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Creating Quality-Based Smart Sustainable Public Parking Enterprises: A Methodology to Reframe Organizations into Smart Organizations

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Abstract: Enterprise sustainability is a key aim in the fourth industrial revolution era, requiring a new approach based on intelligent technologies that considers the new roles of leadership and sustainability as well as the new trends in emerging smart technologies, with a new focus on Society 5.0. Smart parking has a significant role in fostering the determinants of sustainability in public parking enterprises and achieving adequate mobility in smart cities. Thus, smart parking is the subject of the research presented in this paper. This study defines the vital processes, including leadership processes and technologies needed for smart parking, managed by innovative public parking enterprises. Having this in mind, trends, key facts, the results of present innovative technology enterprises, and methodologies for designing and establishing smart public parking enterprises are analyzed. This paper aims to determine the sustainability of parking enterprises in their current states by developing a MORSO methodology. The MORSO methodology includes independent variables, including the leadership level of the intelligent technologies used, quality of the business processes, and risk related to the business processes, and a dependent variable, the sustainability of smart public parking enterprises. The MORSO methodology also includes steps for the definition of indices related to variables that could be assessed by appropriate techniques such as using questionnaires. Finally, the MORSO methodology introduces steps by which statistical approaches and artificial neural networks (ANN) are applied to test hypotheses regarding correlations between independent and dependent variables. The results of the presented model case study application show that there are strong correlations between smart sustainability and leadership (0.769), quality (0.904), and risk (−0.884), respectively. Additionally, at the level of the presented case study, the results of the application of the ANN indicate that the values of the dependent variable in the following time period can be determined with high accuracy, based on the knowledge of the values from the previous period, with a regression coefficient value of R = 0.99482. Finally, in this way, the transition from existing public enterprises to sustainable smart public parking enterprises is envisioned.

Keywords: smart sustainability; quality of business processes; Society 5.0; artificial neural network

1. Introduction

Currently, when the application of new technologies is considered in the research community, the notion of smart cities is increasingly mentioned. The idea of smart cities emerged with the advent of Industry 4.0 and Society 5.0 [1]. This concept started as a visual design of a people-centric society grounded in merging cyberspace and physical space. Considering the smart cities concept as one complex structure consisting of a multitude of pillars, it may be observed that one of the main pillars of smart cities is smart mobility. This development involves many stakeholders, such as residents in urban areas, public management, automotive producers and suppliers, and research organizations, including universities and research laboratories. Smart mobility is primarily associated with smart and preferably electric vehicles, smartphone and vehicle integration, vehicle connectivity, and electrical energy consumption (e.g., smart grid). A new generation of vehicles can synchronize the capability of drivers and performances of multifunctional control devices in vehicles, leading to the development of concepts such as "autonomous driving", "communication vehicle-to-vehicle", and "vehicle/cloud integration". For this purpose, specialized applications supporting drivers' needs (such as pilots for parking, fuel supply, sightseeing, preparation, and food services), such as automatic drivers, are being developed. There are many applications of developed platforms with broader possibilities for comfortable, safe, efficient, and secure mobility.

However, smart parking as a particular branch of smart mobility, transport, and logistics still requires further improvements and adjustments. Smart parking is based on the needs of urban areas and large cities where the concentration of vehicles is increasing, and it is becoming a burning issue requiring an appropriate solution that will provide adequate parking. Consequently, this requires a new business model that integrates old and smart approaches, which depends on existing resources, cost–benefit analyses, and the needs of smart cities and regions.

1.1. Motivations and Aims of the Study

The motive for this study lies in the fact that there is a lack of business models integrating the process of traditional parking with the needs of smart cities and regions and considering new roles of intelligent enterprises while focusing on social responsibility and sustainability of smart public and private parking enterprises. The following are the research questions that have been investigated in this study: (1) Is it possible to apply a business model to parking services? (2) Is it possible to assess the sustainability of public enterprises in Serbia as a developing and transitioning country? (3) Is it possible to identify the determinants for an efficient and effective transition to smart parking enterprises?

The proposed methodology involves different approaches, such as business process management (BPM) with conceptual modeling, assessing the quality of business processes, risk management, and smart and intelligent enterprises. Additionally, it utilizes diverse techniques and tools such as statistical methods, questionnaires, indicator monitoring, and the artificial neural network (ANN) approach to identify the efficiency of the proposed and implemented changes.

The motivation for applying statistical methods and ANNs stems from the fact that these are current methods that predict the future values of dependent variables with significant precision. With the development of computers and information technology and the increase in their budgeting possibilities, ANNs are attracting more and more attention, because there is a growing demand for calculations related to time series and forecasting future values that can now be easily carried out. Additionally, comparing obtained predictions represents an additional motivation for employing statistical methods and the ANN approach.

1.2. Contribution of the Study

Methodological contributions are related to the development of a smart parking services model with decomposed processes and characteristics and the creation of procedures for transforming "closed" parking into smart parking enterprises. For modeling business processes within smart public or private parking enterprises, the approach of business process modeling is applied. This process can be decomposed into five sub-processes:

(1) control of payment for parking services in familiar parking places, (2) payment for parking services at unique parking places, (3) towing away and/or blocking improperly parked vehicles, (4) selling subscription parking cards, and (5) designing parking spots with traffic signalization. Each of these processes is connected, and this study presents their decomposition. Verification of the model is provided in a case study of parking services in Serbia, which is taken as an example of a developing country.

The practical contributions are incorporated in a case study of one public enterprise in Central Serbia and the feasibility of its improvement into a smart public enterprise. The research findings could encourage all relevant stakeholders to promote smart parking in other cities in the Republic of Serbia.

The paper is structured as follows. Section 2 provides an extensive literature review of the following vital topics: sustainability and its success, risk management, quality management, smart technologies, smart mobility, parking management systems, and smart leadership. Section 3 elaborates on the basic methodology for smart public parking enterprises. Section 4 presents results in detail, whereas Section 5 offers discussions and implications. Finally, the last section offers concluding remarks.

2. Literature Review

The research issue is relatively new, and thus authors used an evaluative approach based on current systems' issues. The literature review is organized into seven sub-sections so as to provide a comprehensive overview of current research in the fields devoted to sustainability, leadership, and risk management. The last sub-section presents identified research gaps.

2.1. Sustainability Review

Sustainable development is emerging in the 21st century as a balance between economic growth, environmental problems, and social harmony. Haughton [2] pointed out the following principles of sustainable development: (1) futurity based on intergeneration equity, (2) social justice based on intergeneration equity, (3) transforming responsibility based on geographical equity, (4) procedural equity focused on people being treated openly and fairly, and (5) interspecies equity based on the importance of biodiversity. The concept emphasizes aspects of "sustainable growth" with attention to resources and ecosystems' degradation [3].

Based on broad literature, Hopwood et al. [3] introduced mapping of sustainable development views with two axes: (1) increasing environmental concerns and (2) increasing socio-economic wellbeing and equality concerns. In this map, the authors identified three areas: (1) status quo, meaning that the situation in the future should be maintained as it is at the moment with slight and insignificant improvements in environmental protection and natural resources management, (2) social, environmental, and realist reform, and (3) transformation in the areas of social ecology, quality of life, eco-socialism, etc.

Springett [4] analyzed business conceptions of sustainable development. There are different approaches related to the continuum of sustainable development conceptions from weak to strong [5]. In the next phase [6], neo-classical economic theory attempted to solve the problems of survival and meet consumerism-driven needs. Furthermore, eco-modernism created a shift to sustainable development with concern for business risk, eco-efficiency in using resources, and introducing new business approaches as "green business" for "political sustainability" [7]. Accordingly, it was necessary to transform business through eco-modernism by focusing on reducing environmental and social degradation. This debate about sustainable development has not finished [8]. Thomas et al. [9] analyzed aspects of sustainable development through smart technologies, while Iwano et al. [10] considered future sustainable service and societal systems in Society 5.0. Finally, sustainability is broadened in many fields, including climate change, through the introduction of electric vehicles [11] and local authorities' identification and analyses of drivers and risk factors influencing their financial sustainability [12].

Developing countries emphasize aspects of economic business sustainability by strengthening the capacity of human resources in small- and medium-sized enterprises [13]. The new goal to achieve sustainable development is inevitable for all industries, schools, environmental organizations, and researchers.

2.2. Sustainability Success Review

Quality science [14] has an impact on all aspects of life. One of the developments it supports is sustainable success in harmonizing sustainability and business success. Many theoretical and practical models have been developed for sustainable success identification and measurements, such as the European Foundation of Quality Management (EFQM) model. These models have two essential functions: (1) finding the most influencing factors for sustainable success and (2) comparing a business with other organizations at the level of achieved excellence and success. Furthermore, the ISO organization developed the standard ISO 9004 [15] and the EFQM model of business excellence [16] to identify characteristics and measure sustainable success.

In the Industry 4.0 era, the model of Quality 4.0 has been developed, focusing on the EFQM model [17]. This model has the following structure: (1) leadership, (2) people, (3) strategy, (4) partnership and resources, and (5) processes, products, or services, as enablers. The structure presents results in the form of (6) people results, (7) customer results, (8) society results, and (9) business results. For Industry 4.0, all components of this model are significant, but leadership, people with new knowledge, intelligence and motivation, strategy with new business models, new partnerships, and smart technologies firms are now in the spotlight.

In this way, sustainability is incorporated by Fonseca et al. [18] in clause 4 (creating sustainable value), clause 5 (driving performance and transformation), clause 6 (stakeholders' perceptions), and clause 7 (strategic and operational performances). The EFQM model from 2020 has 23 criteria, 600 points for direction and execution, and 400 points for results [19].

2.3. Risk Management Review

Literature offers numerous definitions of risk. Differences in the definitions of risk are based on existing differences in research domains. Risk can be observed as an unknown change in the future values of an observed system [20]. Moreover, risk can be defined as a measure of a possible adverse event, making it necessary to weigh the advantages and disadvantages of a possible outcome when assessing a risk situation [21].

An essential concept that occurs within risk literature is risk assessment. Risk assessment is a concept that has not been uniquely defined in the literature [22] and can be applied to companies that are considerably diverse. Many authors suggest that it is necessary to determine the quantitative value of risk [23]. Until recently, risk assessment was based on the results of statistical analysis. Recently, many researchers in this field have suggested a proactive approach to risk assessment and defined a strategy for risk management that must be integrated into a company's management strategy.

It is necessary to understand how to manage a business at risk to avoid failure, achieve predefined goals, build trust, and meet corporate governance requirements. Risk assessment is implemented through the following steps: identification of risk factors, identification of consequences arising from the materialization of the identified risk factors, determining the severity of consequences, determining the risk factor's occurrence frequency, identification of the validity of existing procedures for risk management at the level of each enterprise, development of risk management models, and taking management initiatives to reduce or eliminate the impact of identified risk factors that have the highest priority.

Since decision-making should be based on information related to risk factors and not on the consequences of risk, an increasing number of authors and executives are interested in identifying critical risk factors, mainly when resources are limited [24]. The factors that lead to risk occurrences are many and varied. Based on the research results in the risk assessment field, it can be concluded that risk occurrences are influenced by risk factors that should not be overlooked [25–27].

Risk factors leading to economic risks are [28]: (1) price and cost volatility [29], which exists if any supply and sales costs are variable over time; (2) inflation and exchange rate changes [30], which lead to the financial instability of a company; (3) market segmentation due to reduced competitiveness and quality; and (4) risks to company reputation [31], which is explained as a decrease in consumer confidence.

Factors that lead to the emergence of social risks are (1) disrespect for the rights of employees, which emerges if there is a violation of the dignity of workers, (2) an unhealthy or dangerous workplace, (3) lack of business ethics, which can be explained if there is behavior that violates business ethics, such as the existence of corruption, and (4) non-fulfillment of social obligations [32], which is defined as failure to integrate into the local community, education, culture, technological developments, job creation efforts, and health care system.

Risk factors that can lead to the emergence of risk in the company are (1) employee-derived factors [33], such as experience, level of training, belief, and interpersonal relationships, (2) technological factors [34], such as technical characteristics of equipment, level of automation, safety characteristics of devices and production equipment, and the level of equipment maintenance, (3) organizational factors [34], such as workplace, work organization in the workplace, existence of workplace management procedures, workplace ergonomics, and existence and observance of standard procedures, (4) job task factors [34], (5) workplace factors [33], (6) environmental factors [34], such as natural disasters, including earthquakes, stormy winds, floods, lack of resources, lack of air or water, and soil pollution factors, as well as hazards generated by the existence of waste generated during the production process.

These factors can be identified in different ways. One of the most commonly used methods is to have them be assessed by decision-makers based on their experience and best practice results. In practice, many methods are used to identify risk factors. Some of these methods are presented in [35]. They are methods of analysis of indicators (e.g., report on critical events and change-based risk management), creative techniques (e.g., brainstorming), and the Delphi method.

2.4. Quality Management Review

A quality management approach is part of quality science [14]. The first premise is that quality is designed, executed, measured, controlled, and improved according to the well-known PDCA (plan, do, check, action) cycle.

Shtub and Karni [35] explained the basic concepts of enterprise process modeling by focusing on business processes. In general, it is possible to use decomposition of a process derived from ISO 9001:2018 [36] standard or some specification as APQC for different sectors or associations [37], including supply chain management—ISO 26000, enterprise resource planning [38], product life-cycle management [39], an extension to the community [40], and resilience management [41]. According to APQC [37], the general process classification framework consists of (1) vision and strategy, (2) products and services development and management, (3) products and services marketing and sales, (4) products and services delivery, (5) customer service management, (6) human capital development and management, (7) information technology management, (8) financial resources management, (9) acquisition, control, and property, (10) environment, health, and safety management systems, (11) external relationships management, and (12) knowledge, improvement, and change management.

In the Industry 4.0 era, the aspect of quality management is interpreted in the Quality 4.0 concept [42] with an extension of traditional quality in the following areas: (1) technology with data analytics, application development, connectivity, and scalability, (2) people with collaboration competence, leadership, culture, compliance, and (3) the process with a new management system. A management system consists of autonomous and connected processes, including risk compliance, a management improvement review, audits, monitoring, production, external processes, development, and requirement engineering. On the other hand, in Quality 4.0, all smart technologies are included in the process with an e-based quality management system that consists of several contemporary management initiatives, such as supply chain management, customer relationship management, and enterprise resource planning. Thus, smart quality within Quality 4.0 may be defined as a concept that should combine advanced technologies, modern process design techniques, and flexible working methods to help public enterprises reimagine the way quality works.

2.5. Smart Mobility and Parking Management System

Innovative technology is considered a relatively new term. In different sectors, different smart technologies are emphasized. In Wang and Wei [43], six pillars of intelligent manufacturing are defined as follows: (1) material, (2) data, (3) productivity, (4) sustainability, (5) resource sharing and networking, and (6) manufacturing technology and processes. Each of the pillars is developed by intelligent technologies, meaning that technology and processes have used the concepts of additive manufacturing, robots, sensors, and automation processes.

Smart mobility is based on smart technology used to improve mobility, safety, and cost reduction. It is now possible to communicate and solve some business issues from the vehicle, such as searching or controlling home smart devices. In this way, new concepts such as "autonomous driving", "communication vehicle-to-vehicle", and "vehicle integration to the cloud" have been developed using specialized software to support drivers according to their needs. Smart mobility is still in the phase of development and supported by many projects, such as the Smart Transport Middleware project, which is dedicated to (1) data collection from external sources, such as traffic, weather, and unexpected events, (2) collaboration with other alternative nodes competitive with driver's needs, and (3) connecting with a proactive, intelligent system with the possibility of learning from the previous situation. STM components are adapters for parking data and for the weather [44]. All these adapters use other smart technologies belonging to the Internet of Things (IoT) paradigm such as (1) identification with radio frequency identification and barcode, (2) locations with real-time locating systems, (3) finding sense using logger and meshed network, (4) processes using software agents, (5) communications using middleware, and (6) execution using robots and actuators.

2.6. Smart Leadership Review

Smart leadership is an extension of classical leadership approaches intended to satisfy the needs and requests of smart enterprises. Smart leadership presents a blend of soft and hard skills and the processes of setting goals, influencing people, building effective teams, motivating people, and aligning their energies and efforts towards organizational goals [45] through the application of IT tools. For instance, Corbett [46] analyzed the emergence of changes in the leadership paradigm. The author concluded that it was necessary to eventually use new models in the new era by applying statistical methods.

For smart leadership, organizational leadership capacity is crucial to build [47]. In addition, digital smart technologies promote leadership in smart cities and smart public enterprises [48]. Intelligent leadership and leadership competencies are analyzed in [49]. Intelligent leadership is a dialogue between leaders and followers in which they come together in certain situations to effectively achieve a shared vision and shared objectives. This process will occur in a team or organization that shares the same values and culture.

In a complex environment, spirituality and spiritual leadership are interconnected as elements in effective decisions [50]. In addition, the impact of change management on change leadership has been analyzed in [51]. Furthermore, a new type of leadership is needed in chaotic organizations [52]. Finally, for the smart environment, Rolling [53] proposed the concept of swarm leadership with three blocks: (1) building the swarm, (2) leading the swarm, and (3) delivering with the swarm.

On the other hand, information communication technologies (ICT) represent enablers of smart working environments for leaders and followers, which includes virtual exploratory and interaction possibilities, virtual and interactive environments, learning interfaces for knowledge databases and management systems, integration of the existing systems, and a high level of collaboration. A leadership role in the ICT environment has been decomposed into strategic leadership, ICT leadership, team leadership, and self-leadership. Strategic leadership is characterized as the driver of social changes to satisfy the exact needs of followers. According to Laudon and Laudon [54], ICT leadership dominantly covers the following domains: ICT vision, mission, and goals, ICT strategy, ICT for business continuity, and ICT for change support. ICT leadership has been structured on three levels as follows: (1) governance level, with the assessment of leadership role and ICT and the creation of vision in the sense of how leaders should use information, (2) top management level, including an assessment of informational architecture for leadership and the creation of vision in the sense how leaders should use information, and (3) executive level, which includes the creation of ICT operational plans, budgets, and measurement of leadership effectiveness.

2.7. Research Gaps

Many researchers deal with the problem of sustainable parking. While looking into the problem, the authors of [55] analyzed the high motorization rate in Poland and other European countries, and they found that the preferred choice of individual means of transportation hascontributed to a significant increase in congestion over the last ten years. In their results, the authors analyzed almost 550 planning documents from the years 2000–2019 and parking standards operating in individual countries and established that for 20 years, Polish cities have mainly been exploring the possibility of determining the minimum rate of parking spaces. While looking at sustainable parking, the idea of smart parking was introduced to solve the problem of parking space and parking management in megacities. In [56], the authors noted that rapid population growth has led to substantial traffic bottlenecks in recent transportation systems. The authors classified smart parking systems in their paper while considering soft and hard design factors, including IoT. A complete overview of the enabling technologies and sensors commonly used in literature was performed. The authors highlighted the importance of data reliability, security, privacy, and other critical design factors in such systems. They investigated the emerging parking trends while focusing on data interoperability and exchange, aiming at solving the issues in the current state of smart parking systems, and recommended a conceptual hybrid-parking model. Another study of a sustainable parking system considered the problem of difficulties in finding a place to park [57], environmental pollution due to increased fuel consumption when looking for a parking space, the increasing number of cars in urban areas, and the development of the housing market, all being examples of factors that lead to a change in investment objectives concerning parking design. Research results included a questionnaire survey, which shows how important environmental and organizational aspects are becoming in the public consciousness in interchange planning. The paper also presents directions for further research, which should support the eco-design process.

Additionally, the authors of this research noted that smart parking takes up less space and is associated with reduced time searching for a parking space and lower greenhouse gas emissions. It is also characterized by higher electricity consumption, and complete comparison of parking solutions should cover the whole life cycle. In connection with the problem of difficulties in finding a place to park, the authors of [58] proposed a new decision-support concept for the management of illegally parked cars in urban centers, which offers a method that can contribute to solving this problem and improving the flow of pedestrians on city streets. Due to its complexity, the problem addressed in this research was recognized as a multicriteria one. Therefore, the proposed model is based on the multicriteria analysis methods such as the preference ranking organization method for enrichment evaluation (PROMETHEE) and the analytic hierarchy process (AHP), which shows that this methodology is applicable and practical for finding not a temporary but a permanent solution to the problem described.

However, there is a lack of literature describing the ways and possibilities of transitioning from traditional public enterprises to smart public enterprises. Furthermore, decision-making criteria and indicators that would describe the degree of transition of traditional public enterprises to smart public enterprises are still missing. In this study, variables that will enable the assessment of the integration of smart technologies in traditional public enterprises are identified to provide the ability to monitor their progress towards the ultimate goal of becoming a smart enterprise.

Existing studies in the literature are primarily oriented towards the technological aspect with different key variables. Some differences between our approaches and existing approaches are presented in Table 1.

Table 1. Compilation of the MORSO methodology and other studies.

	Authors' Research	**Lower and Szumilas [55]**	**Al-Turjman and Malekloo [56]**	**Baran et al. [57]**	**Ivić et al. [58]**
Integrative methodology	MORSO	Authors' methodology for parking location selection based on standards	Internet of Things technologies review	Authors' methodology for sustainable parking solutions	Decision support concept
Approaches	Grounded theory, Smart sustainability, Quality 4.0, Smart leadership	Smart sustainability	Internet of Things, Smart parking system (SPS) architecture	Computer-assisted web interview (CAWI)	
Methods	Statistics, ANN, DEA, Value analysis	Statistics	Cloud computing, Advanced public transport system, Centralized assisted parking search	Statistics	Preference ranking organization method for enrichment evaluation (PROMETHEE), Analytic hierarchy process (AHP), Geographical information system (GIS)
Key parameters	Smart leadership, Quality management, Risk, Smart sustainability	Sustainable parking management	Smart parking management	Quality management, Smart sustainability	Management of illegally parked cars in urban centers
Simulation results	Correlation measure, Prediction measure, Cost/benefit analysis	Cost/benefit analysis	Cost/benefit analysis	Cost/benefit analysis	Criteria and alternatives definition, Consistency ratio
Field of application	Public services, Smart public services	Public services	Public services, Smart public services	Public services	Public services, Smart public services

The results of this research are challenging to compare with other studies, since it presents one of the earliest studies regarding smart public parking services.

3. Methodology

3.1. Smart Public Enterprise Model

Smart public enterprises are a particular class of smart enterprises dedicated to the public sector. Therefore, society has great expectations for this type of enterprise to resolve operational and market challenges. The significant market challenges are material cost, price reduction pressures, labor costs, transport/logistic costs, environment laws and regulations, business regulations, global competition, labor laws and regulations, global geopolitical risks, and global exposition. On the other hand, the new technology investment priorities are higher production, faster responsiveness, enhanced collaboration with customers and suppliers, more effective customer communications related to quality and safety, and embracing market intelligence.

The smart public enterprise model has a typical structure. It consists of the following macro modules: (1) stakeholders with needs, emotions, and availability of smart technologies, (2) smart economy with a smart strategy at the government and enterprise levels, (3) smart business model, (4) smart leadership, (5) smart business processes, (6) quality of life, and (7) smart sustainable success.

3.2. Smart Sustainable Public Parking Enterprise Model

Each type of public enterprise has a specific structure of macro modules. In the case of a low level of introduction of smart technologies for smart public parking enterprises, the smart public enterprise model is reduced to the following units: (1) part of the smart economy (risk, smart enterprise strategy), (2) adoption of smart technologies, (3) smart business processes, (4) smart leadership, and (5) smart sustainability/sustainable sources, whereby smart sustainability represents a concept of how public enterprises in large cities integrate digital and environmental agendas via entrepreneurial forms of urban governance, i.e., a more holistic general approach to how to govern an urban space through more than mere laws, rules, and regulations, utilizing a participatory approach for the implementation of critical parameters such as transparency, subsidiarity, inclusivity, and responsivity. This novel model is shown in Figure 1.

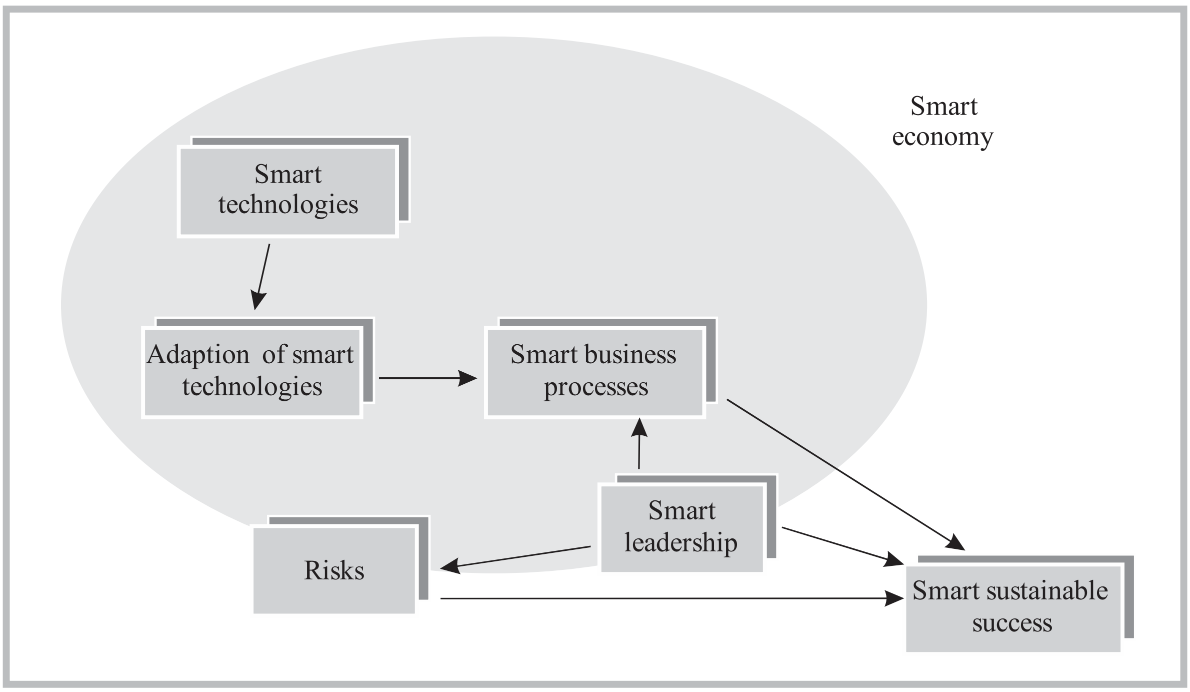

Figure 1. Smart, sustainable public parking enterprise model.

Metrics of smart technologies adoption are introduced in Table 2.

Table 2. Metrics of smart technologies adoption.

	Description of the Application of Smart Technologies
0–1	0—There is no application of smart technologies
	0.5—Collection, data processing, billing tracking
	0.8—Parking via parking places occupancy sensors and cameras
	1.0—Application of RFID and WiFi network
1–2	1.3—Additional use of parking access software
	1.5—Determining the number of free parking places
	2.0—Parking places booking via mobile devices
2–3	2.3—Using the platform to input data from an Android phone
	2.5—Using web applications for the parking area
	3.0—Connecting mobility and parking
3–4	3.3—Application of data analytics for parking process analysis
	3.5—Application of artificial intelligence for business trend analysis
	4.0—Implementation of decision support system
4–5	4.3—Position and capacity optimization of parking places
	4.6—Additional services in parking places (washing, repairs, etc.)
	5.0—Total smart parking (smart and intelligent infrastructure, services, etc.)

The assessment of smart business processes is performed according to a process classification framework that includes leadership criteria. Each process is assessed based on values of criteria/performances on a scale of 1–5. The same principles apply to risk assessment based on different types of risk in smart parking enterprises. The assessment of smart, sustainable success is based on a recommendation from ISO 9004:2012.

3.3. Methodology of Organizations Reframing into Smart Organizations (MORSO)

It is necessary to make significant changes in different domains to transition existing public enterprises into smart public enterprises. The concepts of reframing organizations [59], leading change [60], and conceptual modeling [61] could be helpful during this transition. In addition to these concepts, methods such as qualitative data analysis [62], statistical methods, ANNs, and cost–benefit analysis could also be helpful.

Based on the presented literature review, this study developed a methodology for organizations' reframing into smart organizations (MORSO). Possible phases of transition into smart public enterprises are presented in a flow diagram (Figure 2) that introduces MORSO usage and other approaches and methods.

The first step proposes to analyze the context of organizations. According to ISO 9001:2015, organization context includes issues that are: (1) relevant to its purpose, (2) relevant to the scope of QMS, (3) relevant to its strategy (global and objectives), and (4) affecting the organizations' ability to achieve the intended results and customer needs.

It is necessary to understand external and internal issues relevant to the organization that include the following: (1) the expectation of interested parties, (2) the main products that provide the most value for its interested parties, (3) processes and activities needed to meet specifications and expectations of its interested parties, (4) the influence of the business environment in which the organization is active, (5) availability of resources needed for the realization, (6) competence of the human resources, and (7) statutory and regulatory requirements.

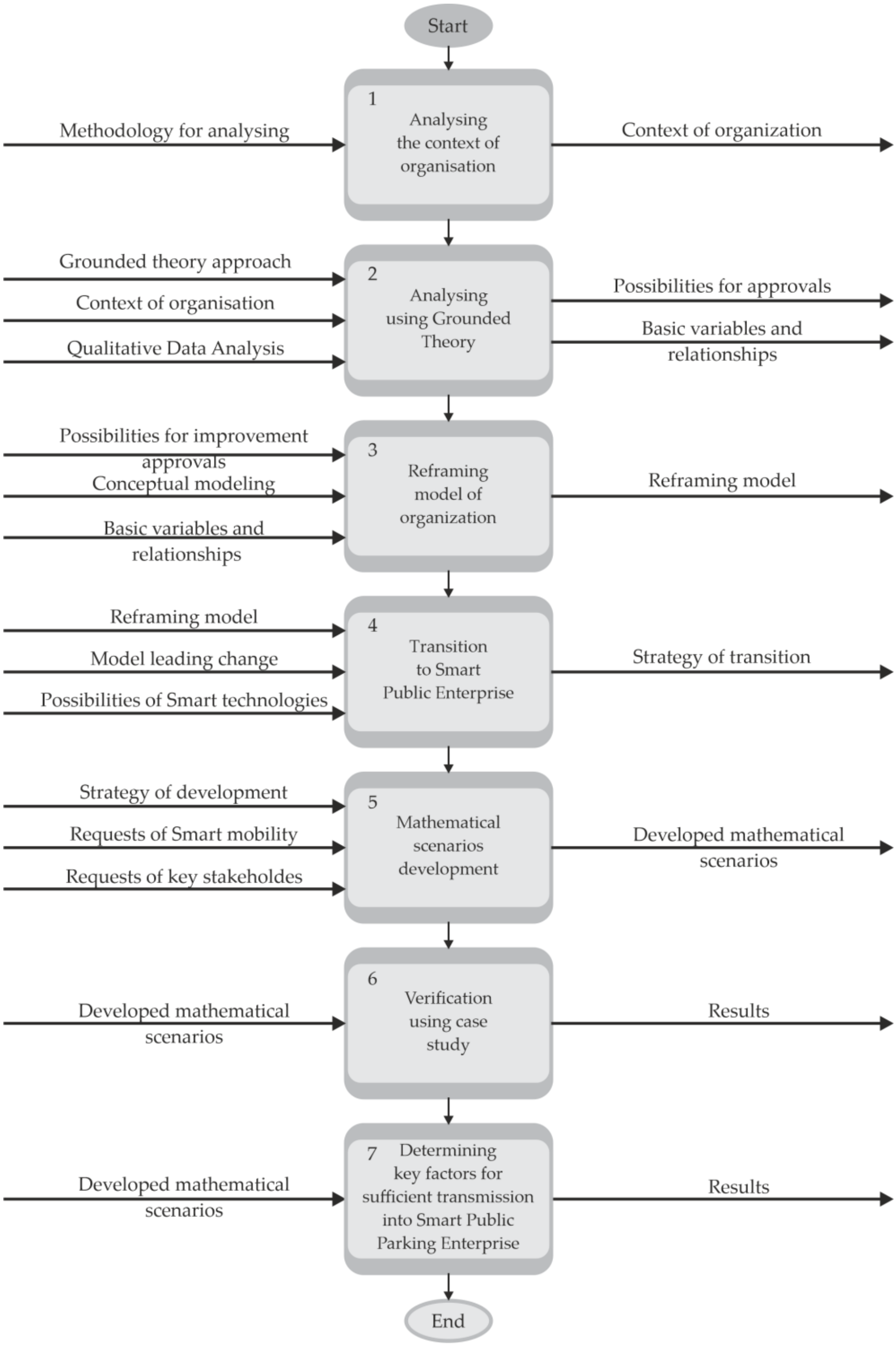

Figure 2. Methodology of organizations reframing into smart organizations.

Stages to understand and define organizational context are [63]: (1) PEST analysis, (2) SWOT analysis, (3) identification of internal and external issues, (4) identification of interested parties, and (5) definition of the QMS scope. In addition, inputs in context analyses are [64]: (1) strategic focusing, (2) purpose, and (3) results of QMS in the previous period. In the same study, outcomes are represented as (1) defined scope, (2) assessed risk and chances, and (3) defined goals and politics.

The methodology described in ISO 9001:2015 is applied and presents an input for the first phase in MORSO research. The output obtained from the same step represents the defined context of the organization (in this case, public enterprise). Together with the grounded theory approach and quantitative data analysis, the organization's context represents the input for the second phase. This phase further encompasses the following: (1) theory of comparative analyses, (2) comparative methods of quality analyses, (3) flexible use of data, and (4) analysis of applying grounded theory. Outputs of the second phase are (1) possibilities for improvement of qualitative and quantitative data and their analyses [62] and (2) searches for essential vital variables and their relationships.

In the third phase, a crucial approach adapted for public enterprises is performed, i.e., "reforming model of the organization". Inputs in this phase are: (1) possibilities for improvements, (2) a conceptual modeling approach based on the model derived from [60], and (3) previously defined essential variables and their relationships. The output of this phase is the reframing model, which is a general case that consists of the following frames: (1) making sense of organization frame, with analysis of the power of reframing and analyses of simple ideas and complexity of an organization, (2) structural frame, with analyses of organizing, structuring, and restructuring, (3) human teams and resource frame, with analyses of roles of people in organizations, improving human resource management, and interpersonal and group dynamics, (4) political frame, with analyses of power, conflict and coalition, roles of managers as politicians, and the organization as a political arena with managers as political agents, (5) symbolic frame, with analysis of the organization of symbols and culture, moving culture in action, and organization as theatre; and (6) improving leadership practice frame with seven parts: (a) integrating frames for effective practice, (b) reframing in action opportunities, (c) reframing leadership, (d) reframing change in the organization through training and negotiating, (e) reframing ethics and spirit, and (f) bringing it all together with change and leadership in action. Finally, inputs are coupled in the reframing model as the output of this third step.

The fourth phase represents the main subject of this study. In this phase, transition stages within a smart public enterprise (SPE) are developed, and the transition strategy into SPE is derived. Inputs in this phase are the reframing model, the leading change model according to Cotter [65], and the possibilities of smart technologies.

In the fifth phase, mathematical development scenarios are analyzed using simulation techniques based on dynamic modeling. The output is the mathematical scenario of transition into SPE. Inputs in this phase are (1) strategy of transition, (2) requests for smart mobility, and (3) requests of key stakeholders (interested parties).

The verification of the MORSO methodology is implemented in the sixth phase through a case study for one public parking enterprise. It uses different methods and techniques, such as statistical analysis, ANNs, cost–benefit analysis, and questionnaire development. These phase results are the results that support stated hypotheses of efficiency of the existing public parking enterprises transitioning into SPE.

4. Case Study

The results of the MORSO application for the public parking service enterprise transition into SPE will be presented in this sub-section. In the first MORSO phase, the context of the public parking enterprise organization located in Kragujevac in Central Serbia is defined. The basis for the context of the organization determination and quality assessment is the decomposition of business processes according to ISO 9001:2015. With the decomposition method applied, it is possible to accurately describe the activities within the process and check all process results so that no process in the organization is isolated. Usually, one process activates another, and the result of applying process decomposition is a data flow diagram.

Process decomposition provides an opportunity to define the processes with inputs that may be converted into outputs for the user or subsequent processes. Furthermore, through decomposition, it is possible to identify and measure the process results, determine the relationship between processes/activities and organizational functions, evaluate results, and determine the impact on stakeholder, management, and customer satisfaction. Additional specific information is derived through decomposition, such as defining responsibilities for specific operations, monitoring processes, and determining the necessary resources, levels of knowledge, and training (Figure 3).

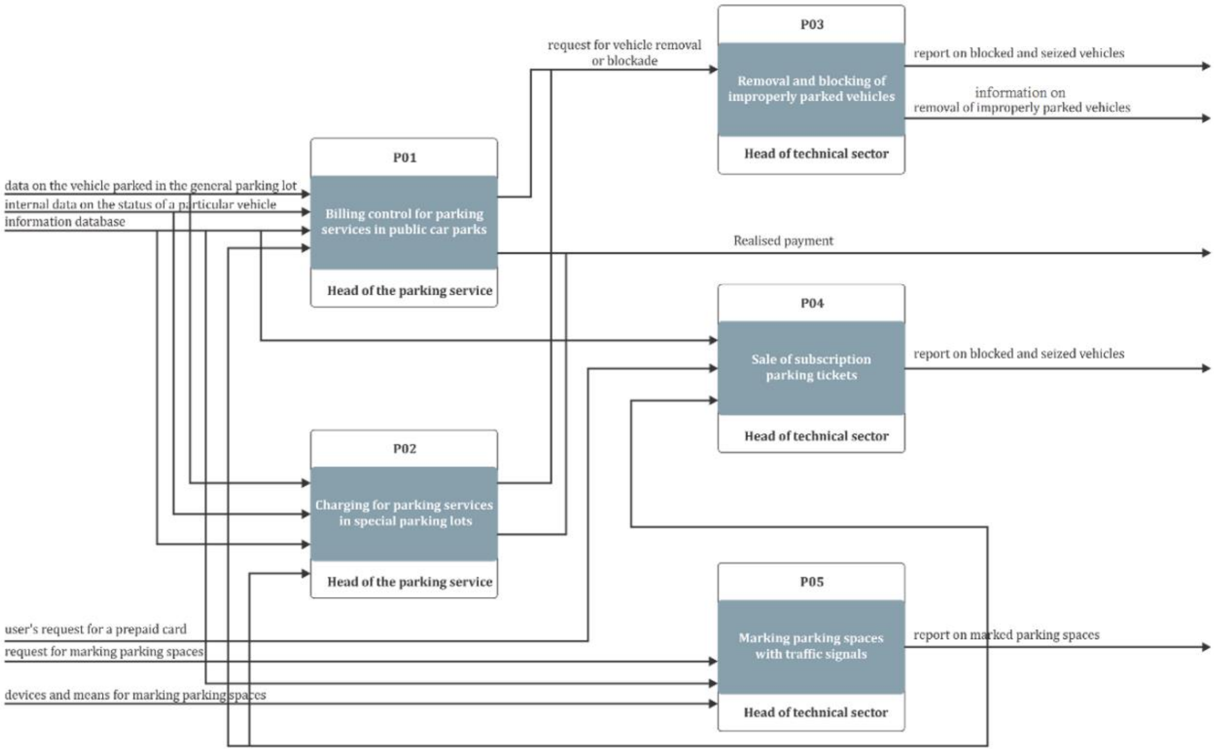

Figure 3. Modeling of the company engaged in parking services processes [66].

According to the presented MORSO phase two, by applying grounded theory, key variables and hypotheses were identified as follows:

H1. *Smart leadership has a possible impact on smart quality;*

H2. *Smart leadership has a positive impact on the reduction of risks;*

H3. *There is also an impact of smart leadership on smart sustainability;*

H4. *Smart leadership, quality, and risk have an impact on smart sustainability.*

The research model stated through the identified variables and hypotheses reflect that smart leadership has been derived from quality, since the new role of leadership in Industry 4.0 has been recognized. Thus, the relations between the smart sustainability (S) variable of the implementation process, the quality (Q) variable of the implementation process, the derived smart leadership (L) variable, and the risk (R) variable of the implementation process of the enterprise were analyzed using data from the observed public parking enterprise for 100 months; i.e., for the period from September 2010 until December 2018. The primary research model is presented in Figure 4.

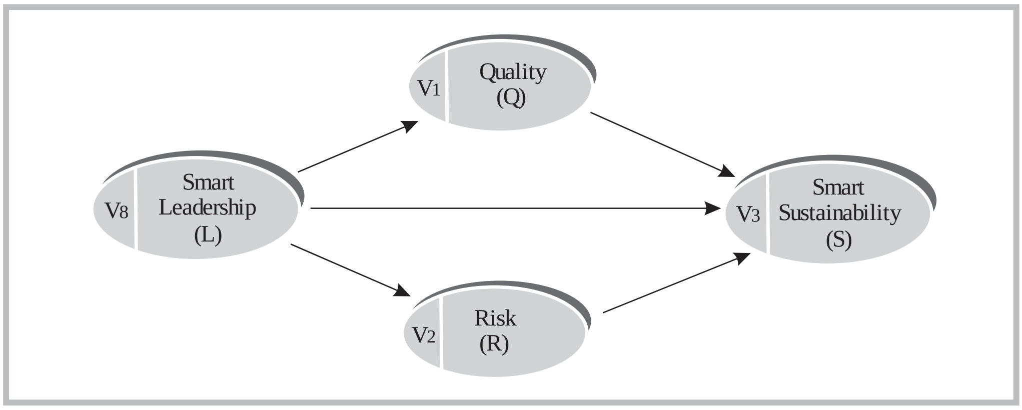

Figure 4. Basic research model.

The stated model presented in Figure 4 was obtained in the first statistical analysis step using the source of 100 mentioned public parking enterprise records from Kragujevac. The sample size should be assumed to exceed the number of independent variables by 20–30 times to achieve relevant results. The sample required for this case study, according to good practice experience, is between 40–60 pieces of data (Table 3).

Table 3. Quality, Risk, Leadership, and Sustainability variable observation values for the research model.

	Q	**R**	**L**	**S**
No. of Observation	**The Average Score in the Range between 1–5 for 20 of 100 Months of Observation**			
1	2.52	3.21	2.2	1.59
2	2.5	3.23	2.2	1.57
3	2.49	3.25	2.2	1.55
4	2.46	3.27	2.19	1.53
5	2.45	3.29	2.18	1.51
6	1.95	3.32	1.71	1.48
7	1.95	3.34	1.71	1.46
8	1.97	3.36	1.73	1.44
9	2	3.38	1.75	1.42
10	2.02	3.4	1.75	1.4
11	2.3	3.41	2.03	1.39
12	2.29	3.43	2.03	1.37
13	2.23	3.45	2	1.35
14	2.12	3.47	1.88	1.33
15	2.14	3.49	1.88	1.31
16	2.11	3.5	1.88	1.28
17	2.08	3.52	1.86	1.26
18	2.06	3.54	1.86	1.24
19	2.03	3.56	1.84	1.22
20	2.01	3.58	1.83	1.2

In this paper, 80 pieces of data were used for the analysis, from September 2010 to April 2017. Twenty of them, from May 2017 to December 2018, were used to check the model, i.e., the assumed functional connections.

The estimated values for sustainability were adopted by consensus for the same period by the team that consisted of the director, executive director, and head of the service. Estimated values are given in the format of real numbers with two decimals. The statistical analyses were derived through the SPSS IBM software and are presented in Table 4.

Table 4. The correlations between considered variables.

	S	**Q**	**R**	**L**
S	1	0.904	−0.884	0.769
Q		1	−0.885	0.710
R			1	−0.627
L				1

Risk (R) variables may have some of the following values: R1: Very small (0–1), R2: Small (1–2), R3: Moderate (2–3), R4: High (3–4), and R5: Very high (4–5).

Smart sustainability (S) variables may have some of the following values: S1: Very small (0–1), S2: Small (1–2), S3: Moderate (2–3), S4: High (3–4), and S5: Very high (4–5).

Based on these results, it is possible to conclude that S has a highly positive correlation with L and Q variables, expressed through correlation coefficient values of (0.769) and (0.904), respectively. R has a negative correlation with S, with (−0.884) correlation coefficient value.

It may be noticed that there are positive linear regression coefficients between L, Q as independent variable, and S as a dependent variable. Furthermore, a negative linear regression coefficient is identified between R as an independent and S as a dependent variable. All linear regression coefficients have somewhat higher values, meaning that possible improvement of predictors L, Q, and R may positively impact the S within a considered public parking enterprise. The impact of L is relatively high (B = 0.278). Thus, this variable's impact is further considered in this paper for significant improvement of smart sustainability.

Further MORSO steps imply the usage of data envelopment analysis (DEA). Previous DEA applications have been presented in research papers [67] and software DEAP version 2.1 [68].

Table 3 shows the results of the impact of L and R on S during the period of the last 100 months. The efficiency of its impact on S was highest in months m06 and m99, and the lowest was in month m28.

The second DEA analysis shows that the high efficiency of Q was lowest in month m28 (Figures 5 and 6) and highest in month 99.

An additional MORSO step implies the usage of ANN. Performed ANN analysis was based on [69] and the application of ANN toolbox within MATLAB 2017 software. The first step was to create an ANN with two inputs (L and R), a hidden layer with ten hidden nodes, and an output layer with one output node (S).

Figure 7 shows the results of the performed ANN training process. Results show a high correlation between real target values and prediction output values obtained by ANN. Since ANN training consists of three different parts (training, validation, and testing with three different data sets), the correlation coefficient value is presented for all three processes. The overall training process correlation coefficient value is presented from the top left to the bottom right side. Correlations are R = 0.9966 for training, R = 0.98957 for validation, and R = 0.99237 for test dataset, while overall correlation is R = 0.99482. Based on these correlation values, it was concluded that sustainability predictions could be performed.

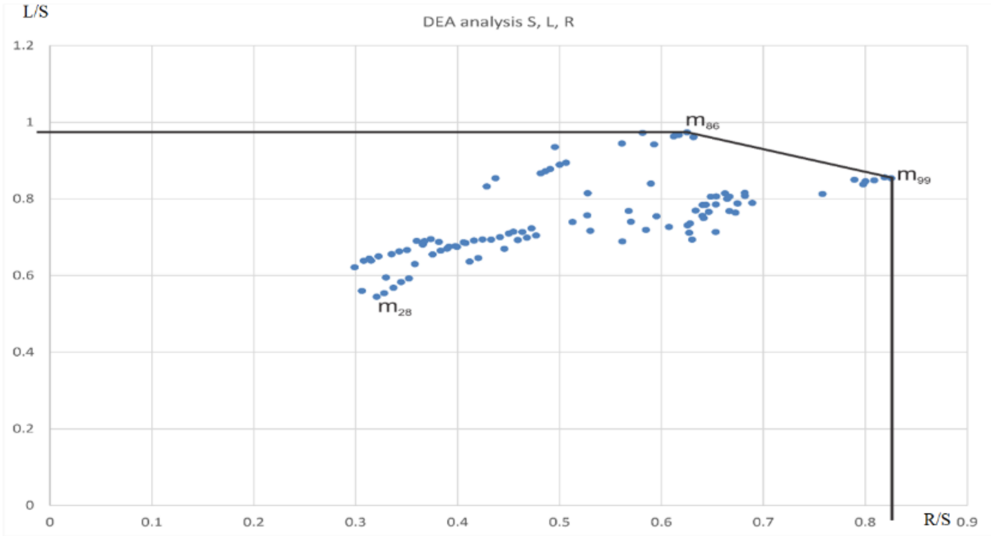

Figure 5. DEA analysis of the L and R impact on S.

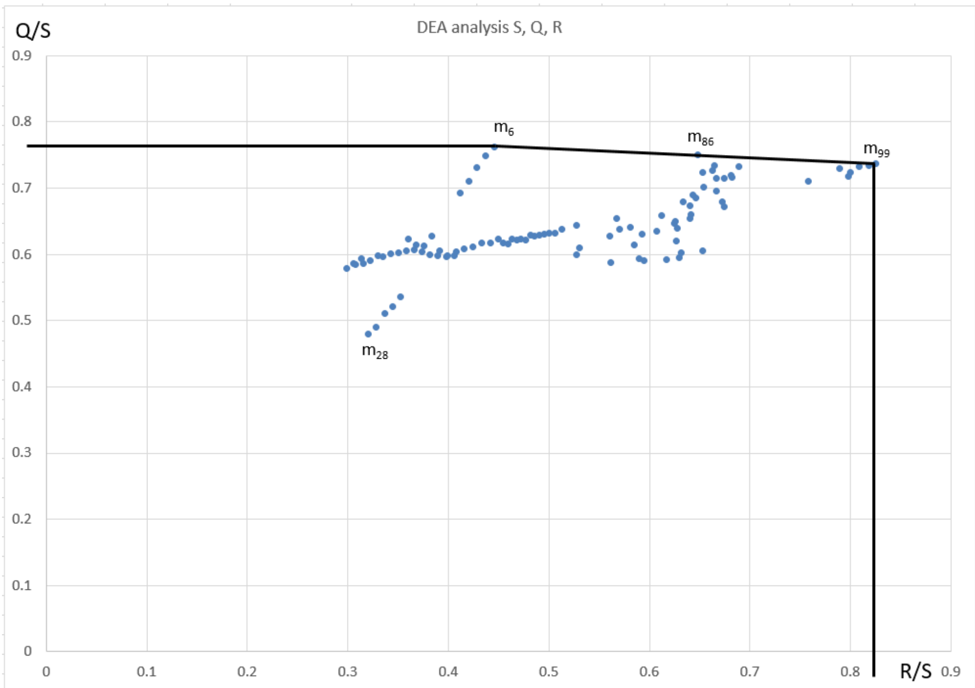

Figure 6. DEA analysis of the R and Q impact on S.

Finally, a comparison of neural networks and regression analysis prediction models for 100 months was performed. (Figure 8). Based on the chart graph, it can be seen that the values determined by ANN (sANN) and regression analysis (sREG) do not deviate significantly from the actual sustainability values.

The analysis of the research results indicates that the initial hypotheses have been proven. Thus, it is possible to focus on the most reliable model for the prediction of S as the dependent variable for Smart Public Enterprises. In this use case, the variable whose values vary is L, in combination with the projected improvement of Q values and the reduction in the R values, over time.

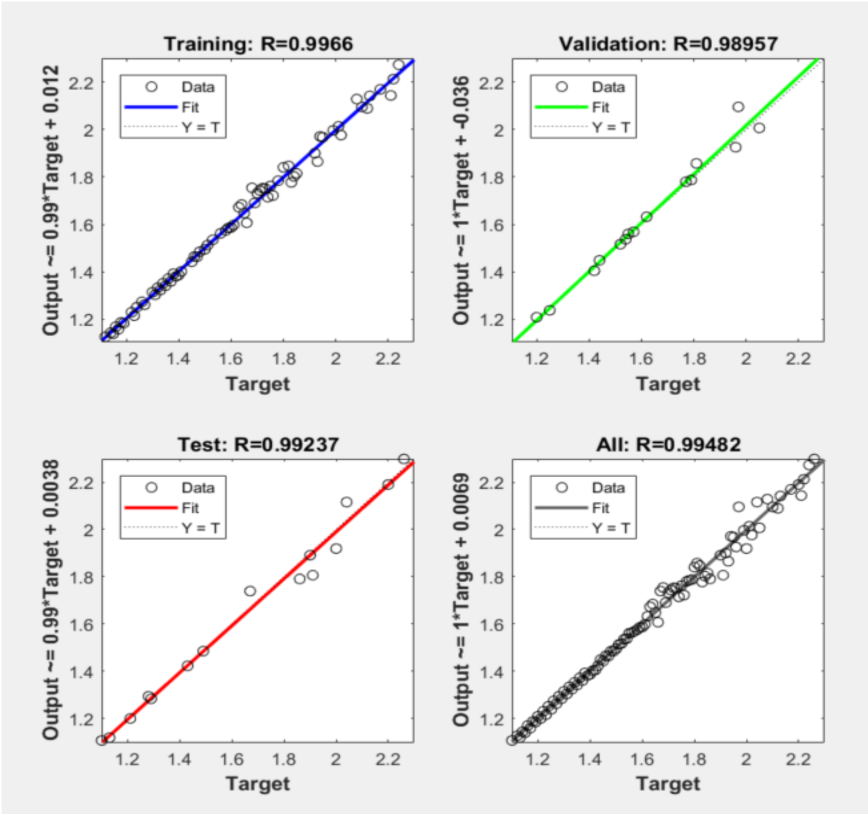

Figure 7. Correlation coefficient obtained after neural network overall testing and training.

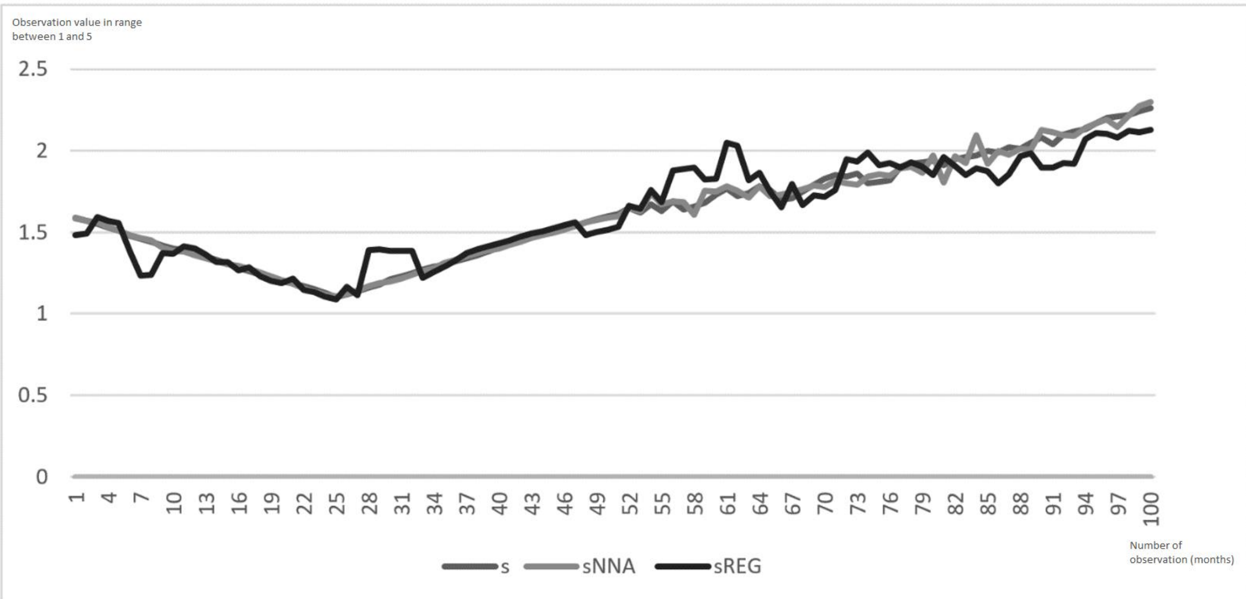

Figure 8. Sustainability predictions by neural network and regression analysis.

5. Discussion and Implications

Data on smart leadership, sustainability, quality, and risk are grouped around their mean values. Using the statistical software SPSS-Statistics 21, their mean values and standard deviations were obtained. While looking at sustainable parking, the idea of smart parking was introduced to solve the problem of parking space and parking management in large cities. Based on the analysis of the correlation coefficients between smart leadership, smart sustainability, smart quality, and risk, the following can be outlined:

1. Very high correlation coefficients were achieved between smart leadership and smart sustainability (0.769), smart leadership and smart quality (0.710), and smart leadership and risk (−0.627), as expected (Table 4).
2. There is also a high negative correlation between risk and quality (−0.885), which calls for an extension of the existing model for determining the relationship between smart quality and risk (Table 4).
3. There is also a high correlation between smart sustainability and smart quality (0.904); with increasing smart quality, smart sustainability increases (Table 4).
4. Very high correlation coefficients between smart sustainability and risk were achieved (−0.884), since increasing risk reduces smart sustainability (Table 4).

This study is primarily related to redesigning quality management, leadership, and risk management through smart technologies and knowledge management. Other authors have highlighted the importance of data reliability, security, privacy, and other critical design factors in such systems, as well as investigating the emerging parking trends in the ecosystem, while focusing on data interoperability and exchange, aiming to solve the issues in the current state of smart parking systems and recommend a conceptual smart parking model [57]. Furthermore, significant enhancement of smart sustainability is expected shortly, with greater effects of improvements, smart technologies, business models, and a higher level of horizontal and vertical integration with business, social, and natural environment. Another aspect of a sustainable parking system considers the problem of difficulties in finding a place to park, environmental pollution due to increased fuel consumption when searching for a parking space, the increasing number of cars in urban areas, and the development of the housing market, all of which are examples of factors that lead to a change in investment objectives concerning parking design [57]. Our research is correlated with other research.

The practical implications of this study are significant in the following areas: (1) the MORSO methodology can be employed by other public enterprises, (2) the general methodology can be used by industrial enterprises, and (3) the results from the provided real-life case study can offer a basis for improving key factors and variables related to smart sustainability. Finally, for each public enterprise, there is a possibility of quantifying the effects of introducing smart technologies using statistical and DEA methods and applying a feasibility study to set priorities of processes and technologies.

6. Conclusions

This study introduces the MORSO methodology to analyze the impact of smart leadership on sustainability, including aspects of smart technologies, smart business processes, and risk management. Applying the MORSO methodology requires a higher level of knowledge and skills of team members with high motivation, passion, and awareness for a more significant impact on smart sustainability.

The advantages of the proposed methodology are manifold. Firstly, it is a general approach that includes internal and external variables related to the business context in the era of Industry 4.0. Secondly, the MORSO methodology may be applied to different enterprises in other public and business sectors with appropriate changes in the model, variables, and performance level of goals. Thirdly, this new methodology results in a synergy of different approaches, theories, and methods and offers the possibility of continuous team building and management. Finally, the most significant novelty is the emphasis on smart leadership and its role as a driver for the low-cost improvement of quality and sustainability while reducing business risk.

Practical findings derived through this study state that the smart leadership level positively impacts smart quality and smart sustainability while reducing business risks. Additionally, DEA and ANN results could be used to forecast the effects of smart leadership improvement on smart sustainability. Furthermore, the significant implications of this study are (a) higher transparency of business processes, (b) preparing enterprises for effective transformation into smart enterprises, (c) adding new variables into the introduced MORSO methodology for specific cases and business models, and (d) better horizontal and vertical integration of interval processes with the social and natural environment, according to the Industry 4.0 concept.

Limitations of the proposed methodology are related to the relatively small sample, effects of smart technologies calculated in the last two years, and the case study with a selected public parking enterprise with a reliable information system for quality and risk management established in the last twelve years. Limitations also encompass reduction of the base model to only three variables (smart leadership, smart quality, and risks and their impact on smart sustainability) and research results that have only indicative effects on other public and business enterprises, since their business context and business models are different.

Future research will include new methods for current business applications and expanding the list of variables toward different public and business enterprise goals. Additionally, future research will cover project management and leadership, improvement and sustainable success, and aspects of knowledge, wisdom, and spirituality to manage greater complexity and achieve the millennium development goals.

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Abbreviations

ANN	Artificial Neural Network
APQC	American Productivity & Quality Center
BPM	Business Process Management
DEA	Data Envelopment Analysis
EFQM	European Foundation of Quality Management
ICT	Information Communication Technologies
IoT	Internet of Things
L	Leadership variable
MORSO	Methodology of Organizations Reframing into Smart Organizations
Q	Quality variable
QMS	Quality Management System
R	Risk variable
S	Smart sustainability variable
s	Sustainability variable real values
sANN	Sustainability variable artificial neural network value predictions
SPE	Smart Public Enterprise
sREG	Sustainability variable linear regression value predictions
STM	Smart Transport Middleware
VIF	Variance Inflation Factor

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