

**MINISTRY OF EDUCATION
„1 DECEMBRIE 1918” UNIVERSITY OF ALBA IULIA
FACULTY OF ECONOMIC SCIENCES
DOCTORAL SCHOOL OF ACCOUNTING**

SUMMARY OF THE PHD THESIS

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**ANALYSIS OF THE COSTS OF DRINKING
WATER PRODUCTION AND SEWAGE
TREATMENT SERVICES: CALCULATION
MODELS AND ANALYSIS**

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**Alba Iulia
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INTRODUCTION

„Water is the driving force of all nature”

Leonardo da Vinci

Water is not only an essential element for humanity and development but also a critical one, without which we cannot live. It is an irreplaceable resource for which there are no alternatives. Many believe that the future depends on oil, yet it is likely that the future of humanity depends much more on water resources than on oil. There can be no agriculture or production of goods without water. There can be no healthy ecosystems and socio-economic development without water. Ecosystems can only be kept healthy through the existence of necessary water quantities. Given that economic growth is also tied to the proper management of water resources, it can be stated that poverty reduction also depends on access to water resources.

Historically, the second half of the 20th century was an important period in the evolution of global water resource usage. These changes are linked to the independence gained by former colonies and the spread of communism after World War II. Communist economies, with extensive agricultural sectors, developed large irrigation systems, which had a negative environmental impact (for example, the Aral Sea, which almost dried up due to intensified irrigation). After 1989, in former communist states and colonies where dictatorships were removed, the approach to water resources also changed. The public was educated about water and local actors were allowed to care for the water resources in the region. These new democracies have not yet managed to rid themselves of all old water-related habits, forgetting that it is a public good. The change in economic priorities in these countries led to a decrease in water management investments.

The dramatic increase in the planet's population over the last century also impacts water resource management. By 2030, the world's population is expected to reach approximately 8.5 billion people¹, compared to 4.43 billion in 1980. During this period, water resources did not increase; in fact, it can be stated without error that they have diminished due

¹ United Nations, Department of Economic and Social Affairs, Population Division, (2015), *Population 2030 Demographic challenges and opportunities for sustainable development planning*, New York - <https://www.un.org/en/development/desa/population/publications/pdf/trends/Population2030.pdf>

to climate change and pollution of existing sources. Feeding the population will require increased food production in 2030, with lower water consumption and more efficient water use in agriculture.

The demand for water in agriculture is continuously increasing. This increase is driven, among other factors, by the rising demand for meat, whose production consumes more water than cereal production.

The energy requirement is expected to increase by 30-35% by the years 2030-2040², both in states with poor economies and in developing countries and hydroelectric plants represent one of the possibilities for producing green energy. Based on recent trends, it can be said that droughts and floods will continue in the future, threatening agriculture and thus the states with strong agriculture, implicitly affecting the lives of those who depend on agriculture.

Industry is another element that requires water and as it develops, the need for water will increase.

Urbanization emerges as a reality that also leads to an increased need for water in households - for washing machines, toilets and personal hygiene. Rigorous management of natural water resources, both surface and underground, is imperative to meet the challenges of the coming years.

Given climate change and the previously mentioned factors, it can be affirmed that the importance and complexity of water resource management will increase and under the incidence of these changes, the problem becomes even more complex. The distribution of water resources is uneven at the global level. In some areas, more water resources will be available, while in others, there will be less than the necessary amount of clean water, which could lead to conflicts over the "blue gold" resources. For example, if 36%³ of the world's population is represented by the Chinese and Indians, they only possess 10% of the clean water resources. Without additional water resources and without efficient management, the economies of these two countries cannot reach the potential predicted by economic analysts in the long term.

² International Energy Agency (2022), *World Energy Outlook 2022* - <https://iea.blob.core.windows.net/assets/830fe099-5530-48f2-a7c1-11f35d510983/WorldEnergyOutlook2022.pdf>

³ Angelo KATSORAS, Pierre FOURNIER (2011), „*What the looming global water crisis means for investors*”, National Bank Financial, p. 2 - https://nashfamilywealth.com/sites/default/files/GP_18Sep2013_NBF_CAID10D2_the%20looming%20global%20water%20crisis.pdf.

At the state, regional and global levels, the development and implementation of rigorous water resource management programs are required to meet the demand for water for domestic, agricultural, environmental and industrial uses. Currently, billions of people do not have access to water and sewerage services. Rigorous water management also plays a role in keeping food and energy prices at a bearable level.

Excessive water demand, water pollution, climate change and inefficient infrastructure lead to an acute water shortage in the future. Meeting the growing water demand becomes difficult for several reasons. The first is natural, namely the lowering of groundwater levels due to climate change; the second is legislative - in some cases, water pollution fees are lower than the cost of water treatment, which does not reduce pollution. In some regions of the globe with a well-developed economy, there is also a third problem related to excessive irrigation. In this way, certain regions consume their clean water resources faster than the time required for natural replenishment, leading to water scarcity.

To bridge the growing gap between global water demand and supply, involved parties must produce greater quantities of food, industrial goods and services with as little water consumption as possible. These goals can be achieved through massive investments in water and sewerage infrastructure, which means modernization in countries with advanced economies and building appropriate infrastructure for developing countries.

General research context

The current economic context is characterized by a continuous change in socio-economic conditions. Gradually, environmental aspects are becoming increasingly important and costly, and numerous challenges related to the water industry and wastewater management are emerging.

In the last 16 years, since our country's accession to the European Union, there have been multiple challenges related to the water industry and wastewater management. The transposition of European legislation into Romanian law has introduced numerous obligations at both the water and sewage industry level and at the level of public enterprises. Since the vast majority of entities in this sector are public enterprises, all these obligations have also affected the regional water and sewage utilities in Romania.

One of the most important commitments made by our country in the accession treaty is related to ensuring the population's access to high-quality drinking water and the treatment

of wastewater. Through the treaty, Romania committed to ensuring by December 31, 2015, access to water in localities with over 2,000 inhabitants and access to sewerage services in localities with over 10,000 equivalent inhabitants (263 agglomerations) and by 2018 in localities with over 2,000 equivalent inhabitants (2,346 agglomerations).

The total investment needed for Romania to comply with the treaty provisions amounts to 24.5 billion euros, of which approximately 40% is in the water supply domain and 60% in the collection and treatment of wastewater.⁴

The country's commitments were assumed under conditions where the water and sewage utilities were characterized by inferior quality services regarding maintenance and operation, a large volume of water losses in the network, and a low level of bill collection, lack of major investments in rehabilitating and extending infrastructures, and lack of specialized staff in this regard, respectively poor management of maintenance and operating costs⁵.

Even though our country has not yet managed to fulfill the commitments it assumed, starting from a water service connection rate of 53% and a sewerage connection rate of 43% in 2007, it has reached 70.9% for water and 54.2% for sewerage in 2019. Unfortunately, with these figures, we are in the last place in Europe and at this rate, we will reach 95% only after another 20 years. We believe that it will never reach 100%, considering the geographical structure of Romania.

Analyzing the presented context, we can assert that in the period following Romania's accession to the EU, significant transformations have occurred in the water and sewage utilities at the institutional, investment, operational levels, as well as in terms of the costs generated by these changes. During this period, there was a consolidation of water and sewage utilities in large localities, transforming them into regional utilities that provide these services not just for one locality, but for increasingly more localities.

It's also noteworthy that in the year of Romania's EU accession, the minimum wage was 390 lei, with a total labor cost of 505 lei, while today, the gross minimum wage is 3,000 lei, with a total labor cost of 3,067 lei. This represents an increase of 6.07 times (607%) in

⁴ <https://www.zf.ro/opinii/suntem-la-jumatatea-drumului-in-ceea-ce-priveste-racordarea-romaniei-19769302> - accesat la 17.07.2021.

⁵ Florian BURNAR (2011), „Regionalizarea serviciilor de apă și apă uzată în România: Proiecte de investiții finanțate prin Programul Operațional Sectorial de Mediu”, Autoritatea de Management POS Mediu – http://www.mmediu.ro/beta/wp-content/uploads/2012/05/2012-05-29_seminar_CE_regionalizare_canal-MMP-POS_12_09_2011.pdf – accesat la data de 17.07.2021.

the minimum wage cost, which has put immense pressure on the wage expenses of water and sewerage operators.

Over the past five years, there has been a significant increase in the price of electricity for industrial consumers – from 0.0635 euros/KWh at the beginning of 2016 to 0.3395 euros/KWh at the end of 2022, which is an increase of 462.53%.⁶ For most water and sewage utilities, energy expenses constitute an important element in the cost structure. In the context of rising expenses of water and sewage utilities in Romania, it's important to know their structure, and to have methods and models for cost analysis.

From the perspective of the national economy, the services provided by water and sewage utilities are vital for the population, as well as for economic and social activities, although proportionally, these activities represent less than 1% of the GDP. In the period 2007-2022, Romania's Gross Domestic Product increased by 224% (expressed in euros – 127.7 billion euros in 2007, 286 billion euros in 2022), which entails an increase in water consumption both in industry and among the population.

In this context, in our research work titled *“Analysis of the Production Costs of Drinking Water and Sewage-Wastewater Service: Calculation Models and Analysis”*, we will use specific economic research tools and will examine the water and sewage industry from the perspective of the expenses it generates and the calculation methods used.

The motivation and importance of the research

To emphasize the importance of the topic, I conducted discreet research on the subject of fresh water, using content analysis method, with articles on the fresh water crisis as the unit of analysis, which affects and will continue to profoundly affect the inhabitants of the planet. "The Economist" magazine represented the sample. In the period from 2010 to 2019, I found two special reports (each month features a special report on topics of high importance and relevance) related to water, published in May 2010 and March 2019, respectively. In the last nine years, I found 44 articles dedicated to the water crisis, all having manifest content (certainly, there are many more articles with latent content on this subject). Based on this brief analysis, I can declare that the chosen theme is very important both economically and socially.

⁶ https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_205/default/table?lang=en – accesat la 19.07.2023

The analysis of expenses, calculation and tracking of costs represent a field of real interest for various categories of users of accounting information. The topic is also interesting from a legislative perspective. While financial accounting is standardized on several levels, managerial accounting and control are not regulated, but are widely debated by researchers.

The main category of users of cost-related information are managers at different levels in entities and the governing structures called boards of directors in companies managed under a dualist system.

The research is important for professional accountants who prepare managerial reports containing information on costs and their analysis and together with the management, they are responsible for cost optimization, which cannot be achieved without using modern methods of cost calculation. This research assists experts in the field in applying modern calculation methods in the water and sewerage sector in Romania.

The research is also very useful for the management of companies in the water and sewerage sector, which often face constraints related to the cost of services provided to the population and legal entities, regardless of their form. The decisions made by managers today have effects on tomorrow's costs and unfortunately, these can be not only positive effects, such as reducing (optimizing) costs, but also negative effects, increasing them. Through the tools provided by this research, managers can observe elements that affect costs and act accordingly.

The research may also be of real interest to researchers in the field, who can see the application of modern methods of cost calculation in the water and sewerage sector and can get an overview of the sector from the perspective of the costs generated by water and sewerage activities. This research can be a starting point for other applied research in the water and sewerage sector. This doctoral thesis aims to create multiple linear equations regarding the tariff of water and sewerage for wastewater, with the help of which researchers, management, the regulatory body and other interested parties can model the effect of changing various cost elements on the tariff of these vital services for society.

This research aims to fill a gap in the literature regarding the application of the Activity-Based Costing method to entities in the water and sewerage sector. Similarly, this gap exists in applied research in this sector compared to countries such as Italy, Spain and

England, where there are multiple studies related to tariffs, costs and efficiency in the water and sewerage sector.

As a final motivation for the research, this doctoral thesis aims to modernize the existing cost calculation system and to highlight the current shortcomings in the use of managerial accounting by regional water and sewage operators in Romania. We believe that the reasons and the importance of such research, which is the first study in the field of expenses of regional water and sewage operators in Romania, fully justify its realization. This research reflects both theoretically and practically important aspects related to the presented theme.

In the context of the definition given by the scientist Albert Szent-Györgyi, research “*means to see what everyone has seen and to think what no one has thought*”. In this research, we address well-known problems and offer new solutions/approaches regarding the cost calculation for regional water and sewage operators in Romania.

Objectives and hypotheses of the research

The main objective of the research is the critical analysis of cost accounting at regional water and sewerage utilities in Romania, identifying models for analyzing expenses, methods of calculating applicable and applicable costs, and identifying ways to optimize costs both theoretically and empirically. Secondary research objectives, related to the chapters of this work, stem from the primary objective of the research.

The operational research objectives on which the first chapter, entitled “*The Importance of the Water and Sewerage Industry in the Context of Sustainable Development*”, was based were as follows:

O1: Presenting the importance of water resources at the global and national levels, identifying and presenting water demand and the factors that drive the increase in water demand, as well as presenting existing water resources at the global and national levels and forecasting their long-term evolution.

O2: Presentation and analysis of the water and sewerage industry in Romania and the related domestic legislation, as well as the national strategy for the development of the water and sewerage industry.

Chapter 2, titled “*Cost calculation, an attribute of Managerial Accounting*”, focuses on the issue of cost calculation and was developed based on the following operational research objectives:

O3: Addressing the concept of accounting as an informational system related to managerial decisions. Approaching the concepts of 'data' and 'information' and presenting managerial accounting both from a historical perspective and in terms of its current evolutions.

O4: Analysis of the evolution of managerial accounting in the context of cost tracking and presenting current trends in this regard, introduction of the concept of “lean” accounting in the context of optimizing accounting as a cost-generating element and a comparative approach to cost calculations starting from traditional methods and ending with modern ones.

In chapter 3, titled "*Critical Analysis of Managerial Accounting and Cost Calculation at Harviz S.A.*", the peculiarities regarding cost calculation in this sector and the regional utility of water and sewage at Harviz S.A. are presented. Chapter three was developed based on the following operational research objectives:

O5: Analysis of the particularities regarding cost calculation in the water industry and wastewater management, and analysis of the development stage of managerial accounting in the regional water and sewerage utilities in Romania, including the presentation of the regional water and sewerage utility Harviz S.A. and the calculation method used by it.

O6: Conducting applied research on the state of managerial accounting in the regional utilities of the water industry and wastewater management in Romania.

Within Chapter 4, titled "*Cost Analysis Models Implemented at the Regional Water and Sewerage Utility Harviz S.A.*", aspects related to cost analysis based on the following operational research objective are presented:

O7: Identifying and proposing cost analysis models in the water industry and wastewater management in Romania and developing a model for applying the ABC (Activity-Based Costing) method in the water and wastewater management industry in Romania.

In the development of Chapter 5, titled "*Econometric Models Regarding Water and Sewerage Tariffs*", the following operational research objective was considered:

O8: Developing econometric models regarding the pricing of drinking water and the sewerage treatment tariff at regional water and sewerage utilities in Romania.

In the process of developing the doctoral thesis, the following hypotheses were established:

I1: The demand for clean water at the global and national level is constantly increasing, while resources are continuously decreasing, and as a result of this, the issue of drinking water is becoming increasingly acute;

I2: The development of managerial accounting is continuous, and classic cost calculation methods are complemented by modern methods, which correspond to the economic reality within entities;

I3: In regional water and sewerage utilities, managerial accounting has the role of providing information for making operational and strategic decisions, and considering that they have two main activities, the global calculation method is used;

I4: The structure and efficiency of expenses do not undergo major changes at the same entity over a five-year period, but trends are already appearing that show the possible evolution over time of the regional water and sewerage utility, respectively, the Activity-Based Costing calculation method is a method that can be easily applied to regional water and sewerage utilities in Romania and provides adequate information for managerial decision-making at this type of entities.

I5: There is a significant relationship between the drinking water tariff, personnel expenses, expenses for services performed by third parties, expenses for raw water, electricity expenses, expenses for consumed materials, maintenance and repair expenses, depreciation and other impairments, royalties, and other unitary operating expenses per cubic meter;

I6: The increase in expenses for personnel, services performed by third parties, raw water, electricity, consumed materials, maintenance and repairs, depreciation and other impairments, royalties, and other unitary operating expenses per cubic meter leads to an increase in the drinking water tariff;

I7: There is a significant relationship between the sewerage treatment tariff, personnel expenses, expenses for services performed by third parties, electricity expenses, expenses for consumed materials, maintenance and repair expenses, depreciation and other impairments, royalties, and other unitary operating expenses per cubic meter;

I8: The increase in expenses for personnel, services performed by third parties, electricity, consumed materials, maintenance and repairs, depreciation and other impairments, royalties, and other unitary operating expenses per cubic meter leads to an increase in the sewerage treatment tariff.

By achieving the main objective and the operational objectives of the research, the doctoral thesis provides answers to the problems formulated in the hypotheses, which are either confirmed or refuted. We consider that through this thesis, both the main objective and the operational objectives of the research have been achieved.

RESEARCH METHODOLOGY

In the doctoral research, the stages required for scientific research were adhered to, starting with the selection of the field of interest, continuing with the formulation of hypotheses, bibliographic study, formulation of a working methodology, collection and analysis of data from models, and ending with the interpretation of the obtained results. The research work encompasses both fundamental and applied research. As the first step of the research, I presented the current state of knowledge by reviewing the specialized literature regarding the concepts and methods studied.

In conducting the research, qualitative methods were combined with quantitative ones. Both inductive and deductive logic were used in the research. In theoretical research, deductive logic was used, starting from concepts, methods, theoretical models, leading to application in the water industry and wastewater management. In the inductive method, starting from the available data at the entities in the water industry and wastewater management and the developed models, some of the hypotheses stated in the research were confirmed, and based on these empirical research and hypotheses, generalizations were made at the level of the water and sewerage industry in Romania.

In all chapters of this work, methods used for research included reviewing specialized literature, case studies, and participatory observation. Additionally, methods such as questionnaires, correlation analysis, econometric modeling, and graphical representation were also used.

As a research technique, the technique of studying accounting situations related to costs developed by the economic operator was also used.

The research work was based on studying extensive bibliography, Romanian and European legislation in the field, and data provided by regional water and sewerage utilities in Romania, numbering 43 (not including the two major private capital operators, APA NOVA Bucharest and APA NOVA Ploiești), over the period 2014-2021.

Numerous bibliographic sources were used in the work, highlighted through footnotes, consisting of books and published works both in physical and electronic format, articles, studies and research published in journals and presented at scientific conferences, national and European legal provisions, and international databases.

SYNTHESIS OF THE MAIN PARTS OF THE DOCTORAL THESIS

The first chapter, titled “*The Importance of the Water and Sewerage Industry in the Context of Sustainable Development*”, highlights the crucial role of water for sustainable development, presenting it as a vital and indispensable resource for agriculture, production, and healthy ecosystems. It also emphasizes its importance in combating poverty and promoting socio-economic development. The chapter presents the existing water resources and their global distribution, analyzing factors that lead to the increasing demand for water. Continuing, it addresses the topic of sustainable development in the water field, highlighting actions and initiatives at the United Nations level and presenting global strategies and policies for sustainable management of water resources. These aspects reflect international concerns related to access to water and the conservation of this vital resource in the context of sustainable development. The second part of the chapter focuses on Romania's water resources and discusses the country-specific strategies and challenges in managing its water resources, presenting transformations in the water and sewage-treatment sector following Romania's accession to the European Union. The last part of the chapter presents the development strategy of this sector for the next 20-30 years, defined with Romania's accession to the European Union, and analyzes the stage of its realization. In conclusion, Chapter One paints a complex picture of the essential role of water in contemporary and future society, highlighting the acute need to address challenges related to the sustainable management of this vital resource.

The second chapter, titled “*Cost Calculation, an Attribute of Managerial Accounting*”, focuses on the role of accounting in assisting managerial decisions and presents the evolution of managerial accounting. The first part of the chapter debates the importance of managerial accounting in the context of globalization and post-2008-2009 economic changes. The chapter emphasizes the need for innovation in managerial accounting to provide relevant data for decision-making. Criticisms of traditional accounting, such as

providing data of little use for managing a company and focusing on data accuracy at the expense of speed, are analyzed and countered by proposing an adapted managerial accounting that emphasizes speed and relevance. In the context of managerial decisions, economic information and managerial accounting are vital, playing an essential role in a company's success. The chapter highlights the evolution of managerial accounting in Romania, underlining the importance of adapting to contemporary changes in management and technology.

The third chapter, titled “*Critical Analysis of Managerial Accounting and Cost Calculation at Harviz S.A.*”, conducts a critical analysis of managerial accounting and cost calculation at Harviz S.A., a company active in the water and sewerage industry. The first part of the chapter emphasizes the importance of optimizing the cost management process in the water-sewerage industry, considering their impact on the population and other industries. It highlights the necessity of a well-defined managerial accounting system and an accurate cost calculation system. The continuation of the chapter discusses the global calculation method used by Harviz S.A. for managerial accounting, chosen based on the needs imposed by the approval of prices and tariffs by the National Regulatory Authority for Community Services of Public Utilities (ANRSC) and their approval by local councils. The end of the chapter deals with the research of the application of managerial accounting and cost calculation in water-sewerage enterprises in Romania. This research was conducted to evaluate how managerial accounting is organized and what calculation methods are used in this industry. The research included formulating hypotheses, establishing goals and objectives, preparing and conducting experimental studies, analyzing data, and formulating conclusions. The research used quantitative methods and was structured in two parts: one focused on the objectives of managerial accounting and the types of costs calculated, and the other on the organization, computerization, and staff development in managerial accounting. The main conclusions reveal that most water and sewerage utilities organize their managerial accounting separately from financial accounting, and they consider the most important objectives of managerial accounting to be cost calculations, budget development and tracking, resource optimization, and support for operational decision-making. It is observed that half of the regional water utilities use the global calculation method, and a quarter, the ABC method. Most economic directors consider cost calculations useful, and the overwhelming majority are familiar with the ABC method. The study's conclusions show that there is room for modernization in terms of managerial accounting and the calculation methods applied.

The fourth chapter, titled “*Cost Analysis Models Implemented at the Regional Water and Sewerage Utility Harviz S.A.*”, focuses on the analysis of expenditure efficiency and the cost structure at Harviz S.A., a regional utility in the water and sewerage field. The first part of the chapter addresses the analysis of expenditure efficiency at Harviz S.A., emphasizing the importance of optimizing expenses in a competitive economy. A detailed analysis of operating expenses is conducted, comparing them with revenues and turnover to evaluate their efficiency, and an analysis of fixed and variable expenses is carried out. In the continuation of the chapter, models for analyzing personnel expenses and material expenses are presented and applied in practice. In the last part of the chapter, the practical application of the Activity-Based Costing (ABC) method at HARVIZ S.A. is carried out. This chapter provides a detailed and complex analysis of various types of expenses at Harviz S.A., emphasizing the importance of analyzing fixed expenses, personnel expenses, material expenses, and the application of the ABC method for more efficient cost management.

The last chapter, titled “*Econometric Models Regarding Water and Sewerage Tariffs*”, focuses on econometric models related to water and sewerage tariffs, highlighting the importance and applicability of econometrics in analyzing and forecasting economic phenomena, including in the water and sewerage industry. In the research, an econometric model was used to analyze the cost structure within the tariffs practiced in the drinking water and sewerage industry in Romania. Data were collected from 43 regional utilities for the period 2012-2021. The model used is a multiple linear regression, which includes several independent variables, to provide forecasts for the dependent variable, namely the water and sewerage tariff. The econometric model's results for the drinking water tariff demonstrate that the model is valid, and the multiple regression correctly indicates the level of increase or decrease in the average water tariff (TMA) based on changes in the independent variables. The regression equation was formulated based on unstandardized coefficients and allowed the interpretation and validation of the hypotheses formulated at the beginning of the research. At the end of the chapter, a forecast of the average water and sewerage tariffs in Romania for the period 2024-2027 was made based on the developed econometric models.

In the conclusion of the thesis, I outlined the general conclusions derived from the analysis conducted in the various chapters, emphasizing both the main results and personal contributions, and identifying the limitations of the conducted research. Also, I explored possible directions for future research.

To strengthen and clarify the arguments presented in the thesis, I included a number of 47 graphs and 79 tables, which help to better understand and illustrate the conclusions.

FINAL CONCLUSIONS, PERSONAL CONTRIBUTIONS, LIMITATIONS AND FUTURE RESEARCH PERSPECTIVES

The research titled “*Analysis of the Production Costs of Drinking Water and Wastewater Treatment Services: Calculation and Analysis Models*” is based on extensive bibliographic research, encompassing both national and international sources, and critically addresses the issue of calculating and analyzing the costs of water and sewerage services. The purpose of the research is to provide support to local public authorities and the general public in assessing the costs of entities in the water industry and wastewater management and their effect on applied tariffs.

In the course of the research, both theoretical and legal aspects, as well as practical outcomes from case studies and empirical research, were analyzed. We offer opinions and appraisals on how these aspects are approached in the specialized literature, both nationally and internationally. By employing a critical vision, we aim to provide an objective and informative approach to the subject.

Opinions and appraisals regarding the theoretical and legal aspects presented, as well as the practical aspects obtained through case studies and empirical research, have been brought forward in the research. These aimed to gain clearer and more precise information about how costs are calculated and analyzed in the water and wastewater management industry, so that local public authorities, the general public, and researchers in the field can make better-informed decisions and understand how tariffs are established.

The research focuses on identifying and analyzing various cost calculation and analysis models used in the water and wastewater management industry. These models are critically analyzed, formulating opinions and appraisals about their advantages and disadvantages, as well as their applicability in the specific context of drinking water supply and wastewater treatment.

Besides the theoretical and legal aspects, the research is also based on case studies and empirical research to provide a real perspective on the current situation in the water and wastewater management industry. The thesis examines current practices of cost calculation

and analysis in the provision of drinking water and wastewater treatment services, identifying good practices and potential improvements.

The study represents an effort to contribute valuable insights to the specialized literature in the field of drinking water supply and wastewater treatment, offering a critical and informative perspective on the models.

The current economic context is marked by permanent socio-economic changes, and the water and wastewater management industry in Romania has faced numerous challenges in the last 16 years, following the country's accession to the European Union. Romania's commitments under the Accession Treaty, related to ensuring access to drinking water and wastewater treatment, have not yet been fully met, although progress has been made in terms of connection rates to water and sewerage services. Institutional, investment, and operational transformations, as well as rising labor costs, have had a significant impact on water and sewerage utilities in Romania. However, the consolidation of regional water and sewerage utilities in larger localities has contributed to expanding service coverage to an increasing number of localities. It is important to note that despite the progress made, Romania remains at the bottom in Europe in terms of connection rates to water and sewerage services, and achieving the goal of 100% access to these services may be challenging given the country's geographical structure. Thus, the water and wastewater management industry in Romania faces complex and costly challenges in the current economic context.

The main objective of the research was to develop a theoretical-empirical approach to analyze the capacity of traditional and modern systems to calculate and analyze costs in the water and wastewater management industry in Romania. The methods used involved calculating and analyzing costs in this industry, with an emphasis on the application of the Activity Based Costing (ABC) method. The research focused on answering the following questions: *What are the implications of the Activity Based Costing method on water and sewerage tariffs in the water and wastewater management industry in Romania?*

The research analyzed how the application of the ABC method could influence water and sewerage tariffs in Romania. The ABC method, which is based on identifying and allocating costs according to specific activities in a process, can provide a more detailed and precise picture of the costs involved in providing water and sewerage services. By more accurately identifying the costs associated with each activity, the ABC method can

contribute to a fair distribution of costs among users and to a more appropriate tariff setting based on consumption and use.

How can this research help optimize costs in the water and wastewater management industry in Romania?

By applying the ABC method and detailed analysis of the costs involved in providing water and sewerage services, the research can identify potential areas for cost optimization. This can provide useful information to authorities and utilities in the water and wastewater management industry to make informed decisions regarding resource allocation, identifying inefficiencies, and implementing cost optimization measures, such as improving technical processes, reducing water losses, optimizing energy consumption, or choosing more efficient technologies. Thus, the research can contribute to the efficient management of costs in the water and wastewater management industry in Romania.

What is the econometric formula that describes the formation of water and sewerage tariffs in Romania?

The research aimed to create econometric formulas usable in Romania for forming water and sewerage tariffs.

Starting from the previously presented aspects, the research began with the formulation of eight operational research objectives, which were met throughout the entire work. These objectives were established to guide the research process and ensure that the desired results are achieved. The operational research objectives were elaborated in accordance with the theme and purpose of the research and were designed to provide a clear and coherent structure for the entire research process. Each objective was formulated in a clear and specific manner, with measurable and achievable terms, to allow the evaluation of progress and the success of the research.

Throughout the work, constant efforts were made to achieve these operational research objectives. Appropriate research methods were used to collect and analyze the necessary data, and the results obtained were rigorously interpreted to extract relevant conclusions.

Achieving these operational research objectives contributed to obtaining significant results and fulfilling the proposed purpose in research. This provided a solid basis for arguing the conclusions and final recommendations of the research. Overall, achieving the operational research objectives played a crucial role in ensuring the quality and validity of the

research and had a significant impact on the value and relevance of the work within the field of study.

The first two operational objectives of the study were achieved within Chapter One of the thesis, titled “*The Importance of the Water and Sewerage Industry in the Context of Sustainable Development*”. This was accomplished through a detailed presentation and analysis of relevant information related to global and national water resources, water demand, and factors contributing to its increase, existing water resources, legislation, and the national development strategy of the water and sewerage industry in Romania.

Thus, operational objective one was achieved by detailing the importance of water resources at the global and national levels, identifying and presenting water demand and factors driving the increase in water demand in subsections 1.1. Additionally, subsection 1.2 presented global and national water resources, while subsection 1.3 discussed water policy in the context of sustainable development.

As the research indicates, water demand is continuously increasing, and this increase is not proportional to the growth in the global population, potentially leading to a future deficit in water sources. It is estimated that water demand will increase by approximately 2% annually, and by 2030, this demand will be 50% greater than in 2010. Global water consumption has increased sixfold over the last 100 years and continues to grow at a rate of about 1% per year. In 2015, approximately 25% of the global population did not have secure access to water, and about 10% will not have real-time access to the water necessary for life. Water demand is driven by population growth, increasing incomes, and urbanization.

The exponential population growth of the 20th century has dramatic implications on water resource utilization. The global population is expected to rise from 7.7 billion in 2017 to 9.4-10.2 billion in 2050, with two-thirds of this growth expected to occur in cities, particularly in Africa and Asia.

The increasing demand for water is a major concern, as it is linked to population growth and the increasing demand for food products, which implies the need for increased agricultural production and irrigated areas.

Agriculture is a primary water consumer, accounting for approximately 82% of total consumption in low- and middle-income countries, compared to 30% in high-income countries. Water consumption in agriculture is expected to remain high in the future, and the

growing share of the industrial sector and its consumption may lead to a relative decrease in agriculture's share of total water consumption.

Forecasts for global water needs for irrigation vary, but indicate a significant increase by 2050, with estimates ranging between 23% and 42% above the 2010 level. This could have implications on water resource management and the sustainable development of agriculture and other economic sectors.

The global demand for agricultural and energy production, especially for food and electricity, is expected to increase significantly by 2025, which may imply the need for appropriate strategies and policies for water resource management and sustainable demand satisfaction.

Operational objective two was achieved by presenting and analyzing in detail the water and sewerage industry in Romania, as well as the related domestic legislation in subsection 1.4. Also, subsection 1.5 addressed legislative aspects related to water and sewerage services, as well as presenting water and sewerage services in Romania in subsections 1.5.2 and 1.5.3. Finally, subsection 1.6 discussed the strategic perspective on the development of the water and sewerage industry.

These subsections were coherently and structurally developed, based on the operational research objectives, and provided a solid foundation for achieving them. Through the detailed presentation and analysis of relevant information, the research successfully met the proposed operational objectives within Chapter 1 of the thesis, thereby contributing to the development and substantiation of the research theme.

Based on the available data, we can state that Romania is relatively poor in water resources, ranking 24th in Europe and 102nd globally in terms of water availability per capita. The country's water resources mainly come from interior rivers and the Danube River, but these sources vary over time and space, with significant fluctuations between seasons and between mountainous and plains areas. Forecasts indicate an estimated decrease of 9.12% in water resources by 2050, with certain hydrological basins like Mureș and Buzău-Ialomița reaching critical situations starting in 2030, when water demand will exceed resource availability.

Given these perspectives, measures are needed to solve these problems, which can exacerbate and create severe social issues. Possible measures could include sustainable water resource management, efficient water use, implementation of water treatment and reuse

technologies, and protection and conservation of water catchment areas to ensure long-term water availability. Difficulties in measuring water resources can lead to differences in data reported by various sources, highlighting the importance of standardizing and constantly monitoring water resource data for an accurate understanding of the situation and for making appropriate decisions in water resource management.

Between 2011-2021, the percentage of the population benefiting from public drinking water supply services increased, reaching 74.10% of the total resident population in 2021. Additionally, regional utilities held a market share of 89.73%.

The coverage rate of drinking water services in rural areas is low, at only 35.28% in 2020 (INSE no longer publishes this proportion in statistics as of 2022), which imposes the need for substantial investments to fulfill the obligations assumed through the Treaty of Accession to the European Union. This coverage rate varies significantly at the regional development level, being the highest in the Bucharest-Ilfov region (87.48%) and the lowest in the North-East region (52.12%).

It is anticipated that by 2030, the market share of regional utilities will reach approximately 99%, due to investments made through POS Environment, POIM, and PDD financing programs.

The average water consumption per capita in Romania fluctuated between 2015-2021, with a decrease in 2018 and an increase in 2021. The decrease in water consumption between 2015-2018 is due, at least in part, to the increased coverage of water services in rural areas, where average consumption is lower than in urban areas, and the increase in water consumption between 2018-2021 is likely the result of an increase in the population's standard of living.

There is a risk that in the coming years, if meteorological conditions are similar to those in previous years and family wells dry up, there may not be enough utility infrastructure to ensure access to drinking water in rural areas, considering the existing low coverage rate.

The degree of connection to sewerage services has increased in recent years, but has not yet reached the 90% value as stipulated in national and European programs. If this pace is maintained, it will take approximately 40 years to reach a value of over 90%.

The length of sewerage networks increased significantly between 2008 and 2020, with an 88.80% increase in the period 2011-2016 due to major investments made through the Operational Program for Environmental Sector. However, this increase is considered insufficient compared to the coverage areas of water networks.

In 2014, the coverage rate of sewerage services for regional utilities was on average 46.13%, and in 2021, this value reached 57.80%. These values can be considered high compared to national values, but low in comparison to the commitments made by Romania in the Treaty of Accession to the EU.

In the future, the share of sewerage networks managed by regional utilities will increase, as they already manage approximately 70.67% of existing networks.

Based on the analyses conducted in Chapter 1, it was found that hypothesis II regarding the continuous increase in the demand for clean water at the global and national levels, in the context of a constant decrease in resources, is confirmed. As a consequence of this trend, the issue of access to drinking water becomes increasingly acute.

Operational objectives three and four of the research were achieved within Chapter 2, through the analysis of the evolution of managerial accounting and the current state of knowledge related to the notion of production cost. Regarding the evolution of managerial accounting, it can be concluded that this is a complex informational system and essential for managerial decisions, which has gone through several development phases. In the initial phases, the focus was on determining complete costs and financial control, while in later phases, concepts such as responsibility accounting and objective-based management were introduced. Additionally, the evolution of managerial accounting shows continuous development and adaptation to new requirements and challenges in the economic environment, highlighting the ongoing importance of research and innovation in this area. In the current context of the market economy, characterized by reorganizations and workforce reductions, costs borne by customers are no longer acceptable, and a more efficient approach to production processes and services is required. In this regard, we presented a four-level model of the evolution of cost calculation systems, from inefficient systems to integrated ones, which provide quality data and prompt feedback. It is highlighted that level I systems are useless, and level II systems, although meeting the expectations of financial accounting, are not integrated with the managerial accounting system and do not provide useful information to management. In contrast, level III and IV systems are created according to management

expectations, integrated, and provide useful information and prompt feedback, thus being more efficient for complex production processes and services.

Managerial accounting has evolved from a simple method of determining the costs of a product or service to the most efficient management of available resources. Nowadays, managerial accounting must support the sustainable development strategies of enterprises. The managerial accounting techniques effective in controlling and coordinating the organization in the 1950s-1960s are outdated and must be replaced with the correct approach from the perspective of management control. A managerial thinking approach that managerial accounting needs to adapt to is the "lean" concept, and as a result, it must achieve "lean accounting." The "lean" concept first appeared with Henry Ford in 1913 and was rethought and applied by the Toyota Production System. "Lean" accounting must be in symbiosis with modern enterprise management methods aimed at efficiency and cost reduction. This accounting method is a comparative approach to cost calculations, starting with traditional methods and ending with modern ones.

We conclude that in the specialized literature, there are many approaches and definitions for the notions of cost and expense, which are often used synonymously in definitions. It is important to clarify the link between the two and to establish which comes first: cost or expense. Cost is related to the production process and managerial accounting, while expense is related to income realization and financial accounting. Additionally, management is concerned with costs and expenses, requiring their optimization in the context of hypercompetition in the market. Regarding the notion of expense, it is defined in the specialized literature as a decrease in economic benefits during the accounting period, in the form of asset outflows or depletions, or the incurrence of liabilities, resulting in reductions in equity. It is important to approach the notion of expense as a commitment accounting concept, not a treasury accounting concept, and focus on the fact that it represents amounts paid or to be paid. Also, current developments in managerial accounting should be considered in the context of cost tracking and presenting current trends, including the concept of "lean" accounting and the comparative approach to cost calculations from traditional to modern methods.

To effectively control costs, it is necessary to know the typology of costs. This typology can be defined from several perspectives, including their management function, ease of tracking, relation to realized revenues, behavior in response to changes in production volume, and relevance for control and decision-making.

This approach to the typology of costs makes possible a comprehensive definition of cost issues and a comparative analysis of cost calculations, starting with traditional methods and ending with modern ones.

In this research, bibliometric analysis was used to highlight the importance and timeliness of the research theme and to identify clusters of researchers and the most prolific authors dealing with production cost issues. The analysis was conducted in the "Web of Science Core Collection" database for the period 2010-2022 and included articles in fields related to economics and the profile of entities in the water and wastewater management industry. As a result of the database query, we obtained 546 articles and 33 proceedings, showing an increasing trend year by year. Based on the bibliometric analysis, four strongly interconnected groups of researchers were identified, with the most connected group focusing on management and production costs. The four independent research clusters on cost issues approach cost from different perspectives.

Analyzing traditional costing methods, such as the global method, the job order costing method, and the phase costing method, we can conclude that these are simple and easy-to-apply methods but have significant limitations in providing a detailed and accurate picture of production costs. These methods can be used especially for calculating production costs in a stable environment but are not suitable for coping with challenges and changes in a dynamic business environment.

On the other hand, modern cost calculation methods, such as the Standard Cost calculation method, the THM cost calculation method, the Georges Perrin cost calculation method, the Direct Costing method, and the Target Costing method, are more complex and require more time and resources to be applied, but can provide a more detailed and accurate picture of production costs.

Based on the analyses conducted, Hypothesis I2 is confirmed, stating that "*the development of managerial accounting is continuous, and the classic methods of cost calculation are complemented by modern methods that correspond to the economic reality within entities*".

Operational objective five of our research was achieved in Chapter 3 of the thesis, where we analyzed the state of development of managerial accounting in regional water and sewerage utilities in Romania, specifically presenting the regional water and sewerage utility Harviz S.A. and the calculation method it uses.

From the analysis, we can conclude that the water and wastewater management industry in Romania is a significant economic force, comprising 43 regional utilities, with a total of 29,257 employees and a total turnover of 709 million euros. In this context, the existence of a well-defined managerial accounting system and an accurate cost calculation system is essential for efficient management and cost optimization in the sector. For a company to be maximally efficient in production and provide high-quality services, an ERP system is necessary to provide real-time data on incurred costs for making relevant decisions. Regarding tariff and pricing calculations, these are monitored and approved by ANRSC, and the calculation formula is based on production and operating expenses, maintenance and repair expenses, amortization, environmental protection costs, and financial costs. Therefore, to be competitive in the water and wastewater management industry, regional utilities must have adequate systems of managerial accounting and cost calculation.

Analyzing the data, we conclude that the regional water and sewerage utility Harviz S.A. shows a good financial position, according to the indicators presented in Table No. 3.2. It can be seen that the overall autonomy rate has steadily increased from 30.6% in 2017 to 39.4% in 2021, indicating a decreasing dependence on borrowed capital. Although debt ratios have increased, this can be explained by the effect of revenues recorded in advance due to investments. Liquidity indicators are very high, indicating that the company does not face problems in paying short-term debts. The profitability of the enterprise is generally good, but a downward trend is observed in the analyzed period. Asset and fixed asset turnover rates have increased, which is a positive aspect. Staff efficiency has seen a significant increase, and the net result and gross margin per employee are above the industry averages for water and sewerage. However, there are still opportunities to improve performance. In conclusion, Harviz S.A. ranks among the efficient utilities in the country, despite its relatively small size and considerable territorial extent.

Harviz S.A. uses the global calculation method, a traditional absorbing method also applied by most water and sewerage utilities in the country. This method is applied despite not fully meeting the three theoretical conditions necessary (the condition of monoproduction or monoservice is not met) for its correct application in the water and wastewater management industry.

Harviz S.A. tracks costs by their nature, behavior relative to production volume (variable and fixed), by activities and centers (on calculation objects). Thus, expenses are

grouped using responsibility centers, and in case of significant changes in the cost structure, the entity adjusts the prices and tariffs practiced with approval from ANRSC and UATs.

For rigorous cost tracking, a well-developed and customizable IT system is necessary, accessible throughout the enterprise's operational area and providing data security. The utility has such a system.

From the point of view of organization, Harviz S.A. has 11 work points and two auxiliary sections, which are tracked separately within financial and managerial accounting. At the enterprise level, there are two administrative sectors in the two major municipalities in the county and represent cost centers for the entity.

Direct-variable expenses for water activity include costs for materials used in laboratory activities and other consumables, electric power consumed for technological purposes, and untreated raw water purchased from Romanian Waters, royalties, and the ANRSC quota.

Direct-variable expenses for sewerage-purification activity include costs for consumable materials, electric power consumed for technological purposes, raw water used in the technological process, water-specific services, royalties, and the ANRSC quota.

In conclusion, Harviz S.A. uses the global calculation method and has a well-organized managerial accounting system.

Regarding the organization of managerial accounting at water and sewerage utilities, it varies depending on each enterprise. Most water and sewerage utilities (62.16%) organize managerial accounting together with financial accounting, following a detailed examination with the help of analytical accounts in financial accounting. There are also utilities (21.62%) that organize managerial accounting independently of financial accounting, and other utilities (16.22%) make subsequent transfers of data exported from financial accounting.

Regarding the objectives of managerial accounting at regional water and sewerage utilities, these are primarily related to the calculation of costs, tariffs, and prices (95% of respondents). Also, the elaboration and monitoring of revenue and expense budgets are considered important objectives by 78% of regional utilities.

The predominant cost calculation method used by water and sewerage utilities is the global method. This indicates that regional water and sewerage utilities use a global approach in cost calculation, rather than other specific methods.

The research results indicate that managerial accounting at regional water and sewerage utilities serves to provide information for making operational and strategic decisions.

However, the usefulness of information from managerial accounting can vary depending on each utility.

The ABC (Activity Based Costing) method is used by approximately a quarter of the regional utilities, allowing for a more detailed calculation of the total cost. There are also utilities that use other methods, such as the phase costing method or the standard cost method.

95% of the financial directors of regional utilities consider the application of a cost calculation method useful, which shows its importance for making operational and strategic decisions. Modern calculation methods, such as ABC and Target Costing, are known by a significant proportion of financial managers, indicating an openness to using these methods in the future.

Cost collection is predominantly done by cost centers, but some water and sewerage enterprises also collect costs by work points. This aspect can contribute to better cost management and identification of specific sources of savings.

Most regional water and sewerage utilities consider managerial accounting to be useful and use it for making economic decisions.

The responsibility for maintaining managerial accounting primarily lies with the financial director or chief accountant, and to a lesser extent with the head of the accounting office. This highlights the importance of proper cost management within regional utilities.

Analyses based on data from managerial accounting are carried out regularly and repetitively by most regional utilities, except for a small proportion that does not use this information for economic decision-making. It is encouraging that monthly or quarterly analyses are given importance, depending on the specific needs of each entity.

These conclusions are obtained based on the analysis of the results of quantitative research, where data collection was carried out through a questionnaire administered via Google Forms. The research results are relevant, as 37 out of the 43 regional water and sewerage utilities in Romania responded, representing a significant coverage of the sample.

Operational objective seven of our research was achieved in Chapter 4 of the thesis, titled "Cost Analysis Models Implemented at the Regional Water and Sewerage Utility Harviz S.A.", where we identified and proposed models for analyzing expenses in the water and wastewater management industry in Romania and developed a model for applying the ABC method in the water and wastewater management industry in Romania.

Implementing the ABC (Activity Based Costing) system at the regional water and sewerage utility Harviz S.A. is essential for a more precise and detailed analysis of costs. The ABC method allows for the allocation of indirect expenses to specific activities carried out at each work point, thus eliminating the underestimation or overestimation of costs.

Identifying activities and subactivities carried out within the operational process and creating an activity catalog are important steps in implementing the ABC method and, considering the specifics of the activity, it can also be applied to other regional utilities in the country. The activity catalog at Harviz S.A. includes both operational and supporting activities.

From the analyses and case studies conducted in the chapter, Hypothesis I4 is confirmed, according to which the structure and efficiency of expenses do not undergo major changes at the same entity over a period of five years, but trends are already appearing that show the possible evolution over time of the regional water and sewerage utility, namely the Activity Based Costing method is a method that can be easily applied to regional water and sewerage utilities in Romania and provides adequate information for making managerial decisions at this type of entities..

The eighth operational objective represents the most important part of our research, which was completed in Chapter 5 through the development of two linear regressions using econometric modeling. The research was conducted on regional water and sewerage utilities in Romania for the period 2012-2021, and data from 43 of the 45 regional utilities were used, with the results obtained being relevant for the entire sector.

The multiple linear regression equations resulting from econometric modeling show us the behavior of the price of drinking water and the sewage tariff upon changes in various expense elements.

In the case of TMA (Tariff for Drinking Water), the initial modeling started with nine possible independent variables, which were: Personnel expenses per cubic meter, Third-party services expenses per cubic meter, Electricity expenses per cubic meter, Material expenses per cubic meter, Amortization expenses per cubic meter, Raw water expenses per cubic meter, Royalty expenses per cubic meter, Other repetitive operating expenses per cubic meter, Maintenance and repair expenses per cubic meter. Through correlation analysis, seven out of the nine were retained. Surprisingly, expenses for raw water per cubic meter were eliminated from the final model. The other variable that did not show a significant

correlation with the dependent variable was maintenance and repair expenses per cubic meter. The strongest correlation is between TMA and personnel expenses with an $R=0.622$, followed by electricity expenses with an $R=0.321$.

Analyzing the linear regression obtained for TMA, it can be seen that there is a significant relationship between the independent variables in the model and TMA with an $R=0.811$. The resulting linear regression for TMA is 65.80% accurate ($R^2=0.651$), meaning the variation of the dependent variable is explained by the predictors used in the model by 65%, and under these conditions, the model can be considered good and reliable. ANOVA tests have convinced us of the global significance of the independent variables and that our results are not due to chance. The quality of the obtained model is also demonstrated by the small difference between R^2 and adjusted R^2 . The resulting multiple linear regression model shows us that an increase of one unit in personnel expenses leads to a 0.66 unit increase in the tariff, and an increase of one unit in electricity expenses leads to a 0.716 unit increase in the tariff.

Considering the obtained econometric model, Hypotheses I5 and I6 are partially confirmed, necessitating the removal from the analysis of expenses for raw water and maintenance and repairs, for the reasons mentioned above. Reflecting on I5 and I6, we can state that there is a significant correlation between the average water tariff and the variables Personnel expenses per cubic meter, Royalty expenses per cubic meter, Third-party services expenses per cubic meter, Electricity expenses per cubic meter, Amortization expenses per cubic meter, Material expenses per cubic meter, Other operating expenses per cubic meter, and the increase in the value of these variables leads to an increase in the average water tariff.

In modeling the behavior of the wastewater tariff (TMAU) upon changes in various expense elements, we initially started with eight independent variables. During the correlation analyses, it was shown that there is a significant correlation between them and TMAU, so all were retained in the final model. These are: Personnel expenses per cubic meter, Third-party services expenses per cubic meter, Electricity expenses per cubic meter, Material expenses per cubic meter, Amortization expenses per cubic meter, Royalty expenses per cubic meter, Maintenance and repair expenses per cubic meter, Other repetitive operating expenses per cubic meter. The strongest correlation between TMAU and an independent variable is with personnel expenses ($R=0.721$), followed by electricity expenses ($R=0.500$).

Analyzing the correlation of TMAU with the dependent variable and the independent variables in the multiple linear regression, it can be seen that there is a strong relationship between TMAU and predictors in the model with an $R=0.846$. The accuracy of the econometric model is 71.50% ($R^2=0.7150$), which can be considered very good and reliable. The obtained model is of good quality, as shown by the small difference between R^2 and adjusted R^2 . ANOVA tests show that the obtained model is not due to chance and that the variables in the model have global significance.

Economically, the model shows us that an increase of one unit in personnel expenses leads to a 0.753 unit increase in the tariff. Detailed conclusions regarding the increase of an expense element and its effect on the tariff can be found in the subsection Interpretation of the Econometric Model Result.

The developed models have the potential to be useful in several areas, including in the management of water and sewerage utilities, in the activities of inter-community development associations responsible for monitoring regional utilities, as well as in the activities of the National Authority for Regulation in the Field of Community Public Utility Services (ANRSC) concerning the approval of prices and tariffs practiced by these utilities. Additionally, researchers in the economic field can benefit from these multiple linear regressions in conducting studies and economic analyses in the field of water and sewerage.

In the present research, a forecasting model was applied, constructed on the basis of multiple linear regressions, derived from the obtained analytical data and integrating the forecast of relevant macroeconomic indicators as presented in the Autumn 2023 Forecast issued by the National Commission for Strategy and Forecasting. The results of this econometric modeling anticipate a significant increase in water and sewage tariffs and average bills at the national level for the period 2023-2027. This upward trend signals imminent financial challenges, particularly for households with low incomes, highlighting the need for a cautious revision of the tariff policies in this sector.

Furthermore, the findings of the study emphasize the importance and effectiveness of applying sophisticated econometric models in the strategic planning and decision-making process, particularly in the context of water supply and sewage services. This analysis also suggests the potential need for emergent social assistance for certain vulnerable demographic segments. Therefore, the study significantly contributes to the specialized literature, offering

valuable perspectives in assessing and managing the economic and social impact of tariff policies in the water and sewage sector.

Personal contributions to the specialized literature

In the context of this doctoral research, originality and personal contribution are fundamental requirements. It is imperative that a scientific research paper reflects the individual input of the researcher. As a result of the analyses conducted, it has been observed that the current work constitutes the first extensive investigation in Romania focusing on the theme of costs associated with regional water and sewage utilities.

The personal contribution at the theoretical level lies in the synthesis and detailed examination of concepts related to costs, expenses, and cost calculation methods. From an empirical perspective, the personal contribution stems from the application of analytical, statistical, and econometric methods to explore the behavior of water and wastewater tariffs in relation to various independent variables.

Analyzing the content of the current research study, the following personal contributions to the advancement of scientific endeavor in the field can be identified:

- Presentation of the global and local importance of water resources and the analysis of their evolution over time;
- Examination of challenges in the water industry caused by increasing water demand, the state of water reserves and their global distribution, the continuously growing gap between water demand and supply, economic development in China and India and the available water resources in these countries, and the modernization and creation of suitable infrastructure in developed and developing countries, respectively;
- Presentation and analysis of factors generating increased water demand;
- Addressing the notion of sustainable development and presenting this concept in the context of water and sewage, viewed through the lens of the United Nations' Goal 6;
- Presentation and analysis of water resources in Romania, their evolution, and forecasts for 2050;
- Presentation and analysis of the potable water industry and sewage treatment services in Romania, starting with the legislation related to these activities and continuing with the evolution of these services over time, including forecasts for coverage of water and sewage services in the Romanian population;

- Conducting a strategic analysis of the development of this sector and presenting perspectives for the coming years;
- Comprehensive approach to the concepts of "data" and "information," and accounting as a component of the information system;
- Presentation of the evolution of managerial accounting;
- Analysis of the interaction between financial and managerial accounting and presentation of the evolution of this symbiosis;
- Analysis based on bibliographic sources of current trends in managerial accounting;
- Presentation of the role of production cost in managerial decisions and a comprehensive approach to the notions of cost, expense, and their typologies;
- Conducting a bibliometric analysis on the issue of production cost;
- Presentation based on bibliographic sources of both classical and modern methods for cost calculation;
- Presentation of the peculiarities of cost calculation at a regional water and sewage utility;
- Presentation of the global calculation method used by the regional utility Harviz S.A., as a preparatory stage for applying the ABC method to this entity;
- Conducting empirical research related to managerial accounting in the water and wastewater management industry;
- Presentation of the applicability of cost analysis models in Romanian water and sewage utilities through a case study conducted at the regional water and sewage utility Harviz S.A. In this modeling, an analysis of operating expenses per 1,000 lei of turnover, diagnostic analysis of fixed expenses, diagnostic analysis of variable expenses, diagnostic analysis of material expenses and personnel expenses were carried out;
- Analysis and presentation of the Activity Based Costing and Time Driven Activity Based Costing systems based on available bibliographic sources;
- Implementation of the ABC method at the regional utility Harviz S.A. and presentation of cost optimization methods based on this approach;
- Econometric modeling of the price of potable water and wastewater tariffs and the execution of two multiple linear regressions that model their behavior based on various predictors.

Limitations and future research perspectives

The analysis and modeling of costs in the water industry and wastewater management represent an exceptionally important and current topic on a global scale. Addressing this subject requires the use of specific methods, tailored to the peculiarities of this field of activity.

The diversity of methods used in cost analysis is vast, but their adaptation to the specifics of the water and sewage industry is essential. This adaptation involves considering various variables and factors that influence costs in this sector, such as the type of infrastructure, the size and density of the served population, geographical characteristics, or the level of economic development.

Given that cost analysis is an extremely complex and extensive subject, it is not possible to exhaust all its aspects in a single study. However, the present research has achieved its initial objectives, demonstrating the importance and relevance of this field of study. Certainly, there are still many possible approaches regarding costs in the water and wastewater management industry, either by exploring other perspectives or by continuing the current research.

As with any study, there are limitations associated with the volume of data available over time and space. Although the current data set allowed for generalizable and valid results, it is expected that with ongoing research and the addition of more data in the future, the developed models will become even more precise and practically applicable.

It is important to mention that technological progress and access to new information can contribute to improving the analysis and modeling of costs in the water industry and wastewater management. Utilizing advanced analytical and simulation tools, as well as the constant collection and updating of relevant data, can enhance the precision and utility of existing models.

In conclusion, the study of costs in the water industry and wastewater management remains an evolving field, offering opportunities for research and the development of new approaches and solutions. Through exploring and gaining a deeper understanding of the costs involved, authorities and utilities in this field can make informed and efficient decisions, contributing to the provision of quality and sustainable services for communities.

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