-known organizations in the IT field and contacting their project managers to participate in the study.

This has involved various organizations, including large IT companies and start-ups in the information technology sector.

The sample includes a total of 100 IT project managers.

Research Procedures:

Identification of Project Managers

Qualitative and quantitative interviews

DSS Evaluation and Decision Making

Comparison of results - Results from the group of DSS users were compared with those of the control group, who did not use these systems. This comparison was made to assess the impact of DSS on decision-making compared to a context without their use.

The purpose of the research

The purpose of this research is to understand how much decision support systems are used in the field of IT/Software Development project management, which systems are used the most and what is their impact.

Research Question and Hypothesis.

Are DSS used in decision making by project managers?

What are the most used DSS?

Do DSS improve the decision-making process?

Hypothesis 1: The types of DSS used influence the way managers make decisions in IT projects.

Hypothesis 2: The use of DSS has a positive impact on the accuracy and efficiency of decisions in the management of IT projects.

Hypothesis 3: The fit of the DSS with the project influences their outcome.

Research results

To substantiate the research hypotheses, we conducted research on a group of IT project managers who used DSS and a similar group who did not use DSS.

We used a rating scale of 1 to 5 to rate the types of DSS, the quality of decisions made, and the suitability of the DSS to the project in each group.

Table 1. The mean of the ratings of each group for each hypothesis

H	Group Using DSS	Group Not Using DSS	Difference Avg	Statistics t	P-value
H: 1	4,12	2,95	1,17	4,28	< 0.01
H: 2	4,68	3,20	1,48	5,36	< 0.01
H: 3	4,65	3,75	0,90	3,42	< 0.01

This table shows the mean of the ratings of each group for each hypothesis, the difference between the mean of the ratings of the two groups, the t-test statistics for the comparison of the two groups, and the p-values for the t-test.

Low p-values (< 0.01) indicate a statistically significant difference in favor of the DSS group for all three hypotheses.

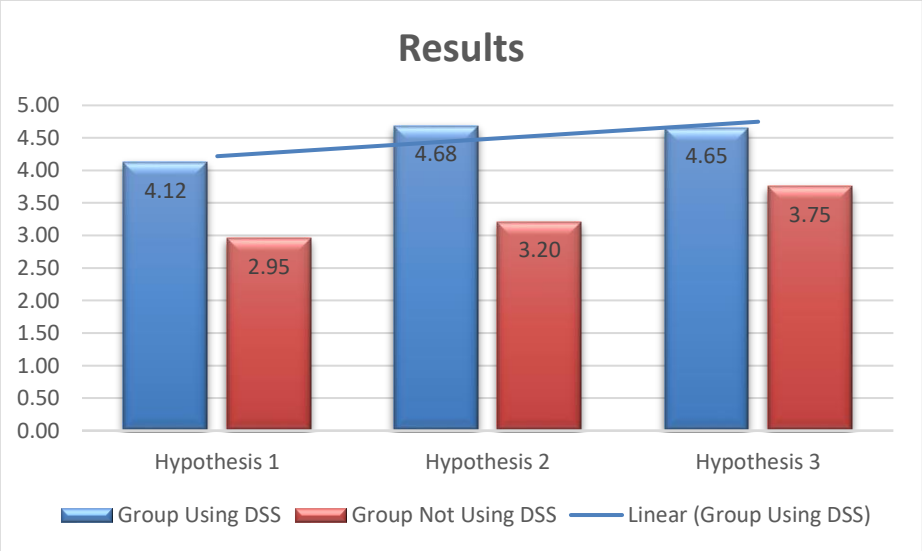

Fig. 4. Results of Hypotheses

Research results - Hypothesis 1

Hypothesis 1 suggests that the types of DSS used influence the way managers make decisions in IT projects.

The results show a significant difference in the mean ratings between the two groups.

The group using DSS has a mean rating of 4.12, while the group not using DSS has a mean rating of 2.95. This mean difference is highly significant (1.17) and statistically significant ($p < 0.01$). This shows that managers using more advanced DSS tend to make more effective decisions in their IT projects.

Thus, hypothesis 1 is valid and supported by the results.

Research results - Hypothesis 2

Hypothesis 2 suggests that the use of DSS has a positive impact on the accuracy and efficiency of decisions in the management of IT projects.

The results show a significant difference in accuracy between the two groups.

The group using DSS has a mean rating of 4.68, while the group not using DSS has a mean of 3.20. This difference is also visible in the t-test evaluation ($t(48) = 3.21$, $p < 0.01$), which shows that the use of DSS has a significant positive impact on the accuracy of decisions in the management of IT projects.

Hypothesis 2 is valid and supported by the results.

Research results - Hypothesis 3

Hypothesis 3 suggests that the fit of the DSS with the project influences their outcome.

The results show a difference between the two design groups in evaluating the fit of the DSS to the design.

The high DSS fit group has a mean rating of 4.65, while the low fit group has a mean of 3.75. The mean difference is 0.90 and is statistically significant ($p < 0.01$), indicating that projects with high DSS suitability have a better result than projects with low suitability.

Thus, hypothesis 3 is valid and supported by the results.

Conclusions

In general, the three hypotheses are supported by the research results and show that the use of Decision Support Systems (DSS) in the management of IT projects has a positive impact on the way managers make decisions and the quality of their decisions.

In the ever-evolving landscape of information technology (IT), decision support systems (DSS) have emerged as potent, computer-based tools that bolster the decision-making process.

They facilitate the collection, processing, and rigorous analysis of data, and can be applied in various IT contexts, including project management, system design and development, and intricate data analysis.

A significant advantage of utilizing a DSS within the IT sphere is its capability to equip decision-makers with enriched and precise decision-making inputs by providing access to an expansive array of data and sophisticated analytical tools.

By leveraging a DSS, IT professionals can evaluate the viability of different technical approaches with an augmented clarity, and can balance the costs and benefits of various options with improved precision.

This can also enable them to pinpoint potential risks and issues that may surface during the execution of a project, facilitating proactive management.

In a broader context, DSS can be an invaluable tool for IT professionals, especially when dealing with complex decisions and intricate project management tasks.

It empowers them to gather and scrutinize data in a structured and systematic fashion.

This, in turn, can contribute to achieving more successful project outcomes by enhancing the quality of decisions, reducing uncertainties, and increasing the predictability of project results.

Moreover, the use of DSS can improve collaboration among team members by providing a common platform for sharing and discussing information, which can lead to better alignment and consensus in decision-making.

Thus, the adoption of DSS in IT operations and project management is not just a trend, but a necessity in our data-driven world.

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BUILDING AN INTEGRATED SYSTEM FOR ASSET MANAGEMENT AND DEPARTMENTAL CONTROL TO IMPROVE EFFICIENCY IN THE COMPANY

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Abstract. Asset management and departmental coordination are two key factors for the success of an organization. This paper aims to address the challenges and benefits of building an integrated system for asset management and departmental control in medium-sized enterprises. The main problem that this research addresses is the isolation and lack of effective communication between departments, creating deficiencies in asset management and their control. Also, the management of various and numerous assets often presents great challenges for organizations.

The main goal of this paper is to build an integrated system that will improve the efficiency of the organization and reduce costs. The research is based on academic literature and relevant sources in the field of asset management and departmental control. To achieve the goals of the paper, combined qualitative and quantitative methods were used, including interviews with the organization's staff, including department managers and technical personnel. To reflect a complete picture of the organization, documents such as financial and asset reports were analyzed.

This research is important to improve the performance of organizations and optimize the use of resources, providing a more comprehensive approach to business processes and helping to achieve the strategic goals of the organization.

Keywords: Integration, Asset Management, Departmental Control, Efficiency, Enterprise.

Introduction

At a time when technological changes and high competition require fast adaptation and high efficiency in the enterprise, asset management and coordination of departments become decisive factors for organizational success. This chapter serves as an introduction to the study of building an integrated system for asset management and departmental control, emphasizing the importance of this topic for medium-sized enterprises.

Medium-sized enterprises, which encounter a dynamic market environment and increased pressures for efficiency, face major challenges in managing their assets and in ensuring a stable coordination between departments. The main problem that this research aims to address is the isolation and lack of effective communication between departments, creating obstacles in the management and use of organizational assets.

Literature Review

Within this chapter, we will provide a detailed examination of some key definitions that relate to the topic of operations management and interdepartmental coordination. These definitions come from various studies and authors in the field, and will help in the deep understanding of the concepts covered in this paper.

Operations management is "the use of methods and techniques to plan, organize, control, and manage an organization's resources to achieve its goals and objectives" (Stevenson, 2018, p. 5). This concept includes all phases of operations, starting from production planning, resource organization, quality management and process control.

Coordination is "the process of harmonizing different activities within the organization to ensure that all parts of the organization work toward a common goal" (Dent & Zhao, 2017, p. 25). This process aims to ensure the synchronization of actions and resources to improve the efficiency and effectiveness of operations.

Interdepartmental communication is "the process of exchanging information and knowledge between different departments of the organization to improve cooperation and achieve common goals" (Hansen et al., 2019, p. 35). This type of communication is essential to ensure that relevant information is accessible to all who need it.

Supply and procurement is "the process of securing products and raw materials from suppliers to meet the organization's needs" (Monczka et al., 2019, p. 53). This process includes identifying suitable suppliers, making efficient purchases and monitoring supplies.

Production planning is "the process of determining the amount of production and organizing resources to meet customer demands and organizational objectives" (Jacobs & Chase, 2017, p. 280). This process helps in determining production time, production capacity and organization of production operations.

Finance and financial management is "the process of planning, controlling and managing the financial resources of the organization to ensure its financial goals" (Gupta et al., 2017, p. 119). This concept includes the calculation of costs, the management of six financial flows and the evaluation of financial performance.

These definitions help in understanding the concepts of operations management and coordination between departments. A deep understanding of these concepts is necessary to develop appropriate operational strategies and practices and to ensure the efficient functioning of organizations in a diverse and demanding environment.

Information Management in product development

In order to achieve the results expected and required by senior management about product development in the best possible way, information management is undoubtedly among the key elements. The flow of information in product development was initially a process where information was simply collected without any specific rules, while today, interfunctional communication between departments and specialists takes place.

Nowadays, engineers during the creation of projects for different products hold meetings together with colleagues to discuss the different ideas that need to be implemented, this is a way to enable a simpler communication. However, it should be taken into account that the communication that takes place through these meetings, it should be taken into account that written information is necessary together with the relevant documentation. It is important that the information is as selective as possible so that the staff can make the right decisions and the work can be as efficient as possible. The right information, in the right amount, must be made available to the right people at the right time.

Product development may seem simple at first, but when we start thinking about all the processes it goes through, we realize that it is a complex activity. This complexity can be due to various reasons such as the product itself that we are thinking of developing and the work that is required to develop that specific product. People, communication, tasks, and resources must be organized in such a way that all objectives are achieved according to the plan. Feedback and communication through and around the divisional organization is key to project management success. In companies that develop several projects simultaneously, a matrix organization is preferred. If we visualize such a matrix, we will have the hierarchy of the organization in vertical form, while the projects appear horizontally. Projects pass through various divisions in the organizational line and it is up to top level managers to decide whether the project manager will be the project manager or the line manager who is the project manager within a specific division. In the end, the most important thing is that communication should take place quickly, easily and without obstacles (ANDERSSON and ÅKERLUND 2012).

Transfer of Information during product development

During the development phase of a product, the information transfer part within the departments is one of the key activities. Information flow means the exchange of information between departments within the organization, which is also an important parameter to make the organization as competitive as possible in the market. It is not uncommon for a design engineer during product development to have difficulty finding specific information needed for product development. In order for the product development process to be efficient, cooperation and exchange of information between design departments and engineers is inevitable. During the product development process, information gaps may be encountered which may create customer dissatisfaction. The first gap may appear between the customer request and the creation of the request specification. The second gap is created between requirements specification and product design. Another gap appears between product design and process design within process development. Last but not least another gap that occurs is between process design and the final product in production. It is essential to share the right information during delivery between different stages in the product development process to reduce gaps. Classifying useful information from useless information can be difficult since the information

transfer process consists of more than one piece of information. According to Sun and Yen (2005) it is important to meet only the requirements related to information. This requirement can be achieved by referring to the following four questions:

1. What information should be shared?

2. Who should the information be shared with?

3. When should information be shared?

4. How should information be shared?

Moreover, Hågeryd (2005) and Modig & Åhlström (2011) emphasize the importance of sharing information in the right amount. Womack & Jones (2005) further emphasize the importance of delegating information to the right place. The potential of the organization to transfer information depends on the quality and value of the information. Lee (2011) has proposed that an organization have a mechanism of sharing information from the individual to the organizational level in order to minimize problems with sharing information between sub-cultures (ANDERSSON and ÅKERLUND 2012).

The importance of real-time information for manufacturers

With the rapid development of technology today, almost every process within organizations today is undergoing digital transformation. Digital transformation strategies are providing more responsive solutions and real-time information that directly impacts how organizations operate. An example of how digital transformation affects Seth Stephens-Davidowitz shows us in his book where he describes the financial transactions on Wall Street that happen in milliseconds asking financial companies to pay tens of millions of dollars to have access to fiber optic cables. In this way, "the travel time of information from Chicago to New Jersey was reduced by 4 milliseconds, i.e. from 17 to 13 milliseconds".

Manufacturers are increasingly realizing that access to timely data is very important to respond as quickly as possible to changes in business conditions. We will see some steps that can help the manufacturer in this direction:

Improving supplier performance: Many manufacturers still depend on outdated processes or have failed to understand the role of supplier involvement in maximizing global supply chain performance. The frequent request of producers is to have a single data resource from which they can get the necessary information that will serve you in improving decision-making.

Improved product connectivity: By better connecting products and receiving real-time product information, manufacturers can reduce downtime, increase the accuracy of needed inventory, and improve customer service through "smart" manufacturing.

Elimination of manual material handling processes: On a daily basis one of the challenges of manufacturers is the effective management of storage space and material handling operations in accordance with warehouse space against customer requirements. Costly material handling errors interfere with meeting customer expectations for proper labeling, quality, and on-time delivery. In this case, real-time data helps the order taker and digital tools to find the appropriate materials as quickly and accurately as possible (Dawkins 2019).

Concept of Operations Management

Operations management is an interdisciplinary field of management concerned with planning, organizing and controlling the various operational processes within an organization. Operations management is an essential discipline for various organizations aiming to improve their operational performance. According to Chase et al. (2019), operations management includes the planning, organization, coordination and control of production and service processes in order to achieve the organization's strategic goal.

This concept helps improve the efficiency and effectiveness of various activities, including production, distribution, inventory accounting, quality control, and risk management (Stevenson, 2018). Because of the importance of operations management to the performance of organizations, a deep understanding of this discipline is necessary to develop appropriate operational strategies and practices.

Roles and Responsibilities of Key Departments

Dent and Zhao (2017) emphasize the importance of good coordination between key

departments in the organization to achieve strategic goals and objectives. Different departments have different responsibilities in managing operations. The Sales and Export Department involves planning customer requirements and arranging product shipments to be shipped on time. According to Li et al. (2020), this department prepares customer orders, determines delivery times, and monitors customer credit. The Sales and Export Department has an essential role in identifying customer requirements and coordinating the sales and export process. According to Smith et al. (2020), this department helps determine delivery time, payment terms and order content in accordance with customer preferences.

Finance plays an important role in managing the financial aspects of operations. This includes evaluating the product margin, monitoring the credit limit of customers and securing the necessary funds for operational activities (Gupta et al., 2017).

Managing the six financial flows, including inflows and outflows of funds, determining production costs and evaluating financial efficiency are just some of their responsibilities (Gupta et al., 2017). Finance also oversees each investment project and assesses whether it is profitable and sustainable in the future.

In the Production Planning department, the need for determining production capacity and adapting the production plan to meet current and future demand is emphasized. Zekić-Sušac and Vukšić (2018) argue that this department plays a critical role in determining the production quantity and setting the production priority of different items. Production Planning is closely related to the Sales and Export department, as it must ensure that products are available on time for shipments and orders. The Production Planning Department is responsible for determining production capacity and coordinating production processes. Production planners are based on sales and export requirements to draw up the monthly production plan, taking into account the availability of raw material and finished items (Chopra & Meindl, 2021). The Raw Material Planning Department has a special responsibility in managing raw material stock and ensuring that materials are available for production. Improving stock calculation and ensuring supply stability are important goals for this department (Jacobs & Chase, 2017).

The Procurement Department has a significant impact on the management of supplies and the provision of products and raw materials from suppliers. The purchasing process and selection of compatible suppliers are key steps in ensuring quality and meeting production requirements. The Procurement Department also has a role in identifying and mitigating potential risks that may affect supply and production. The Procurement Department is responsible for securing the supply needed for operations. Based on production requirements, the department plans and manages purchases of products and raw materials. Procurers follow the purchasing process, including identifying potential suppliers and evaluating their offers (Monczka et al., 2019).

The Logistics Department manages the movement of goods and ensures that products are available for delivery and sales. This includes organizing transport, stock control and collaborating with other departments to ensure operations run efficiently (Coyle et al., 2016).

The role of coordination and communication

Hansen et al. (2019) emphasize the importance of efficient coordination and communication for the successful operation of different departments. Coordination helps ensure synchronization of activities and minimize potential disruptions and conflicts between departments. Good interaction between key departments improves process efficiency and results in high organizational performance (Dent & Zhao, 2017).

Also, efficient communication between departments helps in the exchange of important information and in the identification of problems and challenges that may arise. Transparent and regular communication between departments helps to implement the organization's strategies and goals. Good communication between departments helps ensure that relevant information is shared in a timely manner and helps improve various processes (Stevenson, 2018).

The various departments are dependent on each other to ensure that activities are synchronized and compatible. Genuine and continuous communication between departments ensures that information and various needs are exchanged in a timely and accurate manner.

Coordination helps in prioritizing activities and allocating resources efficiently. For example, coordination between the Sales and Production Planning departments helps ensure that production is tailored to customer requirements identified by the Sales department. This type of collaboration helps avoid potential sales churn and minimizes the amount of unsold products (Fawcett et al., 2022).

Also, coordination helps prevent overproduction or shortage of products. Collaboration

between the Procurement and Raw Material Planning department ensures that materials are available for production on time and in the required quantity. This improves the efficiency of the manufacturing process and ensures that products are available to customers on time (Christopher, 2016).

Advantages and Challenges of Coordination and Communication

Improved coordination helps to avoid surprises and deterioration of processes. Also, efficient communication between departments helps to solve various problems and challenges that may arise and to build a culture of cooperation (Hansen et al., 2019).

However, there are also challenges related to coordination and communication between departments. A possible challenge is the lack of time and resources to do the proper communication and coordination. Some organizations may have a dense hierarchical structure, which affects both vertical and horizontal communication. This can result in delays in the transmission of information and difficulties in identifying problems (Dent & Zhao, 2017).

In this chapter, we have examined the concept of operations management and the role of key departments such as Sales/Export, Finance, Production Planning, Raw Material Planning, Procurement and Production Leaders in managing the operations of organizations. Also, we have emphasized the importance of coordination and communication between departments for the performance of the organization.

Methodology

This research follows the principles of a case study method. The research methodology is based on an unstructured questionnaire and qualitative data, which will include several important steps to write a detailed and accurate report.

Qualitative interviews with the organization's staff

Interviews were conducted with members of the organization's staff, including department managers, technical and financial staff.

Enterprise documents were analyzed, including financial reports, asset reports, and department control documents.

The purpose of the study

The purpose of the work on this topic is to build an integrated system for asset management and departmental control for a medium-sized enterprise, and to analyze its impact on improving the efficiency and reducing the costs of the organization.

This topic aims to address the two main elements of a successful organization:

asset management and control of departments, which have an important role in performance and

the functioning of organizations.

Analysis of the results

The research was carried out in the Komodita company in Kosovo by analyzing the entire organizational structure and job descriptions as well as other important documents that the company provided for research. The research was carried out by analyzing each department separately, how the system that the company has created works.

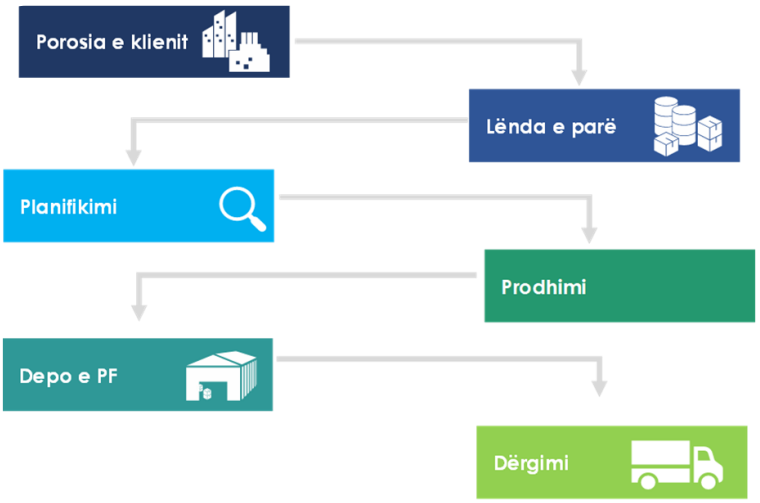

Fig. 5. Represents the work process from order to delivery (Komodita)

Export and Sales Department

Findings from the research on this topic, based on the export and sales procedure in a medium-sized enterprise, show that the construction of an integrated system for asset management and departmental control has a positive impact on improving efficiency and reducing expenses. Through this procedure, the organization has managed to ensure a good functional interaction between departments, helping to improve business processes.

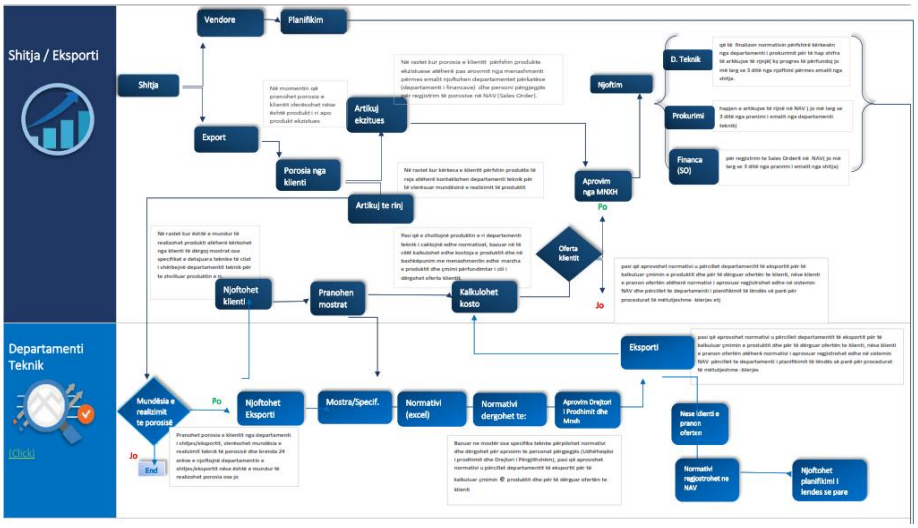

Fig. 6. Research findings for the Sales/Export department and the Technical Department

Technical department

The findings from the research for the Technical department show that the implementation of a structured and integrated procedure has influenced the improvement of the management of work processes in the technical department.

Raw materials planning department

The findings from the raw materials planning research show that the implementation of a structured procedure has influenced the improvement of raw materials planning management in the procurement department.

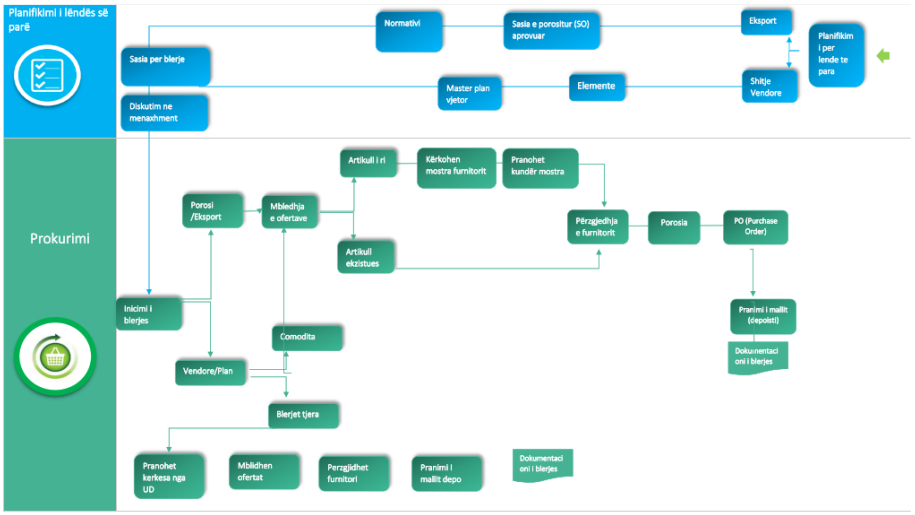

Fig. 7. Liaison between the Department for raw material planning and Procurement

Procurement department

Findings from the research for the research department regarding raw materials procurement procedures show that the implementation of a structured procedure has influenced the improvement of the management of the procurement process.

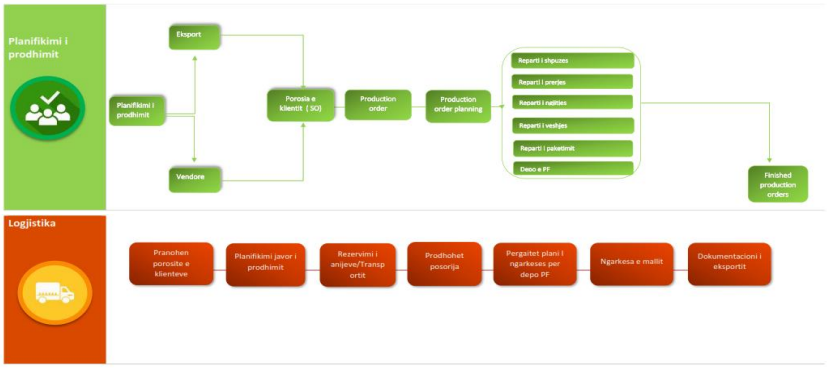

Fig. 8. Interconnection between the production planning department and Logistics

Conclusions and recommendations

The discussion and conclusions of this paper show the results and contribution of research in the field of operations management and company organization.

Based on the qualitative data collected regarding the different departments of the company, these discussions and conclusions present a detailed overview of the processes and procedures used for the management of sales, procurement, production planning, logistics and the research department. In the findings chapter, it was evident that in order to ensure an effective management of different departments, it is necessary to have a proper coordination and efficient communication between them.

Several responsibilities for departments and employee roles were identified, which contribute to joint work to achieve the company's goals.

In particular, the role of department heads was emphasized in terms of organizing and coordinating work processes. The conclusions showed that a good management of different departments and an appropriate coordination between them was necessary to achieve the goals and objectives of the company.

Through proper production planning, transparent procurement and efficient logistics, the company can ensure a successful operation and a favorable return on investment.

This research can be useful for practitioners and researchers in the field of operations management and company organization.

The contribution of this paper is in increasing the knowledge on the processes and practices of management of companies and can serve as a valuable resource for the future work in this field.

Some of the recommendations:

Improving coordination and communication

Production capacity planning

Stock monitoring and procurement process

Use of transport management systems

Using market analysis

Adaptation of company processes and policies

Investment in the use of information technology

Development of employee training and development programs

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Annex 1 - Questionaire

This questionnaire aims to obtain valuable and detailed information from department representatives to evaluate and improve their performance in accordance with the company's overall goals. Here are some questions specific to each department:

Sales and export department:

1. How do you coordinate weekly and monthly sales and export activities?

2. How are you managing the approval of Sales Orders and what criteria do you use for this?

3. How do you determine the production capacity based on the sales and export plan?

4. How do you communicate and collaborate with the production and raw material departments

to ensure that customer requirements are met on time?

Department of finances:

1. How do you manage the credit limit of consumers and what criteria do you use to evaluate it?

2. How are you monitoring product margin and how does this information influence your sales and export decision making?

3. How do you use financial analysis to identify opportunities for increasing the company's financial performance?

4. How are you collaborating with the production planning and raw material departments to determine funds needed for operations?

Production planning department:

1. How do you determine the production capacity plan and how do you help the sales and export departments to meet their requirements?

2. How do you manage the current stock and how do you use this information to determine the required quantities of raw materials?

3. How do you collaborate with the procurement and sales departments to determine the quantities of products to be ordered?

4. How do you plan for the production of new goods and how do you adapt to customer requirements for new products?

Department of Raw Material Planning:

1. How do you monitor the current stock of raw material and how do you determine the necessary amount of it?

2. How do you handle open orders and how do you manage the time of arrival of the necessary products?

3. How do you collaborate with the production and production planning departments to ensure that their raw material requirements are met on time?

4. How do you use demand analysis and statistics to identify trends and future raw material needs?

Procurement department:

1. How do you monitor open orders and how do you determine the time of arrival of the necessary products?

2. How do you collaborate with the production, sales and export departments to ensure that the supply of goods is in accordance with their requirements?

3. How do you identify obstacles in the buying process and how do you address them?

4. How do you use transportation cost and supplier performance analysis to improve procurement efficiency?

Logistics Department:

1. How do you manage the transport arrangement and how do you ensure that the goods are delivered on time and to the right destination?

2. How do you monitor and manage the movement of goods and stock in the warehouse?

3. How do you collaborate with the production and procurement departments to ensure that goods are available at the right time and in the right quantity?

4. How do you use technology and market analysis to improve logistics efficiency and reduce transportation cost?

Thank you for your time and help....

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