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THESIS

Contributions regarding the improvement of data security in the field of intellectual property at the organizational level as a result of the streamlining of quality management

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Content of the doctoral thesis

Contents summary thesis

1st Part. CURRENT STATE OF DATA SECURITY KNOWLEDGE IN AN INTELLECTUAL PROPERTY ORGANIZATION AS A RESULT OF ENHANCEMENT OF QUALITY MANAGEMENT

Chapter 1. INTELLECTUAL PROPERTY ORGANIZATIONS

Intellectual property (IP) pertains to any original creation of the human intellect, such as artistic, literary, technical or scientific creation. In the specialized literature, the legal rights granted to the inventor or creator to ensure protection over his invention or creation, for a certain period of time, are recognized as intellectual property rights (IPR). (EU, 2022)

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1.1 The Organization. Types of organizations

According to the specialized literature (Zlate, 2004) it can be stated that an organization is characterized as a combination and use of material, financial and especially human resources, necessary to achieve its main objectives.

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1.2 The knowledge-based organization. The learning organization

Knowledge is the basic structure and foundation of the knowledge-based economy. In this context, it is essential to be approached interdependently with data and information, concepts with which they have points in common. Relationships as described by Alan Burton Jones (Burton, 1999) between the three concepts - data, information and knowledge to which we can also add intelligence exists and can be graphically represented as those in figure 1.3 (Burton, 1999).

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1.3 The intellectual property organization, its place and role in the knowledge-based economy

Intellectual property refers to all the exclusive rights granted to intellectual creations. This is divided into three distinct branches:

- Industrial property, which includes inventions (invention patents), trademarks, industrial designs and models, utility models, topographies of semiconductor products and designations of origin;
- Copyright and related rights, which focus on literary and artistic works;
- The new varieties of plants.

Intellectual property rights represent the totality of exclusive privileges granted over intellectual creations. This sphere is divided into three distinct categories: designations of origin and copyright, which focus on literary and artistic works, new plant varieties, and industrial property, which includes inventions (patents), trademarks, designs and industrial models, topographies of semiconductor products.

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1.3.1 Knowledge-based economy

The concept of an economy based on acquired knowledge can be considered not just a simple advance of the information or computer revolution. Of course, there is a close connection between the information revolution and the knowledge revolution, but the latter is completely different in scope, nature and end results. In essence, the fundamental shift from a predominantly physical resource-based economy to a knowledge-based economy was achieved through the knowledge revolution.(Jatinder Gupta, Sushil Sharma, 2003).

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1.3.2 Knowledge-based management

Knowledge-based management is based on the use, generation and protection of specific knowledge that can add value to the organization. This knowledge is treated simultaneously as a resource, capital and its product (Claire R. McInerney, Michael E. D. Koenig, 2011). Knowledge-based management is a strategic approach to organizational administration focused on streamlining the collection, storage, processing and use of knowledge for the benefit of the organization.

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1.3.3 The place and role of knowledge in the intellectual property organization

Intellectual property is a type of legal right that gives the owner authorization to control the use of specific intangible assets, such as original creations, patents, trademarks, designs or expressions, topographies of integrated circuits, and plant varieties. (May, 2006).

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1.4 International intellectual property organizations

The main mission of these types of organizations is to ensure and guarantee the protection of intellectual property rights. It is important to highlight that goods that infringe intellectual property rights are products manufactured without the consent of the owner of that right.(Rodney D. Ryder, Ashwin Madhavan, 2014). These may include:

• **Counterfeit goods:** These are products that infringe the rights of a registered trademark and often imitate the original product. Clothes, cosmetics, medicine or printer ink and toner cartridges are among the most commonly counterfeited items.

• **Pirated goods:** These are products manufactured without the approval of the copyright holder. CDs and DVDs containing video games, music or movies are among the most pirated products.

• **Unfair competition:** This represents a form of merchant activity that is carried out by using illegal procedures, commercial practices.

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1.5 The services offered by intellectual property organizations at the international level

In order to maintain a high standard of quality in terms of the services provided, organizations with an object of activity in intellectual property must continuously improve their own quality management system

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1.6 Conclusions

The information technology revolution is changing access to information in fundamental ways in a context where intellectual capital is a highly valuable asset. Increasing amounts of information are available in digital form, networks interconnect the world's computers, and the World Wide Web provides a framework for accessing a vast electronic library of information, through favorite family recipes and newspaper articles, treatises and scholarly music, all available at the click of a mouse.

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Chapter 2. INFORMATION SYSTEM VERSUS COMPUTER SYSTEM IN AN INTELLECTUAL PROPERTY ORGANIZATION

Because of its incalculable value, information is a useful tool in an organization's decision-making, which is why it is necessary to protect it. The advancement of technology in the field of communications, as well as the increase in the ability of computers to communicate with other devices at a distance through what we call a data transmission network, have determined the need to improve the security measures necessary to protect the transmission of this data.

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2.1 Information system and related resources

An information system can be characterized as a set of components involved in the process of collecting, transmitting and processing information, having information in a central role within this system. By the notion of an information system, we mean all the material and financial resources that use information technologies to collect, process, store, search, transmit and visualize the information used in the processes carried out within an organization.

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2.2 Information flows and circuits

Information resources represent a component of the organization whose qualities have a significant impact on the content and overall efficiency. They can be defined as a systemic set of information generated, obtained, available and reusable within the organization. Information resources significantly influence both the manifestation of the organization's functions and the design of the organizational structures that are based on these functions.

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2.3 Specific procedures and particular means of sharing information in an intellectual property organization

The information procedures represent all the elements by which the methods of collection, registration, transmission and processing of information are established. By means of the informational procedures are defined:

a) The information media used, including the equipment used for recording them and their special characteristics;

b) The means used to collect, record, transmit and process information;

c) The procedure for handling information, including the operations they go through, the methods and data processing processes used.

2.4 IT system, components and resources required

The understanding of a computer system as a set of interconnected elements, including computing and data transmission systems, equipment and software applications, processed data, personnel and algorithms, is correct. These elements work together to process and transmit data, thus facilitating various activities within the organization. Information systems are essential for the effective management and manipulation of information in an organizational environment. The computer system occupies a key place within the information system, representing an essential component in its organization and operation. The computer system consists of a well-structured set of procedures and specialized electronic equipment, having a crucial role in facilitating the automated process of data processing and information generation.…

2.5 Organizational culture in an intellectual property organization to improve data security processes

The culture of the organization is a complex system of traditions, rituals, symbols, ideologies, beliefs, values, conceptions, norms and rules of behavior that are valued as representative of the organization and its existence, which are accepted and appropriated by its members.

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2.6 Conclusions

The rapid development of information technology and the exploitation of digital content in areas such as health, social inclusion, cultural heritage, public information, education, public administration or energy efficiency impose the need for more proactive policies. However, there are significant obstacles to the widespread and more effective use of information technology in these areas.

Among the main challenges are the unavailability of services based on information technology, the lack of interoperability of solutions at the level of Member States and the fragmentation of the market in terms of the information space and solutions based on these technologies.

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Chapter 3. QUALITY AND QUALITY MANAGEMENT IN AN INTELLECTUAL PROPERTY ORGANIZATION

3.1 The concept of quality and concepts associated with it

We find the word "Quality" in the specialized literature as having a multitude of meanings (Crosby, 1994):

a) **suitability for use and purpose**: a component is considered to be of good quality if it works well in the equipment for which it is intended. In other words, the product should be fit for its intended use and purpose. It is therefore defined as fit for purpose;

b) **compliance with the requirements:** which represents the ability of the material or component to function satisfactorily in the application for which it is constituted by the user. Therefore, product quality means compliance with customer requirements;

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3.2 The concept of quality management

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The implementation of a quality management system can help strengthen the reputation of the organization and increase customer satisfaction (Strenc, 2019).

In intellectual property organizations the quality management system is a unitary whole that primarily ensures the fulfillment of customer requirements, is established in writing and is applicable to all activities and operations of that organization. In the specialized literature, in accordance with the SR EN ISO9000:2015 standard, such a system guides and controls an organization in terms of quality (David H. , 2018).

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3.3 Quality standards applicable in an intellectual property organization

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The main process-based approach consists in identifying a system of processes within an organization, including identifying and managing the interactions of these processes, with the aim of coordinating them effectively to achieve the desired results. The ISO9000:2015 standard provides the basic principles, concepts and terminology associated with quality management systems (David H. , 2017). The principles of the quality management concept, presented in ISO9000:2015, ISO 9001:2015, ISO 14001:2015, ISO 27001:2018 and ISO 9004:2018, constitute the basis for the development of these international standards (Peckford G. S., 2012).

This standard provides a flexible framework that can be adapted to the diversity of organizations and industries, allowing them to configure their quality management systems according to their specifics, while still maintaining the fundamental principles of quality and continuous improvement. The requirements set out for the quality management system in this standard complement the product requirements. The standard aims to increase customer satisfaction by meeting their requirements. (Tricker, ISO 9000 pentru întreprinderi mici și mijlocii - Ray Tricker, 2000)

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3.4 Quality culture applied within intellectual property organizations

The literature emphasizes that quality management integrates and adapts the general functions of management, as originally identified and formulated by Henry Fayol. These functions include forecasting, organizing, training, coordinating, commanding and controlling. Over time, these general functions have remained valid, even though different specialists have compartmentalized the management process in various ways (Uzuegbu, 2015).

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3.5 An analysis of the need to implement integrated quality management systems in intellectual property organizations

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An important role in the development of a certified quality management system within an intellectual property organization is the involvement of its staff through effective leadership, increasing staff confidence in its development, staff retention and continuous training. All these elements but also the assessment of risks and opportunities are important requirements of the management standards and represent a continuous concern of the top management.

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3.6 The quality of data network security versus the quality of data security in the field of intellectual property

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The grouping of quality criteria of online services into evaluation areas can be achieved by: use, content, management, production and benefits which provide a comprehensive structure for evaluating and improving the user experience and performance of online services (Pușcoci, 2009).

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3.7 Current and perspective solutions regarding the resolution of crisis situations

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The implementation of a disaster recovery plan requires increasing the human resource capacity as well as the material and logistical resources of the IT department of the intellectual property

organization. This need to be able to recover data and computer systems in the event of a disaster requires an annual allocation supported by significant financial resources to implement such a disaster recovery plan.

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3.8 Conclusions

In conclusion, it is evident that the information technology revolution has had a significant impact on the way the public accesses information. The digital transformation has changed the communication paradigm and laid the foundations for a society where intellectual capital has a well-defined role in terms of its value. In this context, I mention that due to the availability of an ever-increasing amount of information in digital form, networks interconnect the world's computers, and the World Wide Web provides a framework for accessing a vast electronic library of information, through dedicated recipes, articles from newspapers, treatises and scholarly music, all now accessible at the click of a mouse.

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Chapter 4. TECHNOLOGIES FOR PROTECTING DATA COMMUNICATIONS NETWORKS IN AN INTELLECTUAL PROPERTY ORGANIZATION

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Data security, also known as information security or information security, is an essential aspect of the IT (Information Technology) department of any size and type of organization. Data security includes concepts such as data encryption and key management practices that help protect data across an organization's applications and platforms. Information and knowledge, enhanced by the use of new technologies, have become a central theme in everyday life. The new society that develops from this way of communicating leads the name of Information Society.

4.1 Authentication technologies at the level of data communications

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It should be emphasized that most users are familiar with the use of passwords as the primary authentication factor. Password is a piece of information known only to the user and is used to confirm his identity during the authentication process. This type of authentication is known as "knowledge-based authentication" and is based on something the user knows.(Todorov, 2007).

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4.1.1 Simple authentications

Authentication can be divided into the following types:

- Form based authentication In the custom form-based authentication process, users use their user ID (account) with the associated password in the Login window to prompt for identities.

- Authentication with SSL client certificate

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4.1.2 Advanced Authentications

This method represents a security system that requires more than one authentication method from independent credential categories to verify the user's identity for a login or other transaction. Multifactor authentication combines two or more independent credentials: what the user knows (password), what the user has (security key), and what the user is (biometric verification).

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4.2 Existing Encryption Technologies in a Data Communications Network

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Cryptology is particularly important in information security, especially in the context of digital communications and the preservation of sensitive data. Its practical uses include securing online communications, protecting personal data and financial information, but also ensuring privacy in various domains. Given the rapid evolution of technology and the rise of cyber threats, cryptology remains essential to maintaining information security in the digital world.

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4.2.1 Symmetric encryption

Symmetric encryption is the classic one, which uses an algorithm and a certain key to encrypt the information. The recipient will need the key with which the information was encrypted to be able to decode it.
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4.2.2 Asymmetric encryption

Public-key cryptography (or asymmetric cryptography) revolutionized information security, addressing the problem of key distribution and secrecy that was one of the major challenges of symmetric cryptography. In this subchapter we will briefly introduce some key points about public key cryptography (Slayton, 2022).
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4.2.3 Quantum encryption

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In this context, the sender wants to send a key to the recipient via a quantum channel. The value of each bit is encoded in a property of a photon, for example its polarization. The polarization of a photon is the direction of oscillation of its electric field. This polarization can be, for example, vertical, horizontal or diagonal (+ 45º and -45º). A filter can be used to distinguish between vertical or horizontal photons. Another filter is used to distinguish between diagonal photons (+45º and -45º).(Lomonaco, 2001)

For each bit of the key, the sender sends a photon, the polarization of which is chosen randomly. The selected guidelines are stored by the sender. For each received photon, the recipient randomly chooses which filter to use, and the selected filter and the measured value are recorded.

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4.3 Digital signatures - a viable option for data protection and certification

In specialized literature, a digital signature is represented as information that identifies the person who sent a document. This approach ensures the authenticity and integrity of messages in the digital environment, protecting them against forgery and unauthorized modification. It is an important aspect in the security of electronic communications and in the verification of identity in the online space (Utkarsh Tiwari, Satyanarayana Vollala, N. Ramasubramanian, 2021).

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4.4 Securing data from a research perspective

Contemporary society is an informational society, the new economy being based on services. Thus, the world of services must transform at a rapid pace into dynamic corporations of the information age. For this, it is necessary to develop, first of all, telecommunications services. The field of telecommunications is extremely important and plays a crucial role in the progress and efficient functioning of all other economic sectors as well as in the evolution of human society as a whole (Robert Deng, Jian Weng, Kui Ren, Vinod Yegneswaran, 2016).

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4.4.1 Presentation of Security techniques

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Data communications play a crucial role in today's interconnected world, and their security becomes a top priority. Our presentation explores various techniques and strategies used to ensure the confidentiality, integrity, and availability of information in data communications.

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4.4.2 Security Models

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The security model for a data network is structured on several levels, each with its well-defined role:

a) Physical security located at the outer level of the security model, the focus is on preventing unauthorized access to equipment and data. This aspect is essential to any electronic computing system, whether distributed or not. This security model aims to:

- Protecting physical infrastructure, including equipment and facilities;
- Monitoring and restricting physical access to critical areas.

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4.5 Conclusions

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Network security focuses on protecting data during transmission. The mechanisms and tools by which data protection is ensured, either stored or transmitted within an information system, are a way to ensure the availability, integrity of the data, but especially their confidentiality. Certain procedures are also indicated to mitigate different types of security threats. They also include a brief description of public key cryptography, symmetric key, and algorithms. Finally, some basic concepts of network perimeter security are discussed, including firewalls and intrusion detection systems such as and common security protocols in wireless networks. In this context, the analysis of risks and vulnerabilities in IT systems becomes a main component in the definition and analysis of modern communication systems.

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Chapter 5. INCIDENT MANAGEMENT IN THE DATA SECURITY PROCESS IN AN INTELLECTUAL PROPERTY ORGANIZATION

5.1 Definition and fundamental principles of the subject addressed

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The development of information systems in intellectual property organizations has also generated an increase in the dependence on the proper functioning of these systems, as well as the awareness of the fact that the issue of their security is becoming more and more relevant. Investing in comprehensive security solutions can enhance the stability and safety of information technology systems. It is often observed that the benefits will be more significant and the investment and effort will be reduced if a comprehensive approach is adopted instead of a one-off approach to the problems or, worse, in the case of an intervention only after the occurrence of a security incident.

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5.2 Incident management policies and strategies that may be implemented in an intellectual property organization

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Systems administrators, incident response team members, and organizational management share responsibility for incident management system activities, including post-incident activities. These include improving the incident management scheme, implementing measures to strengthen security and prevent similar incidents. In this context, there are scenarios where certain stages of the scheme, such as the detection and management of security events, can be outsourced and delegated to external parties, such as contractors, service providers or utilities, etc. (Kathy, 2018).

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5.3 Services, specific roles and responsibilities in the data security process

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To ensure the security of the information system at a level according to international security standards (ISO 27001:2018), the organization must have qualified personnel responsible for incident remediation management. In the doctoral thesis, this team will be referred to as the team that will ensure the appropriate response in the event of incidents. (Hardjono 7. T., 2003).

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5.4 Types of possible threats

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The usual flow of information in a data storage and transmission system is from source to destination. Within the security of these systems, attacks may consist of actions designed to intercept, modify, destroy or delay the normal flow of data (Deac-Șuteu, D.V., Moisescu, R.C., Țîțu, A.M., 2022). Protecting the integrity, confidentiality and availability of this information flow becomes essential to ensure system security.

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5.5 Monitoring data communications and detecting incidents and vulnerabilities and establishing countermeasures against computer attacks

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Existing vulnerabilities in modern information systems refer to any aspect or component of an information system (hardware or software) that presents a fragility, error or deficiency. These weaknesses may result from design, programming, or configuration errors.

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5.6 Event Centralization and Analysis

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Centralization, event analysis and incident management are important pillars in ensuring the security of IT systems. These practices not only help prevent cyber threats, but also help manage them effectively when they do occur. Implementing these processes is essential for organizations that want to maintain the integrity, confidentiality and availability of their information in the digital environment. In accordance with the provisions of security standards, organizations must implement processes and procedures, operational capabilities and technical resources necessary to prevent any type of threats, events or incidents that may occur at the level of information systems as follows:

a. Detection systems (IDS-intrusion detection systems IPS-intrusion prevention systems), firewall equipment, sensors or robots;

b. Systems of communication, centralization and reporting of events;

c. Systems for analyzing incidents and evaluating the most appropriate responses to them;

d. Qualified personnel in incident management who are assigned clear duties, roles and responsibilities in this area.

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5.7 Conclusions regarding the improvement of incident management in the data security process

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Protecting data communication networks thus becomes one of the basic pillars on which securing data and network applications against attacks and information theft is based. Organizations must analyze and implement a complete network security solution adapted to their needs to protect their data and IT resources. In light of increasingly sophisticated threats to data security, incident management is becoming a crucial component of the security process.

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Chapter 6. CONCLUSIONS REGARDING THE CURRENT STATE OF RESEARCH FOR IMPROVING INTELLECTUAL PROPERTY DATA SECURITY AT THE ORGANIZATIONAL LEVEL AS A RESULT OF ENHANCING QUALITY MANAGEMENT

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Information systems security seeks to ensure the confidentiality, integrity and availability of information systems and their components. Three main parts of a computer system are subject to attack: hardware, software and data. These three, as well as the communications between them, are susceptible to computer security vulnerabilities. In turn, those individuals and systems interested in compromising a system can design attacks that exploit existing vulnerabilities in information systems. In the first chapter, knowledge-based organizational models with a focus on intellectual property organizations were presented and analyzed. In the second chapter, the models of information systems, flows and circuits were analyzed and the specific and particular procedures for handling information in intellectual property organizations were detailed.

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2nd Part. CONTRIBUTIONS REGARDING THE RESEARCH AND DEVELOPMENT OF SOME MODELS FOR THE IMPROVEMENT OF DATA SECURITY IN THE FIELD OF INTELLECTUAL PROPERTY, AT THE OSIM LEVEL, AS A RESULT OF THE EFFICIENCY OF QUALITY MANAGEMENT

Chapter7. RESEARCH DIRECTIONS, MAIN OBJECTIVE AND METHODOLOGY

7.1 Research directions

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The process of improving data security and data communications in intellectual property organizations is addressed in this PhD thesis from the perspective of the interaction of quality requirements with engineering process deliverables in these organizations. In this sense, a main direction of research is the development of a model for analyzing the quality of IT data security in these organizations by testing and implementing data rescue and recovery technologies in disaster

situations with the aim of improving management but especially the quality of the associated processes. Among the deliverables that will be studied and modeled in the PhD thesis are the save and restore times required to recover computer data from different storage media and the levels of securing these data by applying encryption and deduplication technologies to these data. In this context, graphical modeling of global engineering processes represents another research direction, whose main goal is to identify the input and output parameters so that these processes can be functionally modeled in relation to their mechanisms. At the same time, we will be able to design a mathematical model related to those engineering processes that will be analyzed, based on the graphical modeling performed, with the aim of being able to measure and calculate the quality level of the deliverables and subsequently, the quality level of the associated services. In this way, we will choose for implementation an analyzed mathematical model that will correspond to the quality and data security requirements of the IT infrastructure within intellectual property organizations. One of the selection criteria of the mathematical model that we will propose for implementation in these organizations is that, regardless of the complexity of the services performed, their sequence or the methods used, this mathematical model should contribute to the improvement of the technical parameters specific to data security processes and data communications.

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7.2 The general objective of the research and the specific objectives

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The research in the preparation for the PhD concerns the improvement of data security in the field of intellectual property as a result of the efficiency of quality management at the organizational level. The doctoral topic to be addressed focuses on researching the methods by which the process of securing communications through data networks can be optimized, saving them in different storage media using specific methodologies and technologies, but also recovering them with the aim of to ensure the continuity of organizational activities after possible disaster scenarios. The doctoral thesis also highlights solutions such as innovation and technology transfer, with the aim of finding optimal solutions to current economic problems. The general objective of the doctoral thesis is to research, analyze and propose methods, solutions and technologies that will contribute to the improvement of data security in the field of intellectual property at the organizational level as a result of the efficiency of quality management. The specific objectives of this thesis are to research and find ways to improve the quality management of securing communications through data networks. These objectives are:

a) Application of new technologies to secure data and data networks;

b) Improving network security management and related services;

c) Designing new security architectures to protect data and data networks;

d) Analysis of existing and potential situations and the proposal of some strategies in order to eliminate the vulnerabilities of computer networks in the field of intellectual property;

e) Implementation of the final solution in the State Office for Inventions and Trademarks (OSIM).

The methodology applied in the development of mental maps aims at the coherent presentation of the logical path of the doctoral research, starting from the main objective and consistently following the logic of the specific objectives developed in the research reports (Ionescu, N., Vișan, A., 2016).

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7.3 Research methodology

Establishing the research objective represented the starting point in studying some possibilities to improve the management, but especially the quality of the sub-processes associated

with the data rescue and restoration processes in these organizations, being the synthesis of the current level of knowledge in the studied field. Thus, the research focused on improving the quality of data security services and data communications within intellectual property organizations, within the quality management system.

Current issues related to securing data and data communications at the organizational level were taken into account when establishing the objective. The concept of computer data security should not be limited only to the methods used to encrypt them in order to eliminate the possibility of interception and unauthorized access to computer resources. The modernization of IT systems has also led to the emergence of new forms of cyber-attacks, which affects the availability of IT system resources and implicitly access to data.

In this context, establishing the methods by which data security can be improved and implicitly its availability for intellectual property organizations was the main objective of the doctoral research. For the choice of the data analysis strategy, the estimated annual increase in the volume of data from the databases in relation to the number of protection requests that are estimated to be submitted during a calendar year to the studied organization was also taken into account. In this sense, the strategy of carrying out a classic experiment was chosen, by which the growth of a monthly data volume was simulated and the times to save and restore this data on various storage media were analyzed. Thus, after the analysis of the obtained data, technical solutions could be proposed for implementation to improve the parameters (times) of saving and restoring this data in the event of disasters. In this research, an analysis will be made of the intellectual property organization as well as of the ways in which the currently known quality principles will be applied. Processes aimed at managing data security and data communications requirements and their implementation in the production environment will also be addressed, as they are an integral part of the state-of-the-art study.

The graphical modeling that will be developed for these processes aims to study the links and interactions between them. By developing these graphical models, the interactions between the objective functions of these engineering processes will be analyzed. At the same time, it will be possible to analyze the interactions between quality requirements and the level of implementation of data security capabilities and data communications in intellectual property organizations, in order to establish the degree of mutual influence.

With the help of these experimental studies and based on the results obtained, the following assumptions can be made:

- the development and establishment of functional mathematical models, which include the key engineering processes, but especially their integration through the use of the IDEF methodology, is the essential starting point for the analysis of the functioning of data and communications security processes in organizations holding intellectual property;
- the establishment by the method of the functional graphic model from the IDEF0 methodology of some mathematical relationships that will allow the realization and analysis of some estimation calculations of the transformations that take place from the point of view of the quality of data security services and data communications.
- establishing the correlation that can be defined and validated between service quality requirements and the level of knowledge in global engineering processes. Carrying out an experiment by simulating the mathematical model is the next step in the applied research methodology.

The analysis and comparison of the simulation results will be performed in accordance with the real data obtained in the experiment carried out in the intellectual property organization (Ionescu, N., Vișan, A., 2016).

Chapter 8. CONTRIBUTIONS REGARDING THE POSSIBILITY OF EFFICIENCY AND COST REDUCTION FROM THE PERSPECTIVE OF THE IMPLEMENTATION OF A PROCESS ARCHITECTURE AT THE OSIM LEVEL

8.1 Data and software application and data rescue and recovery process architecture – solution to streamline intellectual property data security

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Backup operations will be scheduled to run automatically but will need to be checked and monitored periodically by a backup administrator for correct and error-free execution in order to take any remedial actions if the situation requires it. This contribution to the improvement of the computer data saving environment in OSIM is represented in figure 8.1.

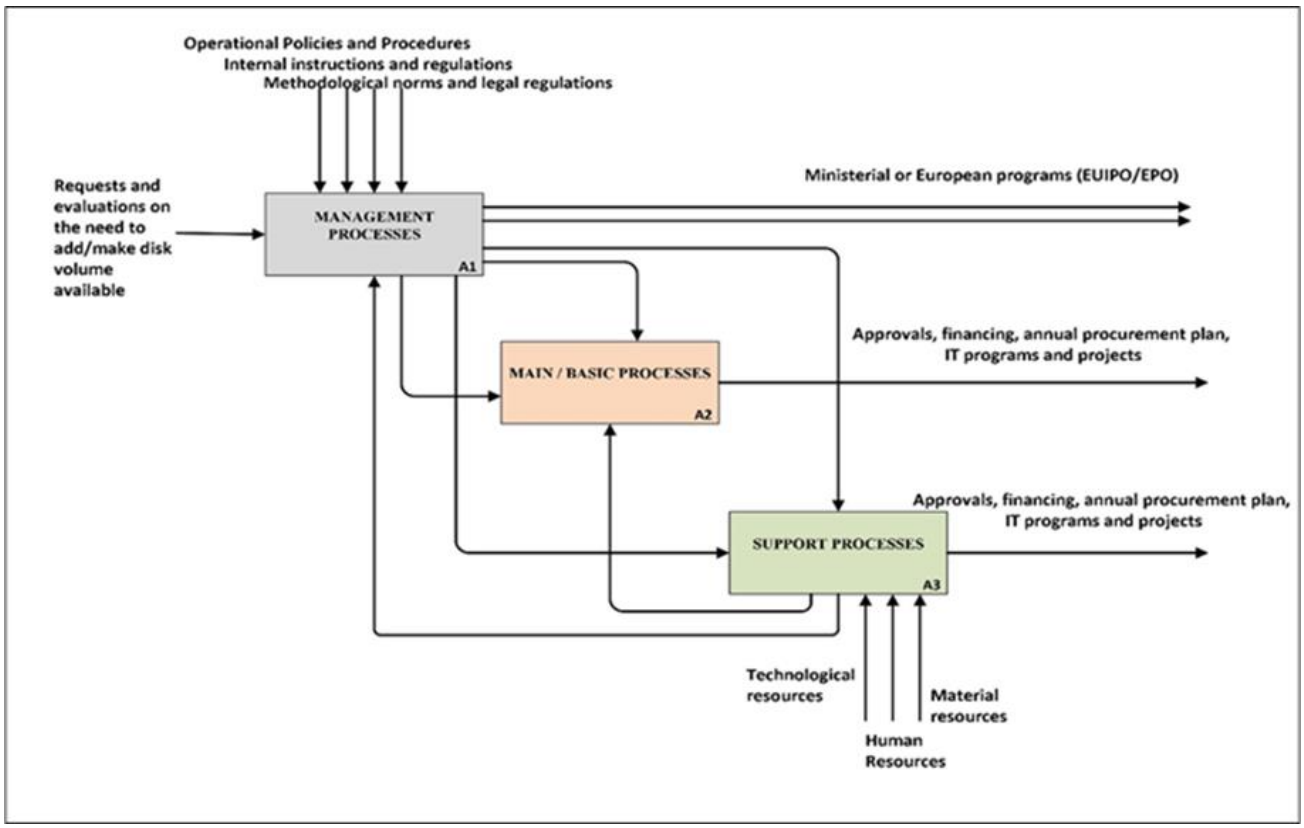

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Fig. 8.1 Global view of the core processes related to the proposed centralized storage system

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8.2 Identification, place and role of IT operations flows at the OSIM level

Electronic services developed in organizations whose object of activity is intellectual property, have a decisive role in facilitating the access of applicants for protection requests to: (Țîțu A. M., Oprean C., Boroiu A., 2011)

a. Search applications in the national invention database (Ropatent Search) or international (Espacenet, Patentscope - databases of the European Patent Office);

b. Search applications in the national and international databases of trademarks or industrial designs (DesignView, TMview - databases of the European Union Office for Intellectual Property);

c. Online registers of inventions, trademarks or industrial designs (Patreg);
d. Online Register of the European Patent Office;
e. The European Patent Register of OSIM;
f. Electronic submission systems for registration applications : invention patents, brands, designs and industrial models;
g. Electronic publishing services (Official Industrial Property Bulletins - BOPI);
h. Online search applications of PCT applications and patent documents of national and regional offices;
i. Electronic training and staff training services: online training in the field of intellectual property.

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8.2.1 Process map – process visualization tool at the OSIM level

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The process map represents an overview of the three types of processes existing in a national IP organization. The main three types of existing processes in OSIM are:

A. The management processes through which government policies are implemented, control in the areas of anti-corruption and anti-fraud, the internal audit is carried out or the coordination of the activities of the regional centers, the relations with similar bodies in the EU (EPO and EUIPO) or with the national offices of the EU member countries and not least the processes related to internal managerial control.

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8.2.2 Analysis and importance of IT operations flows at the OSIM level

Graphical modeling using the IDEF methodology is considered to be able to add value to the implementation of the centralized saving and restoration processes of the institution's data, being able to make the recovery and continuity of OSIM activities more efficient in the event of a disaster in the two scenarios presented. It should be noted that this type of modeling can be applied to all OSIM processes, as shown in figure 8.4, in different specialized branches, starting from the activities of preliminary examination, substantive examination, granting of industrial property titles and in general for all existing sub-processes in the institution. In order to optimize a process it is absolutely necessary to delve very deeply into all the activities and resources used within that process.

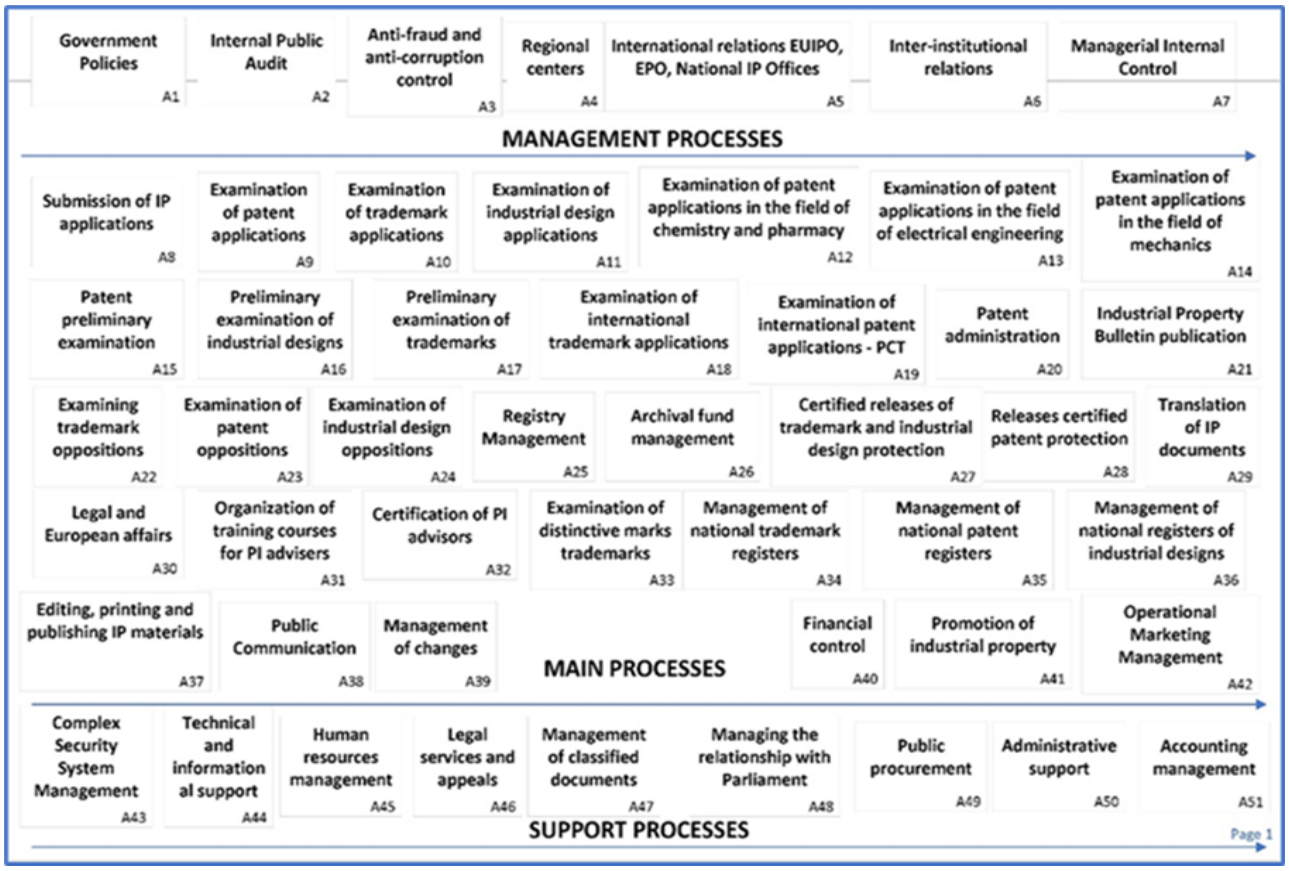

Fig. 8.4 Management processes in IP organizations

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8.3 Streamlining data security through protection mechanisms

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Implementing an effective data protection strategy requires not only technical expertise, but also a careful analysis of the costs and benefits involved. Proper management of this process ensures not only compliance with legal regulations, but also operational efficiency and resilience in the face of threats. Thus, data protection is no longer just an operational task, but becomes a key element in the overall security and continuity strategy of organizations.

…

8.4 Cost efficiency related to the proposed process architecture through the lens of quality management effectiveness

Electronic services are, in organizations with an object of activity in intellectual property, those types of services made available to the public through information and communication technologies in order to facilitate the access of requests to the systems for filing protection requests (NAS Guide: DIY NAS Guide, 2019). Facilitating both the access of requests for protection requests, of the various institutions of the central and local administration, as well as of the general public to the various applications and online registers of intellectual property is the main purpose of the implementation of such services in these organizations (Țîțu A. M., Moisescu R.C., Oprean C, 2021).

…

8.4.1 Efficiency and effectiveness in the context of the implementation of quality management in the analyzed information processes

The premise from which we started when we analyzed the implementation of such a solution for saving and restoring computer data was based on two criteria that define:

- the efficiency with which the data volume is saved and recovered, which represents the ratio between the results obtained in the saving and recovery process and the efforts made to carry out these operations. Indirectly, the efficiency with which the organization's critical data volume is saved and recovered is also determined by parameters such as the recovery point (PR), which characterizes the amount of data that the organization risks losing between two consecutive backup processes.
- the effectiveness with which the data recovery and the resumption of the organization's operations are carried out, determined by the recovery time parameter (TR) (27001:2018, 2018).

…

8.4.2 Cost efficiency perspectives related to the implementation of a process architecture

…

The reduction of the amount of copied data can be achieved through a management of scheduled data saving sessions but also through the use of new technologies such as data deduplication and has the direct result of increasing the efficiency of data saving and restoration processes. The management of scheduled data saving sessions is carried out at the level of the back-up application where full saving sessions can be combined with incremental saving sessions when the volume of data that has been changed from one day to another is reduced and it is not necessary to save the entire volume of data but only those that have been modified compared to the previous save session.
...

8.5 Conclusions

…

Increasing the efficiency of the processes of saving and restoring data from the information systems of intellectual property organizations can be achieved by:

a. reducing the amount of data that will be saved, which can be achieved through an analysis of these data volumes with the aim of selecting only that information that have value for the organization and that will be necessary in the restoration processes to ensure the continuation of operations the organization in cases of disasters;

b. reducing the amount of data to be saved, which can be achieved by applying advanced data deduplication technologies whereby only one sequence of data will be saved in the scenario where it is present several times in the volume of data to be saved. The implementation of this technology also ensures an increase in the level of data security by the fact that through a possible interception of these data sequences, it is impossible to recompose the original data;

…

Chapter 9. CONTRIBUTIONS REGARDING THE GRAPHICAL MODELING OF DATA SAVING AND RESTORATION SUB-PROCESSES WITHIN THE SUPPORT PROCESSES IMPLEMENTED AT THE OSIM LEVEL

9.1 IDEF methodology. Presentation and possibility of graphic modeling. The place and role of the IDEF methodology in the research context

…

The data saving solution that I propose to be implemented at OSIM provides a centralized backup platform for all IT systems in the institution's card, physical and virtual, as well as advanced integrations with hardware equipment from the category of centralized storage (Storage Area Network), for saving on disk or LTO6 type magnetic tape systems. The solution uses an Overland Neo 2000e type library to store backup images, as well as disk space licensed for use in the application within the limit of usable TB before compression and deduplication on Data Domain DD6300 equipment configured as a Data Domain Boost destination.

…

9.2 Application of the IDEF methodology for the data saving sub-process at the OSIM level

…

Within the centralized data saving and restoration system that I propose for implementation at OSIM, the management of the processes related to this system shown in figure 9.4 has as main objectives:

- Establishing the data to be saved and especially the frequency of these saves;
- Establishing the data retention period (processes M9, M10 from figure 9.4);

...

9.3 Application of the IDEF methodology for the data restoration sub-process at the OSIM level

Within the disaster recovery system that we propose for implementation at OSIM, the management of this system has as its main objectives:

- Establishing the data to be restored and especially the version of this data;
- Establishing the data retention period from which the restoration will be carried out (processes M9, M10 from figure 9.5) and implicitly the decision to restore the data from a certain period;
- Search for the version of the object that is requested to be restored. The search will be done according to criteria such as: the date it was saved, on what medium it was saved (disc volumes or LTO6 tapes), retention period – process A3 in figure 9.5.

…

9.4 Conclusions regarding the graphic modeling of the two sub-processes analyzed at the OSIM level

…

Improving the management of data and application quality for the two presented scenarios requires the creation and implementation of a recovery plan for activities after a disaster at OSIM. In this context, we propose the following:
a) Defining, implementing a centralized backup system that ensures the systematic creation, without errors or failed sessions, of backup copies of this data on different storage media (disk volumes, LTO6 type magnetic tapes or remote replications in secondary locations), thereby improving and automating centralized backup and restore processes;
b) Data protection and security by implementing encryption technologies both for data stored on LTO6 type magnetic tapes, on disk volumes in the SAN system and in the remote replication system;

…

Chapter10. CONTRIBUTIONS REGARDING THE MATHEMATICAL MODELING OF OSIM-LEVEL DATA SAVING AND RESTORATION SUB-PROCESSES

10.1 Mathematical modeling in the view of the doctoral research topic

Mathematical modeling is the process of describing a real-world problem in mathematical terms, usually in the form of equations, and using these equations both to help understand the original problem and to discover new features of the problem (Melnik, 2015). Modeling is thus at the heart of a great understanding of processes enabling engineers to design technologies of the future. With the help of mathematical modeling, complex processes can be understood and described, results and future developments can be anticipated.

...

10.2 Mathematical modeling principles related to the analyzed subprocesses

…

Mathematical modeling is a simplification of the studied problem to a small system of equations, which captures the essence by being simple enough to allow analytical calculations to be performed. A formula derived from an analytical calculation can provide a clear picture of the role of the parameters in that system without having to run a very large number of calculations.

…

10.3 Mathematical modeling of the data saving subprocess at the OSIM level

…

One of the most important concepts of data backup and recovery systems is data security. A data backup and restoration solution with robust security is vital to protecting an organization's project management data.

…

10.3.1 Presentation of the experiment, process variables and objective functions

…

In this experiment, the independent variables represent the formulation or process factors that have a set level at the beginning of the experimental design. To carry out the experimental study, the processed input parameters were: the size of the patent database, the growth of the database (which is estimated to be achieved by filing protection applications within the intellectual property organization over a period of 12 months) in each calendar month of the year, the estimated monthly number of protection applications taking into account also the characteristic specificity of the monthly variation of this number and data transfer rates on magnetic tape media and disk volumes (for equipment models used in experimental research).

...

10.3.2 Interpretation and analysis of the data obtained

…

The data obtained from the experiment are presented in table 10.1. I note that in table 10.1, the evolution of save time on disk volumes is presented according to the size of the database and the forecasted monthly growth.

Table 10.1 Experimental determinations of recovery times for parameters X_1 and X_2

	Tsd vs X_1 X_2										
Month	X_1 (TB)	X_2 (TB)	X_3 (Nr.)	X_4 (Mbps)	X_5 (Mbps)	Tsd (minutes)	Tsb (minutes)	Trb (minutes)	Trd (minutes)	FITS1	RESI1
1	1.2034	0.0008	876	381	562	185.5041	341.2132	389.6352	202.4123	173.7562311	11.74786
2	1.2054	0.001	1040	379	574	180.0001	334.6412	411.2411	198.2523	175.4453523	4.5547477
3	1.2074	0.0007	763	352	553	191.1151	344.2131	405.7843	187.2346	177.7260289	13.389071
4	1.2094	0.0006	626	356	586	175.1763	340.1145	417.7654	201.1213	179.7700834	-4.593783
5	1.2114	0.0009	968	348	534	102.4719	365.5241	423.7352	203.3633	181.3408934	-78.86899
6	1.2134	0.0009	988	332	547	195.7708	372.4457	392.7653	198.3466	183.2666368	12.504163
7	1.2154	0.001	1030	335	522	210.4469	381.8532	412.6432	223.7478	185.0740691	25.372830
8	1.2174	0.0009	863	348	561	189.3404	367.2134	413.8982	235.4353	187.1181235	2.2222764
9	1.2194	0.0009	930	364	550	195.6121	388.8716	432.7653	224.2352	189.0438669	6.5682331
10	1.2214	0.001	998	354	553	194.4906	396.1762	453.1213	211.4573	190.8512991	3.6393008
11	1.2334	0.0008	881	369	528	211.4646	421.8172	462.6532	228.6346	202.6423815	8.8222185
12	1.2594	0.0009	903	349	521	222.2008	427.7881	440.2136	235.3465	227.5587341	-5.357934

...

Figure 10.1 shows the surface plot to examine the relationship between the response variable Tsd (minutes) and two predictor variables X1 (database size measured in TB) and X2 (monthly database growth measured in TB) by visualizing a surface three dimensions of the predicted response.

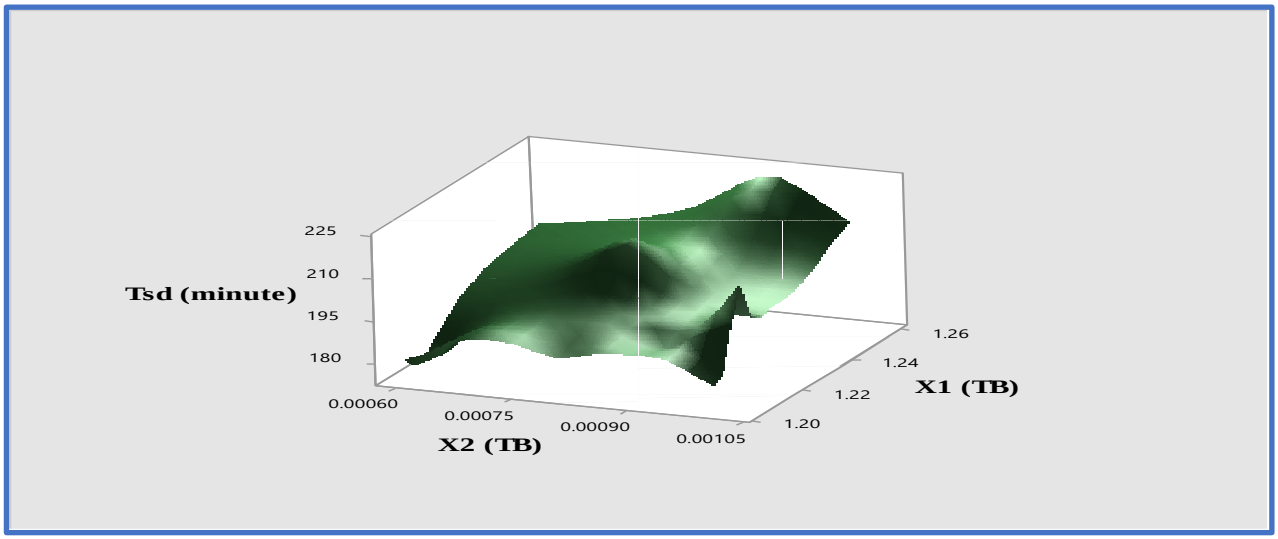

Fig. 10.1 The variation of the objective function Tsd according to the input quantities X1 and X2 nominated in subsection 10.3.1

…

10.4 Mathematical modeling of the data restoration subprocess at the OSIM level

The main purpose of saving data is to ensure its recovery and restoration in cases of necessity. An effective data recovery system reduces the downtime of organizations' IT systems and maximizes the functionality of their operations. Replication operations are a feature that is available in most data backup and recovery applications. This functionality creates and saves real-time copies of the organization's IT data. In case of data loss, replication thus allows projects to be restored in the shortest possible time.

10.4.1 Presentation of the experiment, process variables and objective functions

...

Input parameters

Input quantities (also called input parameters) will be denoted by:
X_1= the size of the database measured in TB where X1Є (1TB÷10TB);
X_2= monthly growth of the studied database measured in TB where X2Є (0.01TB÷0.03TB);
X_3= monthly number of protection requests submitted where X3Є (100÷2000);
X_4= data transfer rate measured in Mbps on magnetic tape where x4Є (100Mbps÷400Mbps);
X_5= data transfer rate on disks measured in Mbps where X5Є (300Mbps÷600Mbps);

…

10.4.2 Interpretation and analysis of the data obtained

A. *Mathematical modeling of Trb parameters as a function of X_1 and X_2*

In table 10.36 we presented the experimental values obtained for the data restoration times on the magnetic tapes that we obtained for the input quantities and for the objective functions presented in subchapter 10.3.1.

Table 10. 36 Experimental determinations of recovery times for parameters X_1 and X_2

	Trb vs X_1 X_2										
Month	X_1 (TB)	X_2 (TB)	X_3 (Nr.)	X_4 (Mbbs)	X_5 (Mbbs)	Tsd (minutes)	Tsb (minutes)	Trb (minutes)	Trd (minutes)	FITS1	RESI1
1	1.2034	0.0008	876	381	562	185.5041	341.2132	389.6352	202.4123	407.0331	-17.3979
2	1.2054	0.001	1040	379	574	180.0001	334.6412	411.2411	198.2523	410.42975	0.81134
3	1.2074	0.0007	763	352	553	191.1151	344.2131	405.7843	187.2346	410.04421	-4.2599
4	1.2094	0.0006	626	356	586	175.1763	340.1145	417.7654	201.1213	411.17155	6.5938
5	1.2114	0.0009	968	348	534	102.4719	365.5241	423.7352	203.3633	415.32465	8.4105
6	1.2134	0.0009	988	332	547	195.7708	372.4457	392.7653	198.3466	417.20843	-24.443
7	1.2154	0.001	1030	335	522	210.4469	381.8532	412.6432	223.7478	419.84865	-7.2054
8	1.2174	0.0009	863	348	561	189.3404	367.2134	413.8982	235.4353	420.975995	-7.0777
9	1.2194	0.0009	930	364	550	195.6121	388.8716	432.7653	224.2352	422.859774	9.9055
10	1.2214	0.001	998	354	553	194.4906	396.1762	453.1213	211.4573	425.499993	27.6213
11	1.2334	0.0008	881	369	528	211.4646	421.8172	462.6532	228.6346	435.289790	27.3634
12	1.2594	0.0009	903	349	521	222.2008	427.7881	440.2136	235.3465	460.535361	-20.3217

...

10.5 Mathematical modeling of the data deduplication subprocess at the OSIM level

…

Solving the requirements related to saving and storing data, regardless of their importance for the organization, often involves making periodic backup copies on tape drives or disks (backup) (Moisescu R.C., Olteanu C.D., Tertereanu P., Tîțu A.M., 2023). This process ensures compliance with regulatory and legislative requirements regarding archiving and facilitates quick access to required data. However, generating redundant data sets can become a challenge. But there are innovative solutions that copy, archive and index data in a single session, reducing the amount of data that needs to be stored long-term and thus saving organizations time. This efficient approach aligns with today's data management needs in a more practical and sustainable way (Moisescu, R.C., Olteanu C.D., Tertereanu P., Țîțu, A.M., 2023).

...

10.5.1 Prezentarea experimentului, a variabilelor de proces și a funcțiilor obiectiv

We used graphical modeling in this experiment to make abstract representations of both associated and related processes and subprocesses. Simulation thus allows imitating reality by manipulating a model. Simulating a model involves testing it under real or simulated conditions. Real-world testing is possible when a real mockup can be built, such as a communication architecture model used to test and determine specific parameters regarding data transmission and security.

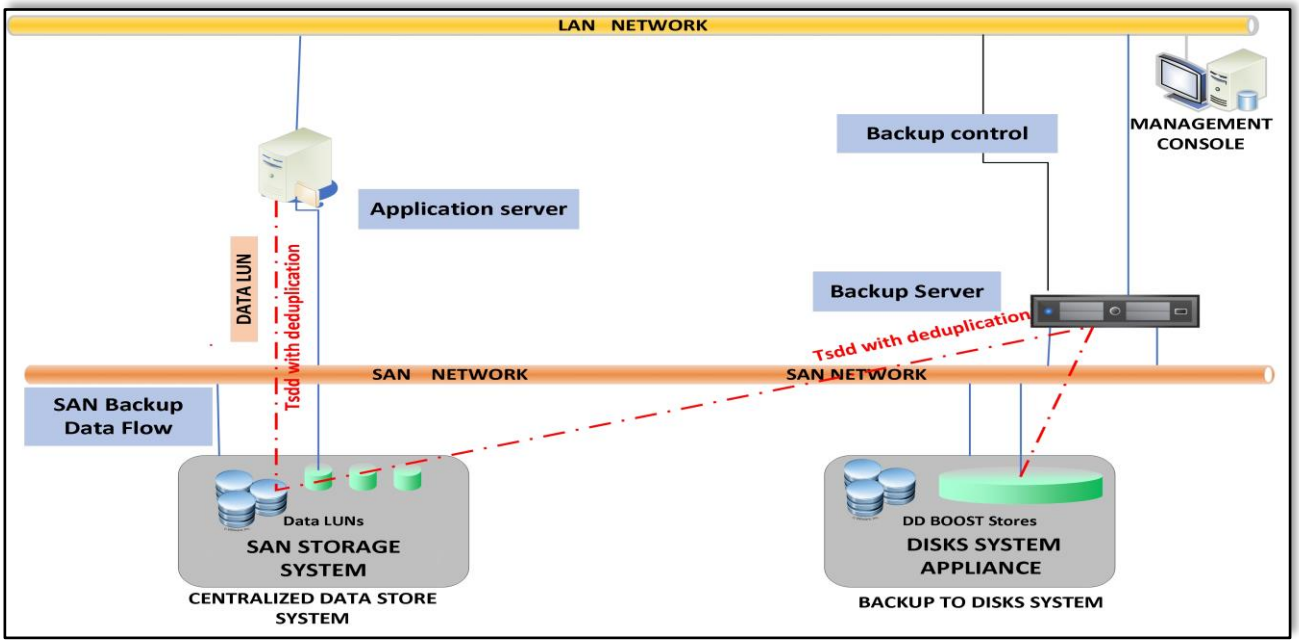

Fig. 10.83 The deduplication data save system used for the experiment

…

10.5.2 Interpretation and analysis of the data obtained

Experimental designs are used in various industrial sectors for the development and optimization of technological processes. In this sense, the use of the term optimization expresses the need to streamline or improve a certain process, the experimenter being responsible for establishing the analysis strategy that leads to the desired results.

...

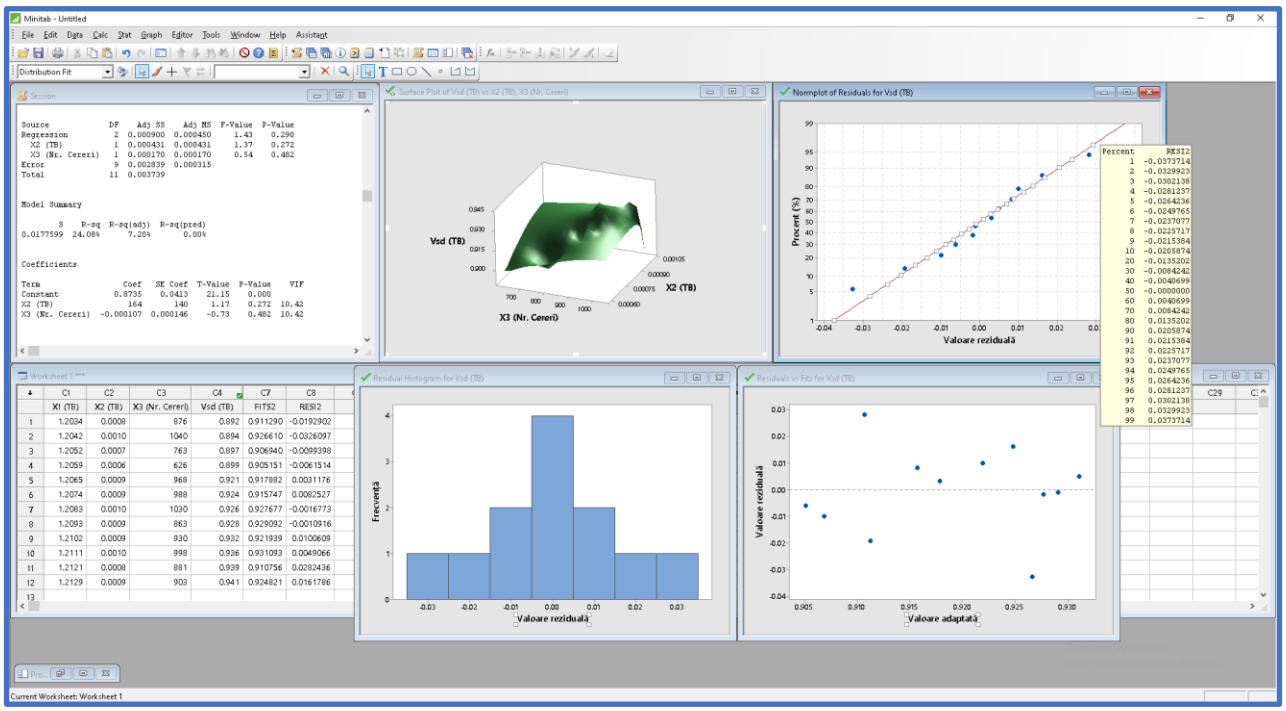

Fig. 10.89 Image from MiniTab GUI with regression analysis

…

10.6 Conclusions regarding the mathematical modeling of the three sub-processes analyzed at the OSIM level

In general, the main purpose of using new communication technologies and IT applications within the central and local public administration is to increase the quality of public services, secure data from intellectual property organizations and make the work of the administrative apparatus more efficient.

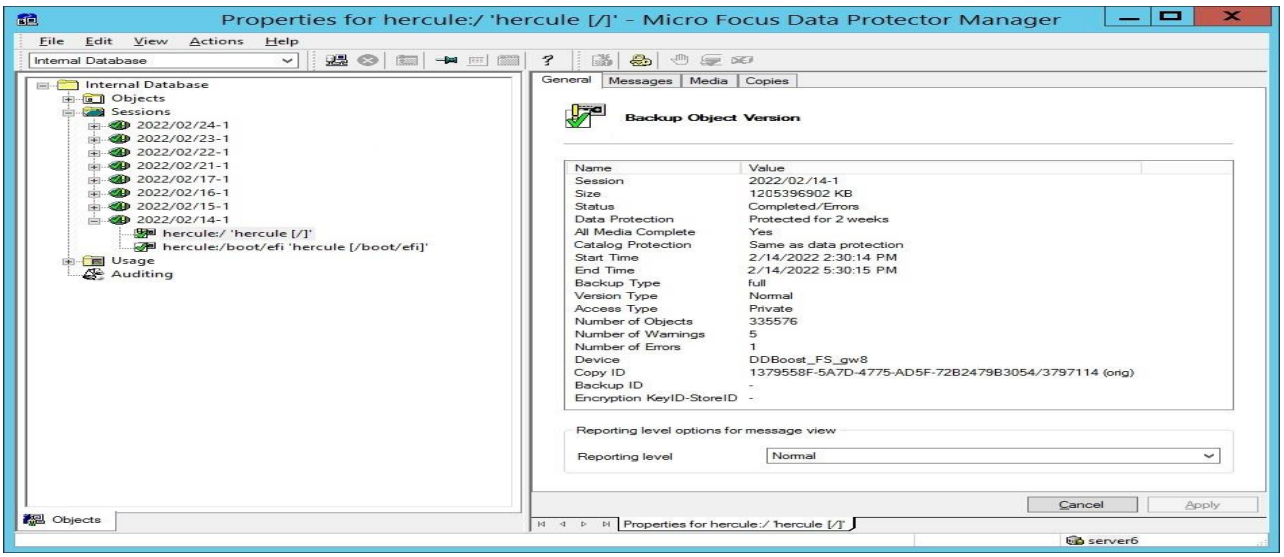

Fig. 10.104 Images from the classic experiment with the MicroFocus Manager interface

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Chapter11. CONTRIBUTIONS TO THE SIMULATION AND VALIDATION OF MODELING PERFORMED AT THE OSIM LEVEL

11.1 The need for simulation and validation for modeling done at the OSIM level

Through the mathematical modeling that I carried out in chapter 10 of the doctoral thesis, I tried to analyze the essential parameters of the security systems through OSIM data saving and restoration technologies, in systems of equations, with the aim of forecasting the evolution of the observed system while also the impact that the introduction of data deduplication mechanisms has on these parameters. The doctoral research that I carried out, which aims to describe a system of saving and restoring data with the help of a model, had three stages of study: the formulation of a model of the OSIM computer data backup system, its verification and carrying out experiments with the help of equipment specific to these processes and validating the proposed model for implementation in this institution.

…

11.2 Simulation of the proposed mathematical model and its implementation at OSIM

The classical experiment method that I used in my PhD research to determine the output parameters or objective functions using the MiniTab application is a valuable tool for analyzing and

validating the results of numerical models for OSIM data storage and retrieval systems in cases of disasters.
In the present study, the OSIM data saving and recovery conditions specific to the cases when these operations are carried out on two data writing and reading media, LTO6 magnetic tapes and SAS and SSD technology disk volumes, were addressed.

...

To calculate the efficiency that, following the implementation of the data deduplication technology, we obtained for the size of the data volumes saved and restored, we used the calculation formula:

$$\boldsymbol{Efficiency} = \frac{\text{Ef } (\boldsymbol{effort\ made})}{\text{E0 } (\boldsymbol{effort\ obtained})} = \frac{\text{X1 (TB)}}{Vsdd\ (TB)} \quad \textbf{(23)}$$

$$\boldsymbol{Efficiency} = \sum_{k=1}^{12} \frac{\text{X1 (TB)}}{\text{Vsdd (TB)}} = \frac{14.4965}{11,029} = 1,3143 \Longrightarrow \text{Efficiency} = +31,43\% \quad \textbf{(24)}$$

…

11.3 Validation of the proposed mathematical model

For the validation of the proposed mathematical models, we calculated the experimental verification of the regression equations obtained in Chapter 10 regarding "Contributions regarding the mathematical modeling of the data saving and restoration sub-processes at the OSIM level".
...

Figure 11.2 graphically represented the evolution of the sizes of the restoration times of the deduplicated data volumes and the evolution of the sizes of the restoration times of the data volumes saved without deduplication.

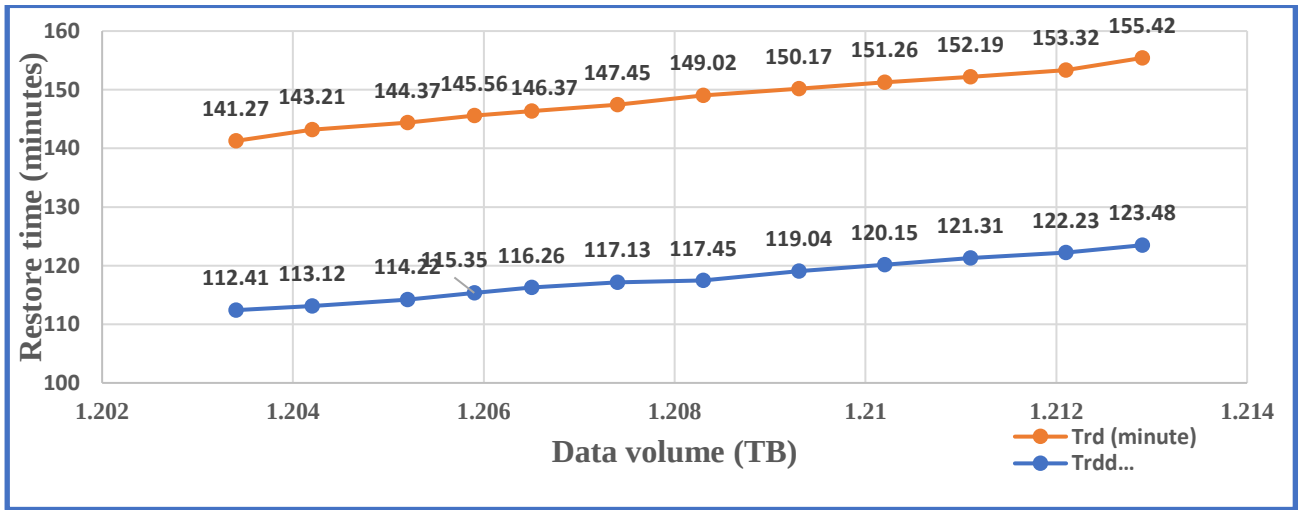

Fig. 11.2 Plot of X1 data volume size values versus restore time from deduplicated disks (Trdd) and restore time from non-deduplicated disks (Trd)

…

The output parameters represent the times required to transfer data in the save and recovery scenarios on and from the two storage media studied, disk volumes and LTO6 magnetic tapes.

A. Mathematical modeling of Tsd parameters as a function of X1 and X2
Determined regression equation:
Tsd = -984 + 963 X1 - 1183 X2 , (27)
Model Validation:
Tsd=-984+963*1.1931-1183*0.0007=164.1272 (minutes)
B. Mathematical modeling of Tsd parameters as a function of X1 and X5
The regression equation:
Tsd = -1354 + 1159 X1 + 0.237 X5 , (28)
Model Validation:
Tsd=-1354+1159*1.1931+0.237*577=165.5519 (minutes)
C. Mathematical modeling of Tsb parameters as a function of X4 and X5
Determined regression equation:
Tsb = 988 + 0.196 X4 - 1.246 X5 , (29)
Model Validation:
Tsb=998+0.196*361-1.246*577=349.814 (minutes)
D. Mathematical modeling of Tsb parameters as a function of X3 and X5
Determined regression equation:
Tsb = 1081 - 0.0243 X3 - 1.247 X5 , (30)
Model Validation:
Tsb=1081-0.0243*795-1.247*577=342.7395 (minutes)
E. Mathematical modeling of Trb parameters as a function of X1 and X2
Determined regression equation:
Trb = -732 + 942 X1 + 7564 X2 , (31)
Model Validation:
Trb=-732+942*1.1931+7564*0.0007=386.6054 (minutes)
F. Mathematical modeling of Trb parameters as a function of X3 and X4
Determined regression equation:
Trb = 352 + 0.0149 X3 + 0.158 X4 , (32)
Model Validation:
Trb=352+0.0149*795+0.158*361=420.8835 (minutes)
G. Mathematical modeling of Trd parameters as a function of X1 and X5
Determined regression equation:
Trd = -608 + 705 X1 - 0.070 X5 , (33)
Model Validation:
Trd=-608+705*1.1931-0.070*577=192.7455 (minutes)
H. Mathematical modeling of Trd parameters as a function of X2 and X5
Determined regression equation:
Trd = 389 + 21591 X2 - 0.356 X5 , (34)
Model Validation:
Trd=389+21591*0.0007-0.356*577=198.7017 (minutes)

…

11.4 Conclusions

…

From the calculations made with the input parameters determined in the classical experiment for the regression equations determined in chapter 10 of the doctoral thesis, it can be seen that, in general, the calculated output parameters fall within the experimentally determined values. Thus we can conclude that the determined mathematical models are validated by the fact that the values obtained

experimentally are consistent with those calculated according to the mathematical models made, the obtained mathematical models presenting a high correlation index. In conclusion, the mathematical model determined, applied to the average values of the studied database sizes, the number of protection requests filed and the monthly increase in the volume of data to be saved and restored, is valid.

…

Chapter 12. FINAL CONCLUSIONS, ORIGINAL CONTRIBUTIONS REGARDING THE DEVELOPMENT AND IMPLEMENTATION OF MODELS FOR ENHANCEMENT OF DATA SECURITY IN THE FIELD OF INTELLECTUAL PROPERTY AT OSIM LEVEL

12.1 Final conclusions

The information technology revolution has made an important contribution to changing the way in which information is made available to the population, in the context in which intellectual capital has become an extremely valuable asset. In this context, I mention that due to the availability of an ever-increasing amount of information in digital form, networks interconnect the world's computers, and the World Wide Web provides a framework for accessing a vast electronic library of information, all of which is now accessible through - a simple online access;

...

12.2 Original Contributions

a) In the first part of the doctoral thesis:

- Regarding the current state of data security in knowledge-based organizations, the following personal contributions were made:
- Carrying out an analysis of the main existing methods of data security at the organizational level;
- Presentation of an analysis of the most important intellectual property organizations at national, European and world level and their role in ensuring the protection of intellectual property rights;
- Documentary research and conclusions regarding standards in the field of quality applicable in intellectual property organizations;
- Carrying out an analysis regarding incident management in the data security process in an intellectual property organization;
- Defining and analyzing the main factors that can contribute to increasing the degree of security of informational data structures.

b) In the second part of the doctoral thesis:

- Designing two scenarios for saving and restoring computer data structures applicable to OSIM in disaster cases;
- Designing a plan for the continuation of OSIM operations applicable in the event of disasters;
- Defining the parameters regarding the times of saving and restoring data structures in the event of disasters;

- Carrying out experimental research with the help of centralized data saving equipment on two storage media: LTO6 magnetic tapes and disk volumes from equipment with Dell DataDomain technology in order to determine the times required to save and restore this data in situations of unavailability of the structure's main information;
- Carrying out experimental research with the help of centralized data saving equipment in order to establish the impact and the effects that the monthly increase in the volume of data structures has on the times and space required for saving and restoring this data;
- Carrying out experimental research related to the implementation of technologies for deduplication of data saved and restored from disk volumes;
- Deduplication has a direct impact on increasing the performance of the organization's data backup system. In this regard, it should be noted that the time required to perform backup or restore sessions is significantly reduced. This has a direct impact on reducing the number of failed backup sessions;
- Implementing the deduplication process has a direct impact on improving backup session management by facilitating session planning and scheduling. This management of backup sessions will eliminate the possibility of scheduling the execution of several backup sessions at the same time, the possibility of overloading the system and avoiding data loss.
- Creation of a mathematical model for checking the times required to save and restore data structures from OSIM as well as the space required to secure these data volumes;
- Validation of the mathematical model proposed for implementation at OSIM for saving and restoring data structures;
- Calculations to determine the increase in efficiency of times and volumes of data saved and restored by applying unstructured data deduplication technologies;
- Experimental research has shown that although the technology of writing and reading data to and from magnetic tapes seems obsolete, it is still a source of data security for organizations worthy of consideration, in that it provides significant storage capacity, on long term and independent of the main information system.

12.3 Further Research Directions

The researches that can be carried out within the data security theme are the following:
a) Research on the impact that the application of data deduplication technologies can have on increasing the level of data security;
b) Experimental research to restore deduplicated data structures to establish the degree of security and availability in the scenario where they would be compromised by a potential attacker;
c) Research on ways to improve technical parameters for remote data replication;
d) Research on the security conditions of data structures saved in the cloud environment;
e) Research on the impact of applying innovative technology for remote replication scenarios of Informix v.14 databases;
f) Experimental research on the migration and security of Informix type databases to version 14 in the context of the development of centralized data saving technologies and equipment;
g) Research on the level of interoperability of information systems in disaster scenarios;
h) The role of knowledge management in the context of securing data structures at the organizational level.

…

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*** Colecţia de Standarde în Domeniul Asigurării şi Managementului Calităţii.

Appendix A1

Appendix A2