İktisat Politikası Araştırmaları Dergisi
Journal of Economic Policy Researches,
JEPR 2025, 12 (1): 154–179

https://doi.org/10.26650/JEPR1590874

Submitted 27.11.2024
Revision Requested 27.12.2024
Last Revision Received 30.12.2024
Accepted 31.12.2024

İktisat Politikası Araştırmaları Dergisi
Journal of Economic Policy Researches

Research Article

Open Access

A Decision Support System (Dss-M) for Municipal Budget and Investment Program Planning Processes in Türkiye

Hüseyin Burak Özgül [1] & Nazan Susam [1]

[1] Istanbul University, Faculty of Economics, Department of Public Finance, İstanbul, Türkiye

Abstract Decision Support Systems (DSS) have been used in a wide range of sectors since their initial development in the 1970s. Recently, however, there has been a notable shift in their utilisation, with an increasing number of DSS being deployed in the planning of public resources. This development coincides with the advent of digital transformation in the public sector. Decision support systems facilitate more effective decision-making processes by processing data obtained with the assistance of information systems. In Turkiye, these systems were identified as a crucial instrument for local governments in the National Smart Cities Strategy and Action Plan, developed by the Ministry of Environment, Urbanisation and Climate Change in 2019. The objective is to extend their implementation. Considering these circumstances, it is imperative to devise a model for the implementation of the system across all municipalities in Turkiye. This model must consider the manner in which decision support systems are utilised, their advantages and limitations within municipalities, which are the local government units where the principle of subsidiarity. The study employed a qualitative research methodology. The study group was constituted using a nested multiple-case design and comprised 18 participants selected from various units of metropolitan and sub-provincial municipalities in Istanbul. Elite interviews were conducted with the participants, and the data obtained were analysed with the MAXQDA program. In this study, the role of decision support systems in budget planning processes was examined, the benefits and shortcomings of the use of decision support systems were identified, and a new decision support system for municipalities (DSS-M) in Turkiye was developed that can be used in the budget planning processes. In the last part of the study, public policy recommendations were included for the implementation of this model.

Keywords Budget planning · planning of municipal budgets · decision support systems · decision support systems in budget planning · decision support systems in public sector

JEL Classification H50 · H72 · D61

Author Note This article is derived from Hüseyin Burak ÖZGÜL's unpublished doctoral dissertation entitled "The Role of Decision Support Systems in Resource Allocation of Municipalities: The Case of Istanbul City", which is completed under the supervision of Prof. Dr. Nazan SUSAM at Istanbul University, Institute of Social Sciences, Department of Public Finance.

Citation: Özgül, H. B. & Susam, N. (2025). A Decision Support System (Dss-M) for municipal budget and investment program planning processes in Türkiye. *İktisat Politikası Araştırmaları Dergisi–Journal of Economic Policy Researches*, *12*(1), 154-179. https://doi.org/10.26650/JEPR1590874

Corresponding author: Hüseyin Burak Özgül burak.ozgul@istanbul.edu.tr

A Decision Support System (Dss-M) for Municipal Budget and Investment Program Planning Processes in Türkiye

The science of public finance begins with an investigation into the rationale behind the state's role in the economy. In the field of public finance, Musgrave (1959) offers an insightful perspective on the state's role in the economy, suggesting that there are three key objectives guiding this intervention (*three branch theory*). These objectives are to ensure efficiency in the allocation of resources, to ensure efficiency in the distribution of income and wealth, and to ensure economic stability. The theory of fiscal decentralisation suggests that two of the three objectives, namely *"distribution"* and *"economic stability"*, can be carried out more effectively by the central government. In the *"resource allocation"* function, local governments can be more effective (Fjeldstad, 2001). It would appear that the most efficient method of resource allocation is for the central government to provide public goods and services that benefit all citizens, such as defence and justice, while local governments are responsible for providing local public goods and services, such as fire protection and sewerage, which benefit the local population (Oates, 1999).

In this context, to ensure efficiency in the allocation of resources, public services should be "provided in line with the preferences of individuals in the area where the benefits are spread and the costs should be shared". The European Charter of Local Self-Government enshrines the principle of *subsidiarity* with the statement "*Public responsibilities shall generally be exercised, in preference, by those authorities which are closest to the citizen*" (Official Gazette, 1992). This principle ensures that public services are produced or provided by the units closest to the public. The principle is presented in the treaty as "a standard that signatory States undertake to incorporate into their laws". The term “in preference” expresses a political preference as it refers to the criterion of closeness to the citizen. It is an expression of the principle of closeness to the people in service, which is the general principle of an institutional organisation that tends to favour the base over the summit (CDLR, 1993).

Local authorities possess a greater degree of insight pertaining to matters at the municipal level when compared with their centralised counterparts.They can identify the needs of local residents more closely and produce or provide local public goods and services at lower costs. For example, the pollution in a local river with wastewater represents *a public bad*. Since identifying the cause of contamination and purifying the water will be the elimination of this bad, in this case, *a public good*, in other words, public goods and services will be produced. Local governments are in a superior position to address environmental issues due to their proximity to the affected areas. They possess a more comprehensive understanding of the geographical characteristics and the underlying causes of pollution, which enables them to devise more effective solutions (Ulusoy & Akdemir, 2012).

Another point is that public sector productive units should act in such a way as to obtain the optimal output at the lowest cost when using the resources they draw from the market. The most efficient use of public resources is achieved by focusing on the benefits and costs. In the public sphere, projects whose social benefit exceeds the cost of financing are brought to the forefront and included in the investment program (Toigo & Woods, 2006). Due to the externality of public goods, the social benefits and costs of public investments are greater than their financial returns. Since only private benefits and costs are taken into account when producing a good in the market, the project to be carried out within the scope of public investment will not be adequately provided under market conditions (Stiglitz, 1994). Especially in local public goods and services that offer high social benefits but low financial returns, such as playgrounds or

libraries, it is more effective for local organisations such as municipalities to make public investments by internalising social benefits and costs.

Cost-benefit and cost-effectiveness analyses are the most commonly used economic and social analyses for selecting alternative public investment projects. These analyses are performed on a project-by-project basis. If the benefit of a project cannot be determined, a cost-effectiveness analysis is used to evaluate the project's effectiveness based on cost analysis alone (Kirmanoğlu, 2021).

However, the use of cost-benefit and cost-effectiveness analyses alone is not sufficient to ensure efficiency in resource allocation for a number of reasons, including the inability of these analyses to identify benefits and costs accurately, the low social discount rate used to calculate the present value of projects, and government failure (politician and bureaucrat behaviour, special interest groups, vote trading). Without analysing data at the neighbourhood level and at the micro scale, it is a challenging task to determine which district or neighbourhood needs which local public goods and services more, as required by the principle of subsidiarity to the people in service. To ensure efficiency in resource allocation, it is more appropriate to use data-driven methods in addition to cost–benefit analysis.

In the National Smart Cities Strategy and Action Plan prepared by the Ministry of Environment, Urbanisation and Climate Change in 2019, one of the main objectives set for local governments is to expand data-driven management. In this context, it is emphasised that decision support systems will be a key tool for the spread of data-driven management. Decision support systems (DSS) are systems that support decision-makers in considering data and various models in the decision-making process. These systems aim to increase both the effectiveness and productivity of the decision-making process and hence resource allocation.

This study considers the role of decision support systems in the allocation of resources, with a particular focus on their use in municipalities in Turkiye. To this end, a qualitative research method was employed to analyse the utilisation of such systems in this context. This study identified the use, benefits, and shortcomings of decision support systems in municipalities in Istanbul and proposed a decision support system model for the dissemination of decision support systems in all municipalities in Turkiye.

Theoretical Framework

This section introduces the concept of decision support systems (DSS) as a tool for municipalities to ensure the effective and productive allocation of resources. The term "decision support systems" was first used in 1971 by Gorry and Scott Morton in their publication "A Framework for Management Information Systems" (Gorry & Scott Morton, 1989). The conceptual basis for this system is derived from Scott Morton's doctoral thesis, which was completed at Harvard University in 1967. In his doctoral thesis, Scott Morton (1971) presented a diagrammatic representation of the impact of computer-based management systems on decision-making processes and concluded that such systems have a significant impact on the way decisions are made.

During the same period, researchers at the Massachusetts Institute of Technology (MIT) employed decision support systems (DSS) in their studies. In his doctoral thesis, Gerrity (1970) developed and tested a decision support system (DSS) designed to facilitate portfolio management for investment managers. Little, another researcher at MIT, focused on the development of DSSs for marketing applications. By 1975, Little's DSS, which he called "BRANDAID," had expanded the boundaries of computer modelling and had become a major application. Scott Morton's published works on the subject of DSS and doctoral theses on the same topic completed by MIT researchers in the late 1970s provided a strong foundation for the development of DSS that followed (Power, 2008).

Decision support systems are defined in numerous ways in the literature. McCosh and Scott Morton (1978) defined decision support systems as; *"Systems that support decision-makers to consider data and various models in the decision-making process. These systems are intended to increase both the effectiveness and efficiency of the decision-making process and hence the use of resources."* Keen and Scott Morton (1978) defined DSSs as "*computer-based systems that support decision-makers in semi-structured decision-making processes*". Sprague and Carlson (1982) defined DSSs as "*computer-based interactive systems that assist decision makers by using data and models to solve unstructured problems*".

In the decision support system definitions, the main features of this system are mostly emphasised. Figure 1 provides a brief overview of these features.

Figure 1

Key Features of Decision Support Systems

Source: Sharda, R., Delen, D. and Turban, E. **Analytics, Data Science, & Artificial Intelligence Systems for Decision Support**, 11th Edition, Pearson, New Jersey, 2020, p.17.

Sharda et al. (2020) defined the principal characteristics of decision support systems as follows:

- Support decision-makers in solving semi-structured and unstructured problems by combining the judgement of decision makers with big data.
- They are open for use by all levels of management, from senior executives to line managers.
- It supports interdependent and/or sequential decisions. Decisions can be made once, multiple times, or repeatedly.
- Supports all stages of the decision-making processes.
- It supports different decision-making processes and styles.

- It is flexible so that decision makers can add, delete, modify or reorganise key elements. Decision makers should react quickly to changing conditions by using these features.
- A user-friendly, interactive interface increases the efficiency of the decision-making processes.
- It improves the effectiveness of decision making (accuracy, timeliness, quality of decisions) rather than the productivity of decision making (such as cost). When the DSS is involved, decision-making takes longer, but decisions are made on a better basis.
- It allows the decision-maker to have full control over all the steps of the decision-making process in solving a problem. Decision support systems aim to support decision makers, not replace them.
- DSS allows decision makers to develop and modify simple systems on their own. However, with the help of experts, larger and more complex decision support systems can be built using OLAP, data mining, and data warehouses.
- It provides modelling capability to analyse problems. Modelling allows experimentation with different strategies under different scenarios.
- It provides access to various data sources, formats, and types.
- It can be used by a single decision-maker in a single location or distributed to several organisations. It can be integrated with other DSSs and applications and used internally and externally through network and web technologies.

Decision support systems have both positive and negative aspects. Research has identified instances where decision makers have found the system to be complex, time-consuming, and costly (Ubbels & Verhallen, 2000). It is also emphasised that the use of decision support systems can only become effective with detailed training (Loucks, 1995). Additionally, risk factors such as the inability to collect data due to the lack of qualified and trained personnel and the lack of healthy data are also negative aspects for the use of the system.

Literatur Review

A review of the literature on decision support systems (DSS) reveals that these systems are widely used in both the private and public sectors.

Table 1

Decision Support Systems in the Private Sector

Sector	Scope	Authors
Tourism	Tourism planning	J. Beedasy & D. Whyatt (1999)
Health	Improving the well-being of inpatients	Y. M. Chae et al. (2003)
Agriculture	Pest management	A. Perini ve A. Susi (2004)
Tertiary	Improving the quality of management in companies	I. S. Jalham & W. T. Abdelkader (2006)
Education	Balancing the supply and demand for education	S. Mansmann & M. H. Scholl (2007)
Health	Health managers to make more efficient decisions	E. Aktas et al. (2007)
Tertiary	Labour productivity	Ç. Özsever et al. (2009)
Tourism	Planning tourists' trips	N. Noor et al. (2010)
Education	Determination of students' professional expectations	V. Kostoglou et al. (2014)
Agriculture	Developing an automatic irrigation system	E. Giusti and S. Marsili-Libelli (2015)
Tertiary	Selection of suppliers	Y. Şahin & A. Supçiller (2015)
Health	Estimation of the likelihood of developing liver disease	T. R. Baitharu & S. K. Pani (2016)

Sector	Scope	Authors
Tourism	Planning transfers between the hotel and the airport	M. Aksaraylı et al. (2017)
Agriculture	Increasing the productivity of production	R. Shirsath et al. (2017)
Education	Evaluation of students' achievements	Y. Zhu et al. (2018)
Health	Mitigating the effects of COVID-19	K. Govindan et al. (2020)
Tertiary	Production planning	B. Dulkadir (2021)
Health	Treating neonatal jaundice	Y. Doğanşah (2022)
Education	Increasing the skills of disadvantaged students	P. Prinsloo et al. (2024)
Agriculture	Detection of harmful microorganisms and diseases	E. Bolat et al. (2024)

A review of the literature on the usage areas of decision support systems in the private sector reveals that (See:Table 1) decision support systems are used in the field of education to evaluate the success and professional expectations of students and to develop the talents of disadvantaged students; in the field of health to predict the probability of contracting various diseases and for hospital managers to make more efficient decisions; in the field of tertiary to increase labour productivity, supplier selection and production planning; in the agricultural sector to detect harmful microorganisms, to increase production efficiency and to manage irrigation systems; and in the tourism sector to make tourism planning. From these findings, we can see that the use of decision support systems, which were first employed in the private sector in the 1970s, has become quite widespread.

Table 2

Decision Support Systems in the Public Sector

Sector	Scope	Authors
Disaster Management	Use in earthquake mitigation, crisis response, and toxic chemical spill control	W. A. Wallace & F. De Balogh (1985)
Infrastructure	Determining the location for solid waste treatment and disposal facilities	P. Haastrup et al. (1998)
Transportation	Designing the Dutch railways	J. S. Hooghiemstra et al. (1999)
Infrastructure	Managing the potable water system in Boston	K. S. Westphal et al. (2003)
Infrastructure	Managing water resources in Athens	D. Koutsoyiannis et al. (2003)
Transportation	Establishment of an urban transportation network	G. Arampatzis et al. (2004)
Disaster Management	Managing forest fires in Greece	I. Keramitsoglou et al. (2004)
Disaster Management	Managing flood	C. J. Windhouwer et al. (2005)
Transportation	Ensuring the efficiency of passenger and freight transportation	Ülengin et al. (2007)
Transportation	Ensuring the efficient management of railways	A. D'Ariano (2009)
Disaster Management	Ensuring the coordination of disasters and emergencies	R. Kondaveti & A. Ganz (2009)
Infrastructure	Managing the drainage system	T. Park & H. Kim (2012)
Transportation	Identification of the cycling routes	A. Çolakoğlu and G. Küçükpehlivan (2014)
Infrastructure	Determining which neighbourhoods will be prioritised in urban transformation	A. Alaybeyoğlu et al. (2016)
Transportation	Determining the location of the bus stops	J. K. Kazak et al. (2018)

Sector	Scope	Authors
Disaster Management	Managing chemical, biological, radiological and nuclear disasters	H. İ. Cebeci & D. Odabaş (2019)
Transportation	Ensuring optimisation of city bus transportation	M. Mathirajan et al. (2020)
Disaster Management	Managing fires and air waves in South Korea	D. Jung et al. (2020)
Infrastructure	Positioning renewable energy technologies in the UK	D. Beriro et al. (2022)
Transportation	Making metro investment decisions in China	Q. Zhang & C. Zeng (2024)

Table 2 shows that decision support systems are mostly used in areas such as transportation, infrastructure services, and disaster management in the public sector. Decision support systems are used for the effectiveness and productivity management of resource use in many areas such as the mitigation of earthquakes, management of forest fires and flood disasters, and coordination in emergency situations in disaster management; the management and spatial selection of solid waste, drinking water and sewerage infrastructure, and the spatial selection of renewable energy technologies in infrastructure services; the creation of railways, metro investment decisions, and the spatial selection of bus stops and bicycle paths in transportation services.

Table 3

Decision Support Systems for Budget Planning Processes in the Public Sector

Level	Scope	Authors
Central Government	Planning the US Department of Agriculture's budget	R. K. Davis (1979)
Central Government	Planning the defence budget in Taiwan	W. Wen et al. (2005)
Local Government	Chiang Mai budget planning	A. Robaka et al. (2007)
Local Government	Budget planning of municipalities in Slovenia	J. Benčina (2007)
Local Government	Highway infrastructure budget planning	M. Yadollahi & R. M. Zin (2014)
Local Government	Participatory budget planning in municipalities	A. Alvarez (2014)
Local Government	Planning the budget of the Kozhikode municipality	M. A. Naseer et al. (2014)
Local Government	Planning the budget of Perm municipality	D. Vancutsem et al. (2014)
Local Government	Planning the budget of the municipality of Lagoa	H. Rego et al. (2015)
Central Government	Planning the budget of the Iranian Ministry of Health and Medical Education	Tabari vd. (2019)
Central Government	Planning the budget for the environment in Indonesia	M. H. Hidayattuloh et al. (2019)
University	Planning the university budget	A. Naderi et al. (2023)
Local Government	Planning the management of local government funds, student fees, and scholarships	Q. Li (2024)

Table 3 shows that decision support systems are used in the budget planning of local and central government and organisations, mostly municipalities. DSSs map the spatial needs of a new project in municipalities and determine which neighbourhood or district is in priority need of the public goods and services in question. This ensures the effectiveness and productivity management of budget planning processes in which public resources are planned.

Although the use of decision support systems in central government institutions in Turkiye is older, the use of decision support systems by municipalities has accelerated in the last five years. The Smart Cities Strategy and Action Plan for 2020-2023 published by the Ministry of Environment, Urbanisation and Climate Change in 2019 includes the goal of ensuring data-driven management:

"Local governments will be enabled to develop effective, efficient and accurate services and make decisions by utilising data in the provision of urban services, improvement of service quality, development of new services and decision-making processes. In this context, ***decision support systems and big data applications*** *are among the smart solutions."*

As indicated in the Plan, the Ministry of Environment, Urbanisation and Climate Change has established the objective of enhancing the utilisation of decision support systems in local governments (Ministry of Environment, Urbanisation and Climate Change, 2019).

In order to realise the goal of data-driven management, there is a need to determine how the decision support system, which is a very important tool of data-driven management in municipalities, is used, its benefits and shortcomings, and to formulate policy recommendations to increase its use. A review of the literature reveals a lack of detailed research on the use of decision support systems by municipalities in Turkiye. Given the lack of existing research in this area, the following section of the study examines the use of decision support systems in different municipalities. Furthermore, an organisational decision support system model will be developed to facilitate the widespread use of this system.

Methodology

The main objective of this study is to identify the advantages and shortcomings of decision support systems in the budget and investment program planning processes of municipalities. The primary research question of the study is as follows*: "How are decision support systems used in the planning processes of budget and investment programs of municipalities, and what are the benefits obtained with the system in question?"*

Since this research is about analyzing the use of decision support systems, which have recently started to be used in municipalities in Turkiye, it was essential to conduct qualitative research for this study. A case study is an approach that allows the researcher to analyse in depth a particular situation, a program, an event, an action, a process, or one or more individuals. (Creswell, 2016). The case study is a research design based on "how" and "why" questions as opposed to other research types. In the nested multiple-case design, the situation that is handled and examined is studied by dividing it into various sub-units within itself (Yıldırım & Şimşek, 2016). Given the objective of examining the types of municipalities in the study by dividing them into units according to the types of expenditures, it is believed that the nested multiple case design is the optimal approach for achieving the research's objectives. Accordingly, the study will employ a nested multiple case design.

This research was conducted using a multiple-case study design, with more than one sampling method employed to form the study group. The study was conducted among metropolitan and sub-provincial municipalities because these local governments have a significant population and budget size. Consequently, metropolitan and sub-provincial municipalities were selected as the primary focus of this study. Istanbul was selected for two reasons. First, 25.21% of the local government budget expenditures are managed from Istanbul. Ankara followed with 7.22% (Ministry of Treasury and Finance, 2023). The fact that a quarter of local government expenditures are managed from Istanbul alone increases the representative power of Istanbul in local governments. Another key factor is the city's diversity. Among the metropolitan cities in Turkiye, Istanbul has the most diversity, with 39 sub-provincial municipalities. Given these characteristics, the scope of the study is focused on the metropolitan and 39 sub-provincial municipalities within Istanbul, recognising it as the most comprehensive and representative city in terms of local governance. The Istanbul Metropolitan Municipality is the sole metropolitan municipality within the Istanbul service area. Furthermore, the study evaluates the role of decision support systems in resource allocation by comparing the practices

of metropolitan and sub-provincial municipalities. Considering the aforementioned factors, the Istanbul Metropolitan Municipality was the first municipality selected for the study group.

Table 4

Stratification of the 39 Sub-Provincial Municipalities

	Sub-Provincial Municipality	Budget Proposals for 2023 (the Turkish Lira)		Sub-Provincial Municipality	Budget Proposals for 2023 (the Turkish Lira)
High Budget-Municipalities	Esenyurt	3.370.750.000	Medium High Budget-Municipalities	Pendik	2.220.000.000
	Üsküdar	3.300.000.000		Şişli	2.100.000.000
	Başakşehir	3.250.000.000		Gaziosmanpaşa	2.065.000.000
	Esenler	2.700.000.000		Beşiktaş	1.988.140.000
	Bahçelievler	2.552.059.895		Beykoz	1.988.140.000
	Eyüpsultan	2.500.000.000		Sancaktepe	1.910.530.000
	Kadıköy	2.450.000.000		Kartal	1.890.000.000
	Küçükçekmece	2.450.000.000		Arnavutköy	1.800.000.000
	Bağcılar	2.350.000.000		Maltepe	1.720.000.000
	Ümraniye	2.300.000.000			
Medium Budget-Municipalities	Beylikdüzü	1.705.000.000	Low Budget-Municipalities	Tuzla	1.411.650.000
	Ataşehir	1.700.000.000		Avcılar	1.360.000.000
	Sarıyer	1.692.508.000		Silivri	1.348.000.000
	Sultangazi	1.634.000.000		Beyoğlu	1.071.000.000
	Çekmeköy	1.575.000.000		Bakırköy	1.070.163.000
	Zeytinburnu	1.550.000.000		Güngören	1.034.000.000
	Büyükçekmece	1.523.000.000		Bayrampaşa	804.000.000
	Fatih	1.511.592.000		Çatalca	672.604.000
	Kağıthane	1.491.997.000		Şile	485.232.000
	Sultanbeyli	1.450.000.000		Adalar	107.000.000

To obtain qualified information in accordance with the nature of the qualitative research method in the study, as illustrated in Table 4, the 39 sub-provincial municipalities were classified into four strata on the basis of their initial budget allocations for the 2023 fiscal year, with the assistance of quartile. The first quartile was named as municipalities with low budget, the second quartile as municipalities with medium budget, the third quartile as municipalities with medium-high budget and the last quartile as municipalities with high budget. A single district municipality was selected from each strata through simple random sampling. In all, five municipalities were selected, consisting of four sub-provincial municipalities and a metropolitan municipality. However, due to the fact that the organisational charts of the municipalities are not identical, and in order to conduct a comparative analysis in line with the objectives of the study, the municipalities were examined according to specific types of expenditure.

To examine the role of decision support systems in municipalities' consolidated public expenditures and strategies for these expenditures, "*General Public Expenditure and Strategy*" has been identified as the first expenditure to be examined. Then, in line with the research questions, it is planned to examine the role of decision support systems not only in consolidated public expenditures but also in sub-divisions of expenditures. The calculation of the benefits and costs associated with investment projects for social services, which often offer high social benefits, such as the construction of kindergartens, playgrounds, and libraries, is more complicated than that of traditional infrastructure projects, such as the development of roads, water systems, and sewerage networks. This complexity comes from the difficulty of measuring

positive externalities. As a result, it is more difficult to apply the cost-benefit and cost-effectiveness analyses included in the investment program to the evaluation of these projects. Decision support systems play a crucial role in addressing this issue. For these reasons, it would be more beneficial to examine the role of decision support systems in the planning processes of investment projects for social services, as opposed to traditional infrastructure projects, to better align with the objectives of the study. Based on this, *"Investment Projects for Social Services* " has been identified as the second type of expenditure. In addition, it is planned to examine the role of decision support systems in the social expenditures of municipalities. Accordingly, *"Social Expenditures*" were identified as the third expenditure type. In addition to the general public expenditures and strategy, the sub-divisions of public expenditures (Investment Projects for Social Services and Social Expenditures) were determined by employing the classification of real and transfer expenditures in accordance with the prevailing literature on public finance (Susam, 2024).

Once the municipal units had been identified, a decision was made as to which personnel would be interviewed. The criterion sampling method was used to determine the participants. In the sample in question, the criterion can be determined by the researcher as any situation that is the subject of the research (Baltacı, 2018). The selection criteria were based on experience and knowledge. Before conducting the interviews, the relevant unit was informed about the subject matter, scope, and objectives of the research. The most senior staff in each unit, in terms of their involvement in decision support systems and budget processes, were selected to participate in the interviews. The study employed elite interviews as a data collection instrument. The elite interview technique, conducted with individuals possessing expertise and authority, ensured the acquisition of expert opinions on the subject matter. The term *"elite"* is used to describe a group of individuals who, by virtue of their position, exert greater influence over political processes than the average person (Richards, 1996). Such interviews are referred to as *"elite interviews"*. The fact that these individuals possess firsthand knowledge of political processes enables the researcher to conduct a comprehensive analysis of the subject matter (Gözler Çamur, 2020). The elite interview technique was selected to obtain direct and qualified information on the budget planning processes of municipalities in Istanbul. As illustrated in Table 5, interviews were conducted with senior bureaucrats for the aforementioned purpose.

Table 5

Profile and Code Names of the Participants

Municipality	***Expenditure***	***Participant Profile***	***Code Name***
Metropolitan Municipality	Investment Projects for Social Services	Chief	ML1
	Social Expenditure	Director	ML2
		Expert	ML2.1
	General Public Expenditure and Strategy	Director	ML3
High Budget-Sub-Provincial Municipality	Investment Projects for Social Services	Director	H1
		Director	H1.2
	Social Expenditure	Director	H2
	General Public Expenditure and Strategy	Director	H3
		Expert	H3.1
Medium-High Budget-Sub-Provincial Municipality	Investment Projects for Social Services	Director	MH1
	Social Expenditure	Chairman Advisor	MH2
	General Public Expenditure and Strategy	Director	MH3
Medium Budget-Sub-Provincial Municipality	Investment Projects for Social Services	Chief	M1
	Social Expenditure	Director	M2
	General Public Expenditure and Strategy	Director	M3

Municipality	*Expenditure*	*Participant Profile*	*Code Name*
Low Budget-Sub-Provincial Municipality	Investment Projects for Social Services	Chief	L1
	Social Expenditure	Director	L2
	General Public Expenditure and Strategy	Expert	L3

Source: Compiled from the study.

In qualitative research, data saturation is an important indicator of the quality of the study (Akçay & Koca, 2024). The term *"saturation"* is used to describe a situation in which the collection of additional data regarding a specific event does not yield any new insights (Bryant & Charmaz, 2007). As illustrated in Table 5, 18 individuals were interviewed as part of the study. Upon recognising that the responses from the participants were largely repetitive, the researcher concluded that data saturation had been reached and concluded the data collection process. The interviews were conducted in person at the institutions where the participants were employed between July 2, 2024, and September 9, 2024. The duration of the interviews was, on average, approximately 30 minutes. In the interviews, the consent form was initially presented to the participants, their consent for participation in the study was subsequently obtained, and the consent form was formally signed.

Before obtaining consent, the participant was provided with comprehensive information regarding the study's anonymity and confidentiality protocols. Throughout the study, ethical principles were upheld in accordance with the relevant standards. Participants were asked a series of open- and closed-ended questions. These questions were designed to determine the usage, advantages, and limitations of decision support systems. As illustrated in Table 5, each participant was assigned a code name for interview classification. The code names of the participants were determined according to the *"ML"* for metropolitan municipalities and according to the municipality's budget size for other municipalities. The numerical values assigned to the code names are as follows: 1 for Investment Projects for Social Services, 2 for Social Expenditures, and 3 for General Public Expenditure and Strategy. The interviews were audio-recorded with the consent of the participants to facilitate data collection. It was not permitted to record audio for H1.2, H2, L2, and M2. During the interviews with these participants, the data were recorded in notes. Following the conclusion of the interviews, the notes were compiled into a Word document, which was created under the code name of each participant. A total of 353 minutes of audio recordings were obtained from 14 participants who granted permission to record audio in the study. The audio recordings were transcribed using a specialised program that employed artificial intelligence. Following the implementation of the requisite controls, the data were recorded in their original form with the code names of the participants.

As demonstrated in Table 6, to ensure the internal validity of the study, the semi-structured questionnaires used for the elite interviews were reviewed for comprehensibility by two academics with professor titles in the field of public finance. Considering the expert feedback, the questions were revised once more. To facilitate the appointment process, questionnaires were distributed to the units of the participants. Before the commencement of the interviews, comprehensive explanations were provided at the unit level, and the most experienced personnel for budget processes were selected to participate in the interviews. Subsequently, the participants engaged in a natural conversation to facilitate the explanation of the questions and to enhance the accuracy of the responses. During the interviews, the researcher confirmed the answers given after the questions were posed and corrected any misunderstandings. To guarantee the study's external validity, the research method, the study group's selection, the data collection and analysis process, and the validity and reliability measures were all explained in detail. To facilitate the understanding of the transferability of the study, direct quotations were included in the findings. Furthermore, the study

group was constituted in accordance with the study's objectives by using stratified sampling from the purposive sampling type.

Table 6

Validity and Reliability Measures in Study

Internal validity (Credibility)	Peer debriefing
	Prolonged engagement
	Member checks
	Explain the rationale for the choice of research method and design used
	Using the stratified sampling method from the purposive sampling methods
	Explanation of the characteristics of the study group
External validity (Transferability)	Specifying the method of selection of the working group
	Specifying the data collection process of the study
	Explanation of the data analysis process of the study
	Explanation of the validity and reliability measures
	Including direct quotations in the findings
Reliability (Dependability)	Dependability audit
	Audio recording
	Intercoder agreement
Objectivity (Confirmability)	Confirmability audit
	Detailed the data collection and analysis process

To ensure the reliability of the study, the data collection procedures were presented to an expert in the field of public finance and the expert's comments were sought. During the coding phase of the study, the codes were reviewed with the relevant expert to ensure accuracy and consistency. The reliability of the coding process is ensured through the implementation of the intercoder agreement. To prevent data loss during the study, voice recordings were taken from the participants, and all efforts were made to avoid any loss of data during the transcription process. The study employed a comprehensive and meticulous approach to data collection and analysis, to ensure the highest degree of objectivity. Furthermore, the findings were reviewed with the expert who conducted the confirmability audit and provided agreement on the codes, and the results were confirmed. The study is limited in terms of its validity and reliability due to the inability to obtain audio recordings from four participants and the collection of data from a single source. The study employed only interviews as data collection instruments.

Descriptive statistics of the participants are presented in Table 7 and Table 8. Table 7 reveals that 61% of the participants were directors, while 34% were chiefs and specialists. Table 8 indicates that 61% of the participants have been employed in municipal units for over a decade. It is evident that the participant profiles are well-suited to the provision of the qualitative information sought through the qualitative research method and the elite interview data collection tool.

Table 7

Distribution of the Participants According to Their Titles

	Frequency	***Percentage***
Chairman Advisor	1	5
Director	11	61
Chief	3	17
Expert	3	17
TOTAL	**18**	**100**

Source: Compiled from the study.

Table 8

Distribution of Participants According to Years of Work Experience

	Frequency	***Percentage***
1-10 year	7	39
11-15 year	6	33
16-20 year	3	17
21 years and over	2	11
TOTAL	**18**	**100**

Source: Compiled from the study.

Empirical Results and A Decision Support System for Municipalities (DSS-M)

This section presents the findings from the elite interviews. The findings include valuable insights into the use of decision support systems in the budget planning processes of municipalities in Istanbul. This is demonstrated by presenting the qualitative data in the form of figures and maps created with the MAXQDA program. To ensure external validity, direct quotes are also included. The section concludes with a model proposal based on the findings. The research theme was identified as the use of decision support systems. Table 9 shows the codebook of the study.

Table 9

Codebook of the Study

THEME	**CODE**
Use of Decision Support Systems	Decision Support System Usage
	Advantages of the Decision Support System
	Opinions on Decision Support Systems
	Problems Caused by Not Using a Decision Support System

Decision Support System Usage

The participants in the municipalities were provided with an explanation of the nature and function of the decision support systems, as well as an overview of their typical applications. Subsequently, they were kindly requested to share whether the system in question was used in their units, if so, how it was used and what benefits were obtained.

Figure 2

Decision Support System Usage in Municipalities in Istanbul (%)

Source: Compiled from research data.

As shown in Figure 2, it appears that 50% of the 18 participants indicated that decision support systems were used within their units. Table 10 illustrates that decision support systems are used in four out of five municipalities in Istanbul at varying levels. The findings indicate that these systems are used in at least one unit of the four municipalities, and in some cases, in all units of a municipality. A review of the data on the use of decision support systems (DSS) reveals that DSS is primarily used in investment projects related to social services among expenditure types. Furthermore, the metropolitan municipality uses the DSS in all three expenditure categories.

Table 10

Classification of Decision Support System Usage in Municipalities in Istanbul by Municipality and Expenditure Type

Municipality	**Public Expenditure**		
	Investment Projects for Social Services	Social Expenditure	General Public Expenditure and Strategy
Metropolitan Municipality	*DSS*	*DSS*	*DSS*
High Budget Sub-Provincial Municipality	*DSS*	-	-
Medium-High Budget-Sub-Provincial Municipality	-	*DSS*	-
Medium Budget-Sub-Provincial Municipality	*DSS*	-	*DSS*
Low Budget-Sub-Provincial Municipality	-	-	-

Source: Compiled from research data.

Our research revealed that metropolitan municipalities have certain advantages over sub-provincial municipalities. These advantages include the presence of qualified personnel, a high budget allocation, and a data-driven organisational culture. A participant, ML3, expressed the issue as follows:

> *"The metropolitan municipality plays **a pioneering and leading role** with **its source of income in** such a way. We have 30 staff. Which municipality has such resources? Go to X Metropolitan Municipality, how many people do they have? How many engineers do they have? More than half of the colleagues are industrial engineers. Which company has **so many engineers**? .... **There is a data-driven culture. There is corporate culture..." (ML3)***

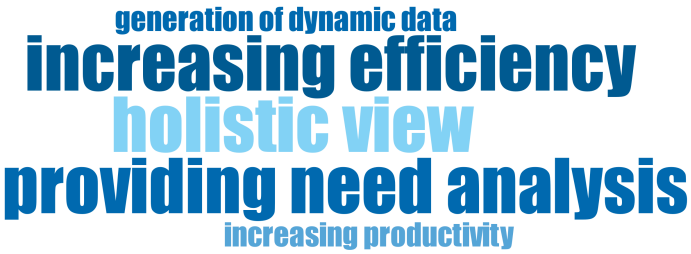
From this perspective, it can be concluded that municipalities with a sophisticated organisational culture in terms of data-driven management are more likely to use decision support systems, which are a key component of data-driven management.

Advantages of Decision Support Systems

After investigating the details of the use of decision support systems in municipalities, we asked the participants working in the units where decision support systems are used about the benefits of decision support systems. Figure 3 presents the findings.

Figure 3

Code Cloud on the Advantages of Decision Support Systems



Source: Compiled from research data.

A review of the opinions of municipal units using decision support systems indicates that these systems facilitate needs analysis within the district or neighbourhood where they are implemented. Furthermore, they are perceived as an invaluable source of information, particularly for newly elected mayors, in understanding citizen demands. M1 and M3 express this situation as follows:

> *"It is a data-driven process. Therefore, it saves one from blindness. There was also a demand at that time. The current* ***mayor*** *had just arrived here. He didn't know much about the area. So I have to say this especially. It is* ***a precious documentation*** *for a newly elected mayor."* ***(M1)***

> *"I have actually known* ***what the district actually needs in total*** *for three and a half years thanks to this system. So, for example, when I click on a thematic survey on security, I can measure* ***what is going badly, what is going well, what tends to decrease, what tends to increase, and which problems are on the rise****."* ***(M3)***

Furthermore, decision support systems can be used to improve the efficiency of projects that are initiated without preliminary analysis with a decision support system. The system ensures a more productive outcome of existing projects, which can be defined as the use of public resources. M3 expresses this situation with the following statements:

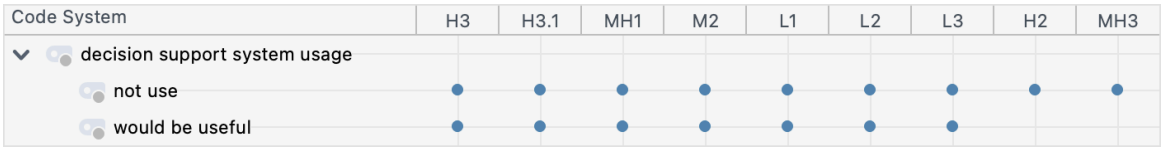
> *"Look at the thing that was built before and was inefficient. So there are no customers here. People don't come. Why not? Because we built an information centre when there were many disabled people there. We are now* ***transforming*** *it into* ***a disability centre****. Because we have seen that people are disabled and in need. People from there go to different districts for rehabilitation. We heard and saw this in the field, people demanded."* ***(M3)***

In this example, a spatial needs analysis was conducted using a decision support system in an area where an inefficient facility was previously constructed without a decision support system analysis. This analysis revealed the actual needs of the district. Subsequently, the inefficient facility was transformed into a productive one.

Opinions on Decision Support Systems

Figure 4

Code Matrix Related to the Opinions of Participants in Municipalities



Source: Compiled from research data.

Following an investigation into the utilisation of decision support systems in municipal contexts, the participants who had not previously employed such systems within their own units were provided with an explanation of their functions. They were then invited to consider the potential benefits of integrating decision support systems within their own units or municipalities. As illustrated in Figure 4, seven of the nine units that do not use decision support systems (77%) believe that the implementation of such systems within their units would be useful. In this regard, L1 and L3 made the following statements:

> *"**It would be very useful**. Infrastructure, especially the Istanbul Water and Sewerage Administration (ISKI). Because we don't know if there is rainwater on a street if we haven't done it ourselves, we ask ISKI for help... It would be great if there was a common pool."* ***(L1)***

> *"Of course, as you say, we can avoid bureaucracy and reach citizens **in a faster and more efficient way**. Of course, it would be great to use it. That is my own opinion. If there is such a system, when they ask me for my opinion, I would definitely say so."* ***(L3)***

Problems Caused by Not Using a Decision Support System

As illustrated in Figure 5, the most significant challenge in the units is the absence of data sharing. Upon analysis of the findings, it becomes evident that there is a lack of data sharing between the central government and the metropolitan municipality, as well as between the metropolitan municipality and the sub-provincial municipalities. This is despite the fact that these entities are governed by the same political party.

Figure 5

Code Cloud on Interagency Coordination Problems in Municipalities

Source: Compiled from research data.

The main reason for the central government not sharing data with municipalities was found to be the implementation of the Personal Data Protection Act (PDPL). L2 and H3 explain this as follows:

> *"The Ministry has a system, but **we cannot check this data. We ask the citizen to open his/her e-government and check it. The ministry does not provide data for data security reasons. Not much integration with metropolitan cities.**" **(L2)***

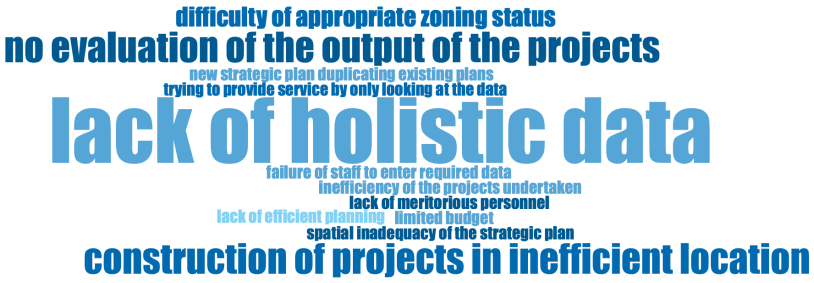
*"We cannot **even** get data from a **police department or a district health department**. It is very difficult. In fact, the use of automation has not yet been established in institutions. **While creating open data, we could not receive data from institutions properly**." **(H3)***

Indeed, these findings demonstrate that the failure to share the necessary data at the point of production or provision of public services, for which the law assigns authority and responsibility, leads to significant inefficiencies.

The municipality's organisational structure and expansive service area present unique challenges, particularly in metropolitan municipalities where these issues are more common than in sub-provincial municipalities. The most significant challenge is the provision of the same public service to the same or nearby areas, which results in the provision of duplicative public services.

Figure 6

Code Cloud on Institutional Problems in Municipalities



Source: Compiled from research data.

Figure 6 clearly shows that units without decision support systems are struggling with numerous issues. The findings clearly show that the most important problem is the lack of holistic data. Furthermore, the inability to analyse the outputs of the projects and the inefficient location of the projects without analysing them are key findings. Furthermore, it is crucial to note that the outputs of the projects are not followed up after implementation, and the criteria used to determine the success of the projects are not clearly defined, making it difficult to evaluate the effectiveness of the projects.

The implementation of projects in locations where there is no spatial need, without the use of DSS, clearly demonstrates that the absence of DSS reduces the productivity and effective use of public resources. Furthermore, the practice of duplicating existing plans without conducting the necessary analysis demonstrates a lack of efficiency in the allocation of resources. Moreover, it was found that the strategic plans were not aligned with the needs of the organisation due to the lack of spatial references.The findings demonstrate that inadequate planning and analysis lead to inefficient allocation of public resources.

In evaluating the findings, the most significant challenges facing local governments stem from the inadequate use of decision support systems within their units. Despite evidence that decision support systems have been employed in recent years, there is currently no clear obligation for their implementation. To date, there has been no inclusion of the DSS in either Law No. 5018[1] or in the strategic plans and the preparation of investment program guidelines. The principal objective of the study was to demonstrate the optimal utilisation of decision support systems in all municipalities in Turkiye. The following section of the study will present the Decision Support System for Municipalities (DSS-M) with due consideration to the findings mentioned above.

[1] Public Financial Management and Control Law.

Decision Support System for Municipalites (DSS-M)

The previous section provided a comprehensive overview of how municipalities in Istanbul use decision support systems, the benefits they obtain from using such systems, and the consequences of not using such systems. This section outlines the development of an organisational model for the widespread use of decision support systems in all municipalities in Turkiye, based on the findings presented in the previous sections. It should be noted, however, that the model in question is an institutional model. The technical specifics of the system are not within the scope of this study. This is an institutional model that will operate in collaboration with the central government, metropolitan municipalities, and sub-provincial or district municipalities. The model is founded on two fundamental components: *the database and the system interface*.

Database System

The study's findings indicate that the primary challenge in implementing decision support systems at an optimal level is inter-organisational data sharing and data collection. The field research findings indicate that many factors, particularly the PDPL, are causing difficulties in data sharing between the central government and municipalities. This relates to the coordination of the three levels of data.

Coordination of the Central Goverment Data

It is recommended that the establishment of the database system be conducted under the coordination of the Geographic Data Supply Unit, which is under the Ministry of Environment, Urbanisation and Climate Change. Indeed, the responsibilities of the Geographic Data Supply Unit encompass the following duties, as outlined by the Ministry of Environment, Urbanisation and Climate Change (2024a):

> *"To ensure **the relational coordination of the data** within the applications that produce spatial data in all software of the Ministry, to establish, manage, ensure the security and sustainability of the National Geographic Information Platform, **of the data and services produced by the Ministry, private or public institutions and organisations,**, to provide technical opinions in all kinds of contracts, protocols, memorandums of understanding that the Ministry will make with other persons, institutions and organisations for purposes such as data and information access and sharing"*

It can be stated that the coordination of data sharing between ministries, metropolitan municipalities, and sub-provincial and district municipalities can be ensured by using the experience of this unit. This unit serves as the external database of the decision support system, determining how the Ministry distributes data to metropolitan, subprovincial, and district municipalities.

Coordination of Metropolitan and Sub-Provincial Municipalities' Data

It is recommended that "*Data Sharing and Statistics Offices*" be established in all 81 provinces under the authority of the Ministry of Environment, Urbanisation and Climate Change. The function of these offices will be to ensure the collection of data and the coordination of data sharing at the provincial level.

Figure 7

Public Institutions in the DSS-M

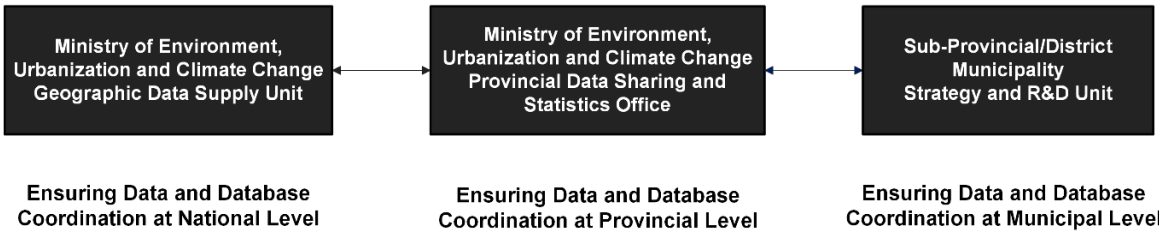


Figure 7 shows the public institutions that will coordinate the database system. The Geographical Data Supply Unit is responsible for ensuring the supply and coordination of data at the national level. The Data Sharing and Statistics Offices, which are to be established in 81 provinces under the Directorate General for Local Authorities of the Ministry of Environment, Urbanisation and Climate Change, will be responsible for data supply and coordination between metropolitan-sub-provincial municipalities or province-district municipalities in the provinces. The offices would serve to coordinate provincial data while ensuring the distribution of central government data to municipalities.

Coordination of the Municipal Units' Data

It is recommended to establish a *Strategy and R&D Unit* in each municipality to collect data and demand for local public services at the neighbourhood level. This unit will be responsible for coordinating data between municipal units and for collecting local public service demands. To facilitate the collection of local public goods and services demands, it is recommended that *a Field Team* be established at the local level in each district/sub-provincial municipality. The decision support system in the model employs a field team of sociologists, psychologists, and social workers who collect data through household visits.

In alignment with the principles of local democracy, it would be useful for municipalities to consider the establishment of a field team, reporting directly to the mayor and coordinated by the Strategy and R&D unit. Conducting comprehensive household surveys to determine the local demand for public goods and services is a crucial step in promoting *local democracy*. Once the database system has been established, the subsequent phase is the development of a decision support system software to make the database available to decision makers.

Software and Interface of the DSS-M

Once the data is collected in an integrated manner between the Ministry and the municipalities, it should be made available directly to the mayors via *a common interface*. The reason for not processing these data with different software is that it leads to inefficiency in integration. It is evident that tendering different software with the municipal budget will not result in a unified and comprehensive solution. Furthermore, the procurement of this system will present a challenge for municipalities with limited budgets, as they may not have the resources to use these systems. Additionally, it will increase expenditure for each municipality. ML3 offers the following explanation of this situation:

> *"In general, we need **an integrated system** that overlaps with each other. What is everyone doing this time? They buy their own software. I go and examine a company called A. The other one makes a deal with the other one. **They are not talking. There is also a problem in terms of collection this time. Everyone has a different system.** One standard thing can be made and divided into all metropolitan cities like the same unit logic." **(ML3)***

It is recommended that the decision support system software be designed as a holistic system that each municipality can develop and add to within the Artificial Intelligence and Data Analytics Unit of the Directorate of Geographical Information Systems of the Ministry of Environment, Urbanisation and Climate Change. This approach ensures that the data are not scattered. In fact, the relevant directorate is responsible for the following tasks (Ministry of Environment, Urbanisation and Climate Change, 2024b).

> *"To design, install and operate information systems, software and computing infrastructures on issues related to artificial intelligence, data science and* ***decision support systems****, to cooperate with artificial intelligence, data science and* ***decision support systems****, to conduct research and development activities, to participate in national and / or international studies, to ensure coordination with relevant units, to work in coordination with relevant units to* ***ensure data security*** *"*

In light of the aforementioned reasons, it would be more efficient for the relevant directorate to produce or provide the decision support system and make it available to the municipalities. The current approach of having separate decision support systems in each municipal unit leads to inefficiencies in the process: first, it does not allow a comprehensive view of the public service, and second, it makes it difficult to monitor and manage the results of each project. From this perspective, it is believed that the strategy and R&D units of the municipalities would be more effective if they provided the coordination of the software and field teams in the municipalities in such a way that the job definitions are regulated by the legislation.

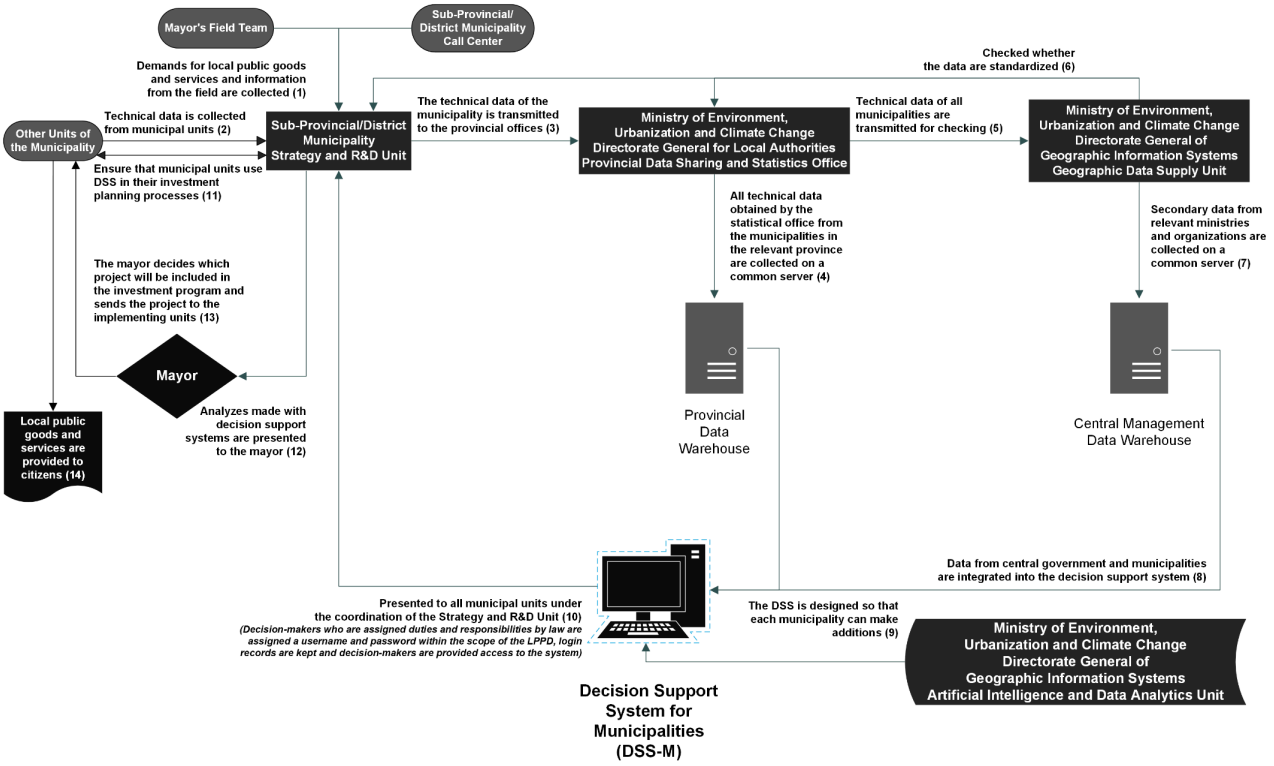
The main challenge with the decision support system currently used by municipalities is the selection of public services based on secondary data. MH2 made the decision to open a kindergarten in a neighbourhood based on secondary data, but when they visited the neighbourhood, they discovered that the demand for local public goods and services was different from what they had expected. This example illustrates the importance of conducting field research before making decisions about local public services.

> *"If decision support systems* ***did not engage with participation processes,*** *they would become very alienated and unrealised. We were building a kindergarten and we were building something large and beautiful in the garden.* ***They said no, they said we also want a park. We also want an earthquake assembly area****. Then there were gains such as open space, parks, etc.* ***It has become something more accurate. Now, this can be realised in such a picture, with decision support systems and participation processes working together****. So there is a completely different thing between you working at a desk and actually understanding the living being. It is best to manage it continuously with that knowledge."* ***(MH2)***

One of the most significant findings of the study is that decision support systems should be integrated with participation processes. In the DSS interface, where a mayor decides which investment should be made in a neighbourhood or district, it is essential to ensure that spatial analyses and the local public goods and services demanded by citizens in that neighbourhood are considered together. Therefore, it is recommended that the decision support system be used in conjunction with participatory processes. Integrating other stakeholders, such as city councils, into the e-governance process can also contribute to its enhancement. Figure 8 illustrates the operational mechanism of the Decision Support System for Municipalities (DSS-M).

Figure 8

Operational Mechanism of the Decision Support System for Municipalities (DSS-M)



Conclusion and Policy Recommendations

The main challenge in public finance is the effective and productive use of public resources. In the current era, driven by technological advancement, numerous tools have been introduced to enhance resource efficiency. Since the 1970s, decision support systems have been used in a variety of fields due to their flexible and adaptable structure and have become an essential tool in many companies.

The research was conducted with participants from various departments of the metropolitan municipality and four sub-provincial municipalities in Istanbul, selected according to different budget sizes. This study examined the use, benefits, and shortcomings of decision support systems in municipalities in Istanbul. It also determined the problems in municipalities where decision support systems were not used. The categories were analysed from three perspectives: the municipality's general public expenditures and strategy, investment projects for social services, and social expenditures.

In the municipalities, participants were asked whether decision support systems were used in their respective units, and the results showed that 50% of the participants used decision support systems in their units. In a survey conducted by the Ministry of Environment, Urbanisation and Climate Change in 2019, this rate was 21% for all municipalities in Turkiye (Ministry of Environment, Urbanisation and Climate Change, 2019). It can be stated that the use of DSS has reached an important level in Istanbul over the last five years. A review of the use of decision support systems (DSS) in municipalities reveals that at least one unit in four municipalities uses DSS.

The literature clearly shows that decision support systems are used primarily in transportation and infrastructure services in urban areas. A review of the types of expenditures of the municipalities in Istanbul reveals that decision support systems are predominantly used in investment projects for social services. We conducted interviews with the Public Works and Engineering, Plan and Projects departments of the

municipality, which manage infrastructure projects, to gain insight into this type of expenditure. Therefore, it is expected that decision support systems will be used more widely in this expenditure type.

We then asked the municipal unit participants about the specifics of the decision support system usage and subsequently inquired about the advantages these systems offer municipalities. The system in question demonstrably increases communication between the municipality and citizens. Furthermore, it enables the redesign and optimisation of projects that were previously done without the use of a decision support system. Decision support systems are invaluable for not only analysing new projects but also efficiently using previous ones. Most units that do not use decision support systems (77%) believe it would be beneficial to implement such a system within their units or municipalities. The study findings indicate that decision support systems play a crucial role in resource allocation.

The main challenge for participants in inter-institutional coordination is the absence of data sharing. It was observed that sub-provincial municipalities encounter difficulties in receiving data from the metropolitan municipality. Similarly, sub-provincial and metropolitan municipalities face challenges in receiving data from the central government due to the presence of PDPL. During the household visits of the low-budget sub-provincial municipality, it was noted that the data received from the citizens could not be integrated into a centralised system such as the Ministry. Instead, control was maintained by requesting the citizen to open his or her e-government account.This situation leads to inefficient use of resources by decision-makers who are legally obliged to produce or provide local public goods and services.

The research findings revealed that a significant number of challenges encountered by municipalities can be attributed to the absence of a decision support system. Before the decision support system in municipalities, the main problems were that projects were prepared by different directorates for the same or close piece of land, the data were scattered, the analysis of the projects could not be done sufficiently, and the projects were built in inefficient places where they were not needed. If the decision support system is well designed, it can solve both the data sharing problem and the coordination problem.

In the final stage of our research, we have presented *a Decision Support System for Municipalities (DSS-M)* that aims to address the challenges faced by municipalities and facilitate the adoption of decision support systems in all municipalities in Turkiye. Considering the considerations above, we present the following recommendations for the implementation of the proposed model and the resolution of the challenges encountered in the field.

The use of decision support systems should be made mandatory in municipalities by Law No. 5018. The relevant regulations and guidelines should provide detailed guidance on the implementation of these systems. It is recommended that municipalities use the data generated by this system in the preparation of their strategic plans, performance, and investment programs. Therefore, it is expected that the use of data-driven management in municipalities will increase.

To expand the use of decision support systems, the Artificial Intelligence and Data Analytics Unit of the Ministry of Environment, Urbanisation and Climate Change should develop a flexible and adaptable decision support system that will be available to all municipalities. It is recommended that the developed system be logged in with usernames and passwords to be defined for decision makers in municipalities, and that login records be kept within the scope of PDPL. The system should be designed in a manner that restricts access to data to the specific area of responsibility of the decision-maker.

Each province should have a Data Sharing and Statistics Office under the Ministry of Environment, Urbanisation and Climate Change. These offices collect data from municipalities in a standardised manner. These offices should collect data from all municipalities in the provinces, and each province should have a data warehouse. The Geographic Data Supply Unit of the Ministry of Environment, Urbanisation and

Climate Change should coordinate data warehouses and central government data in each province. It is the responsibility of this unit to establish the specifics of the data collection procedure and to guarantee that the data are uniform.

It is recommended that strategy and R&D units be established in all municipalities, with direct reporting to the mayor, for coordinating the use of decision support systems. These units coordinate the use of decision support systems by departments, while also collecting local public goods and services demands through a field team. It would be beneficial to select the members of the field team to be formed under the Strategy and R&D Units to collect the local demand for public services based on an understanding of urban sociology. Additionally, data from citizens should be collected at regular time periods to ensure that the system is based on the most current information.

The decision support system should enable the collection of requests from the public on the one hand and use a spatial decision support system to analyse both primary data and data from the central government and the relevant province on the other. Therefore, it will be ensured that the demand for local public goods and services and spatial analyses are compatible, and the demand for local public goods and services will be transformed into the production or provision of local public goods and services in the most efficient manner.

Ethics Committee Approval: This study was approved by the ethics committee of Istanbul University Social Sciences and Humanities Research Ethics Committee. (12.02.2024-2415972)

Informed Consent: Written consent was obtained from the participants.

Peer Review: Externally peer-reviewed.

Author Contributions: Conception/Design of Study- H.B.Ö., N.S.; Data Acquisition- H.B.Ö.; Data Analysis/Interpretation- H.B.Ö., N.S.; Drafting Manuscript- H.B.Ö., N.S.; Critical Revision of Manuscript- H.B.Ö., N.S.; Final Approval and Accountability- H.B.Ö., N.S.

Conflict of Interest: Authors declared no conflict of interest.

Grant Support: This study was funded by Scientific Research Projects Coordination Unit of Istanbul University. Project number: 39794. Project Code: SDK-2023-39794.

Author Details

Hüseyin Burak Özgül (Res. Asst. Dr.)

[1] Istanbul University, Faculty of Economics, Department of Public Finance, İstanbul, Türkiye

0000-0002-0620-2493 burak.ozgul@istanbul.edu.tr

Nazan Susam (Prof. Dr)

[1] Istanbul University, Faculty of Economics, Department of Public Finance, İstanbul, Türkiye

0000-0003-4078-3217 nsusam@istanbul.edu.tr

References

Akçay, S. & Koca, E. (2024). Nitel Araştırmalarda Veri Doygunluğu. *Anadolu Üniversitesi Sosyal Bilimler Dergisi*, 24(3), 829-848.

Aksaraylı, M., Pala O., Cenger A., Özlü, Y & Ersoy, M. A. (2017). Turizm Sektöründe Araç Rotalama Problemi Ve Karar Destek Sistemi Uygulaması. *Adnan Menderes Üniversitesi Sosyal Bilimler Enstitüsü Dergisi,* 4(4), 203-213.

Aktaş, E., Ülengin, F. & Şahin, Ş. Ö. (2007). A Decision Support System to Improve the Efficiency of Resource Allocation in Healthcare Management. *Socio-Economic Planning Sciences*, 41, 130–146.

Alaybeyoğlu, A., Kılıç, U., İregöl, A. & Konbul, Y. (2016). Kentsel Dönüşümde Mahalleler Arası Öncelik Sıralaması: Örnek Bir Karar Destek Sistemi, *Uludağ Üniversitesi Mühendislik Fakültesi Dergisi*, 21(2), 377-402. https://doi.org/10.17482/uumfd.278133

Alvarez, A. (2014). Towards Intelligent E-Participatory Budgeting, In Balula Bina & Ricci (Eds.), *Urban Futures-Squaring Circles: Conference Proceedings*. Lisbon:Institute of Social Sciences of the University of Lisbon and Calouste Gulbenkian Foundation.

Arampatzis, G., Kiranoudis, C.T., Scaloubacas, P., & Assimacopoulos, D. (2004). A GIS-based decision support system for planning urban transportation policies. *European Journal of Operational Research*, 152, 465-475.

Baitharu, T.R. & Pani, S.K. (2016). Analysis of Data Mining Techniques for Healthcare Decision Support System Using Liver Disorder Dataset. *Procedia Computer Science*, 85, 862-870. https://doi.org/10.1016/j.procs.2016.05.276

Baltacı, A. (2018). Nitel Araştırmalarda Örnekleme Yöntemleri ve Örnek Hacmi Sorunsalı Üzerine Kavramsal Bir İnceleme. *Bitlis Eren Üniversitesi Sosyal Bilimler Dergisi*, 7(1), 231-274.

Beedasy, J., & Whyatt, D. (1999). Diverting the tourists: a spatial decision-support system for tourism planning on a developing island. *International Journal of Applied Earth Observation and Geoinformation*, 1 (3-4), 163-174.

Benčina, J. (2007). Web-based Decision Support System for the Public Sector Comprising Linguistic Variables. *Informatica,* 31, 311-323.

Beriro D., Nathanail J., Salazar J., ... , Nathanail, P. (2022). A Decision Support System to Assess The Feasibility of Onshore Renewable Energy Infrastructure. *Renewable and Sustainable Energy Reviews*, 168, 1-16.

Bolat, E., Altundağ, Y., & Arıkan Yıldız, Y. (2024). Çiftçiler İçin Web Tabanlı Destek Sistemi. *Yönetim Bilişim Sistemleri Dergisi*, 10(1), 1-11.

Bryant, A. & Charmaz, K. (2007). *The SAGE Handbook of Grounded Theory*, Trowbridge: Sage Publications.

CDLR. (1993). Definition and Limits of the Principle of Subsidiarity. *Local and Regional Authorities in Europe*, 55.

Cebeci, H. İ., & Odabaş, D. (2019). Kimyasal, biyolojik, radyolojik ve nükleer afetleri yönetmek için bir karar destek sistemi modeli önerisi. *Sakarya Üniversitesi İşletme Enstitüsü Dergisi*, 1(1), 41-50.

Chae, Y.M., Kim, H.S., Tark, K.C., Park, H.J., & Ho, S.H. (2003). Analysis of healthcare quality indicator using data mining and decision support system. *Expert Systems with Applications, 24*, 167-172.

Coşkun, G. (1986). *Devlet Bütçesi: Türk Bütçe Sistemi*, Ankara, Turhan Kitabevi.

Creswell, J. W. (2016). *Araştırma Deseni-Nitel, Nicel ve Karma Yöntem Yaklaşımları* (Demir, S. B. Çev.), Ankara: Eğiten Kitap.

Çolakoğlu, A. & Küçükpehlivan, G. (2014). *Kullanıcı Odaklı Bisiklet Yolu Güzergahı Belirlenmesi İçin Karar Destek Modeli Önerisi*, VIII. Mimarlıkta Sayısal Tasarım Ulusal Sempozyumu, İzmir.

D'Ariano, A. (2009). Innovative Decision Support System for Railway Traffic Control. *IEEE Intelligent Transportation Systems Magazine, 1*, 8-16.

Davis, R. K. (1979). Strategic, Tactical, and Operational Planning and Budgeting: A Study of Decision Support System Evolution. *MIS Quarterly*, 3(4), 1–19. https://doi.org/10.2307/249044

Doğanşah, Y. (2022). *Yenidoğan Sarılığına Yönelik Fototerapi Tulumu ve Klinik Karar Destek Sistemi Tasarlanması*. (Yüksek Lisans Tezi). Selçuk Üniversitesi Fen Bilimleri Enstitüsü, Konya.

Dulkadir, B. (2021). Bilişim Teknolojisi Tabanlı Karar Destek Sistemleri ile İplik Üretim Tesislerinde Üretimin Planlanması. *Alanya Akademik Bakış*, 5(1), 193-209. https://doi.org/10.29023/alanyaakademik.705424

Ertan, B. (2002). Yerel Yönetim Kavramı. *Çağdaş Yerel Yönetimler*, 11(1), 22–30.

Fjeldstad, H. (2001). Intergovernmental Fiscal Relations in Developing Countries: A Review of Issues. Bergen: Chr. Michelsen Institute (CMI Working Paper),11.

Gerrity, T. P. (1970). *The Design of Man-Machine Decision Systems*. (Doctoral Dissertation) Massachusetts Institute of Technology, Cambridge.

Giusti, E., & Marsili-Libelli, S. (2015). A Fuzzy Decision Support System for irrigation and water conservation in agriculture. *Environmental Modelling & Software, 63*, 73-86.

Gorry, G.A., & Morton, M.S. (1989). A Framework for Management Information Systems. *Sloan Management Review*, 30(3), 49–61.

Govindan, K., Mina, H., & Alavi, B. (2020). A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: A case study of coronavirus disease 2019 (COVID-19). *Transportation research. Part E, Logistics and Transportation Review*, *138*. https://doi.org/10.1016/j.tre.2020.101967

Görmez, K. (1997). *Yerel Demokrasi ve Türkiye*, Konya:Vadi Yayınları.

Gözler Çamur, E. (2020). *Sosyal Bilimlerde Bir Araştırma Yöntemi Olarak "Elit Görüşme": Teknikler ve Sahadan Notlar*, Tunçsiper, B. (Ed.), III. Uluslararası Sosyal Bilimlerde Kritik Tartışmalar Kongresi Tam Metin Kitabı içinde (67-77), İzmir.

Haastrup, P., Maniezzo, V., Mattarelli, M., Mazzeo Rinaldi, F., Mendes, I. & Paruccini, M. (1998). A Decision Support System for Urban Waste Management, *European Journal of Operational Research*, 109, 330-341.

Hidayattuloh, M. H., Bambang, A. N. & Amirudin, A. (2019). Environmental-Based Budget Planning in The Tegal Regency Government, *E3S Web of Conferences*, 125, 1-6.

Hooghiemstra, J. S., Kroon, L. G., Odijk, M. A., Salomon, M. & Zwaneveld, P. J. (1999). Decision Support Systems Support the Search for Win-Win Solutions in Railway Network Design. *Interfaces*, 29(2), 15-32.

Jalham, I.S. & Abdelkader, W.T. (2006), Improvement of organizational efficiency and effectiveness by developing a manufacturing strategy decision support system. *Business Process Management Journal*, 12(5), 588-607. https://doi.org/10.1108/1463715

Jung, D., Tran Tuan, V., Quoc Tran, D., Park, M. & Park, S. (2020).Conceptual Framework of an Intelligent Decision Support System for Smart City Disaster Management, *Applied Sciences*, 10(2), 1-13.

Kazak, J. K., Castro, D. G., Swiader, M. & Szewranski, S. (2019). *Decision Support System in Public Transport Planning for Promoting Urban Adaptation to Climate Change*, IOP Conf. Series: Materials Science and Engineering, IOP Publishing.

Keen, P. G. W. & Scott Morton, M.S. (1978). *Decision Support Systems: An Organizational Perspective* Reading:Addison-Wesley.

Keramitsoglou, I., Kiranoudis, C. T., Sarimveis, H., & Sifakis, N. (2004). A multidisciplinary decision support system for forest fire crisis management. *Environmental management*, *33*(2), 212–225. https://doi.org/10.1007/s00267-003-0092-4

Kirmanoğlu, H. (2021). *Kamu Ekonomisi Analizi*, İstanbul:Beta Yayınevi.

Kondaveti R. & Ganz, A. (2009). *Decision Support System for Resource Allocation in Disaster Management,* 31st Annual International Conference of the IEEE EMBS, Minnesota, 2-6.

Kostoglou, V., Ploskas, N., Vassilakopoulos, M., & Tsantopoulou, V. E. (2014). Analysis and Design of A Web-Based Decision Support System For Choosing Higher Education Studies. *Yugoslav Journal of Operations Research, 24*, 399-414.

Koutsoyiannis, D., Karavokiros, G., Efstratiadis, A., Mamassis, N., Koukouvinos, A., & Christofides, A. (2003). A decision support system for the management of the water resource system of Athens. *Physics and Chemistry of The Earth, 28*, 599-609.

Li, Q. (2024). Empowering Financial Management in Educational Institutions: A Multi-Objective Decision-Making System using Intelligent Fuzzy Logic Algorithm and Digital Marketing, *Computer-Aided Design & Applications*, 21(4), 198-210.

Loucks, D. P. (1995). Developing and Implementing Decision Support Systems: A Critique and A Challenge 1. *JAWRA Journal of the American Water Resources Association*, 31(4), 571-582.

Mansmann, S., & Scholl, M.H. (2007). Decision Support System for Managing Educational Capacity Utilization. *IEEE Transactions on Education, 50*, 143-150.

Mathirajan, M., Devadas, R., & Ramanathan, R. (2020). Transport analytics in action: A cloud-based decision support system for efficient city bus transportation. *Journal of Information and Optimization Sciences*, *42*(2), 371–416. https://doi.org/10.1080/

McCosh, A. M. & Scott Morton, M. S. (1978). *Management Decision Support Systems*, London:The Macmillan Press Ltd.

Ministry of Environment, Urbanization and Climate Change. (2019). Smart Cities Strategy and Action Plan for 2020-2023, Ankara.

Ministry of Environment, Urbanization and Climate Change. (2024a). Geographic Data Supply Unit,https://cbs.csb.gov.tr/birimler/cografiveri-temini-sube-mudurlugu/2296, 23.11.2024.

Ministry of Environment, Urbanization and Climate Change. (2024b). Artificial Intelligence and Data Analytics Unit, https://cbs.csb.gov.tr/birimler/ yapay-zek-ve-veri-analitigi-subemudurlugu/2307, 23.11.2024.

Ministry of Treasury and Finance. (2023). "Local Government Statistics", https://www.hmb.gov.tr/muhasebat-genel-mudurlugu-istatistikleri, 01.10.2024.

Musgrave, R. A. (1959). *The Theory of Public Finance, Bombay*, Tata: McGraw-Hill Book Company.

Nadaroğlu, H. (1998). *Mahallî İdareler: Teorisi, Ekonomisi, Uygulaması*, İstanbul:Beta Yayınevi.

Naderi Rushnavand, A., Fathtabar Firouzjaei, K., Ezzati, M., & DinMohammadi, M. (2023). Decision Support System for Financial Resource Allocation at the University: Requirements and Outcomes. *Quarterly Journal of Research and Planning in Higher Education*, *29*(2), 27-50. doi: 10.61838/irphe.29.2.2

Naseer, M. A., Bimal, P. & Vinod Kumar, T. M. (2014). *Participatory E-Budgeting Using GIS-Based Spatial Decision Support System: Kozhikode Municipal Corporation*. In Vinod Kumar T. M (Ed.), E-Governance for Smart Cities (307-350), New York: Springer.

Noor, N. M. M., lina Ahm, I. A., Ali, N. H., & Ismail, F. (2010). *Intelligent decision support system for tourism destination choice: A preliminary study*. In 2010 International Symposium on Information Technology (3, 1357-1361). IEEE.

Oates, W. E. (1999). An Essay on Fiscal Federalism. *Journal of Economic Literature*, 37(3), 1120–1149.

Official Gazette. (1992). European Charter of Local Self-Government.

Ortaylı, İ. (1982). Osmanlı İmparatorluğunda İdari Modernleşme ve Mahalli İdare Alanındaki Gelişmeler. *İdare Hukuku ve İlimleri Dergisi*, *3*(1-3), 137-148.

Özsever, Ç., Gençoğlu, T., & Erginel, N. (2009). İşgücü Verimlilik Takibi İçin Sistem Tasarımı ve Karar Destek Modelinin Geliştirilmesi. *Journal of Science and Technology of Dumlupınar University*, 18, 45-58.

Park, T., & Kim, H. (2013). A data warehouse-based decision support system for sewer infrastructure management. *Automation in Construction*, *30*, 37-49.

Perini, A., & Susi, A. (2004). Developing a decision support system for integrated production in agriculture. *Environmental Modelling & Software*, *19*(9), 821-829.

Power, D. J. (2008). *Decision Support Systems: A Historical Overview.* In Burstein, F. & Holsapple, C. W. (Ed.), Handbook on Decision Support Systems 1- Basic Themes (121-140), Berlin:Springer.

Prinsloo, P., Khalil, M., & Slade, S. (2024). Vulnerable student digital well-being in AI-powered educational decision support systems (AI-EDSS) in higher education. *British Journal of Educational Technology*, *55*(5), 2075-2092.

Rego, H., Mendes, A. B., & Guerra, H. (2015). *A decision support system for municipal budget plan decisions*. In New Contributions in Information Systems and Technologies: Volume 2 (129-139). Springer International Publishing.

Richards, D. (1996). Elite interviewing: Approaches and pitfalls. *Politics*, *16*(3), 199-204.

Robaka, A., Herabata, P., & Gupta, A. D. (2007). Decision support system for water infrastructure planning under budget uncertainty: A case study from Thailand. *Water International*, *32*(S1), 822-843.

Scott Morton, M. S. (1971). *Management Decision Systems: Computer-Based Support of Decision Making,* Boston:Harvard University Press.

Sharda, R., Delen, D., & Turban, E. (2021). *Analytics, data science, & artificial intelligence: systems for decision support*. New York:Pearson.

Shirsath, R., Khadke, N., More, D., Patil, P., & Patil, H. (2017). *Agriculture decision support system using data mining*. In 2017 International Conference on Intelligent Computing and Control (I2C2) (1-5), IEEE.

Shirsath, R., N. Khadke, D. More, P. Patil & H. Patil "Agriculture Decision Support System using Data Mining", 2017 International Conference on Intelligent Computing and Control (I2C2), Coimbatore, India, 2017, pp. 1-5.

Sprague, R. H. & Carlson, E. D. (1982). *Building Effective Decision Support Systems*, New Jersey:Prentice-Hall.

Stiglitz, J.E. (1994). *Kamu Kesimi Ekonomisi*, İstanbul:Marmara Üniversitesi Yayınları.

Susam, N. (2024). *Kamu Maliyesi*, Ankara:Seçkin Yayıncılık.

Şahin, Y., & Supçiller, A. (2015). Tedarikçi seçimi için bir karar destek sistemi. *Mühendislik Bilimleri ve Tasarım Dergisi*, *3*(2), 91-104.

Tabari, M. Y., & Memariani, A. (2019). *Developing a decision support system for big data analysis and cost allocation in national healthcare*. In Healthcare Data Analytics and Management (89-109). Academic Press.

Toigo, P., & Woods, R. (2006). Public investment in the United Kingdom. *OECD Journal on Budgeting*, *6*(4), 63-102.

Ubbels, A., & Verhallen, J. M. (2000). Suitability of decision support tools for collaborative planning processes in water resources management. *RIZA rapport* (No. 99.067).

Ulusoy, A. & Akdemir, T. (2012). *Mahalli İdareler*. Ankara: Seçkin Yayıncılık.

Ülengin, F., Önsel, Ş., Topçu, Y. I., Aktaş, E., & Kabak, Ö. (2007). An integrated transportation decision support system for transportation policy decisions: The case of Turkey. *Transportation Research Part A: Policy and Practice*, *41*(1), 80-97.

Ülkmen, İ. H. (1960). *Mahali İdareler Maliyesi*, Ankara:Ankara Üniversitesi Siyasal Bilgiler Fakültesi Yayınları.

Vancutsem, D., Maksimova, S. V., Zavialov, A. Y., Mezenina, K. O., & Mikushin, P. S. (2014). Information-Analytical System for Managing Cities of Perm Region Spatial Development. In Proceeding of 19th International Conference on urban planning, regional development and information society (295-301), Vienna.

Wallace, W. A., & De Balogh, F. (1985). Decision Support Systems for Disaster Management. *Public Administration Review*, *45*, 134–146. https://doi.org/10.2307/3135008

Wen, W., Wang, W., & Wang, C.H. (2005). A knowledge-based intelligent decision support system for national defense budget planning. *Expert Systems with Applications, 28*, 55-66.

Westphal, K.S., Vogel, R.M., Kirshen, P.H., & Chapra, S.C. (2003). Decision Support System for Adaptive Water Supply Management. *Journal of Water Resources Planning and Management, 129*, 165-177.

Windhouwer, C.J., Klunder, G.A. & Sanders, F.M. (2005). *Decision Support System Emergency Planning, Creating Evacuation Strategies in the Event of Flooding*, In B. Van de Walle & B. Carlé (Ed.), Proceedings of the 2nd International ISCRAM Conference (171-180), Belgium.

Yadollahi, M., & Zin, R. M. (2014). Multi-strategy budget allocation decision support system for seismic rehabilitation of road infrastructure. *Structure and Infrastructure Engineering*, *10*(2), 239–260. https://doi.org/10.1080/15732479.2012.737810

Yıldırım, A. & Şimşek, H. (2016). *Sosyal Bilimlerde Nitel Araştırma Yöntemleri*. Ankara:Seçkin Yayıncılık.

Zhang, Q. & Zeng, C. (2024). Design and Implementation of an Intelligent Metro Project Investment Decision Support System. *International Journal of Information Technologies and Systems Approach (IJITSA), 17*(1), 1-15. https://doi.org/10.4018/IJITSA.342855

Zhu, Y. (2018). A Data Driven Educational Decision Support System. *International Journal of Emerging Technologies in Learning (iJET), 13*(11), 4-16.