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THESIS SUMMARY:

**CONTRIBUTIONS REGARDING THE
IMPROVEMENT OF SERVICE QUALITY IN
KNOWLEDGE-BASED ORGANIZATIONS
PROVIDING SERVICES TO CITIZENS**

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The summary of the doctoral thesis includes only a short rendering of the most relevant information contained in the thesis. (The author)

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FOREWORD

The thesis, "Contributions to Improving the Quality of Services in Knowledge-Based Organizations Providing Services to Citizens," represents research aimed at enhancing the quality of services of a public organization that offers services to citizens.

The entire course of the doctoral research was marked by the collaboration and professional guidance of the distinguished Professor Aurel Mihail ȚÎȚU in his capacity as scientific supervisor. I express my deep gratitude for the attentive guidance I received throughout my doctoral studies and the support and constant assistance. I particularly appreciate the availability provided along with the precious time given, the patience, and the trust I have gained from all this time. I express my appreciation for sharing your vast knowledge and exceptional professional experience, which has made the academic journey an inspiring and enlightening path.

The intellectual property rights for this doctoral thesis belong equally to the doctoral candidate, the doctoral supervisor, and the organization that contributed to the research presented. It is understood that the organization that contributed to the study refers to the organization mentioned in this doctoral thesis, especially in the second part. We comply with copyright law and its updates and acknowledge the organization's copyright, which provided us with all the support needed to develop the theoretical and practical elements.

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INTRODUCTION

Public organizations that provide services to citizens are established and funded by the government to deliver public services. Current digital technologies provide public administration with an opportunity to offer services to citizens more efficiently and with high quality. Gradually, changes began to emerge in the functioning and organization of public organizations. Citizens and public service beneficiaries are increasingly perceived as clients like private organizations. The specific behavior of private companies is becoming increasingly common among public organizations, which are starting to transform and operate similarly to private ones. An essential factor in achieving this endeavor is the increasing implementation of information technology; therefore, digitalizing public organizations' activities is a natural step.

The main objective of the researched public organization is coordination and control, while the use and improvement of knowledge are essential for fulfilling job responsibilities. For a public organization under investigation to function efficiently, it is essential for its members to share knowledge and continuously acquire new information. The organization operates within a legislative framework that is undergoing changes, which compels employees to enhance their knowledge continuously; therefore, it ensures that the services provided to citizens are efficient and prompt, meeting expectations and responding to the community's needs.

The Lisbon Strategy from the year 2000, adopted by the states of the European Union, emphasizes that it is essential for organizations, citizens, and European authorities to complete the transition to the digital age and to truly build a knowledge-based economy and society. It also calls for citizens to have a more significant presence of technology and science in their daily lives and to promote an inclusive knowledge society. (Lisbon, 2024) E-governance offers a solution for the digitalization of public services. Through e-governance, we understand the use of information and communication technology within the public sector to improve public services, facilitate citizen participation in this process, and lead to increased efficiency and accountability of the government.

The research aims to analyze, identify, and provide solutions for improving organizational activities to enhance the efficiency and quality of services offered to citizens. Thus, the general objective of the doctoral research theme has been defined as providing technical solutions regarding the enhancement of service quality in knowledge-based organizations that provide services to citizens by proposing solutions that will lead to the improvement of activities and processes taking place within the researched organization.

The doctoral thesis is divided into two sections. The first part, titled "The Current State of Knowledge Regarding the Improvement of Service Quality in Knowledge-Based Organizations Providing Services to Citizens," contains four chapters, while the second part, titled "Contributions to the Research and Development of the Service Quality Improvement Process in Public Knowledge-Based Organizations Providing Services to Citizens," contains six chapters.

The first chapter, "The Current State of Knowledge in the Field of Doctoral Research on Knowledge-Based Organizations, Management, and Economy," is structured into four subsections. Concepts related to knowledge-oriented organizations, knowledge management, and knowledge-based economy were addressed, aspects that are applicable to any type of organization.

In the next chapter, "The Current State of Knowledge in the Field of Doctoral Research on Quality and Quality Management in Public Knowledge-Based Organizations Providing Services to Citizens in the Context of a Knowledge-Based Economy," structured into seven subsections, aspects regarding concepts of quality, quality management, management principles, and continuous improvement are presented. These are ways to improve the quality of services in public organizations that provide knowledge-based services to citizens.

In chapter three, "The Current State of Knowledge in the Field of Doctoral Research on Internal and External Quality Assurance in Knowledge-Based Public Organizations Providing Services to Citizens," three subsections analyze aspects of service quality and management and the importance of implementing an integrated quality management system in a knowledge-based public organization providing services to citizens.

Chapter four is dedicated to the first part's conclusions regarding improving service quality in public organizations that provide knowledge-based services to citizens. The second part of the thesis is a section of contributions and begins with the chapter dedicated to "Directions, general objective, specific objectives, and research methodology for improving the quality of services in public organizations based on the knowledge that provides services to citizens."

Chapter six, "Contributions Regarding Quality and Quality Management in a County Direction for Personal Records," is structured into six subsections. The concepts regarding the public organization that provides services to citizens and implements a quality management system have been analyzed, including elements related to quality and quality management in service-providing organizations for citizens and the necessity of implementing an integrated quality system. In this chapter, a SWOT analysis was conducted, along with some research and perspectives regarding the approach to service quality in public organizations that provide knowledge-based services to citizens.

Chapter seven, "Contributions Regarding the Evolution of Information Systems in the County Direction of Personal Records in Sibiu," is structured into seven subsections that analyze the information system versus the informational system with their particularities, the typology of the information system, and the informational system of e-Government. Additionally, analyses were conducted regarding implementing an information system within the studied organization and the contributions concerning managing informational processes within the studied organization.

The next chapter, "Contributions Regarding the Graphic Modeling of Processes within the Sibiu County Directorate for Person Records," is structured into five subsections in which the studied organization is presented, existing processes within the organization are identified and analyzed, the departments and services within the organization are outlined, and a map of the identified processes is created. It was also recommended that a process map be created with proposed recommendations for improvement. Graphic modeling was performed using the IDEF0 methodology for the process of computer system management, specifically for the subprocess Data and Network Security, as well as a graphic model for the subprocess Digital Archiving.

Chapter nine, "Contributions to the mathematical modeling of the computer system management process the digital archiving subprocess," is structured into three subsections. The mathematical modeling of the Digital Archiving subprocess has been conducted, and a central composite factorial experiment has been carried out for the same Digital Archiving subprocess.

The last chapter is dedicated to the final conclusions, where conclusions have been defined, original contributions have been presented, and research directions that can be further explored have been highlighted.

PART I. CURRENT STATE OF KNOWLEDGE REGARDING THE IMPROVEMENT OF SERVICE QUALITY IN KNOWLEDGE-BASED ORGANIZATIONS PROVIDING SERVICES TO CITIZENS

1. CURRENT STATE OF KNOWLEDGE IN THE FIELD OF DOCTORAL RESEARCH ON ORGANIZATION, MANAGEMENT, AND KNOWLEDGE-BASED ECONOMY

1.1 Knowledge-Based Organization

Organizations have played a very important role through their contribution to the development of society and the modern economy. They are part of our lives and have evolved significantly over the years. According to the Oxford Dictionary, an organization can be considered a group of people working together to achieve a common goal (Oxford Learner's Dictionaries, 2023). Organizations have complex structures that are oriented toward achieving their goals.

The information society humanity is heading towards is defined as a society of knowledge and organizations simultaneously. (Drucker, 1992). Since the 1980s, when the notion of knowledge-based organization emerged, the concept has gone through successive stages.

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1.1.4 The learning organization. Innovative Organization

One step in the emergence of a knowledge-based organization is transforming the organization into a learning organization. In the specialized literature, a learning organization is defined as one in which the members continuously develop their ability to achieve desired results, where new ways of thinking materialize, and where employees learn how to learn together. This implies the existence of an environment that allows and encourages collective experiences, and collaborative learning benefits both employees and the organization. In practice, a learning organization develops a clear understanding of the current reality accessible to the entire organization and is used to create new knowledge available to all to undertake useful actions for the organization's objectives (Senge, și alții, 2016).

Organizations that learn exist only through employees who learn, but individual learning does not guarantee organizational learning; however, organizational learning does not occur without individual learning. (Senge, și alții, 2016).

The concept of a knowledge-based organization emerged from the resource-based theory of the organization as an adaptation to the ongoing knowledge revolution.

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1.1.5 Characteristics of Knowledge-Based Organizations

The concept of a knowledge-based organization

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The knowledge-based organization evolved from the resource-based organization. Knowledge is one of an organization's main values. Using knowledge within an organization can enhance quality and competitiveness in the competitive market and significantly improve the organization's image.

1.1.6 Public Organization Providing Services to Citizens

According to the Law on the Administrative Code of Romania, a public institution is a functional organization that operates under public authority, provides public services, and is financed from state funds, by public finance law.

In a traditional sense, a public organization is a social entity that operates to achieve specific objectives to fulfill its purpose of meeting public needs. (Vlăsceanu, 2002)

A public organization is one with decision-making authority and resources to achieve its main objectives and operate within a specific framework to meet social needs.

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The trend is for public organizations to develop management based on financial efficiency, focusing on improving the quality of services and adopting behaviors typical of private organizations. The citizen, who is the beneficiary of public services, is starting to be seen by public organizations as clients, similar to private organizations. Public organizations are increasingly behaving like private organizations, and the barriers between the two types of organizations tend to diminish.

1.2 Knowledge-Based Management

One of the first definitions of knowledge-based management in the specialized literature in Romania is provided by Nicolescu (Nicolescu & Nicolescu, Economia, firma și managementul bazate pe cunoștințe, 2005):

- Knowledge-based management is a science that studies the processes and management relationships that rely on knowledge, identifies the principles that coordinate them, and creates new methods, procedures, technologies, etc., to improve an organization's performance and efficiency by harnessing the power of knowledge;
- Knowledge-based management, from a practical activity perspective, is characterized by the approaches taken, the manner of action, and the techniques of the company that focus on the production and utilization of knowledge. This ensures a superior utilization of knowledge compared to previous periods.

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1.3 Knowledge-Based Economy

In a global economy that relies on knowledge, significant opportunities and major threats arise. These opportunities are more evident for less developed countries, which have a problem with poverty but wish to achieve sustainable development. Similarly, these opportunities are also for countries transitioning from centralized to democratic forms of economic organization.

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Ovidiu Nicolescu, a management expert, points out that the knowledge-based economy is characterized by the ability to transform knowledge into raw resources, values, goods, and essential production elements through economic methods that include producing, marketing, purchasing, studying, storing, evolving, sharing, and protecting knowledge. These processes are essential for generating profit and ensuring the sustainability of the economy. (Nicolescu & Nicolescu, *Economia, firma și managementul bazate pe cunoștințe*, 2005)

...

1.4 Conclusions

A modern organization is based on achieving results by ensuring an employee-oriented environment and fostering stronger employee relationships. This makes organizations more flexible and adaptable, allowing them to withstand market changes and respond more promptly and efficiently to the needs of employees and customers.

In a modern vision, we can consider an organization to be a group of people with a specific organization oriented toward obtaining a product or service intended for a client.

In a modern vision, people and their relationships are the key elements of an organization. The organization functions efficiently when people interact to fulfill certain essential roles in achieving goals.

A modern vision organization aims to enhance its performance by motivating employees, utilizing technology, and diversifying how it provides value to partners and clients. These aspects contribute to creating a motivating and productive work environment, achieved by implementing changes in management practices and how employees are engaged to contribute to the organization's goals.

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Knowledge-based management is one of the latest management theories and practices, and different perspectives define this concept. We believe that knowledge-based management has scientific and artistic values, and previous experiences in managerial practice lead to an effective utilization of knowledge through decisions that make the organization more efficient and sustainable.

We consider that in the current knowledge-based economy, knowledge represents the raw material, resources, and product of a knowledge-based organization. Knowledge has become essential

for achieving high productivity and serves as a foundation for attaining high competitiveness for organizations in the current context of the global national economy.

2. CURRENT STATE OF KNOWLEDGE IN THE FIELD OF DOCTORAL RESEARCH ON QUALITY AND QUALITY MANAGEMENT IN PUBLIC ORGANIZATIONS BASED ON KNOWLEDGE PROVIDING SERVICES TO CITIZENS IN THE CONTEXT OF A KNOWLEDGE-BASED ECONOMY

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2.2 The concept of quality in a modern vision

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The ISO 9000:2015 standard offers a new perspective on the fundamental concepts of quality: Quality represents an entity's characteristics that enable it to meet declared or implied requirements. According to this definition:

- quality is described by a group of characteristics (not just one characteristic);
- quality is dependent on customer needs;
- quality is not a discrete variable but a continuous one;
- quality meets both explicit and implicit needs.

According to the standard definition, an entity can be an activity, process, product, organization, system, person, or a combination of these. The product represents the result of specific actions or processes. Products, by their nature, can be grouped into several categories: a) hardware (including components and subassemblies); b) software - applications that include programs, procedures, information, and data; c) materials that have been processed; d) services. The product name can be used for both a category and combinations.

The term services refers to the interactions between the producer and the consumer, as well as the producer's internal activities to meet the consumer's needs.

The characteristics of quality form the foundation of quality. Quality characteristics are any size, chemical characteristics, organoleptic properties (such as taste, smell, etc.), shelf life, reliability, or others that provide the product with the features that make it suitable. (Juran & Grynia, 1973)

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We consider quality to be a set of characteristics closely reflected in customers' needs and the price of the product or service. On the other hand, the costs necessary for producing products and services also play an essential role for the organization. Quality is crucial in positioning an organization in an increasingly competitive market.

2.3 Quality management in the context of knowledge-based management in public organizations providing services to citizens

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In specialized literature, quality management is described as a set of administrative functions that determine the policies, objectives, and responsibilities related to quality and implement them within the quality system using methods such as planning, control, assurance, and quality improvement. Each level of management is responsible for quality, but coordination is the task of the organization's leadership. The participation of every employee in the organization is essential for the implementation of quality management.

The implementation of quality management begins with the development of a quality policy, which outlines the organization's general directions for achieving quality and establishes the responsibilities for the activities necessary to meet quality objectives. These activities include planning, monitoring, ensuring, and improving quality, all of which are components of the quality management system within the organization. (Oprean, Tițu, & Boroșiu, 2011)

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2.6 Continuous improvement – a solution for enhancing the quality of services in knowledge-based public organizations providing services to citizens

Continuous improvement can be applied in any organization, and for a public organization providing services to citizens through its implementation, it can lead to an increase in service quality and involves the following:

- Continuous improvement of processes and services must be a constant concern for all employees within the organization;
- Applying the fundamental principles of continuous improvement is necessary to achieve the desired results of significant improvements.
- To timely determine the areas that require improvements, it is necessary to evaluate the level of excellence periodically;
- Analyzing all processes and actions within the organization and implementing a continuous improvement of quality and efficiency;
- Prevention actions should be a priority;
- Providing training and education to all staff to familiarize them with continuous improvement methods and quality management, among others;
- Determining the areas for improvement as well as the strategies needed to achieve them;
- Appreciation of employees for the objectives achieved in the direction of continuous improvement of processes

Continuous improvement of processes within the organization at all stages of product realization, starting from identifying the needs of beneficiaries through market research and reaching the commitment to the proper use of products, is the way in which the organization can continue to improve the products and services offered. Employees play an important role; their concerns must be ongoing to improve their work and enhance the activities performed.

2.7 Conclusions

In the current economy with knowledge-based organizations and management, we consider quality to be a set of characteristics reflected in customer needs and the price of the product or service. On the other hand, the costs necessary for producing products and services also play a very important role for the organization. Quality plays a crucial role in positioning an organization in an increasingly competitive market.

It can be said that quality cannot be achieved at a high level solely through inspection and control; it is built step by step through rigorous planning. Achieving quality in a knowledge-based organization can only be accomplished by implementing a quality management system, which can provide a competitive advantage in today's market.

Long-term quality is achieved through a constant focus on obtaining quality, with a management approach centered on and supported by quality. Excellence is a goal that any organization can achieve. Excellence means success in the activities carried out by producing high-quality products quickly and efficiently so that they reach the recipients within the established timeframe. This is possible through a particular interest in technology, organization, and business.

...

Total quality can only be achieved with the involvement of all employees through continuous improvement and total quality management.

We consider quality management to be implemented through a quality system with managerial architecture supported by well-defined procedures, efficient processes, and the necessary resources. In an organization, quality management develops a policy focused on improving quality, which involves planning, control, assurance, and continuous quality optimization.

...

3. CURRENT STATE OF KNOWLEDGE IN THE FIELD OF DOCTORAL RESEARCH TOPIC REGARDING INTERNAL AND EXTERNAL QUALITY ASSURANCE IN KNOWLEDGE-BASED PUBLIC ORGANIZATIONS PROVIDING SERVICES TO CITIZENS

3.1 Quality and quality management of services in knowledge-based public organizations providing services to citizens

...

In quality management, organizations aim to achieve products that (Fig. 3.1) (Oprean, Țîțu, & Bucur, 2011): meet a requirement or satisfy a clear purpose; fulfill the beneficiaries' requirements; comply with established standards and requirements; meet societal standards; consider the importance of environmental protection; have reasonable prices; and generate profit.

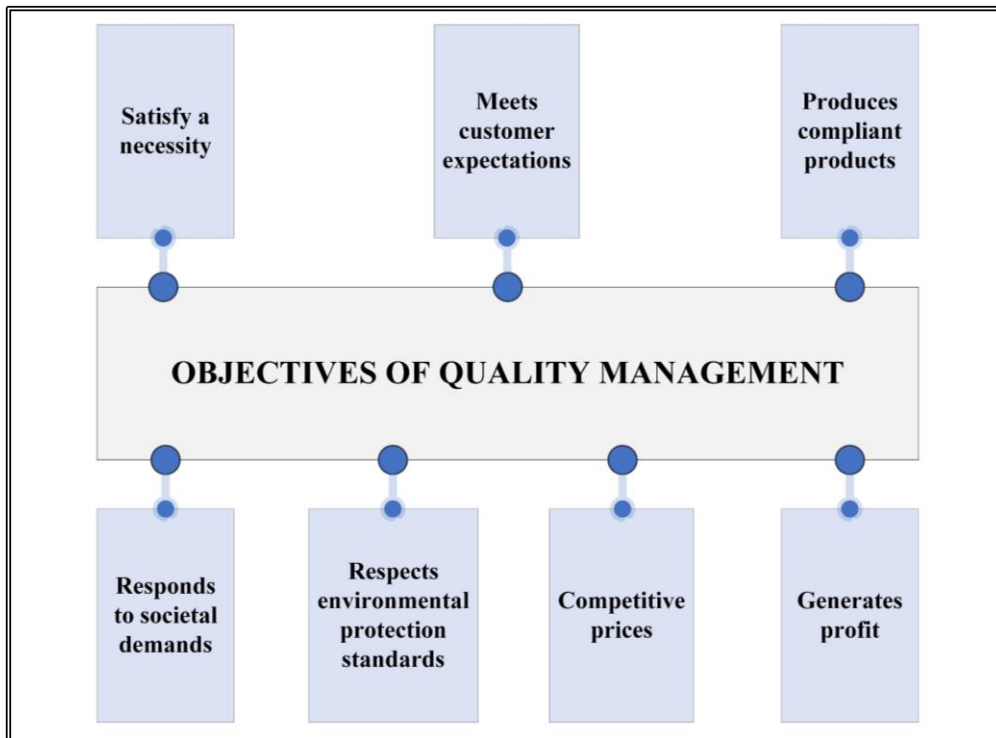


Fig. 3.1 Objectives of quality management

It can be considered that quality management can be implemented through a quality system, encompassing everything it represents: the organizational structure, procedures, processes, and necessary resources. Within the researched organization, quality management must create a policy for improving service quality through planning, control, fulfillment, and quality enhancement, focusing on meeting the citizens' requirements.

It can be said that the quality management system is the organizational framework that includes the processes, procedures, and resources necessary to implement quality management.

3.1.1 Service to citizens. Concepts and Perceptions

...

Public service can be considered a set of planned and approved activities by the public administration to meet the social demands of public interest.

...

For the establishment of a public service, certain basic principles must be observed:

- the principle of continuity - the permanence of the public service;
- the principle of adaptability - adapting to changes and demands of the public interest;
- the principle of neutrality - meeting the general interest;
- the principle of equality - all interested individuals can request and benefit without differentiation or discrimination.

...

3.1.4 The concept of total quality applied in a management system within a public organization providing services to citizens

...

Total quality can be understood as an organization's goal, while total quality management represents the means by which an organization achieves total quality. (Oprean, Țîțu, & Bucur, 2011)

...

In other words, overall quality is not limited to the product or service offered; it also includes meeting consumer expectations. The organization's needs must be taken into account to ensure profitability. An organization's objective can be total quality, and total quality management should be the means by which this objective is achieved.

An alt specialist describes the relationship between "quality," "total quality," and "total quality management" in a similar way: quality means meeting the beneficiary's requirements, while total quality involves consistently satisfying the customer's demands while keeping costs as low as possible.

...

3.2 The importance of implementing an integrated quality management system in knowledge-based public organizations providing services to citizens

Integrated quality management systems

An integrated management system (ISO) combines an organization's relevant elements into a single system, allowing the organization to achieve its objectives.

The integrated management system ISO unifies all the organization's systems and processes into a single system, allowing for coordinated operation to achieve common goals. By implementing this integrated system, the organization becomes a coherent entity, with each activity directed towards a single goal: enhancing performance within the organization.

...

An integrated management system can be called one that integrates two or more components from quality management, environmental management system, and occupational health and safety management. In some organizations, an information security management system can also be integrated.

...

The role of an integrated management system is to assist managers in achieving the organization's objectives, reducing costs, optimizing processes, supporting employees in implementing processes, providing a positive evaluation of management activities within the organization, and bringing sustainability to the organization.

The integrated management provided by quality management, environmental management, occupational health, and safety management, and an information security management system offer interrelated management types, each based on similar principles. Integrating management systems

through ISO certification represents a solution for implementing strategy and total quality management.

3.2.1 Standards in the field of quality in the context of the doctoral research theme

Compliance with quality standards and procedures, as well as formal correctness, has been and will continue to be an essential component of the development of public administration. Conceptually, quality must be an integral part of the public system. Additionally, for the implementation of an integrated management system, a report can be made to the standard systems regarding the characteristics of products or services and the possibilities of meeting the requirements expected by citizens, according to Figure 3.7.

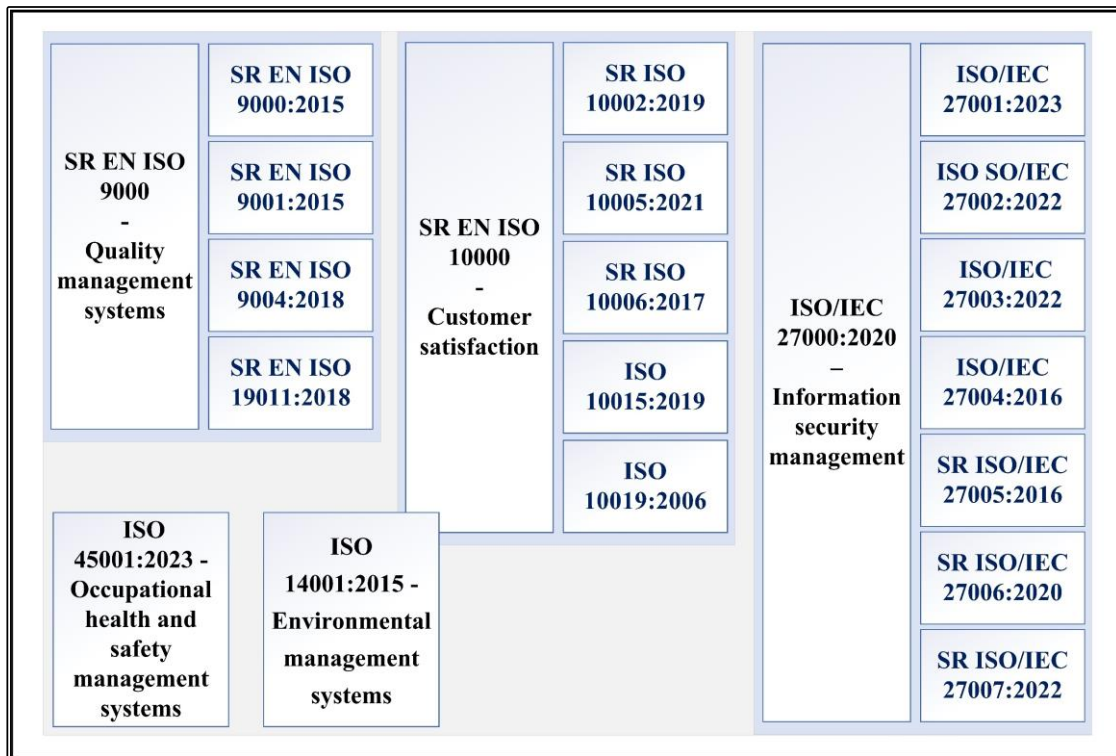


Fig. 3.7 Standards in the context of the doctoral research theme.

...

3.3 Conclusions

...

The current trend is for public organizations to develop management based on financial efficiency with certain profitability aspects, emphasizing improving service quality. In this way, the tendency is to adopt behaviors specific to private organizations. The citizen, who is the beneficiary of public services, is beginning to be seen by public organizations as a client, as in the approach of private organizations. By employing increasingly effective service quality management, public organizations are drawing closer to private organizations, and the barriers between the two types of organizations tend to diminish.

The best evaluation indicator for public organizations that provide services to citizens is the level of citizen satisfaction. High-quality services are necessary to maintain citizens' trust in these organizations.

Total quality must represent an important and permanent objective of a public organization that provides services to citizens, and the way to achieve this is by implementing total quality management. Total quality not only represents the quality of the services or products offered; it refers, in a broader sense, to the continuous satisfaction of citizens' needs while achieving minimal costs.

In a knowledge-based organization, total quality management considers quality the most important aspect of all organizational activities. Achieving the quality goal must be done with the full involvement of all employees. The organization should achieve long-term results by increasing citizen satisfaction and creating opportunities for the entire staff and community.

Achieving total quality can be realized through continuous improvement of the products and services offered, which is implemented at every stage of the quality spiral. The "zero defects" strategy, in which activities and processes within the organization are carried out "without errors," aims to produce goods and services that meet the citizens' requirements. We can consider that the concept of "zero defects" means that the activity must be done right every time, without errors, with zero inventory, without interruptions in operations, and without loss of customers. The principle of "zero defects" is usually correlated with the concept of "continuous improvement," which is typically implemented in total quality management.

The implementation of an integrated management system is achieved by integrating two or more components from the following: quality management, environmental management system, and occupational health and safety management. In some organizations, an information security management system can also be integrated. These are interrelated types of management, each based on similar principles. Integrating management systems through ISO certification represents an optimal solution for an organization that intends to implement total quality management.

By implementing an integrated quality management system, public organizations will be able to achieve high-performance standards for quality under ecological conditions and health and safety at work for both the organization's employees and other members of the local community.

4. CONCLUSIONS REGARDING THE CURRENT STATE OF RESEARCH IN THE FIELD OF IMPROVING SERVICE QUALITY IN KNOWLEDGE-BASED PUBLIC ORGANIZATIONS PROVIDING SERVICES TO CITIZENS

...

The knowledge-based organization evolved from the resource-based organization theory and came as a natural progression, adapting to the ongoing knowledge revolution. Using knowledge within an organization adds quality and competitiveness in the competitive market.

...

In a modern vision, an organization can be considered a group of people with a specific organizational configuration aimed at obtaining a product or service intended for a client.

In a modern vision, the key element of an organization is people and their relationships; the organization functions when people interact to fulfill certain essential functions for achieving goals.

...

The knowledge-based organization evolved from the resource-based organization. Knowledge is one of an organization's main values. Using knowledge within an organization can enhance quality and competitiveness in the competitive market and significantly improve the organization's image.

...

Knowledge-based management is one of the latest management theories and practices, which defines this concept from different perspectives. We believe that knowledge-based management has scientific and artistic values, and previous experiences in managerial practice lead to an effective utilization of knowledge through decisions that make the organization more efficient and sustainable.

It can be considered that in the current knowledge-based economy, knowledge represents raw material, resources, and the product of a knowledge-based organization. Knowledge has become an

essential element for achieving high productivity and serves as a foundation for attaining strong competitiveness for organizations in the global national economy.

In the current economy with knowledge-based organizations and management, we consider quality to be a set of characteristics that are reflected in customer needs as well as in the price of the product or service. On the other hand, the costs necessary for producing products and services also play an important role for the organization. Quality plays a crucial role in positioning an organization in an increasingly competitive market.

It can be said that quality cannot be achieved at a high level solely through inspection and control; it is built step by step through rigorous planning. Achieving quality in a knowledge-based organization can be accomplished by adopting a quality management system, which can provide a competitive advantage in today's market.

Long-term quality can be achieved with a permanent orientation and a management approach focused on and supported by quality. Excellence is a goal that any organization can achieve. Success in competition means achieving excellence through producing high-quality, efficient products delivered to consumers on time. It is possible through a particular interest in technology, organization, and business.

...

Total quality can only be achieved with the involvement of all employees through continuous improvement and total quality management.

It can be considered that quality management can be implemented through a quality system encompassing everything it represents: the organizational structure, the procedures, the processes, and the necessary resources. Within the organization, quality management creates a policy for enhancing quality through organization, control, implementation, and improvement of quality.

...

The current trend is for public organizations to develop management based on financial efficiency with certain profitability aspects, emphasizing improving service quality. In this way, the tendency is to adopt behaviors specific to private organizations. The citizen, who is the beneficiary of public services, is beginning to be seen by public organizations as a client, as in the approach of private organizations. Public organizations are drawing closer to private organizations by employing increasingly effective service quality management, and the barriers between them tend to diminish.

The best evaluation indicator for a public organization that provides services to citizens is the level of citizen satisfaction. High-quality services are necessary to maintain citizens' trust in the organization.

Total quality must represent an important and permanent objective of a public organization that provides services to citizens, and the way to achieve this is by implementing total quality management. Total quality not only represents the quality of the services or products offered; it refers, in a broader sense, to the continuous satisfaction of citizens' needs while achieving minimal costs.

In a knowledge-based organization, total quality management considers quality to be an objective to be achieved in all activities within the organization. Quality must be realized with the involvement of all employees. The organization should achieve long-term results by increasing citizen satisfaction and creating opportunities for the entire staff and the community.

Total quality can be achieved through continuous improvement of the products and services offered, implemented at every stage of the quality spiral. The "zero defects" strategy, in which activities and processes within the organization are carried out "without errors," aims to produce goods and services that meet the citizens' requirements. We can consider that the concept of "zero defects" means that the activity must be done right every time, without errors, with zero inventory, without interruptions in operations, and without loss of customers. The principle of "zero defects" is

usually correlated with the concept of "continuous improvement," which is typically implemented in total quality management.

The integrated management system includes quality management, environmental management, occupational safety, and information security, which are interrelated types of management, each based on similar principles. Integrating management systems through ISO certification represents an optimal solution for an organization that intends to implement total quality management.

By implementing an integrated quality management system, public organizations will be able to achieve high-performance standards for quality under ecological conditions and health and safety at work for both the organization's employees and other members of the local community.

PART II. CONTRIBUTIONS REGARDING THE RESEARCH AND DEVELOPMENT OF THE PROCESS OF IMPROVING SERVICE QUALITY IN PUBLIC ORGANIZATIONS BASED ON KNOWLEDGE PROVIDING SERVICES TO CITIZENS

5. DIRECTIONS, GENERAL OBJECTIVE, SPECIFIC OBJECTIVES, AND RESEARCH METHODOLOGY FOR IMPROVING THE QUALITY OF SERVICES IN PUBLIC ORGANIZATIONS BASED ON KNOWLEDGE PROVIDING SERVICES TO CITIZENS

5.1 General objective of the research

The general objective of the doctoral research theme is to provide technical solutions to enhance service quality in knowledge-based organizations that provide services to citizens by proposing solutions that will improve the activities and processes carried out within the researched organization.

5.2 Specific objectives of the research

The specific objectives of the doctoral research are:

- Identification of the core processes - support, central, and management within the researched organization;
- Designing and creating a map of the processes within the researched organization;
- Proposals for improving the processes within the researched organization;
- Creating a graphical model for an existing process within the researched organization;
- Creating a graphic model for a proposed process;
- Conducting a SWOT analysis for the implementation of a quality management system;
- Mathematical modeling of the digital archiving subprocess in order to implement it for the improvement and efficiency of this activity.

5.3 Research directions

...

One research direction is identifying the processes within the organization and creating a process map to pinpoint the processes that can be improved. The graphical representation of a process can provide a more precise visualization of the inputs and outputs of the system.

The need to reduce the size of the physical spaces used for storing the physical archive has been identified. The creation of a digital archive solves the problem of using large physical spaces, reduces costs, and shortens the response times for a significant portion of citizens' requests. The quality of services provided by the researched organization to citizens will increase considerably. Additionally, by reducing large amounts of material resources, the organization becomes more sustainable, and the impact on the environment will decrease.

One research direction involves creating a mathematical model of the digital archiving subprocess, allowing for the identification of the most important variables that can lead to increased efficiency and quality of services provided to citizens.

5.4 Research methodology

The purpose of the research methodology was to meet the requirements of the doctoral research thesis's main objective while laying the groundwork for future research. The research methodology was realized through the completion of several successive steps, reaching multiple stages of research:

- Establishing an initial general objective of the research thesis by analyzing the current state within the studied organization;
- Deepening the current state in the researched field for an analysis of the existing situation in the studied organization;
- Identification of processes and creation of a process map, as well as stating proposals for improving the services offered to citizens;
- Graphical modeling of the processes and subprocesses under investigation;
- Mathematical modeling of the process under investigation,
- Analyzing the results obtained from the models;
- Issuing conclusions regarding the conducted research.

It is worth noting that during the development of this doctoral thesis, a mind map was used, a very effective visual tool. Tony Buzan introduced this term: the mind map represents an expression of branched thinking and, therefore, is a natural function of the human mind. It is an essential visual technique that is a universal tool for unlocking cognitive potential. A mental map, also known as a heuristic scheme, can be applied in any area of life where improving learning and clarity of thought enhance human performance. (Buzan & Buzan, 2012).

...

5.5 Conclusions

To achieve the stated steps, a sustained research effort was undertaken, which materialized in four doctoral research reports. Several research papers have also been completed, which were published in journals or presented at various conferences. Mind maps were used to track the steps of the research more clearly. The applied methodology can be applied to any process within an organization.

6. CONTRIBUTIONS REGARDING QUALITY AND QUALITY MANAGEMENT IN A COUNTY DIRECTORATE FOR PERSONS REGISTRATION

6.1 Public organization providing services to citizens that has implemented a quality management system (QMS)

...

A quality management system can be implemented in private and public organizations. The current trend is implementing attitudes, approaches, and procedures within the public system primarily found in the private sector. Knowledge-based organizations are a modern approach to public organizations. The focus on knowledge, the continuous improvement of professional levels, the orientation towards the citizen, and the provision of quality services lead to increased efficiency. Thus, the services provided by public organizations will lead to higher satisfaction among citizens. The general perception will improve with the increased service quality, resulting in a favorable image among citizens.

6.2 Quality and quality management in organizations providing services to citizens – Particularities

...

Citizen orientation makes their needs and desires better known, and this focus ensures that the services provided to citizens are more efficient, resulting in a higher level of citizen satisfaction. Creating a leadership attitude within the organization makes the staff more motivated, and the

evaluation and correlation of activities are done in a unified manner. The involvement of the entire staff leads to motivation, increased creativity, and innovation in achieving the organization's goals, and the desire to participate and contribute to improving service quality will grow. The process-based approach increases efficiency, better resource utilization with improved results, and cost reduction.

...

It is well known that employee resistance to change is significant. In the environment of public organizations, in many cases, the employed staff is at an age where inertia and a conservative attitude can hinder change. Managers must be able to prepare the organizational culture for an approach where quality is an essential factor. Continuous improvement, knowledge, and the focus on becoming a knowledge-based organization can lead to adopting a quality management system.

In the studied organization, the County Directorate for Personal Records, there is an approach that emphasizes the quality of the activities carried out within the organization, but there is no dedicated office for quality. We propose to establish a quality office within the organization, and the person who will serve it should be appointed to handle the implementation and control of the quality level of activities and services offered to citizens, as well as to find and propose new ways to enhance the quality level within the organization.

The improvement in the quality of activities, particularly the services provided to citizens within an organization, is primarily due to the managers' ability to create a supportive environment that allows for the highlighting and development of each organization member, utilizing individual skills to achieve the organization's goals. Continuous training and improvement make the organization's staff efficient, and the quality of services provided to citizens increases.

Another aspect is the increasingly evident decentralization of public institutions, which leads to the possibility of increasing the degree of autonomy in the financing and management of services. This can be achieved by adopting specific procedures and activities that can enhance the quality of these services.

6.3 The place and role of an integrated quality management system in a public organization providing services to citizens

An integrated management system involves the interconnection of multiple processes that utilize the same infrastructure and shared human, material, and financial resources to achieve the organization's objectives. The purpose of an integrated management system is to optimize the organization's efforts to meet the requirements regarding the coordination of activities to ensure quality alongside those related to environmental management. (Olaru, Quality Management, 1999)

To improve the services offered to citizens, the studied organization DJEP Sibiu can adopt an integrated management system that includes quality management with the ISO 9000:2015 family of standards, occupational health, and safety management as outlined in the ISO 45001:2023 standard, and environmental management with the ISO 14001:2015 standard. Another standard that can be integrated into the management system of the studied public organization, DJEP Sibiu, is the security standard ISO 27000:2020.

...

The implementation of an integrated management system allows the organization to increase its focus on organizational objectives, as well as to optimize and harmonize the organization's activities. It will enhance management consistency, improve communication, facilitate training, development, and growth of the organization's staff, help reduce duplications and risks, and last but not least, assist in defining objectives more clearly.

By implementing an integrated management system, the aim is for quality management to provide services that meet customer needs, environmental management to create a harmonious relationship with the environment, occupational health, and safety management to ensure a risk-free environment for employees and the community, and information security management to comply with the requirements of the General Data Protection Regulation.

Implementing an integrated management system in the studied organization, the County Directorate for Personal Records, will assist managers in achieving the organization's objectives, optimize existing processes, and reduce costs.

...

6.4 Designing a SWOT analysis in the aforementioned field

Within the studied organization, the County Directorate for Personal Records, to enhance the quality of services offered to citizens and also to increase efficiency, as well as to ensure that the activities carried out become sustainable, to ensure the physical and mental health of employees and other individuals, and to guarantee the security of the information handled within the organization, we believe that there is a desire to implement a quality management system.

Next, a SWOT analysis was conducted on the strengths, weaknesses, opportunities, and threats.

...

6.6 Conclusions

Quality management can be implemented through a quality system encompassing everything it represents: the organizational structure, procedures, processes, and necessary resources. Within the organization, quality management must create a policy for improving quality through organization, control, implementation, and enhancement.

All principles of quality management are equally important; they can be utilized by an organization's management team, with the help of a quality system, to achieve its current objectives, continuous improvement, profitability, sustainability, and enhanced image with partners and society.

In an organization, quality must represent an objective of all its activities for total quality management. Quality must be achieved with the involvement of all employees. The organization must aim to achieve long-term results by meeting the citizens' expectations and obtaining benefits for the entire staff and the community.

The role of an integrated management system is to assist managers in achieving the organization's objectives, reducing costs, optimizing processes, supporting employees in implementing processes, providing a positive evaluation of management activities within the organization, and bringing sustainability to the organization.

Integrated management carried out by quality management, environmental management, occupational health and safety management, and information security management are interconnected types of management, each based on similar principles. A company that wishes to implement total quality management (TQM) can integrate the management systems with the ISO mentioned above certification.

7. CONTRIBUTIONS REGARDING THE EVOLUTION OF INFORMATION SYSTEMS IN THE SIBIU COUNTY PERSON REGISTRATION OFFICE

7.1 Computer system versus information system

...

The functioning of an information system within an organization involves activities related to the collection, processing, transmission, and storage of data and information. To carry out these activities, means of transmitting information, processing, and storage provided by an information

system are necessary. In addition, using these means requires specialized personnel with a high level of qualification.

With the increasing use of computing systems, organizations' efficiency has improved. Software implemented at the organizational level has allowed the activities within the organization to be structured and organized more efficiently. Many organizations' activities are carried out with the help of computers.

Most of the time, carrying out activities related to the collection, processing, transmission, and storage of data and information within an information system involves the use of computing technology. In this case, we have a computer system.

...

By its nature, the computer system deals with the collection, transmission, and processing of information using automated technologies. It can be said that the information system is much more comprehensive. The development of computing performance has led to an increase in its usage and the growing involvement of the information system within the structure of the information system. In organizations within high-performing economies, the information system increasingly occupies a significant share of the overall information system. The high level of the human component determines the high-quality level of the information system.

Very often, it is considered that the computer system is synonymous with the informational system, but the information system is a subsystem of the informational system. The idea of a computer system refers to the fact that the organization's activities are computerized and that information resources are used for organizing and managing information with the help of IT resources.

...

7.6 Contributions regarding the management of information processes within the Sibiu County Directorate for Person Registration

...

Within the DJEP, Sibiu is an information system where information technology is present through hardware computing devices and software applications, communications, and methods of database storage, as well as the staff that services these services. The information system within the DJEP organization is structured into several components: human component, organizational component, technological infrastructure component, and software applications component. The human component is the most important part of the information system. The staff responsible for the maintenance and development of the system consists of qualified specialists with training in computer science. The users of the information system are the employees within the organization, with the trend being to carry out most activities with the help of the information system. The beneficiaries are the citizens who request the services of the DJEP Sibiu institution.

The process-based approach we proposed highlighted the fact that at the level of the DJEP Sibiu organization, there is no dedicated office with hired personnel specialized in quality. At this time, the control, verification, and quality of the activities within the organization are followed by the responsible for each department, the Executive Director, and the Director General. Establishing a quality office and the emergence of a distinct quality monitoring process could improve the overall quality, focusing on the interaction and interconnection of activities within the organization. The beneficiaries of this office would primarily be the citizens who come with requests to the Sibiu County Directorate for Personal Records

...

The existence of a staff member in this office who specializes in quality, does not belong to an existing service, and is directly subordinate to the executive director would bring objectivity and impartiality to the specific activity of quality control.

7.7 Conclusions

The computer system is a subsystem of the informational system. To ensure the three functions of the information system: the documentation function, the decision-making function, and the operational function, the computer system utilizes computing technology (computers, servers, etc.) and specialized software applications. The concept of a computer system is associated with digitizing an organization's activities and using IT resources for managing and administering information.

The current trend is for more and more activities to be supported by IT technology and largely taken over by computers. On the other hand, this calculation technique complements and supports human activity, increasing productivity and efficiency. This trend is becoming increasingly pronounced in public organizations as well, where current IT technologies are used to implement applications that enhance efficiency and resource savings in the ongoing activities carried out within these organizations.

E-governance is a constantly growing concept that significantly impacts public sector activities. It can be a solution to the problems of public administration. Organizations in the public sector use IT technology as a step towards e-governance.

There are still no informational systems that fit perfectly into the specified structures. Even integrated systems cannot resolve this aspect. Thus, in the case of financial accounting systems, human intervention is evident both in the phase of organizing and collecting data and in the phase of interpreting and utilizing the obtained information.

Implementing a computer system in today's organizations is no longer an alternative to the existing situation; using an efficient information system is a necessity.

8. CONTRIBUTIONS REGARDING THE GRAPHICAL MODELING OF PROCESSES WITHIN THE SIBIU COUNTY DIRECTORATE FOR PERSON REGISTRATION

...

8.3.1 Process map. Own analysis by categories of processes and proposal for a process map

...

The studied organization does not currently use a process-based approach in its quality management. We propose to apply a process-based approach. In this way, the principles recommended by quality management in ISO 9000:2015 and ISO 9004:2018 are respected. The process-based approach has the advantage of controlling the connection between individual processes and the control and interaction between those processes.

The processes I have identified within the DJEP Sibiu are based on the organization and functioning regulations that outline the activities corresponding to the services and departments within the organization.

...

I created the process map, establishing the connections between the basic processes, the central ones, and the management processes.

Following identifying and classifying processes, we created a map of the existing processes. The process map visually illustrates the processes within the organization and illustrates their flows.

Below is a map of the processes that reflect the existing processes within the public organization being researched, which provides services to citizens. (

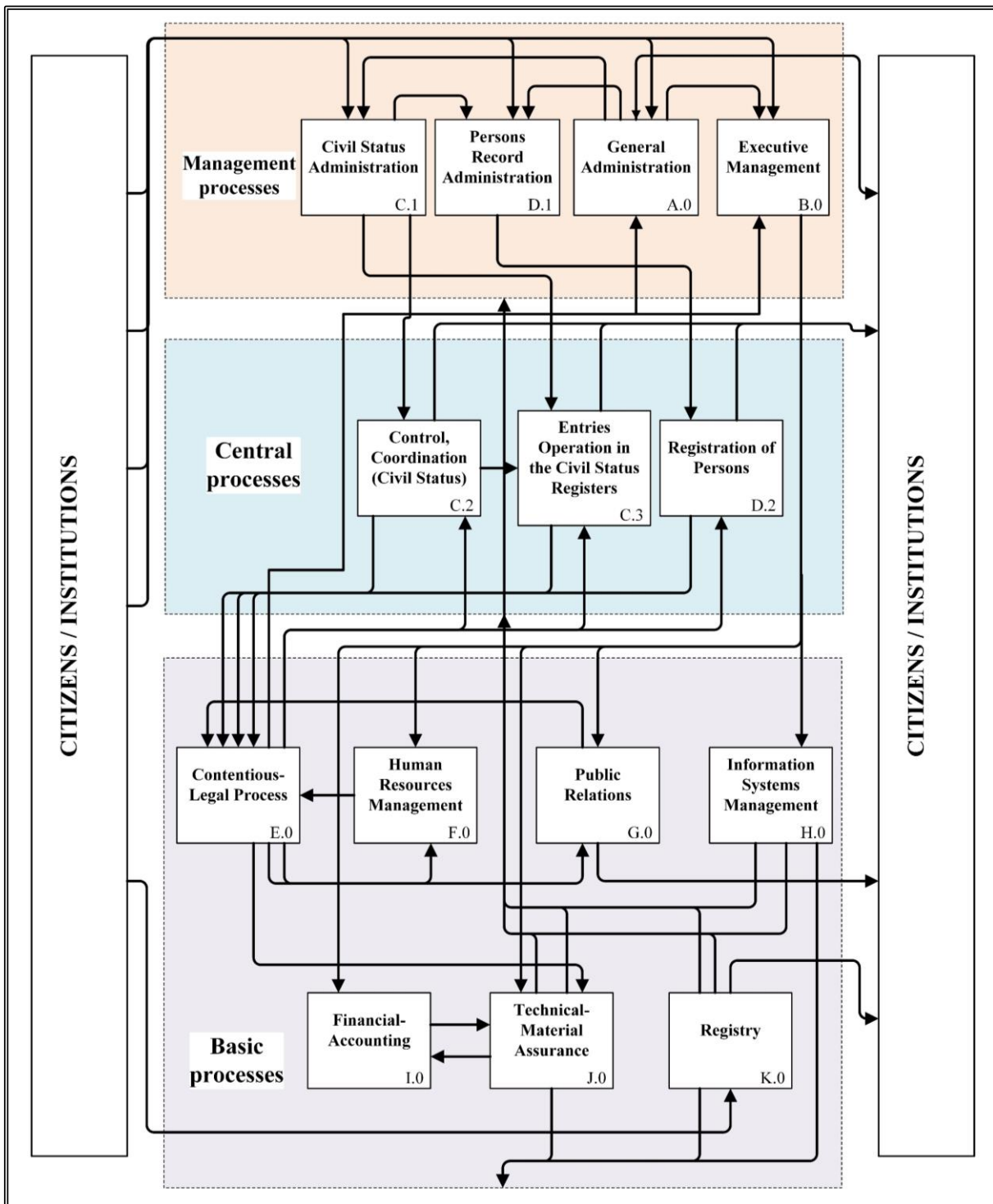


Fig. 8.1 (Olteanu & Moiescu, Process management in a public organization providing services to citizens, 2022)

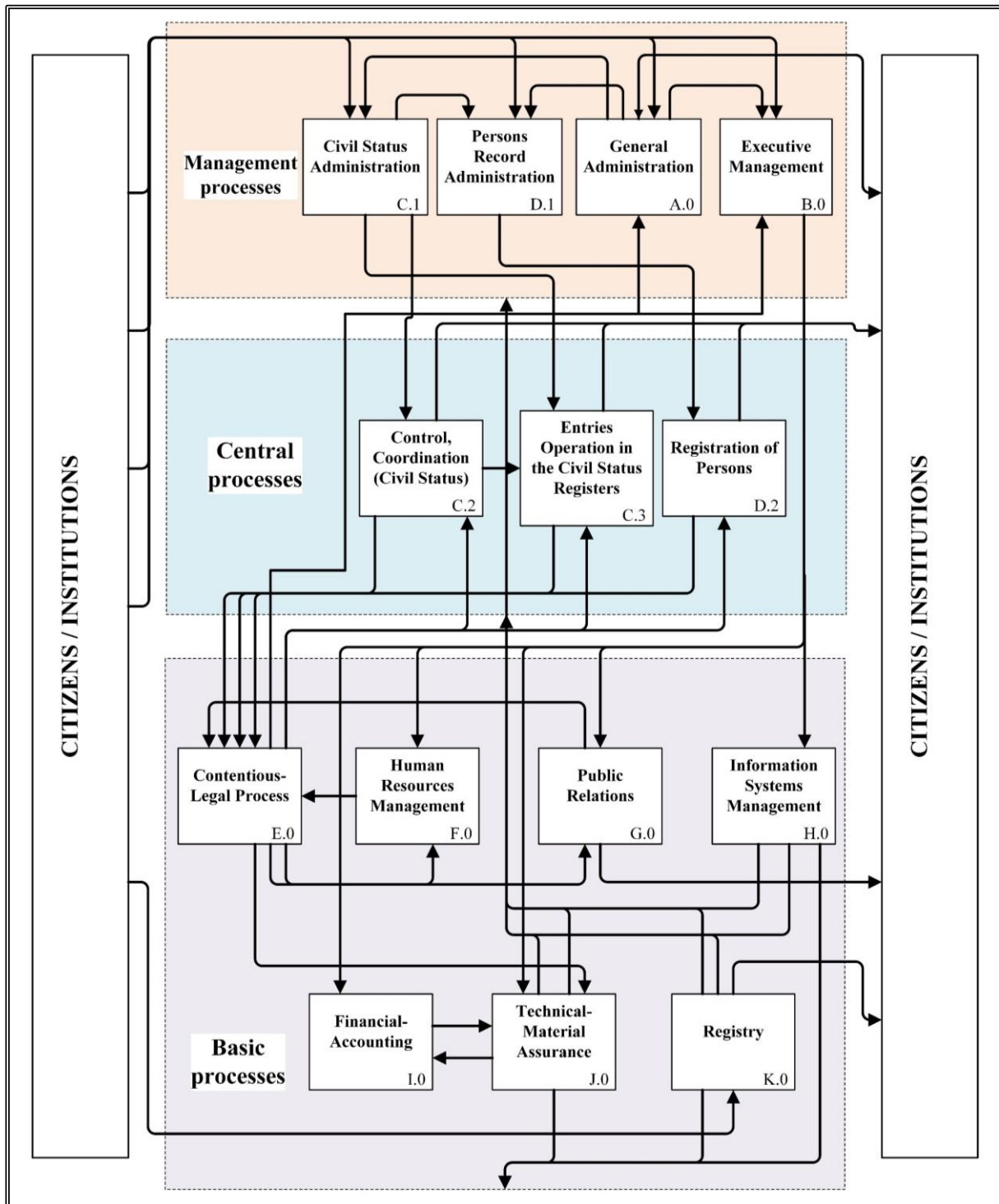


Fig. 8.1 The process map within the DJEP Sibiu organization (Olteanu & Moiescu, Process management in a public organization providing services to citizens, 2022)

Following the identification, presentation, and analysis of such a map previously presented, a personal version of a process map will be introduced in the continuation of the doctoral thesis, which will be analyzed, optimized, and subsequently proposed for implementation.

...

In accordance with the proposed improvements, we are revising the process map presented in Figure 8.1. The new process map in Figure 8.2 shows a reorganization of the processes and their connections. (Olteanu & Moiescu, Process management in a public organization providing services to citizens, 2022)

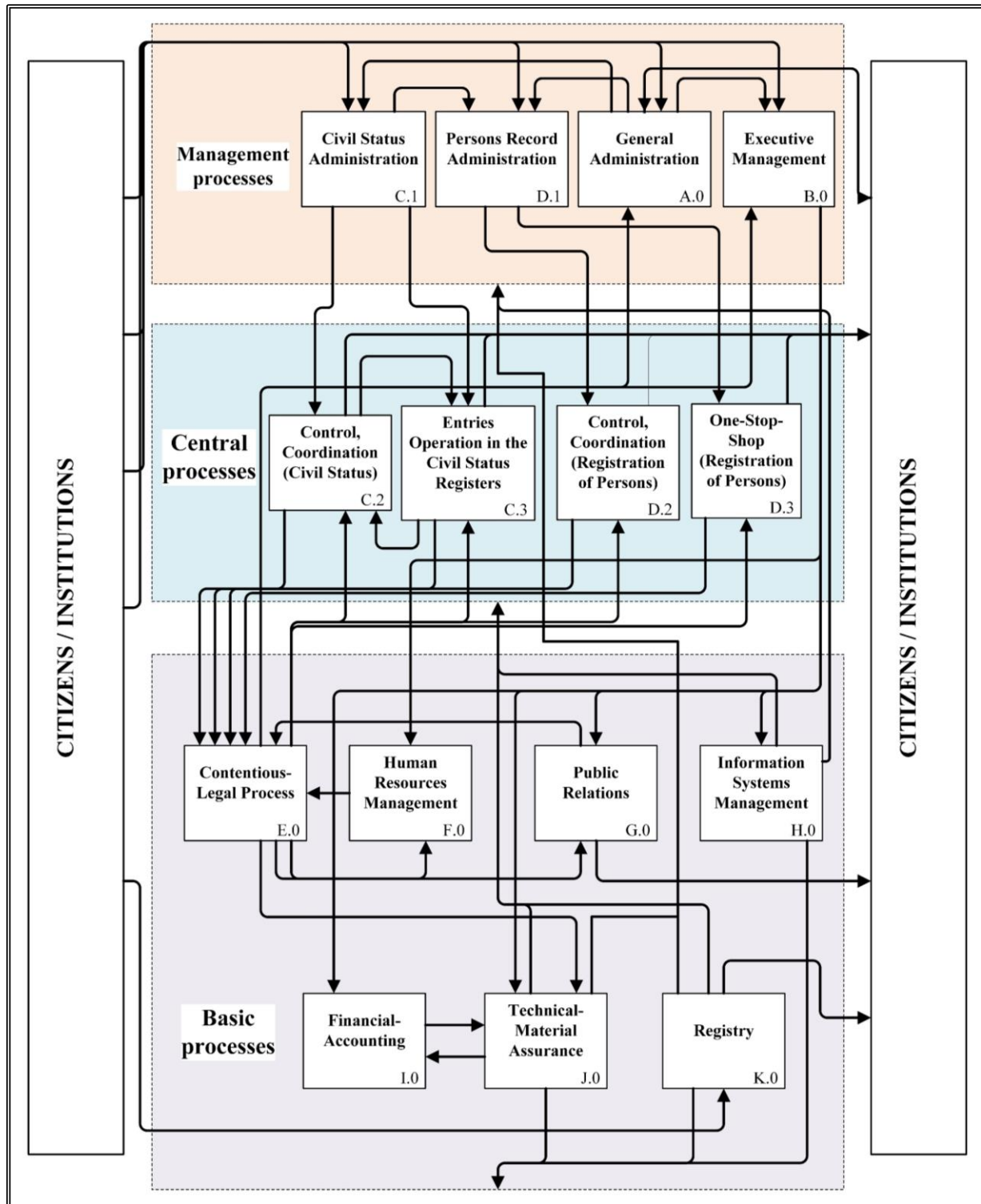


Fig. 8.2 Map of the proposed processes within the DJEP Sibiu organization (Olteanu & Moisescu, Process management in a public organization providing services to citizens, 2022)

The process-based approach we propose highlights the need to establish a dedicated office with a specialized, quality employee. The Civil Registry service can be divided into two compartments: the Single Counter and Coordination and Control, both of which are subordinate to the head of the service. This would lead to a more precise division and delineation of the tasks for each department employee.

...

8.4.1 Contributions to graphical modeling using the IDEF 0 methodology for the Computer System Management Process, sub-process Data and Network Security H1

... To visualize and better understand the relationships between the Information System Management process and other processes, as well as the position of this process within the process map, they are highlighted in the figure 8.4. (Olteanu C. , Moisescu, Deac-Șuteu, & Tîțu, 2022)

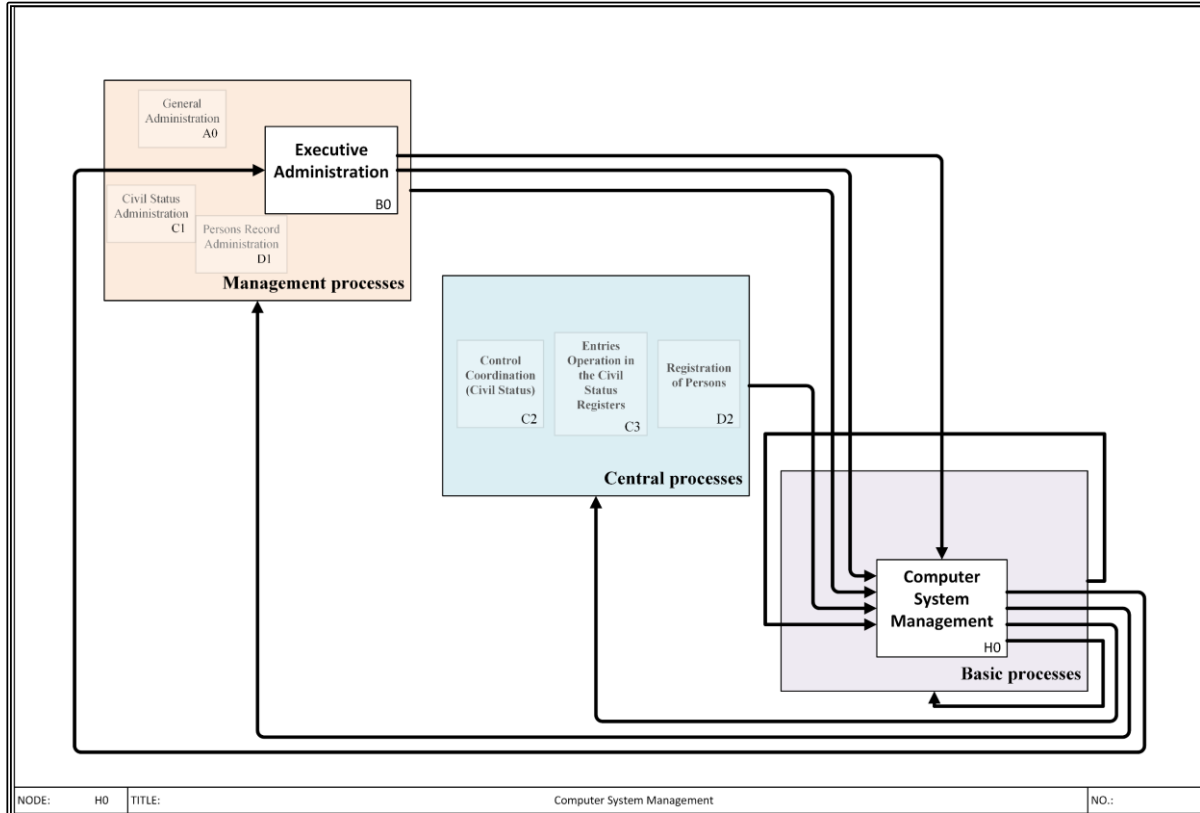


Fig. 8.3 The process of Information System Management within the process map (Olteanu C. , Moisescu, Deac-Șuteu, & Tîțu, 2022)

In the core process of Information System Management, the following subprocesses can be distinguished, highlighted in Figure 8.5 (Olteanu C. , Moisescu, Deac-Șuteu, & Tîțu, 2022):

- Subprocess Data and Network Security H.1;
- Subprocess Equipment Audit H.2;
- Subprocess Equipment Installation H.3;
- Subprocess Technical Support and Consulting within the institution H.4;
- Subprocess Technical Support and Consulting for collaborating institutions H.5;
- Subprocess Website Maintenance H.6;
- Subprocess Email Address Management H.7;
- Subprocess Digital Archiving H.8.

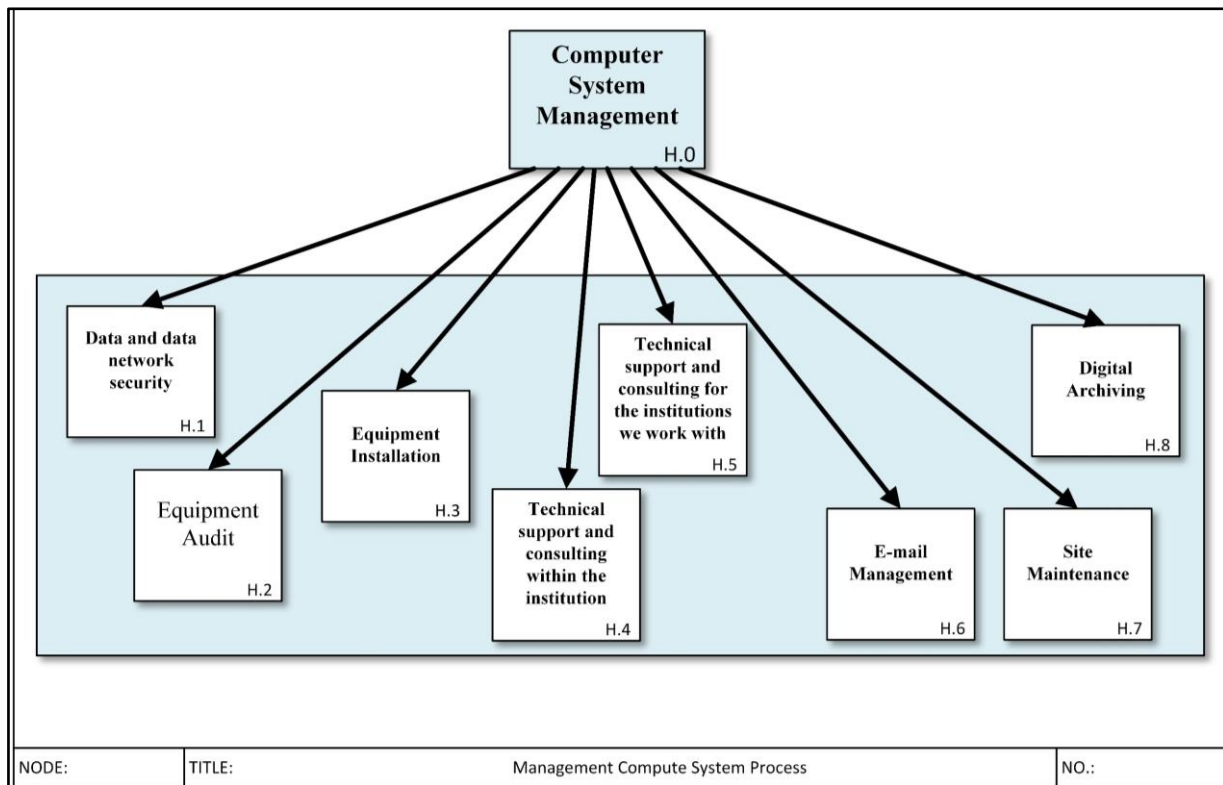


Fig. 8.4 Subprocesses within the process of Information System Management (Olteanu C. , Moisescu, Deac-Șuteu, & Tîțu, 2022)

The Digital Archiving H8 subprocess is a subprocess that is proposed for implementation. Currently, archiving is done in physical format in the form of files in which all documents that need to be archived are bound together. These files are bound by an external company specialized in this activity. The current archiving process involves significant human resources, material, and financial resources, as well as the allocation of spaces that meet the necessary conditions from various perspectives: storage volume, environment, and the security of the stored documents. Considering the resources involved and the difficult management of this physical archive, the proposal to digitize this archive is necessary for streamlining this activity.

The process of Information System Management is complex, with many subprocesses and activities serving all the processes within the organization. This report does not allow for the analysis and modeling of all subprocesses; therefore, we aim to focus on the subprocesses of data security and data network security.

Graphical modeling of the subprocess Data and Network Security H1

One of the most important subprocesses in the Information System Management process is Data and Network Security H1.

...

The IT department fully manages the Data and Network Security subprocess. This subprocess protects the data network and the existing data within the computer network and enables its recovery in the event that this data is compromised. To achieve this goal, this subprocess is composed of several subprocesses presented in Figure 8.6.

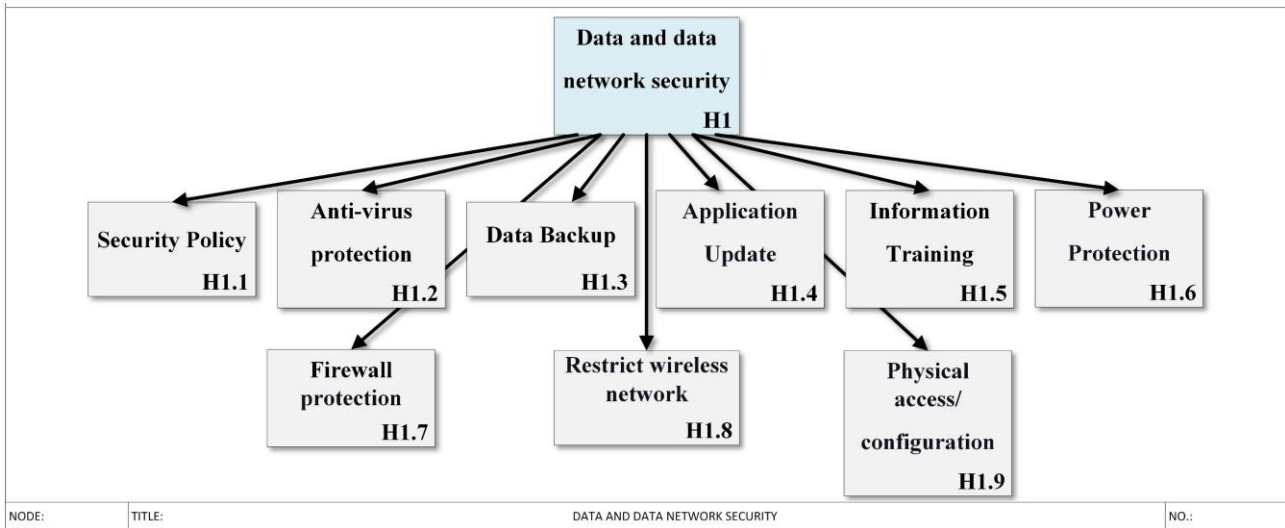


Fig. 8.5 Subprocesses within the Data and Network Security subprocess. (H1)

In the studied organization, within the subprocess Data and Network Security (H1), from the process Information System Management (H0), we will focus on the following subprocesses: Security policies (H1.1), Antivirus protection (H1.2), Data backup (H1.3), Firewall protection. (H1.7). These subprocesses have been analyzed in detail, and graphical representations have been created. Also, the subprocesses Application Updates (H1.4), Training and Information (H1.5), and Current Food Protection (H1.6) have been analyzed, but in a more summary manner.

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The Security Policies subprocess (H1.1) is a process that protects both existing data and the data network. Within the studied organization, the computer network has a domain managed by a physical server with an installed operating system. (Windows Server). Some security policies are implemented at the domain level, while others are implemented at the workstation level; their presentation is shown in Figure 8.7.

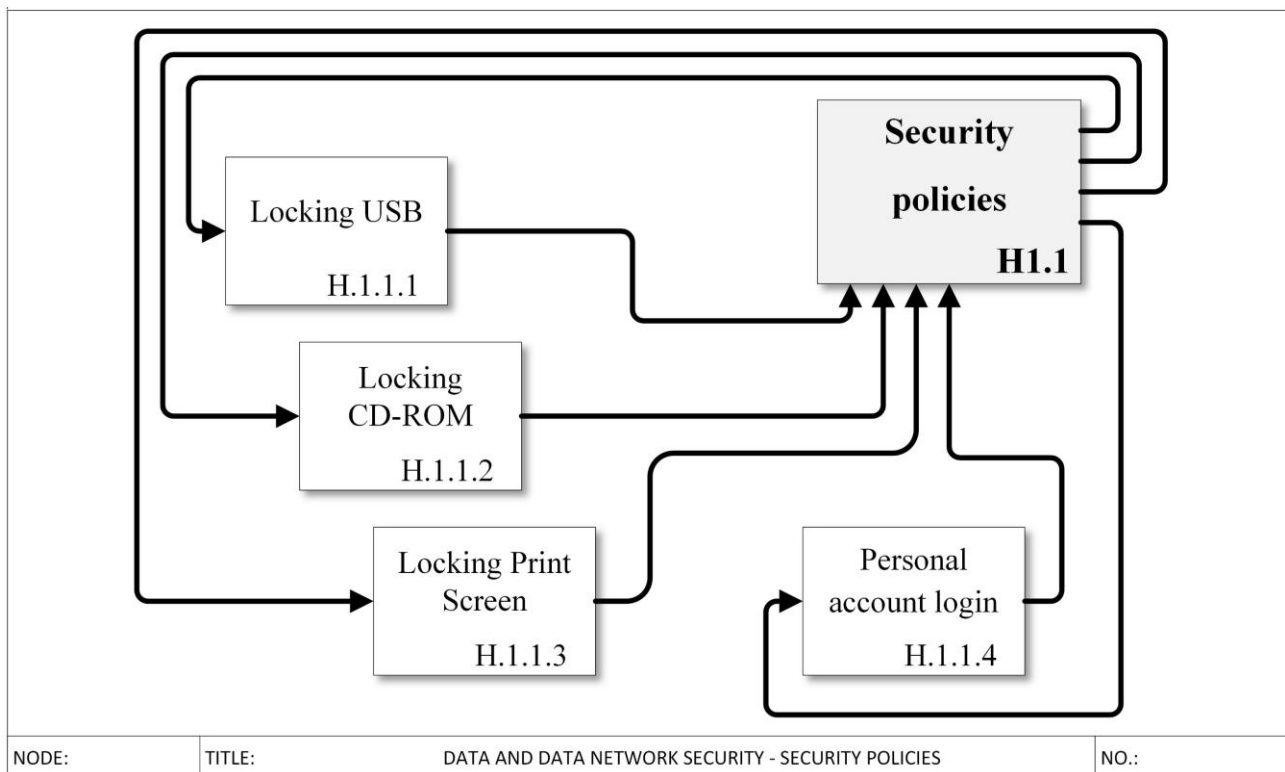


Fig. 8.6 Subprocesses and activities within the subprocess of Security Policies

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8.4.2 Contributions to graphical modeling using the IDEF 0 methodology for the computer system management process - sub-process Digital Archiving

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A large part of the work carried out within the organization requires original documents that are then copied. All documents resulting from these works are added to archived files. Depending on the type of documents, the archiving period varies; some must be archived indefinitely. This entire process causes the physical archive to grow annually. The physical archiving of documents involves a series of steps that consume multiple resources. (Fig. 8.7).

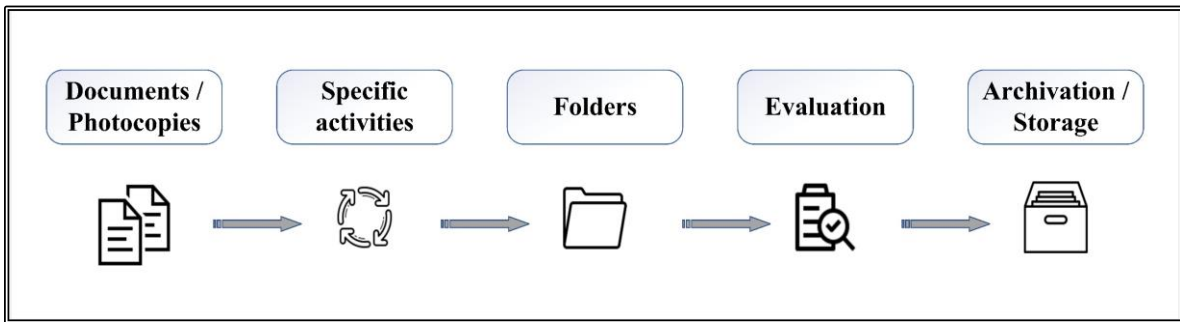


Fig. 8.7 Physical archiving flow (Olteanu & Țițu, Innovative aspects regarding the improvement of it infrastructure in a public organization providing service to citizens, 2023)

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Implementing the digital archiving process in the studied organization, with the complete update of the existing archive and its use in current activities, involves going through two stages with distinct processes. In the first stage, the existing physical archive must be digitized, and in the second stage, the current archiving process is used, which can be integrated with the electronic registry application. For the complete digital archiving of documents, two distinct components are identified (Fig. 8.17):

- the subprocess of digital archiving of documents that currently exist in physical format;
- the subprocess of current digital archiving of documents is in progress.

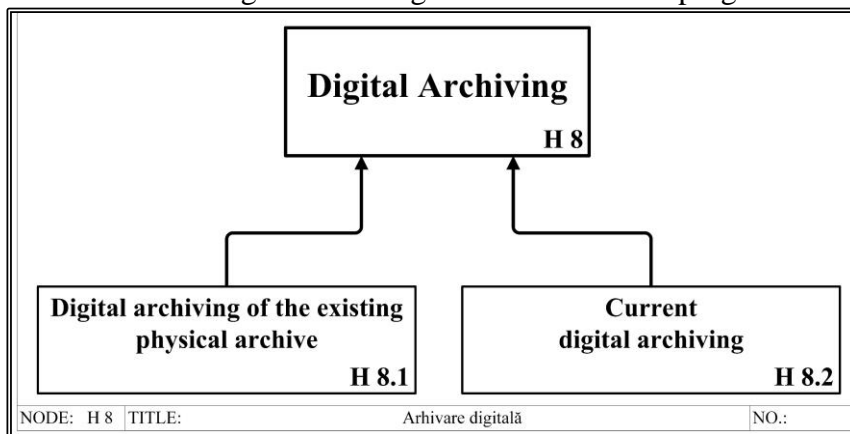


Fig. 8.8 Components of the Digital Archiving Process

The physical archive of documents from 2009 to the present can be preserved and used just as before. In this case, the benefits brought by the use of a digital archive are considerably reduced, and document handling efficiency will not increase. The transition of the current archive from physical documents to a digital format can be done by outsourcing this activity or using in-house resources. It is preferable that this transition to the archiving of documents in digital format be carried out gradually with in-house resources.

The transition of documents from physical archives to digital format is a complex activity that requires significant resources. The creation of the digital archive must be carried out in accordance

with the laws in force, respecting the rules regarding the protection of citizens in relation to the processing of personal data and their free circulation while ensuring the safety of classified information. This conversion of the physical archive can be done by going through several stages (Fig. 8.9):

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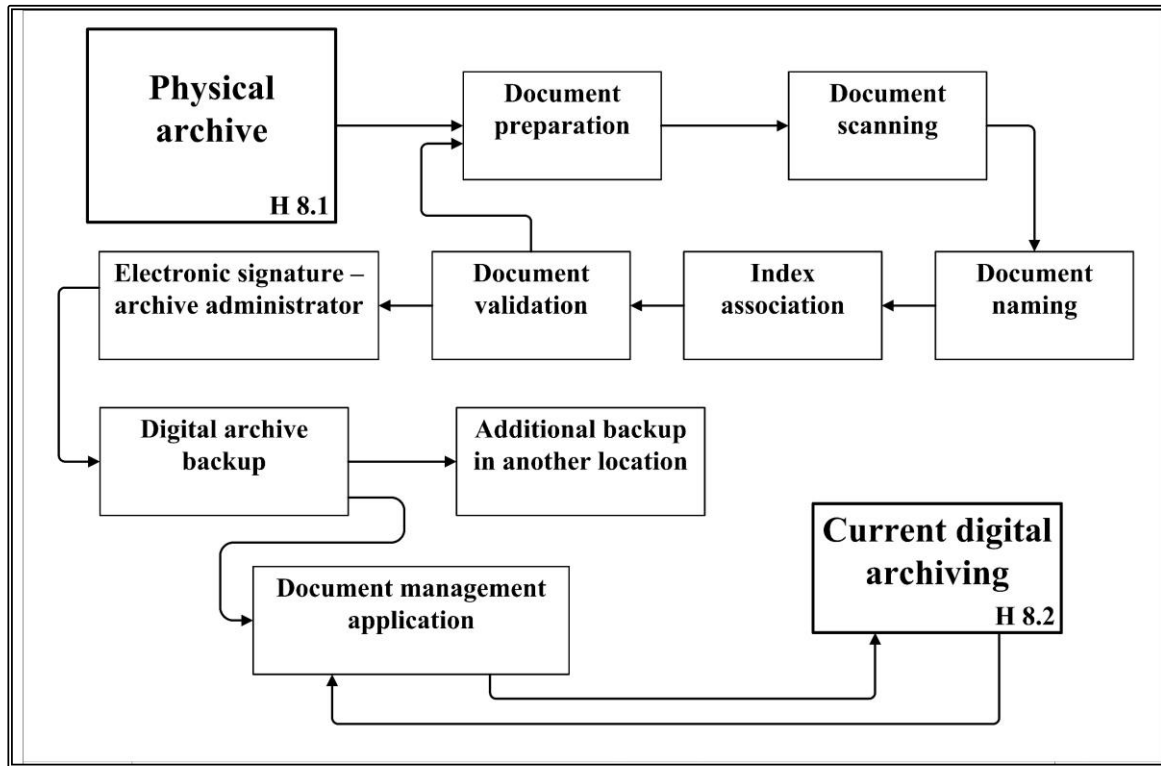


Fig. 8.9 Digitization of documents from the existing physical archive

The second component of the electronic archiving process is current digital archiving, which requires that all documents used regularly in the organization's activities be integrated into a document management system, their format be digital, and their flow occurs through a document management software application, with the regular use of qualified electronic signatures. Finally, these documents are attached to the digital archive. This current process of digital archiving a document involves several activities necessary to complete all the specific steps of the organization's activities (Fig. 8.10).

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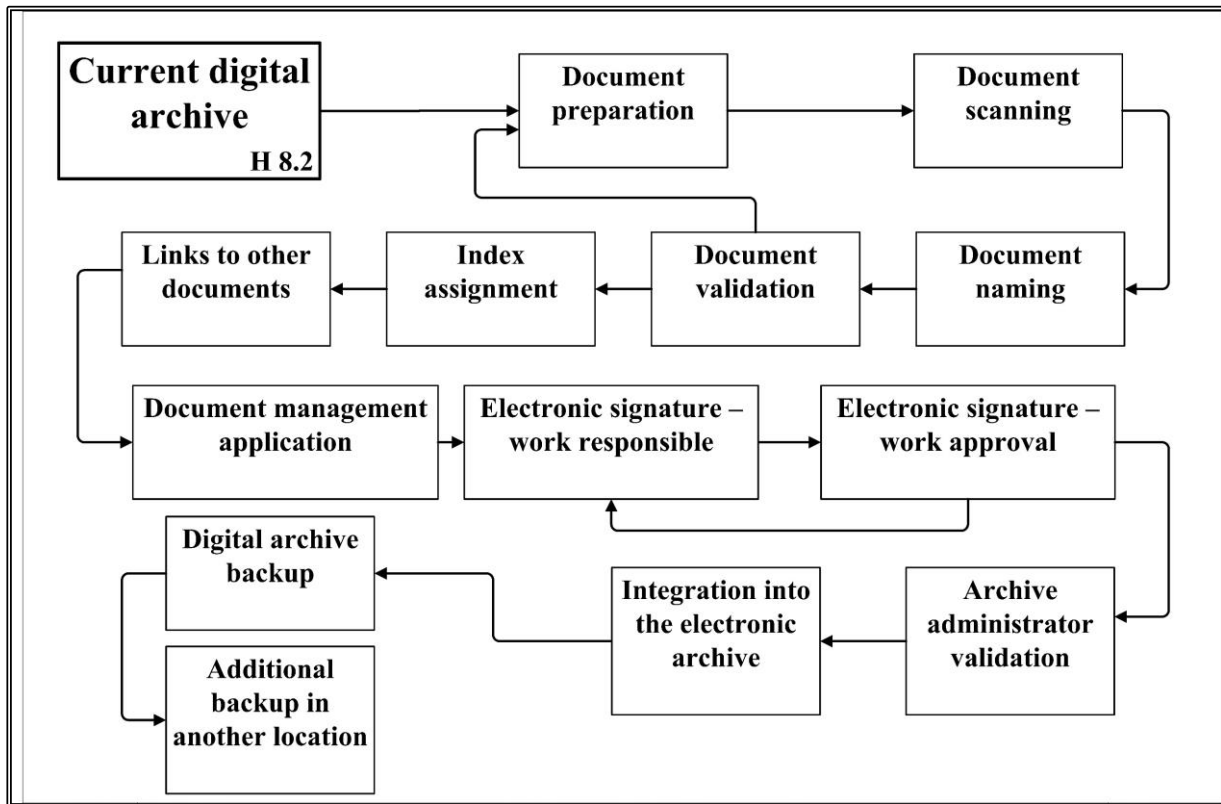


Fig. 8.10 Proposed digital archiving

The indexes associated with the document provide information that will streamline searches in the digital archive, making it very quick to find a document. The information these indexes provide is important; choosing them appropriately greatly enhances search efficiency. To meet this objective, we propose a series of indices that should contain the following information: number; date; origin of the document: internal or external; name or identifier of the person who created it; name of the organization that created it; its purpose; if created externally, where it comes from; the person who created it internally; the person who targeted it internally; department or service assigned to resolve the document; type of document based on its content; access regime of the document; its connections with other documents; description, brief content; observations.

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The implementation of an integrated document management solution within the County Directorate for the Registration of Persons would increase fluidity in document flow, reduce the amount of printed documents on paper, result in material and time savings, enhance the efficiency of activities and services offered to citizens, and improve overall quality within the organization.

8.4.3 Conclusions and proposals regarding graphical modeling using the IDEF 0 methodology (within the chosen process for study), for the two Sub-processes H1 and H8

The graphical modeling of a data and network security process highlights its complexity. In creating a graphic model of this process, one can visually highlight the connections at the process level, the location of each subprocess, and the activities taking place within the process. In this way, the weaknesses can be observed for improvement. One can better understand how it operates by creating a structured visualization of the process. To improve the process, various modifications at the model level can be tried at no cost. Thus, it is easier for a model to find solutions for improvement at the process level.

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The aim of the graphical modeling of the Information System Management process within the studied organization is to achieve efficient management and meet the objectives set within it. The

study of important activities, their interactions, and decision-making methods were taken into consideration in the realization of the modeling. (Franceschini, Galetto, & Maisano, 2007)

Following the analyses conducted, it is recommended to physically separate the wired internet network from the wireless network. It is well known that wireless networks are a rather insecure way to access a network. The radio signal can often extend beyond the organization's premises, thus increasing exposure. This aspect increases the risk of access by unwanted individuals. The number of wirelessly connected devices is increasing. Accessing the organization's wireless network is done in an advanced, secure manner through the measures taken. The fact that the network is not visible reduces some of the vulnerability. Using an advanced encryption method (WPA2) and employing a complex password reduces the risks of unauthorized access. A MAC address filtering procedure is also implemented for devices that wish to connect. Despite all these safety measures, the Wireless network is still considered a vulnerable point for security. We propose to physically separate the two networks, the wired one from the wireless one. In this way, in the event of a security incident on the wireless network, the organization's internal network will not be affected. For the wireless network, we propose to acquire an additional internet service separately.

Currently, a data backup and recovery solution is being implemented for the network within the organization. All workstations benefit from this solution, and data is backed up daily. These backups are realized on devices within the organization. For ordinary situations, such as a workstation or hard drive failure, the information recovery solution is very effective and has been successfully used. We propose a distributed data backup for exceptional disaster situations, such as an earthquake or a large-scale fire. We propose to create at least one copy of the data on a device located in another location, preferably at a considerable distance from the organization's headquarters. Another possibility for making a copy of the data is to use cloud technologies.

The process-based approach we proposed highlighted that at the level of DJEP Sibiu, there is no dedicated office with hired staff specialized in quality. Currently, the control and quality verification of the services within the organization are monitored by the person responsible for each service, the executive director, and the general director. Establishing a quality office and the emergence of a distinct quality monitoring process could improve the overall quality, focusing on the interaction and interconnection of activities within the organization. The beneficiaries of this office would primarily be the citizens who come with requests to DJEP Sibiu. The existence of staff employed in this quality-focused office, directly subordinate to the executive director and not belonging to any existing service, would bring objectivity and impartiality to the specific quality control activities.

Periodic training and information sessions with employees on IT topics lead to improved employee performance. Training and periodic information on protection against cyber attacks and data security can be considered a proactive approach. It is well known that the success of cyber attacks is largely due to employees, who, due to a lack of training or carelessness, allow these attacks to happen. Of course, an antivirus protection solution is implemented at the organizational level, but most cyber attacks succeed not by bypassing the antivirus but due to the inappropriate actions of the human user.

Another proposal is to conduct an external audit to assess cybersecurity and information protection. At this moment, the organization is taking action in these directions. An antivirus solution has been implemented across the entire computer network. The antivirus solution is of the end-point antivirus type, and its management is done from a centralized management console. Training and informing employees is done whenever necessary or when new information needs to be known. Nevertheless, we believe there is a need for an external cybersecurity audit to provide a more objective perspective, and the recommendations received can lead to improvements in the current situation.

Under the given conditions, we recommend and believe using a document management system that employs a digital document workflow is feasible. In this direction, the implementation of a digital document management platform has begun. It is desired that starting from the organization's registry, where all entries are recorded, a document flow can be utilized, with tracking of tasks and their approval being done digitally. The action to implement this solution is initiated by the Sibiu County Council, the institution to which the studied organization is subordinated.

Another proposal is to consider the current use of qualified electronic signatures. More and more organizations are allowing, and some even requiring, the use of qualified electronic signatures on documents sent to them. The use of qualified electronic signatures for signing documents has the same legal validity as documents signed by hand. The PDF format is the most commonly used format for electronic documents. Also, documents such as Word, Excel, PowerPoint, or other types of files can be signed electronically.

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The analyses and research have highlighted the need to find a solution for the institution's archive. In recent years, due to the increase in the number of archived files, expanding the space allocated for the archive has been necessary. The creation of this archive involves considerable material and human resources. The preparation of files for archiving is done by an external company, which also involves considerable financial resources. Creating a digital archive would address these shortcomings, leading to significant savings and freeing up physical spaces used for storage. Additionally, the existence of a digital archive can make the time taken to find information from archived documents much faster and more efficient. In the next chapter, we aim to create a mathematical model for this proposal.

8.5 Conclusions

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The process-based approach involves creating organizational processes so the management system operates as an integrated system. This approach assumes that the management system integrates processes and measures to achieve its objectives while the processes establish the interdependent activities and checks necessary to ensure the desired outcomes.

The current trend is for public organizations to develop management based on financial efficiency, focusing on improving the quality of services and adopting behaviors typical of private organizations. The citizen, who is the beneficiary of public services, is starting to be seen by public organizations as clients, similar to private organizations. Public organizations increasingly exhibit behaviors typically found in private organizations, and the barriers between the two types of organizations tend to diminish. An important instrument for achieving this goal is e-governance. The implementation of e-governance is in line with all the recommendations of the European Union.

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In the studied organization, implementing a digital archive eliminates certain costs associated with the company that handles the filing of documents that need to be archived. It also eliminates the costs associated with the physical space required for archiving these files. Thus, pregnant individuals' responsibilities for managing this archive are being removed.

A significant benefit is the increase in the efficiency of civil servants' activities by reducing the time needed for trips to the physical archive and shortening the time spent searching in the archive.

Using a digital archive eliminates the risk of document deterioration, especially for very old documents or due to non-compliant storage conditions regarding temperature, humidity, biological agents, or in the event of floods, fires, earthquakes, or other disasters. The deterioration of documents can also occur due to repeated use.

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9. CONTRIBUTIONS REGARDING THE MATHEMATICAL MODELING OF THE COMPUTER SYSTEM MANAGEMENT PROCESS – DIGITAL ARCHIVING SUBPROCESS H8

9.1 Mathematical modeling of the Digital Archiving subprocess H8

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Within the studied organization, the County Directorate for Personal Records, the majority of archived documents are produced by the Civil Status Service and the Personal Records Service. Currently, in the conduct of activities related to civil status and personal records, it is considered that a file is created for each case, which contains copies of the original documents necessary for resolution, as well as other documents specific to each case. Also, in the other departments of the studied organization, namely the Accounting and Technical Material Assurance Department, the Legal Department, and the Human Resources and Public Relations Department, as a result of the activities carried out, there is a significant amount of paper documents that also need to be archived.

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The latest evidence from the archived files of the studied organization is from the year 2021. In that year, the files created until the end of 2019 were archived because the files created in the last two years are not archived, as it is considered that these documents are still needed for current activities. The number of files completed in 2019 is 389 files. Depending on the nature of the information in the documents, the files must be kept for a minimum of 3 years, with some of them being permanently retained. Most documents are kept for ten years.

Under these conditions, the number of archived files increases yearly, and storing the archive poses serious problems. The storage space is increasing, and the allocated resources—material, human, financial, and time—are growing. It must be taken into account that depending on the retention period, a portion of the documents will be removed from the archive each year. The first term is three years, then five years, ten years, 15 years, 50 years, 80 years, and 100 years, and some files must be kept permanently.

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Based on the data obtained for the year 2019, it appears that 389 files were added to the archive. The Personal Records Service created the majority of archived files, totaling 164 files with 39,538 pages. The average file for a case is approximately 241 pages per case.

It is proposed that an indicator be defined by abbreviating the name of each service/department that archives documents. This indicator will reflect the number of archived files for each service/department individually at the time of the research. The situation of this data is shown in Table 9.1, with the number of files for each service/department created in 2019.

Tab. 9.1 Files archived in 2021 for the year 2019

	Service/Department	Indicator	Archived files from 2019
1	Civil Status Service	SSC	153
2	Personal Records Service	SEP	164
3	Financial, accounting, and technical-material assurance department	CFCATM	53
4	Legal litigation compartment, human resources and public relations	CCJRU	17
5	IT department	CI	2
	TOTAL ARCHIVED FILES		389

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It is proposed that a digitized solution be adopted for this process. The necessary documents for each case are proposed to be scanned in PDF format and electronically signed by the official handling the case and their superiors who review and approve these files. Subsequently, these documents will be saved in digital format, and the archiving of these documents can be done on a server, while for safety, a backup is made on a NAS-type data storage device. (Network Attached Storage). A NAS device is recommended for reducing the risk of data loss in the event of a disaster, as it allows for a copy of the digital archive to be made in another location, off-site from the organization's headquarters, at a considerable distance.

It is important to assess the quantity of files that accumulate over time in order to provide archiving solutions. This will help us understand how the number of files is increasing and the need for digital storage capacity.

In order to have a clearer picture of the actual dimensions with which the database will grow each year, it is necessary to consider that the retention period for files in the archive varies. A division of the files has been made based on the archiving period for which each must be kept, highlighted in table Tab. 9.3. These retention periods are outlined in the law regarding national archives no. 16 from 1996, republished in 2014.

Another important aspect is estimating the time required to scan the documents that will be digitized. It is also important to estimate the electricity consumption required for scanning documents.

We set out to estimate the quantity of archived files for 20 years. It is taken into account that not all files need to be kept permanently, and most of the archived files have a retention period of 10 years.

To estimate the evolution of the number of archived files, we started from the actual situation of recent years. The last archiving occurred in 2021, when the files resulting from 2019 were archived. So, we have an exact situation regarding the number of files that have been archived from 2009 to 2019. This situation is presented in Table 9.3. (Olteanu C. D., Țițu, Doicin, & Ionescu, 2023)

Tab. 9.2 Archived files from the years 2009 – 2019 (Olteanu C. D., Țițu, Doicin, & Ionescu, 2023)

Indicator	Archiving period	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
SSC	5 ani	0	0	0	6	2	5	12	5	1	1	2
	10 ani	0	1	11	28	36	39	33	76	106	116	139
	20 ani	1	0	0	2	2	0	0	0	0	0	0
	50 ani	0	0	1	29	33	35	35	10	11	12	10
	100 ani	0	0	1	0	1	1	1	1	3	0	2
SEP	5 ani	4	11	14	23	12	17	19	44	82	81	50
	10 ani	4	4	77	63	71	102	93	110	140	123	107
	15 ani	2	3	16	12	13	11	6	8	8	5	6
	Permanent	0	1	2	0	1	1	2	1	1	0	1
CFCATM	5 ani	0	0	4	11	62	13	4	8	8	5	6
	10 ani	24	1	0	37	45	55	43	49	47	37	40
	50 ani	0	0	0	1	0	0	0	0	0	1	0
	Permanent	0	0	0	7	4	4	2	4	4	1	7
CCJRU	3 ani	0	0	0	0	0	0	4	6	1	1	3
	5 ani	0	3	1	2	4	9	4	4	3	2	2
	10 ani	5	8	4	6	4	6	2	2	5	3	1
	50 ani	0	0	0	1	0	0	1	0	0	0	0
	80 ani	2	2	1	13	7	8	8	7	2	12	6

Indicator	Archiving period	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	Permanent	2	4	2	4	1	7	4	2	5	7	5
CI	5 ani	0	0	0	5	5	3	0	1	3	2	2
	20 ani	0	0	2	1	1	1	0	0	0	0	0
Total		44	38	136	251	304	317	273	338	430	409	389

It has been identified that the number of files is not evenly distributed across services and departments. (Tab. 9.3). This observation created a Pareto analysis, shown in Fig. 9.1, covering the situation from the last four years. It was noted that the number of files is very high for two services, namely the Personal Records and Civil Status services, with the following values: 75.44% in 2016, 81.86% in 2017, 82.64% in 2018, and 81.49% in 2019.

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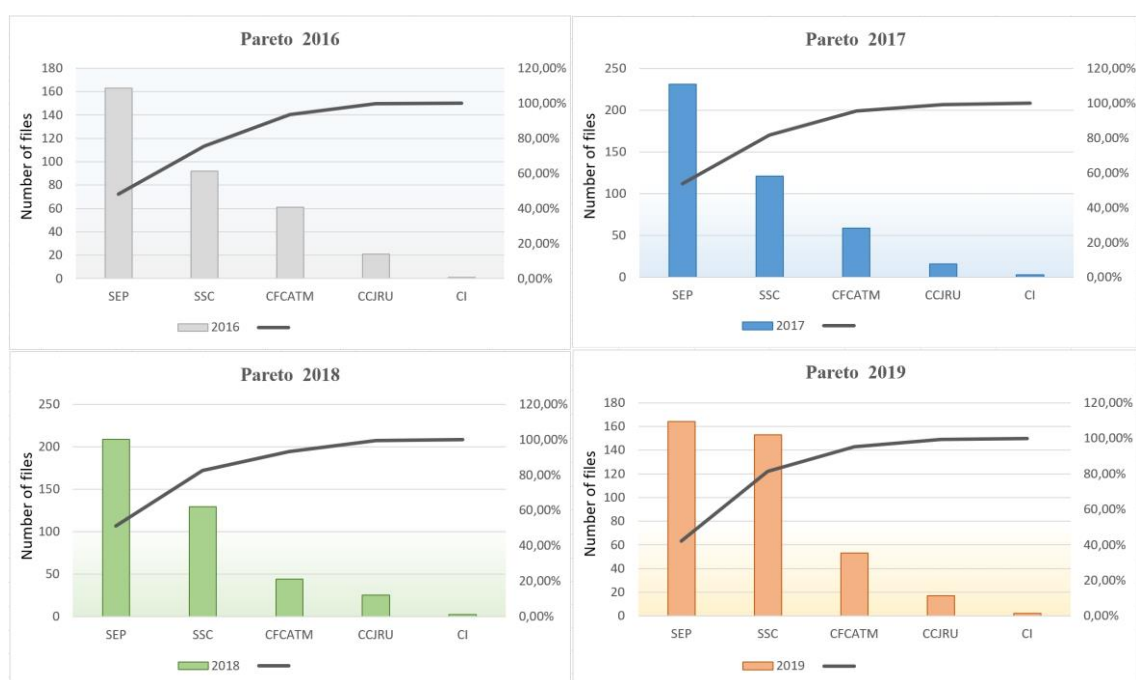


Fig. 9.1 Pareto analysis for the number of files in the years 2016, 2017, 2018, 2019.

From this data, MINITAB data analysis and graphical representation software were used to analyze and visualize this data. A linear regression was used for the analysis. The resulting graph is presented in Fig. 9.2.

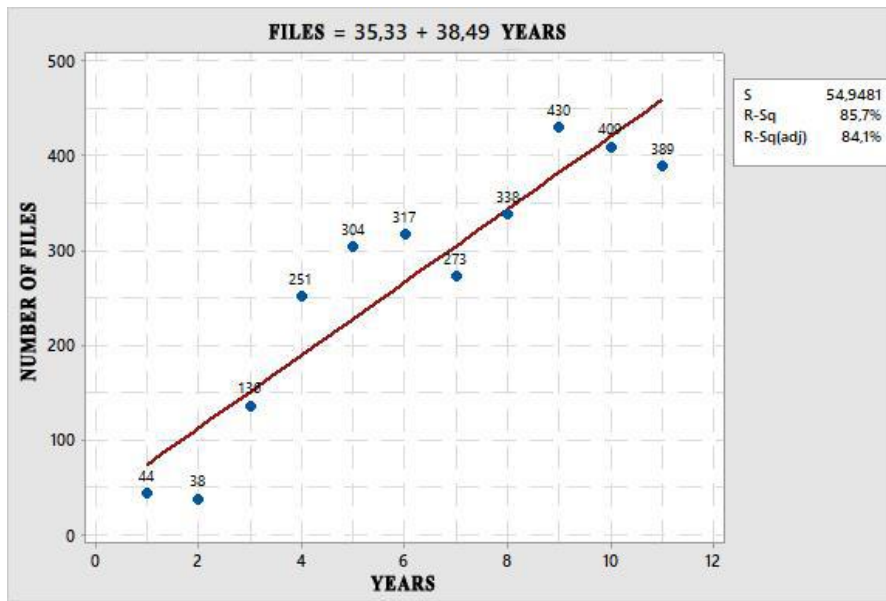


Fig. 9.2 The evolution of the number of files - linear regression

The following equation resulted in a linear regression when the data was processed with the program:

$$\text{Number of files} = 35,33 + 38,49 * \text{Years} \tag{9.1}$$

Starting from this relationship, an estimate of the number of files for twenty years was made. It must be taken into account that not all archived files need to be kept permanently. Depending on the nature of the documents, they have different archiving deadlines. The archiving terms range from 3 years to 100 years, and some must be kept permanently.

For each archival retention period, the number of files was obtained using the corresponding proportions derived from the actual data from the last year, for which there is a clear assessment, namely the files from 2019. For example, for the retention period in the archive of 10 years, after dividing the total number of files (389 files) by the number of files with a 10-year retention period (287 files), a proportion value of 1.3554 was obtained. Thus, to obtain an estimate of the number of files that need to be kept in the archive for a defined period of years corresponding to a specific year, the total estimated number of files for that year was divided by the value of the proportion resulting from the calculation for the files from the year 2019. An example of the number of files in year 10, using calculations with these proportions, can be found in Table 9.5.

Tab. 9.3 Estimate proportions for archiving periods and an example of calculation

YEARS	3	5	10	15	50	80	100	Permanent	Total files
Number of actual files	3	62	287	6	10	6	2	13	389
Proportions	129,667	6,274	1,355	64,833	38,9	64,833	194,5	29,923	
Determine the number of files for year 10, using proportional calculations	420 / 129,667 = 3,239	420 / 6,274 = 66,94	420 / 1,355 = 309,87	420 / 64,833 = 6,478	420 / 38,9 = 10,796	420 / 64,833 = 6,478	420 / 194,5 = 2,159	420 / 29,923 = 14,0359	420
Rounded number of files for year 10	3	67	310	6	11	6	2	14	

Table 9.6 lists the results obtained for each year of the estimated 20 years. The estimate of the total number of files annually resulting from the organization's activities was obtained using the equation derived from the analysis with the MINITAB data analysis and graphical representation software: Number of files = 35.33 + 38.49 * Years.

To calculate the number of files that remain in the archive, starting from the fourth year, the estimated annual number of files has been reduced by the files for which the retention period in the archive expires. The results can be found in Table 9.6.

Tab. 9.4 Estimate the number of archived files in the next 20 years.

Archiving period Years	3			5			10			15			50	80	100	Permanent	Total/Year	Total / year without Expired	Total Collected Files	Total Archive
	1	-	0	12	-	0	54	-	0	1	-	0	2	1	0					
2	1	-	0	18	-	0	83	-	0	2	-	0	3	2	1	4	112	112	186	186
3	1	-	0	24	-	0	111	-	0	2	-	0	4	2	1	5	151	151	337	337
4	1	-	1	30	-	0	140	-	0	3	-	0	5	3	1	6	189	189	526	526
5	2	-	1	36	-	0	168	-	0	4	-	0	6	4	1	8	228	227	754	753
6	2	-	1	42	-	12	196	-	0	4	-	0	7	4	1	9	266	253	1020	1006
7	2	-	1	49	-	18	225	-	0	5	-	0	8	5	2	10	305	285	1325	1291
8	3	-	2	55	-	24	253	-	0	5	-	0	9	5	2	11	343	317	1668	1609
9	3	-	2	61	-	30	282	-	0	6	-	0	10	6	2	13	382	350	2050	1958
10	3	-	2	67	-	36	310	-	0	6	-	0	11	6	2	14	420	382	2470	2340
11	4	-	3	73	-	42	338	-	54	7	-	0	12	7	2	15	459	359	2929	2699
12	4	-	3	79	-	49	367	-	83	8	-	0	13	8	3	17	497	363	3426	3062
13	4	-	3	85	-	55	395	-	111	8	-	0	14	8	3	18	536	366	3962	3428
14	4	-	4	92	-	61	424	-	140	9	-	0	15	9	3	19	574	370	4536	3799
15	5	-	4	98	-	67	452	-	168	9	-	0	16	9	3	20	613	374	5149	4172
16	5	-	4	104	-	73	480	-	196	10	-	1	17	10	3	22	651	376	5800	4549
17	5	-	4	110	-	79	509	-	225	11	-	2	18	11	4	23	690	379	6490	4928
18	6	-	5	116	-	85	537	-	253	11	-	2	19	11	4	24	728	382	7218	5311
19	6	-	5	122	-	92	566	-	282	12	-	3	20	12	4	26	767	386	7984	5696
20	6	-	5	128	-	98	594	-	310	12	-	4	21	12	4	27	805	389	8790	6085

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In Figure 9.4, the evolution of the number of archived files each year can be visualized over 20 years. If all files had a permanent retention period, the number of files in the archive after 20 years would be 8,790, which is 44% more than the number of files obtained from the calculated estimate. The difference is significant in the capacity for digital storage, specifically in the physical medium on which the digital archive will be stored. This fact is shown in Fig. 9.4, which illustrates the estimated number of files that result each year and the estimated number of files archived annually after removing from the archive those files whose archiving deadlines have expired.

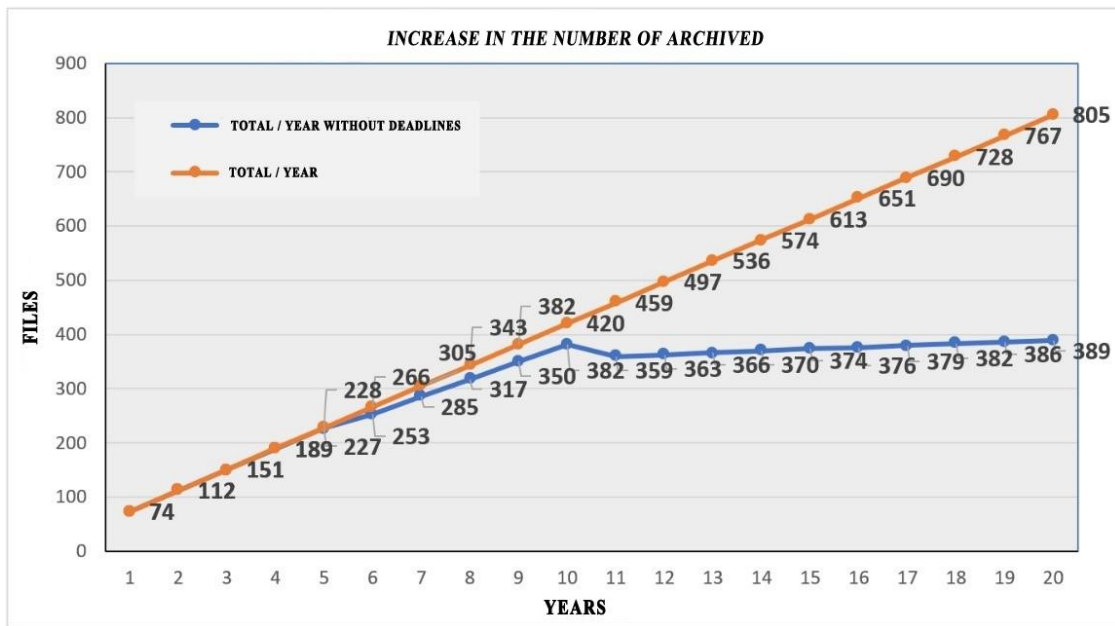


Fig. 9.3 The annual increase in the total number of files and the number of archived files.

Figure 9.5 presents a graphical representation of the estimated growth in the total number of archived files over twenty years. The total number of files for each year is the result after subtracting the number of files that have exceeded the archiving deadline.

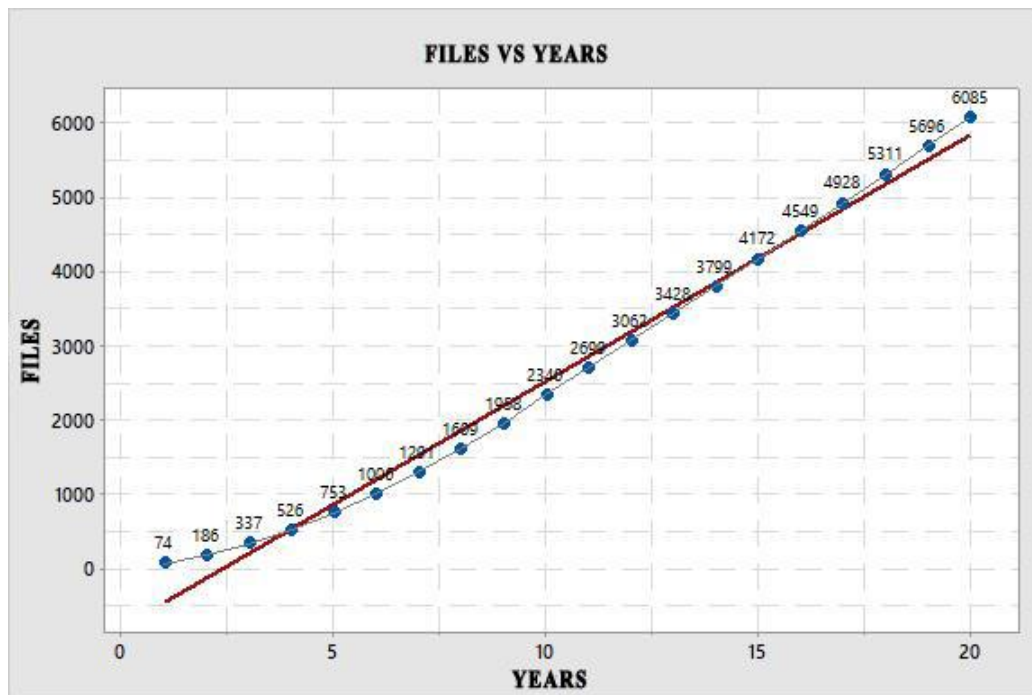


Fig. 9.4 Estimating the total number of files for a period of 20 years.

Up to this point, a physical assessment of the number of files in the current archive has been conducted, and an estimate has been made regarding how much the number of files will increase over the next 20 years. In order to digitize this archive, it is important to continue with a digital assessment of the storage capacity needed to proceed with digital archiving.

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For a regular scan without increased compression (SSFC), the size for ten sheets used as a model was 5.06 MB, while for a scan with increased compression prioritizing the smallest possible size (SSCCCP), the size obtained for the same ten scanned sheets was 0.87 MB. The quality of the scanned image decreases within acceptable limits, and the difference from 5.06 MB to 0.8 MB is significant. These differences will be felt in the reduction of storage capacity. The values obtained for each scanning method are represented in Table 9.8, with the most attractive scanning method being Standard Scanning with Compression and Quality Priority. (SSCCCP)..

Tab. 9.5 Size of scanned pages

Scanning method in PDF format		10 pages in MB	10 pages in GB	1 pages in GB
Standard scanning without compression	SSFC	5,06 MB	0,004941 GB	0,0004941 GB
Standard scanning with compression and priority quality	SSCCCP	1,75 MB	0,001709 GB	0,0001709 GB
Standard compression scanning	SCCS	1,03 MB	0,001006 GB	0,0001006 GB
Standard scan with priority compression	SSCCP	0,871 MB	0,000851 GB	0,0000851 GB

The storage capacity estimate for each year was calculated in Table 9.9, using the estimated number of archived files for each year, which can be found in Table 9.6. An average of 250 pages per archived file was used for the calculation.

Tab. 9.6 Simulating storage capacity – calculation with a simulated number of files.

Year	Total files	Pages	Scanning method				
			SSFC	SCCS	SSCCCP	SSCCP	
			0,506	0,103	0,175	0,0871	MB / pag
			0,000494	0,000101	0,0001709	0,0000851	GB / pag
1	74	18500	9,14085	1,8611	3,16165	1,57435	GB
2	186	46500	22,97565	4,6779	7,94685	3,95715	GB
3	337	84250	41,62793	8,47555	14,39833	7,169675	GB
4	526	131500	64,97415	13,2289	22,47335	11,19065	GB
5	753	188250	93,01433	18,93795	32,17193	16,020075	GB
6	1006	251500	124,2662	25,3009	42,98135	21,40265	GB
7	1291	322750	159,4708	32,46865	55,15798	27,466025	GB
8	1609	402250	198,7517	40,46635	68,74453	34,231475	GB
9	1958	489500	241,862	49,2437	83,65555	41,65645	GB
10	2340	585000	289,0485	58,851	99,9765	49,7835	GB
11	2699	674750	333,394	67,87985	115,3148	57,421225	GB
12	3062	765500	378,2336	77,0093	130,824	65,14405	GB
13	3428	857000	423,4437	86,2142	146,4613	72,9307	GB
14	3799	949750	469,2715	95,54485	162,3123	80,823725	GB
15	4172	1043000	515,3463	104,9258	178,2487	88,7593	GB
16	4549	1137250	561,9152	114,4074	194,356	96,779975	GB
17	4928	1232000	608,7312	123,9392	210,5488	104,8432	GB
18	5311	1327750	656,0413	133,5717	226,9125	112,99153	GB

Year	Total files	Pages	Scanning method				GB
			SSFC	SCCS	SSCCCP	SSCCP	
19	5696	1424000	703,5984	143,2544	243,3616	121,1824	GB
20	6085	1521250	751,6496	153,0378	259,9816	129,45838	GB

According to the calculations, the necessary size for digitizing the archive is acceptable and does not pose any implementation issues. Thus, for twenty years, taking into account an estimated number of files and performing a low-compression scan of the scanned PDF document, a size of 751 GB was obtained. This is the most unfavorable scenario. The smallest dimension is 129 GB for a standard scan with prioritized compression, where the scan quality is not the best. But, for a document scan in PDF format using the optimal method of Standard Scanning with Compression and Quality Priority (SSCCCP), the storage sizes decrease significantly, from 751 GB to 259.98 GB. Current storage devices (such as NAS or servers) can easily store these capacity sizes.

The following presents an experimental statistical modeling using the second-order central composite design method.

In Fig. 9.6, the evolution of the digital storage level for archived files over twenty years can be visualized for all four scanning methods: SSFC, SCCS, SSCCP, and SSCCP. The most attractive scanning method has been chosen, which is standard scanning with compression and prioritized quality. (SSCCCP). With this scanning method, it is possible to achieve very good scan quality while maintaining an acceptable file size.

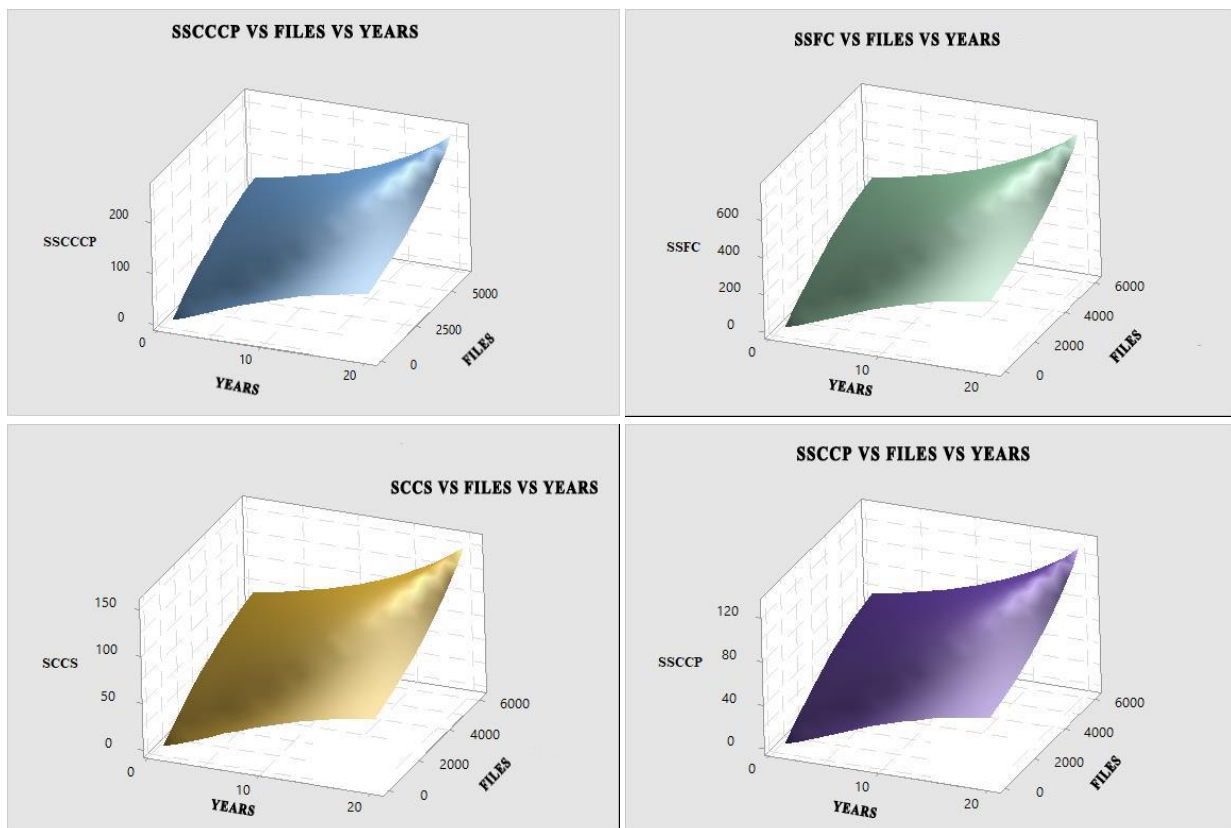


Fig. 9.5 Estimation of digital storage capacity for 20 years. Scanning method: SSFC, SCCS, SSCCP, SSCCP

The proposal for digital archiving must comply with the existing legal framework. Law 135 of 2007 regarding the archiving of documents in electronic form is cited. (Lege 135 15/05/2007 - Portal Legislativ, 2024)

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9.2 Application of a central composite factorial experiment for the Digital Archiving subprocess H8

Mathematical modeling has established itself as one of the most powerful and flexible support tools for decision-making. Modeling techniques can be applied in any field of activity.

...

The experiment's objective is to optimize the archiving process, aiming to provide the necessary information and solutions to facilitate a transition from physical archiving, which currently exists within the studied organization (with all its advantages and disadvantages), to digital archiving. It is intended to be a step towards digitizing activities within the organization, thereby increasing the efficiency and quality of services offered to citizens.

The objective functions chosen for the research are:

- **SSCCCP – Standard Scanning with Compression and Quality Priority** - represents the digital storage capacity required for the chosen scanning method, with high compression but prioritizing scanning quality. It is measured in GB, necessary for a year of scans. These figures' minimum and maximum values are derived from Table 9.9, which presents a simulation for storage capacity over 20 years. For a scan of 10 pages, 1.75 MB was generated, using 0.175 MB per page, which converts to 0.000170898 GB per page. Thus, for the simulation for the first year, for which the number of 74 files is estimated, there are 18,500 pages, and we have a capacity of 3.16162 GB. For the year 20, for which an estimated 805 files containing 201,250 pages are expected, 34.3932 GB is needed.

$$\begin{aligned} \text{SSCCCP} &= 18500 \text{ pages} * 0,000170898 \text{ GB} / \text{page} = 3,16162 \text{ GB} \\ \text{SSCCCP} &= 201250 \text{ pages} * 0,000170898 \text{ GB} / \text{page} = 34,3932 \text{ GB} \end{aligned} \quad (9.3)$$

- **TS – Scanning Time Required** - represents the time needed for scanning documents over the course of a year. A real scan was used on the equipment employed for this research to determine this time.

Thus, it took 33 seconds to scan 10 pages. In Table Tab. 9.9, with the simulation for storage capacity over 20 years, the first year shows the smallest number of files, 74. Using 250 sheets of paper for a file results in 18,500 pages. For each scanned page, an average of 3.3 seconds is needed. For this number of pages, 16,958 hours are needed.

These are the lowest values for the simulation in the first year. For the maximum values in the year 20, with 805 files containing 201,250 pages, 184,4792 hours are required for scanning.

$$\begin{aligned} TS &= \frac{18500 \text{ pages} * 3,3 \text{ seconds}}{3600} = 16,958 \text{ hours} \\ TS &= \frac{201250 \text{ pages} * 3,3 \text{ seconds}}{3600} = 184,4792 \text{ hours} \end{aligned} \quad (9.4)$$

- **CAD – Consumption for Digital Archiving** - represents the electrical energy required to scan documents. The unit of measurement used for energy is the joule. (J). In practice, kilowatts are frequently used. (KW). The equivalence is given by the formula: 1Wh = 3600J = 3.6kJ. A wattmeter was used to measure the actual nominal power during the scanning. The scanning function consumes approximately 60 W = 0.06 KW. For the smallest time value in Table 9.10 (the variable design matrix), we have 16.958 hours, and multiplying this value by 0.06 KW results in a consumption of 1.01748 KW. For the maximum scanning time of 184.4792 hours, the consumption amounts to 11.06875 KW. (Olteanu C. D., Țițu, Doicin, & Ionescu, 2023)

$$\text{Minimum CAD} = \text{Minimum TS} * 0.06 \text{ KW} = 16.958 \text{ hours} * 0.06 \text{ KW} = 1.01748 \text{ KW}$$

Maximum CAD = Maximum TS * 0.06 KW = 184.479 hours * 0.06 KW = 11.06875 KW (9.5)

...

For the input data used in the experiment, the indicators obtained by abbreviating the name of the service/department were used. For the **Civil Status Service**, the indicator will be named **SSC**; for the **Personal Records Service**, the indicator will be named **SEP**; for the **Financial, Accounting, and Technical-Material Assurance Department**, the indicator will be named **CFCATM**; for the **Legal Contention, Human Resources, and Public Relations Department**, the indicator will be named **CCJRU**, and for the **IT Department**, the indicator will be named **CI**. Each indicator reflects several archived files.

To determine the minimum and maximum values of the **SSC, SEP, CFCATM, CCJRU, and CI** indicators, the actual situation of archived files in the year 2022 was used, respectively with the files completed in 2019, in order to calculate the proportions of each indicator from the total number of files. These proportions were used to calculate the number of files for each indicator applied to the estimates of the number of files in years 1 and 20, resulting in the minimum and maximum number of files for each indicator. The results of these calculations for each indicator are presented in Table 9.11.

Tab. 9.7 Minimum and maximum calculations for the selected indicators

	2019 - real	Ratio	Year 1 - Estimated	Year 1 - Rounded	Year 20 - Estimated	Year 20 - Rounded
SSC	153	39,33%	29,11	29	316,6195	317
SEP	164	42,16%	31,2	31	339,383	339
CFCATM	53	13,62%	10,08	10	109,6787	110
CCJRU	17	4,37%	3,234	3	35,17995	35
CI	2	0,51%	0,38	1	4,138817	4
Total	389			74		805

Using these proportions, the minimum and maximum values for each experimental factor can be calculated, which are presented in a Table 9.12.

Tab. 9.8 Entry date – experimental factors

Input data		U.M.	Minim	Maxim
SSC	Civil Status Service	Nr. Files	29	317
SEP	Personal Records Service	Nr. Files	31	339
CFCATM	Financial, accounting, and technical-material assurance department	Nr. Files	10	110
CCJRU	Legal litigation compartment, human resources and public relations	Nr. Files	3	35
CI	IT department	Nr. Files	1	4

For this experimental project, a second-order central composite factorial experiment of the order of 2^2 , respectively 2^5 , was used. It involved the interaction of three factors: $Y1 = SSSCCP$, $Y2 = TS$, and $Y3 = CAD$. To capture all the situations within the experiment, there will be a total of $2^5 = 32$ determinations.

Table 9.13 lists each indicator/experimental factor along with the minimum and maximum values for each, and the objective functions are calculated based on the experimental factors. (Olteanu C. D., Țițu, Doicin, & Ionescu, 2023)

Tab. 9.9 The design matrix of variables (Olteanu C. D., Țîțu, Doicin, & Ionescu, 2023)

	X1	X2	X3	X4	X5	Y1	Y2	Y3
Number of determinations	SSC	SEP	CFCATM	CCJRU	CI	SSCCCP	TS	CAD
1	29	31	10	3	1	3,16165	16,95833	1,0175
2	29	31	10	3	4	3,289825	17,64583	1,05875
3	29	31	10	35	1	4,52885	24,29167	1,4575
4	29	31	10	35	4	4,657025	24,97917	1,49875
5	29	31	110	3	1	7,43415	39,875	2,3925
6	29	31	110	3	4	7,562325	40,5625	2,43375
7	29	31	110	35	1	8,80135	47,20833	2,8325
8	29	31	110	35	4	8,929525	47,89583	2,87375
9	29	339	10	3	1	16,32095	87,54167	5,2525
10	29	339	10	3	4	16,44913	88,22917	5,29375
11	29	339	10	35	1	17,68815	94,875	5,6925
12	29	339	10	35	4	17,81633	95,5625	5,73375
13	29	339	110	3	1	20,59345	110,4583	6,6275
14	29	339	110	3	4	20,72163	111,1458	6,66875
15	29	339	110	35	1	21,96065	117,7917	7,0675
16	29	339	110	35	4	22,08883	118,4792	7,10875
17	317	31	10	3	1	15,46645	82,95833	4,9775
18	317	31	10	3	4	15,59463	83,64583	5,01875
19	317	31	10	35	1	16,83365	90,29167	5,4175
20	317	31	10	35	4	16,96183	90,97917	5,45875
21	317	31	110	3	1	19,73895	105,875	6,3525
22	317	31	110	3	4	19,86713	106,5625	6,39375
23	317	31	110	35	1	21,10615	113,2083	6,7925
24	317	31	110	35	4	21,23433	113,8958	6,83375
25	317	339	10	3	1	28,62575	153,5417	9,2125
26	317	339	10	3	4	28,75393	154,2292	9,25375
27	317	339	10	35	1	29,99295	160,875	9,6525
28	317	339	10	35	4	30,12113	161,5625	9,69375
29	317	339	110	3	1	32,89825	176,4583	10,5875
30	317	339	110	3	4	33,02643	177,1458	10,62875
31	317	339	110	35	1	34,26545	183,7917	11,0275
32	317	339	110	35	4	34,39363	184,4792	11,06875

In a factorial experiment, the proposed process is optimized by conducting experimental determinations, which generate a quantity of information that will be analyzed later.

The objective functions SSCCCP, TS, and CAD values were calculated based on the values of the experimental factors SSC, SEP, CFCATM, CCJRU, and CI, presented in Table 9.11. Thus, for calculating the values of the objective function SSCCCP, listed in Table 9.11, the calculation formula Formula 9.3 was used. Also, for calculating the values of the objective function TS, presented in Table 9.11, Formula 9.4 was used, while for the objective function CAD, Formula 9.5 was applied.

9.2.1 Mathematical modeling for the objective function SSCCCP - Standard scanning with compression and priority quality

1. Mathematical modeling $y1 = f(x1, x2) \rightarrow \text{SSCCCP} = f(\text{SSC}, \text{SEP})$

Figure 9.7 shows the evolution of the objective function **SSCCCP** as a function of the experimental indicators/factors **SEP** and **SSC**. The objective function **SSCCCP** - *Standard scanning with compression and quality priority*, reaches a maximum value of 34.39363 GB per year when the **SSC** indicator (number of files archived for the Civil Status Service) has a value of 317 archived files and the **SEP** indicator (number of files archived for the Personal Records Service) has a value of 339 archived files.

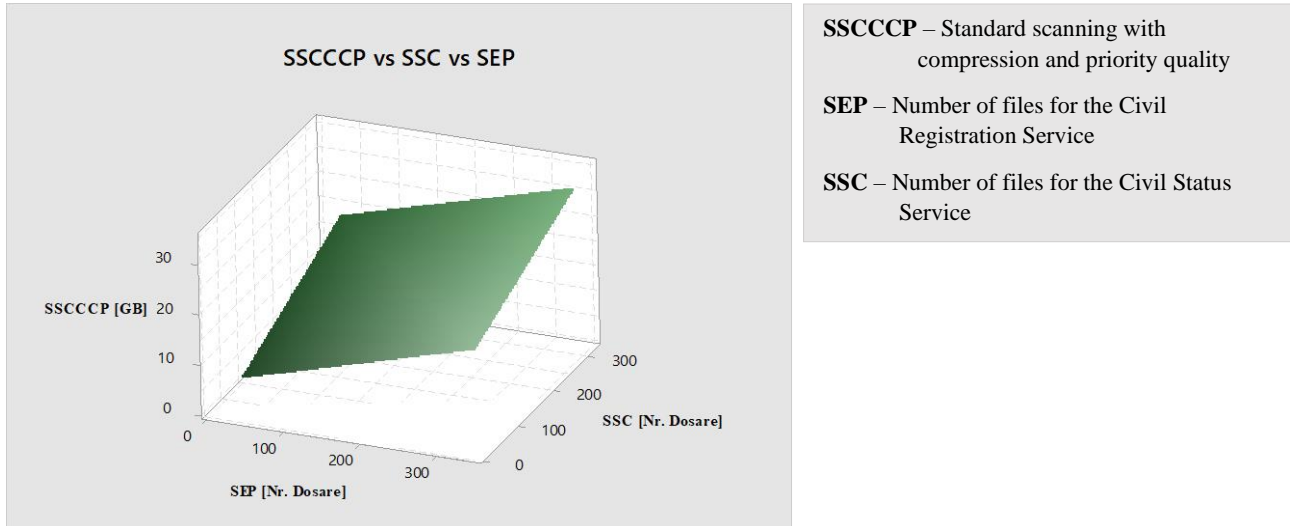
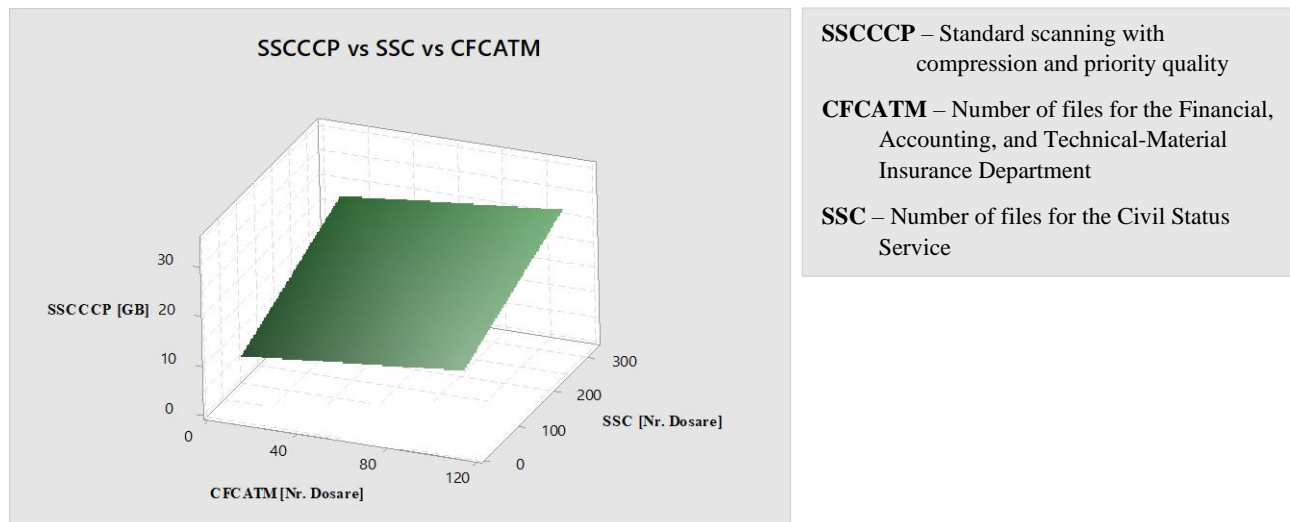


Fig. 9.6 The 3D response surface diagram results from modeling the relationship between the objective function **SSCCCP** and the variables **SSC** and **SEP**

2. Mathematical modeling $y_1 = f(x_1, x_3) \rightarrow \text{SSCCCP} = f(\text{SSC}, \text{CFCATM})$

Figure 9.8 shows the evolution of the **SSCCCP** objective function as a function of the



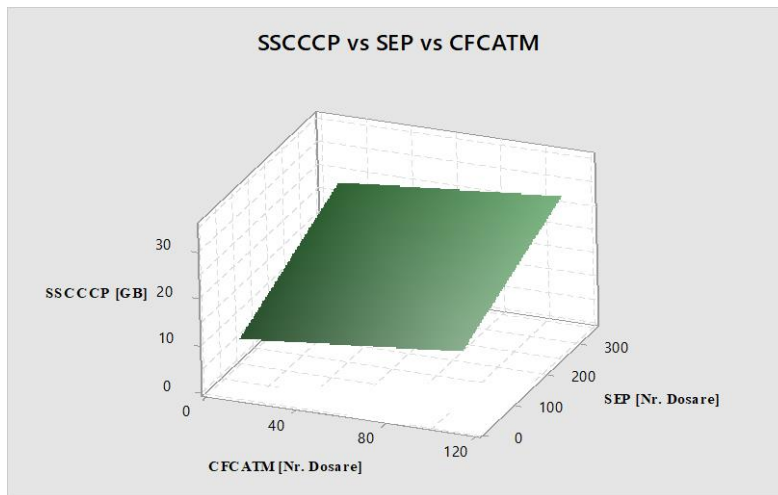
experimental indicators/factors **SSC** and **CFCATM**. The objective function **SSCCCP** (standard scanning with compression and quality priority) reaches a maximum value of 34.39363 GB per year when the **SSC** indicator (number of archived files for the Civil Status Service) is 317 archived files. The **CFCATM** indicator (number of archived files for the Financial, Accounting, and Technical-Material Assurance Department) is at 110 archived files.

Fig. 9.7 Diagrama suprafeței de răspuns 3D, care rezultă în urma modelării relației dintre funcția obiectiv **SSCCCP** și variabilele **SSC** și **CFCATM**

3. Mathematical modeling $y_1 = f(x_2, x_3) \rightarrow \text{SSCCCP} = f(\text{SEP}, \text{CFCATM})$

Figure 9.9 shows the evolution of the **SSCCCP** objective function as a function of the experimental indicators/factors **SEP** and **CFCATM**. The **SSCCCP** objective function (standard

scanning with compression and priority quality) reaches a maximum value of 34.39363 GB per year when the **SEP** indicator (number of archived files for the Personal Records Service) has a value of 339 archived files and the **CFCATM** indicator (number of archived files for the financial, accounting, and technical-material insurance department) has a value of 110 archived files.



SSCCCP – Standard scanning with compression and priority quality

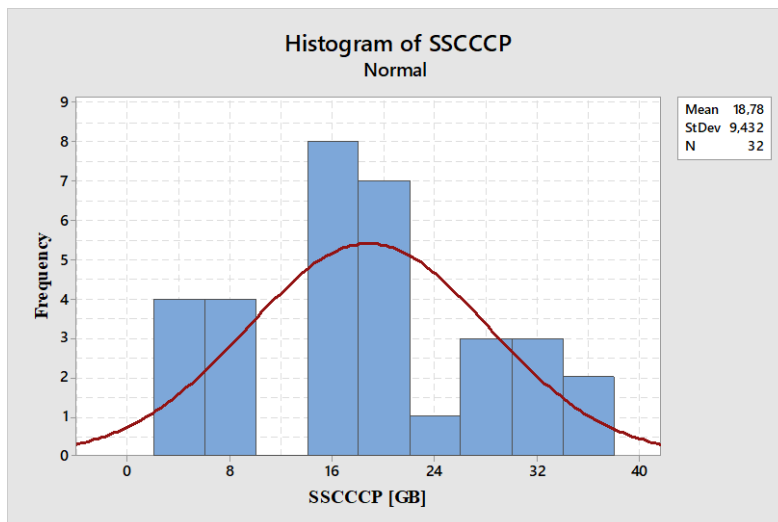
CFCATM – Number of files for the Financial, Accounting, and Technical-Material Insurance Department

SEP – Number of files for the Personal Records Service

Fig. 9.8 The 3D response surface diagram results from modeling the relationship between the objective function **SSCCCP** and the variables **SEP** and **CFCATM**.

4. Histogram of the objective function **SSCCCP**

A histogram provides data on how the values of the objective function **SSCCCP** are distributed; it shows us whether the data falls within 6 SIGMA, within the normal range, under the bell curve of Gauss, and illustrates the frequency distribution. In the histogram of the objective function, it can be observed that the data dispersion is not uniform, and most values vary between 14 and 23. It is observed that there is a lack of data between the values of 10 and 14. The graphical representation of this histogram is shown in Fig. 9.10.



SSCCCP – Standard scanning with compression and priority quality

Fig. 9.9 A diagram representing the frequency distribution (Histogram) results from modeling the relationship between the objective function **SSCCCP** and **SSC** and **SEP** variables

5. The main effects on the objective function **SSCCCP**

The main effects of the **SSCCCP** objective function are observed in Fig. 9.11. The **SSC** indicator (number of archived files for the Civil Status Service) has values ranging from 29 to 317 archived files. The **SEP** indicator (number of archived files for the Personal Records Service) has

values ranging from 31 to 339 archived files. The **CFCATM** indicator (number of archived files for the Financial, Accounting, and Technical-Material Insurance Department) has values ranging from 10 to 110 archived files. The **CCJRU** indicator (number of files archived for the Legal Contentious Department, Human Resources, and Public Relations) has values ranging from 3 to 35 archived files. The **CI** indicator (number of archived files for the IT Department) has values ranging from 1 to 4 archived files.

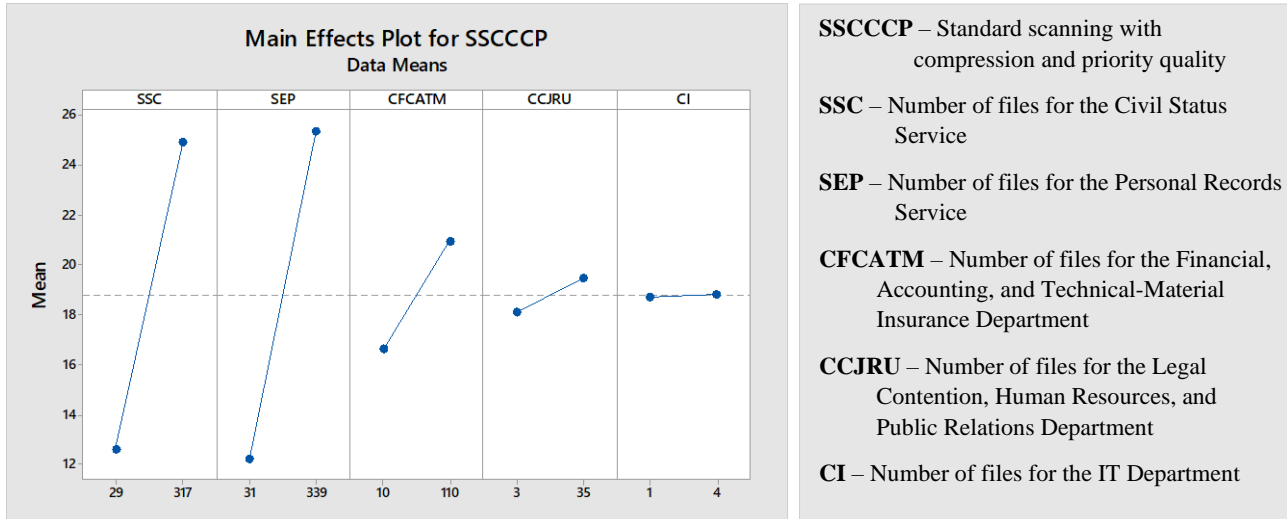


Fig. 9.10 Diagram with the main effects in the case of the SSCCCP objective function

9.2.2 Mathematical modeling for the objective function TS – Time required for document scanning

6. Mathematical modeling $y_2 = f(x_1, x_2) \rightarrow TS = f(SSC, SEP)$

Figure 9.12 shows the evolution of the objective function **TS** as a function of the experimental indicators/factors **SSC** and **SEP**. The objective function **TS** - *Time required for scanning* reaches a maximum value of 184.48 hours per year when the **SSC** indicator (number of archived files for the Civil Status Service) has a value of 317 archived files, and the **SEP** indicator (number of archived files for the Personal Records Service) has a value of 339 archived files.

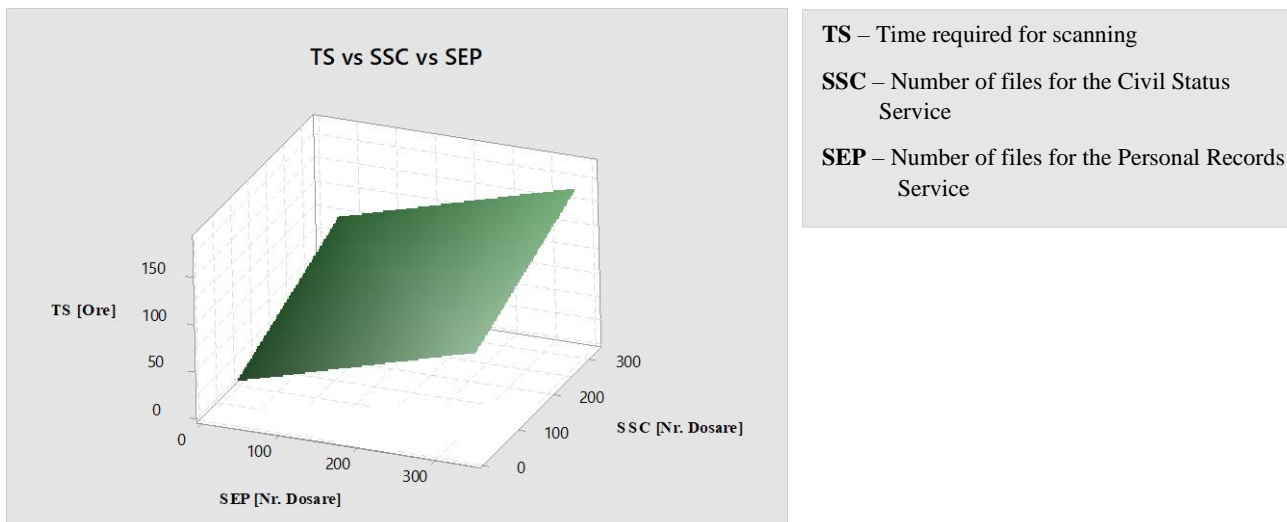


Fig. 9.11 The 3D response surface diagram results from modeling the relationship between the objective function TS and the variables SSC and SEP

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9.2.3 Mathematical modeling for the objective function CAD - Electricity consumption for digital archiving

7. Mathematical modeling $y_3 = f(x_1, x_2) \rightarrow \text{CAD} = f(\text{SSC}, \text{SEP})$

Figure 9.17 shows the evolution of the **CAD** objective function as a function of the experimental indicators/factors **SSC** and **SEP**. The objective function **CAD** (electricity consumption for digital archiving in KW/year) reaches a maximum value of 11.06875 KW for a year when the **SSC** indicator (number of archived files for the Civil Status Service) has a value of 317 archived files. The **SEP** indicator (number of archived files for the Personal Records Service) has a value of 339 archived files.

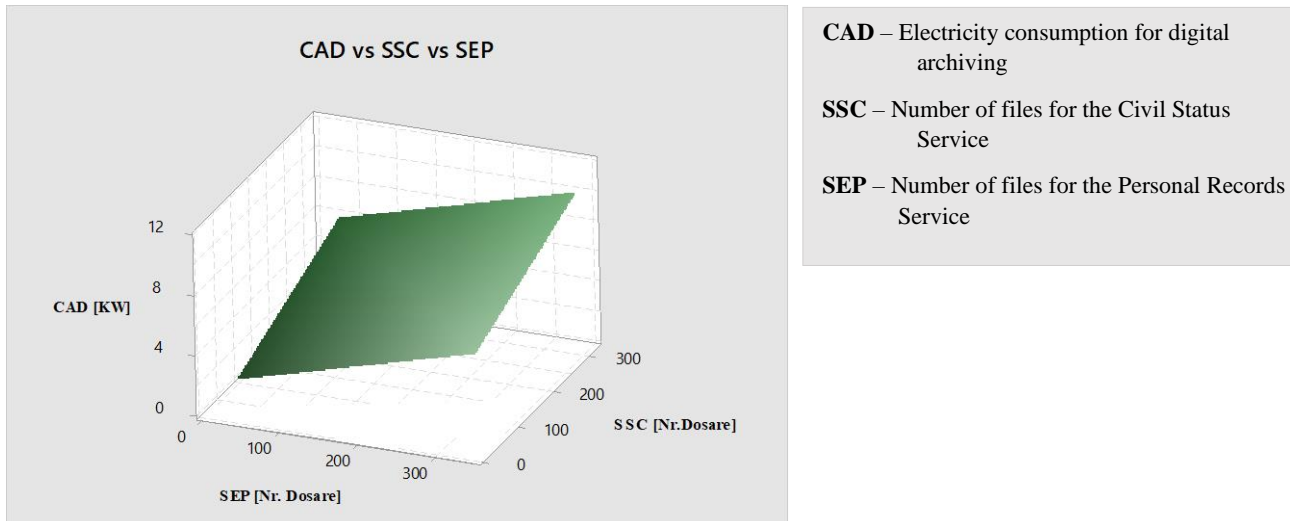


Fig. 9.12 This is a 3D response surface diagram resulting from modeling the relationship between the CAD objective function and the SSC and SEP variables.

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9.3 Conclusions regarding the proposed mathematical modeling

Conclusions regarding the mathematical modeling of the *Digital Archiving Subprocess*

We propose to create a digital archive of the documents within the institution. At this moment, the documents resulting from the activities within the services and departments of the organization are archived in physical format. In the current situation where archiving is done in physical format, there is a need for physical space dedicated to storage that must be arranged appropriately. In the case of physical archiving, there is also the risk that archived documents may deteriorate due to storage conditions, moral wear, or handling. Searching for information in files is difficult and inefficient, consuming much time. Access to the physical archive is also not easy.

Creating a digital archive eliminates the need for storage space, documents will not deteriorate, and searching for information in documents will be very quick. There is also the possibility of printing the information sought. At the same time, by implementing a digital archive, significant costs will be reduced for maintenance and ensuring storage conditions and the annual costs for paying the archiving services provided by the external company that organizes the documents that need to be archived.

To estimate whether a digital archiving system can be implemented from a technical standpoint, we started by examining the records of the current physical archive, which has existed from 2009 to 2019. An estimate of the number of files for a twenty-year period was made using a linear regression conducted with the MINITAB data analysis and graphical representation software.

Several scanning methods were tried for the documents, and based on the research conducted, the following method was chosen: *Standard scanning with compression and priority quality*

(SSCCCP) because the scanned files have very good quality and convenient size for the scanned document.

The necessary digital storage capacity for creating a digital archive has been determined, using the chosen scanning method and the estimated number of files. For a more accurate estimate, it was taken into account that very few files are kept permanently. An important part of the number of files, after the period for which they need to be archived has ended, can be removed from the archive. Thus, the storage capacity will increase moderately after ten years.

An estimate was also made of the time required to scan the documents and the amount of electricity consumed for the scanning process. The data analysis and graphical representation software MINITAB was used to carry out the mathematical modeling. Following the analyses, it was found that within the studied organization, the two services, the Civil Registry and Vital Statistics Service, produce the majority of the files that are archived as a result of their activities. Due to this finding, in implementing a digital archive, we believe that because of the large volume of scanning, it is necessary to have a scanning device for each of these services.

In the mathematical modeling of this subprocess of *Digital Archiving*, it has been confirmed that, from a technical standpoint, it is possible to transition from physical archiving to digital archiving. The existing servers within the organization can be used to host the digital archive, and the necessary storage capacity for archiving the scanned files can be ensured. Using a digital archive will improve the quality of services offered to citizens. Time will be used more efficiently, and the savings will be significant financially.

10. FINAL CONCLUSIONS, ORIGINAL CONTRIBUTIONS, AND FUTURE RESEARCH DIRECTIONS

10.1 Final conclusions

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In the first chapter, an analysis of the current state regarding knowledge-based organizations was conducted, followed by an analysis of the concept of knowledge-based management, and then an examination of the knowledge-based economy.

The thesis continues with an analysis of the current state regarding quality and quality management in public organizations that provide knowledge-based services to citizens, in the context of a knowledge-based economy where continuous improvement is a solution for enhancing the quality of services in public organizations that deliver knowledge-based services to citizens.

Aspects regarding internal and external quality assurance in public organizations based on knowledge that provides services to citizens have been analyzed, focusing on the quality and quality management of services in these organizations. Subsequently, the importance of implementing an integrated quality management system in public organizations based on knowledge that provides services to citizens was examined.

10.2 Original contributions

The second part of the doctoral thesis begins with defining the general objective of the doctoral research theme, which aims to provide technical solutions regarding the enhancement of service quality in knowledge-based organizations that provide services to citizens by proposing solutions that will lead to the improvement of activities and processes carried out within the researched organization.

The specific objectives of the doctoral research have also been defined:

- Identification of the processes within the researched organization;
- Designing and creating a map of the processes within the researched organization;
- Proposals for improving the processes within the researched organization;

- Creating a graphical model for an existing process within the researched organization;
- Creating a graphic model for a proposed process;
- Conducting a SWOT analysis for the implementation of a quality management system.
- Mathematical modeling of the digital archiving subprocess.

Furthermore, an analysis was conducted regarding the quality and quality management in the researched organization, and a SWOT analysis was carried out concerning the implementation of an integrated quality management system.

An analysis has been conducted regarding the evolution of the information system within the studied organization. Particularities of the information system and the informational system have been identified from the perspective of doctoral research, highlighting aspects of the e-Government information system in the context of the conducted research. Aspects regarding implementing an information system within the researched public organization were analyzed from the perspective of a management system.

Currently, the management system does not have a process-based approach in the studied organization. In this context, we propose a method of improvement through a process-based recommendation approach that adheres to the quality management principles outlined in ISO 9000:2015 and ISO 9004:2018. In implementing the process-based approach in the application of the quality management system, emphasis is placed on understanding and meeting the citizens' requirements, on performance, effectiveness, and on the continuous improvement of processes, resulting in an increased level of satisfaction for the citizen, who is the beneficiary of the services provided by the studied organization.

A detailed and systematic analysis of the County Directorate for the Registration of Persons in Sibiu has been conducted, identifying the existing processes which I have categorized into three types: management processes, core processes, and basic or support processes.

A map of the existing processes has been created after the analyses conducted. We mention that, at this moment, there is no process map in the organization. Following the analyses conducted on the process map created by the author of this thesis, proposals for improvement were made, resulting in a new process map with the main suggestion to establish a specialized office for quality verification and control staffed by specialized personnel.

Graphical modeling was carried out using the IDEF 0 methodology for the Information System Management Process, specifically for the Data and Network Security subprocess. Additionally, using the IDEF 0 methodology, graphical modeling was carried out for the Information System Management Process and the proposed subprocess, Digital Archiving. This process does not currently exist; the proposal for its emergence also comes from the author of this thesis. Currently, in the researched organization, archiving is done in physical format. Implementing a digital archive eliminates expenses incurred by paying the company that organizes the documents to be archived.

Additionally, the costs associated with maintaining the physical space required for archiving these files are eliminated. Pregnant individuals are relieved of the responsibility of managing the physical archive. As a result of using a digital archive of documents, the efficiency of officials increases by reducing the time needed for trips to the physical archive and shortening the time spent searching for documents. Additionally, using a digital archive eliminates the risk of document deterioration.

The mathematical modeling of the Digital Archiving H8 subprocess has been completed in order to estimate the storage capacity needed for the next 20 years. This estimate was made using existing measurable indicators regarding the number of files from the past. I applied a central composite factorial experiment for the Digital Archiving subprocess to carry out this estimation. The data analysis and graphical representation software MINITAB was used for mathematical modeling.

In order to streamline the doctoral research activity and maintain a logical progression of the research, the graphic tool, Mind Maps, was used as a means of visualization, analysis, and evaluation of the activity throughout the doctoral research. These mind maps can be found in the Annexes.

10.3 Further Research Directions

A series of additional research studies can be developed regarding the subject of this doctoral thesis:

- The development and implementation of a dedicated, optimized, and secure application that meets the requirements imposed by the implementation of a digital archive;
- The interconnection of the registration application with the digital archiving application;
- Creating graphical modeling for all processes identified in the organization;
- Creating graphic models for the processes intended to be optimized and improved.

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ANNEX

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