Determining Digital Maturity in Metropolitan Municipalities: The Example of Sakarya and Kocaeli Metropolitan Municipalities

Büyükşehir Belediyelerinde Dijital Olgunluğun Belirlenmesi: Sakarya ve Kocaeli Büyükşehir Belediyeleri Örneği

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ABSTRACT

Research shows significant differences between private sector enterprises and public institutions in the context of digital transformation, which determines an organizations' digital maturity level. While private-sector enterprises are more progressive in digital transformation, public institutions face specific challenges. These challenges necessitate maturity models for public institutions. This study was conducted in the TR42 sub-region of the Nomenclature of Territorial Units for Statistics, as it hosts a significant portion of large-scale industrial organizations and R&D/Design centers that are effective in digital transformation. In this respect, this study aims to determine the factors that determine the digital maturity levels of metropolitan municipalities in the TR42 subregion and the effects of these factors. In this research, a case study design was used to investigate digital maturity in an in-depth and holistic way in an institutional context and to analyze the case of metropolitan municipalities in a real-world context. Data on municipalities' digital initiatives, policies, and online platforms were obtained from semi-structured interviews, documents, and observational notes. Data were analyzed and interpreted using single-case and cross-case analysis techniques using MAXQDA qualitative analysis software. Although Sakarya and Kocaeli Metropolitan Municipalities have made significant progress in digital transformation, they still have areas for improvement. The research findings point to vital factors influencing digital maturity, including leadership commitment, organizational culture, technical infrastructure, data management, and citizen engagement. Holistic and comprehensive models that evaluate various dimensions, such as technological infrastructure, digital services, data management, and cyber security, provide a suitable framework for understanding the digital maturity components in municipalities. Each element, from appropriate technological infrastructure and data governance practices to user-friendly e-government services and a competent workforce, is critical to raising digital maturity. Municipalities can overcome the complexities of digital transformation through comprehensive digital strategies, user-centered design, and collaboration with stakeholders.

Keywords: Metropolitan Municipalities, Digital Maturity, Digital Transformation

ÖZ

Araştırmalar, örgütlerin dijital olgunluk düzeyini belirleyen dijital dönüşüm bağlamında özel sektör işletmeleri ve kamu kurumları arasında önemli farklılıklar olduğunu göstermektedir. Dijital dönüşümde özel sektör işletmeleri daha ilerici olmakla birlikte kamu kurumları bazı zorluklarla karşı karşıya kalmaktadır. Bu zorluklar kamu kurumlarında belirli olgunluk modellerini gerekli kılmaktadır. Bu çalışma, dijital dönüşümde etkili olan büyük ölçekli sanayi kuruluşlarının ve Ar-Ge/Tasarım Merkezleri'nin önemli bir kısmına ev sahipliği yapması nedeniyle İstatistiki Bölge Birimleri Sınıflandırması'nın TR42 Alt Bölgesi'nde gerçekleştirilmiştir. Bu bağlamda, bu çalışma TR42 Alt Bölgesi'ndeki Büyükşehir Belediyeleri'nin dijital olgunluk düzeylerini belirleyen faktörleri ve bu faktörlerin etkilerini belirlemeyi amaçlamaktadır. Bu araştırmada, dijital olgunluğu kurumsal bağlamda derinlemesine ve bütünsel bir şekilde araştırmak ve büyükşehir belediyeleri örneğini gerçek

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dünya bağlamında analiz etmek için vaka çalışması tasarımı kullanılmıştır. Belediyelerin dijital girişimlerine, politikalarına ve çevrimiçi platformlarına ait veriler yarı yapılandırılmış görüşmelerden, belgelerden ve gözlem notlarından elde edilmiştir. Veriler MAXQDA nitel analiz yazılımı kullanılarak tek vaka ve çapraz durum analizi teknikleri ile analiz edilmiş ve yorumlanmıştır. Sakarya ve Kocaeli Büyükşehir Belediyeleri dijital dönüşümde önemli ilerlemeler kaydetmiş olsalar da iyileştirilecek alanlara sahiptir. Araştırma bulguları, liderlik bağlılığı, organizasyon kültürü, teknik altyapı, veri yönetimi ve vatandaş katılımı dahil olmak üzere dijital olgunluğu etkileyen hayati faktörlere işaret etmektedir. Teknolojik altyapı, dijital hizmetler, veri yönetimi, siber güvenlik gibi çeşitli boyutları değerlendiren bütünsel ve kapsamlı modeller, belediyelerde dijital olgunluk bileşenlerinin anlaşılması için uygun bir çerçeve sunmaktadır. Uygun teknolojik altyapı ve veri yönetimi uygulamalarından, kullanıcı dostu e-devlet hizmetlerine ve yetkin bir iş gücüne kadar her unsur, dijital olgunluğun artırılması açısından kritik öneme sahiptir. Belediyeler, kapsamlı dijital stratejiler, kullanıcı odaklı tasarım ve paydaşlarla iş birliği yoluyla dijital dönüşümün karmaşıklığının üstesinden gelebilirler.

Anahtar Kelimeler: Büyükşehir Belediyeleri, Dijital Olgunluk, Dijital Dönüşüm

INTRODUCTION:

Municipalities must recognize that successful digital transformation is not solely dependent on new technology but also necessitates cultural and process changes within the institution (OECD, 2023). This recognition includes developing a comprehensive digital strategy aligned with municipalities' vision and goals. Digital strategies should also include training and skill development programs that enable employees to use new technologies and digital tools effectively. Promoting collaboration among departments is another crucial aspect of institutional transformation. Municipalities should encourage interdepartmental communication to create a more integrated and efficient digital ecosystem (Heeks, 2018; Carter & Weill, 2019). Governments play significant roles in empowering municipalities with relatively limited resources on their digital transformation journeys in this process by providing funding, technical support, and capacity building. Furthermore, advancements in digital technology serve crucial functions in improving resource management, energy efficiency, and the well-being of citizens. Digital maturity, which focuses on citizen-centric services, institutional transformation, and challenges municipalities face, is essential for effective governance and citizen engagement.

Municipalities increasingly turn to digital initiatives to streamline operations and improve service delivery. One notable advancement in this area is the implementation of innovative city technologies, which encompass the Internet of Things (IoT), data analytics, and artificial intelligence-based decision-making systems (Gil-Garcia et al., 2016; Albino et al., 2015). For example, cities like Barcelona and Singapore use IoT sensors for real-time monitoring of traffic flow, waste management, and environmental quality (Bibri & Krogstie, 2017). Such initiatives contribute to more sustainable urban development by enhancing infrastructure management and resource allocation. Municipalities' digital maturity status manifests in providing citizen-focused services through online platforms and mobile applications (Moon, 2015). Governments utilize digital channels to facilitate easy access to public services such as permit applications, public service payments, and information dissemination. For instance, New York City's 311 mobile application allows residents to report non-emergency issues and receive updates on service requests, thereby promoting transparency and accountability (Dwivedi et al., 2017; Linders, 2012).

Despite advances in digital technologies, municipalities need support in reaching digital maturity due to bureaucracy, resource constraints, and digital inequalities (Van De Walle & Estevez, 2018). Additionally, promoting digital literacy, ensuring inclusiveness in digital services, and addressing equal development pose essential challenges. West, 2004). Collaborative partnerships among government, industry, and academia are increasingly crucial in overcoming these challenges (Gil-Garcia & Martinez-Moyano, 2007). Improvements in digital maturity dynamics enable municipalities to address complex urban challenges and deliver more efficient and citizen-centric services. Municipalities pave the way for sustainable and inclusive urban development and social governance by adopting intelligent technologies, enhancing data governance, and prioritizing citizen engagement. However, field research indicates municipalities encounter significant challenges in their digital transformation

journeys. Limited financial and human resources appear to be essential obstacles for municipalities (Lafioune et al., 2023; Sharkov & Miller, 2024).

Additionally, smaller municipalities, in terms of population and scale, often need more expertise to develop and implement comprehensive digital strategies. Bridging this gap necessitates shared resources, best practice sharing programs, and support initiatives to help smaller municipalities achieve digital maturity. At the same time, as data-driven services become widespread, concerns about data security and ethical implications arise. (Janssen et al., 2017; Chen et al., 2012). Municipalities invest in robust data protection measures, such as encryption protocols and access controls, to safeguard sensitive information. Regulatory frameworks like the EU's General Data Protection Regulation (GDPR) impose stringent requirements on data processing practices, shaping municipal digital strategies (European Commission, 2016).

Municipalities must have adaptable and advanced technological infrastructure to increase their digital maturity level. Digital maturation requires fundamental competencies in high-speed internet access, data centers, cloud computing, and big data. Achieving a certain level of competence in agile and digital organizational models and digital leadership is critical. Digital solid leadership is crucial for aligning digital strategies with the municipality's overall goals (Petrovčič et al., 2018; Dwivedi et al., 2017; Alford et al., 2019). For municipalities to overcome digital challenges and derive maximum benefit from digitalization, municipal stakeholders must have high levels of digital literacy (Helbig et al., 2009). Workshops and digital skills events organized at the neighborhood level help prevent the digital divide by increasing the digital literacy of citizens. Rationality, accuracy, and data-based decision-making are essential in achieving high digital maturity. Therefore, it is necessary to establish a solid data processing and management information system for effective management and service delivery.

1. Conceptual Framework and Literature

Digital transformation forces organizations to undergo strategic and customer-centric organizational change driven by emerging technologies (Kurniya & Andriani, 2023). Digital transformation involves radically transforming business models, processes, and infrastructure using digital technologies to increase performance, capabilities, and competitiveness (Heeks, 2018). Digital transformation is not a one-time event but a holistic and ongoing approach. Digital technologies such as IoT, cybersecurity, big data, cloud computing, RPA, artificial intelligence, and blockchain activate growth and operational improvement levers, transforming the role of technology from a support function to a driver of innovation and competitive advantage (Carter & Weill, 2019). Digital transformation offers new perspectives, such as digital innovation and ecosystem, while moving organizations to different digital transformation platforms (Heeks, 2018). The successful implementation of digital technological initiatives is directly related to the position and position taken by the organization in the digitalization process. Digital maturity, which is the ability of an organization to respond to changes and trends in technology, and digital transformation are closely related concepts in organizational development. Digital transformation is the change process between different digital maturity states (Carter & Weill, 2019), while digital maturity indicates successful digital transformation. Higher levels of digital maturity, especially in agile practices, are positively associated with digital transformation success (Kurniya & Andriani, 2023). This relationship extends to business performance, with digital business model maturity positively affecting sustainable business success (Heeks, 2018). Achieving digital maturity requires a comprehensive approach, including implementing advanced technologies, developing digital infrastructure, reviewing management approaches, and changing organizational culture (Kurniya & Andriani, 2023).

For metropolitan municipalities, digital maturity is crucial for addressing urban challenges, enhancing public services, and supporting sustainable development. Integrating advanced digital solutions helps cities manage their growth and complexity more efficiently. Digital maturity requires a digital infrastructure that includes essential technologies and systems such as high-speed internet, data centers, and cloud computing (Gil-Garcia, 2016). Municipalities offer various online services to citizens, including e-governance platforms, digital portals for public services, and mobile applications that enhance accessibility and convenience. Effective data management involves collecting, storing, and analyzing data to inform decision-making processes and improve service delivery. Data-driven approaches help municipalities become more responsive and proactive (Castelnovo et al., 2016). Protecting digital assets and ensuring the privacy and security of citizen data is critical. Robust cybersecurity measures are necessary to mitigate risks and build trust in digital systems (Rodrigues-Bolivar, 2015; Clarke & Knake, 2019). Successful digital transformation requires strong leadership and a strategic vision. Municipal leaders must promote a culture of innovation and the ability to adapt to new technologies.

Organizational digital maturity is defined as the level of digital advancement and readiness to maximize the benefits of existing technology in achieving strategic goals and the ability to undertake digital transformation throughout the organization, leading to positive business outcomes (Clarke & Knake, 2019; Díaz-Díaz et al., 2019). Research has explored the multifaceted nature of digital maturity in metropolitan municipalities like Sakarya and Kocaeli, examining the techno-digital and socio-digital dimensions contributing to digital transformation. An in-depth analysis of various indicators and criteria provides valuable insights into the factors influencing digital maturity and strategies to address the complexities of the digital environment. Studies on the techno-digital dimension highlight the critical importance of robust information technology (IT) infrastructure, technological innovation, and efficient digital services in achieving digital maturity. Analysis of the socio-digital dimension emphasizes the importance of organizational culture, employee skills, and governance structures in shaping digital maturity. Transformational governance, organizational agility, and stakeholder digital literacy are identified as critical drivers of successful digital transformation initiatives. By fostering a culture of innovation, investing in human capital development, and adopting effective governance mechanisms, municipalities can create an environment conducive to digital innovation and collaboration (Hartl & Hess, 2019; Ismagilova et al., 2019). Research indicates the need for a holistic approach encompassing technological and human factors in addressing digital maturity. By addressing the challenges and opportunities of digitalization from multiple perspectives, municipalities can unlock new opportunities for growth, efficiency, and citizen engagement in the digital age.

Digital skills encompass a wide range of competencies, including the ability to adapt to change quickly, adopt new tools and methodologies, and stay informed about the latest trends and developments in the digital field. Employees' ability to adapt to the digital environment and work processes depends on their willingness to learn new technologies and skills continuously. With the threat of cyberattacks and data breaches, cybersecurity awareness is essential for all employees. Knowledge of cybersecurity practices such as password management, data encryption, secure coding, and phishing awareness is crucial. Cybersecurity skills help protect the institution's digital assets, safeguard sensitive data, and mitigate security risks (Laaber et al., 2023; Çallı & Çallı, 2021; Braga Tadeu et al., 2019). Learning agility is part of digital competency, which refers to the ability to effectively acquire and apply new skills and knowledge to solve complex problems and drive innovation. Clear and effective communication, collaboration across channels and platforms towards common goals, and leveraging digital technologies for effective teamwork are also considered digital skills.

While private sector firms are often perceived as more progressive in using digital technologies, studies show that there are only marginal differences in the required digital competencies across sectors

(Hofmann & Ogonek, 2018; Nerima & Ralyté, 2021). Both sectors emphasize soft skills such as digital literacy and impact awareness rather than technical skills (Venkateswaran & Jyotishi, 2017). Public institutions face unique challenges in digital transformation, necessitating multidimensional maturity models (Nerima & Ralyté, 2021). This multidimensional model reveals varying maturity levels across dimensions, with digital technologies and digitalization-oriented management scoring the highest (Kafel et al., 2021). The performance differences between the digital strategies of public and private sector firms have been attributed to factors that cause differences in institutional environments, such as ownership regimes, transaction costs, and institution-related costs (Venkateswaran & Jyotishi, 2017). These factors affect stakeholder accountability, agility, innovation, and commitment to change, indicating the need for different performance measurement approaches and digital maturity models in each sector.

Digital transformation in public institutions is affected by social inequality in the digital sphere, the need for improved administrative regulations (Sorokina et al., 2019), population size, and the digital literacy rate within this population (Debeljak & Dečman, 2022). For example, a more significant proportion of young people expand the use of e-government applications and increase the speed of integrating digital municipal services into these applications (Budding et al., 2017). In addition, the ambiguity in the digital transformation approach of municipalities and the fragmented organizational context further complicate institutional data and information management (Lafioune et al., 2023). The lack of standardized digital technology principles makes it challenging to transform municipalities into data-driven organizations (van der Hoogen et al., 2024).

These challenges that municipalities face in the digitalization process emphasize the need for frameworks to guide digitalization efforts and a holistic approach encompassing strategic, organizational, and technological aspects (Likhtin, 2022; Van der Hoogen et al., 2024). A holistic approach to digitalization depends on creating a clear digital vision shared by the municipal top management and disseminating this vision throughout the institution (Salviotti et al., 2019). Digital transformation in municipalities requires changes in management systems and corporate culture, focusing on revising strategic goals to ensure long-term sustainability (Biryukov & Geokchakyan, 2022). Municipalities that assess their current digital maturity levels should map their digital business processes and formulate strategies based on these insights (Kurniya & Andriani, 2023). By addressing these factors, municipalities can develop comprehensive roadmaps for digital transformation and adapt to the evolving digital environment by increasing their digital maturity levels. These findings highlight the complex nature of digital transformation in local governments and the need for a multidimensional assessment to determine the factors affecting the digital maturity levels of local governments.

2. Methodology

2.1. Case Study Design

This research employs a case study design to deeply understand and uncover the factors influencing the level of digital maturity in the metropolitan municipalities of Sakarya and Kocaeli. According to the Statistical Regional Units Classification, the TR42 region, which includes Sakarya and Kocaeli provinces, hosts 4.82% of Turkey's population with 4.02 million people and is the second region with the highest exports with 17.6 billion US dollars. One hundred twenty-six of Turkey's 500 largest industrial establishments are in the TR42 region. Kocaeli and Sakarya provinces host 11% of Turkey's total, with 154 R&D and design centers (Doğu Marmara Kalkınma Ajansı, 2023). Sakarya and Kocaeli provinces were chosen as case studies because they have metropolitan municipality status in the TR 42 region, where the population rate and industrial companies that have taken essential steps in digital

transformation are located. Case study design is particularly suitable when the boundaries between context and phenomenon are not clearly defined, allowing the examination of any subject within its natural setting and context-dependent circumstances (Yin, 2014). Another reason for choosing this design is that case studies help examine a general problem or situation in detail from real life, identifying significant variables and relationships that are not visible in the literature (Tutar, 2023). Since multiple sub-elements, layers, or units are considered within a single case, this research uses an embedded single-case design (Yin, 2014).

2.2. Study Group

In this research, the purposive sampling technique was utilized to select individuals or units based on the research objective and problem rather than to give all individuals or units in the population an equal chance to be included in the sample (Neuman, 2014; Tutar & Erdem, 2022). The data were collected through in-depth interviews and on-site observations with IT specialists working in the information processing departments of Sakarya and Kocaeli Metropolitan Municipalities, selected based on their ability to provide relevant data on the research topic. The interviews included employees from the information processing departments of Sakarya and Kocaeli Metropolitan Municipalities with various experiences who had participated in projects during the digitalization process. Open-ended questions were initially asked to gather insights on how they interpret organizational digital maturity without imposing preconceived notions about digitalization and digital maturity (Robson, 2005; Blaikie, 2018). The sample size was determined based on theoretical saturation, at which gathering more data about a theoretical category does not reveal new properties or provide further theoretical insights (Charmaz, 2014; Guetterman, 2015).

Table 1. Participant information

Participant	Age	Municipality	Level of education	Position and status	Experience (years)
P1	34	Sakarya	Undergraduate	IT Officer	7
P2	41	Sakarya	Undergraduate	IT Officer	4
P3	37	Sakarya	Master's Degree	Software development manager	5
P4	34	Sakarya	Master's Degree	Hardware Manager	8
P5	48	Sakarya	Doctorate degree	Software development manager	5
P6	30	Kocaeli	Undergraduate	IT Officer	6
P7	53	Kocaeli	Master's Degree	Information Systems Manager	8
P8	49	Kocaeli	Undergraduate	Hardware Manager	4
P9	40	Kocaeli	Master's Degree	Software development manager	9

2.3. Data Collection Instruments and Procedures

Data in this study were collected through observation, interviews, and document analysis. Written texts, observed behaviors, visual data, and artifacts (anything artificial and tangible) were utilized during this process (Tutar & Erdem, 2022). Multiple data collection tools and techniques were used to reach data saturation (Mason, 2010). This research collected in-depth data through focus group discussions with IT specialists from Sakarya and Kocaeli Metropolitan Municipalities using a semi-structured data collection instrument. The description, analysis, and interpretation technique were employed, and the collected data were analyzed using the MAXQDA qualitative analysis software. The analyses were conducted with direct quotations from interviews and observation notes to remain faithful to the original form of the collected data. Repeated and semantically similar statements were then grouped to form codes, which were further categorized into sub-themes/categories and final themes, and the findings were interpreted and reported (Tutar & Erdem, 2022; Mackey & Gass, 2005).

2.4. Transcription of Interview Notes

With participants' consent, the recorded audio was transcribed before data analysis. The MAXQDA software's transcription function, which features automatic speaker recognition and time-stamping was used to transcribe the audio recordings. MAXQDA Transcription labeled each speaker's contributions with their name, allowing individual or collective analysis of voices and opinions. Time stamps linked text sections to corresponding audio segments, providing a clear and organized transcript. The resulting transcripts were compared by re-listening to the audio recordings to prevent data loss.

2.5. Data Analysis

The analysis process of the data obtained from the study group followed an iterative data collection and analysis phase conducted with note-taking and continuous comparative analysis. In the coding and theme development process, Charmaz's (2014) strategies of initial coding, focused coding, and theoretical coding were employed. As researchers delved deeply into the data, some themes were discovered even during the transcription of the interviews before coding began. Initial coding started with line-by-line coding of the first transcript set to identify participants' general perspectives on digitalization and their interpretation of the impact of digital transformation in the organizational context without imposing any preconceived notions. During this phase, technical themes such as the necessity of integrating digitalization into municipal services, the need for holistic services, and the standardization of data formats were identified alongside organizational themes like the leadership of senior management in digitalization, having a digital transformation strategy, and the speed of response to problems. Focused coding was then conducted to develop categories, increase the level of abstraction in the analysis, and select the most analytical codes from the initial coding. In this phase, data obtained from purposively sampled participants revealed patterns related to the impact of digital transformation on organizational structure, functions, and processes and how challenges faced in the organizational context could be addressed. In the theoretical coding phase, thematic categories were organized in MAXQDA 24 according to the hierarchical code-subcode model to structure the hierarchical organization of codes.

2.6. Case Analysis

In this research, all interviews were classified under two cases: "Sakarya Metropolitan Municipality Case" and "Kocaeli Metropolitan Municipality Case". Research data were obtained from nine participants, five from Sakarya Metropolitan Municipality and four from Kocaeli Metropolitan Municipality. As the qualitative data set increased, a cross-case analysis was conducted, which included comparing the patterns and similarities and differences that emerged in both cases as a fundamental component of the continuous comparative analysis process. Cross-case analysis aimed to determine whether the patterns and relationships identified in each case were shared across both cases. The cross-case analysis allowed for a clearer understanding of the general patterns and trends in the data.

3. Findings

3.1. Two-Case Model of Kocaeli and Sakarya Metropolitan Municipalities

The dual-case model presents a valuable methodological approach for exploring complex phenomena through comparative analysis. This approach allows researchers to compare the similarities and differences between cases, enhancing the depth of understanding and providing a richer insight into the phenomenon under study. According to Yin (2014), the dual-case model is beneficial in

comparative case studies where researchers aim to understand how different conditions or contexts affect the outcomes of interest.

As illustrated in Figure 1, common indicators such as data storage cost, digital customer service, IT/digital literacy, backup frequency, leadership, and current IT practices are prominent in determining the digital maturity levels in the Sakarya and Kocaeli Metropolitan Municipalities. The distribution of these common indicators shows that both techno-digital and socio-digital dimensions hold similar weight. In the Sakarya Municipality, the number of specialized trainings provided within the scope of digital transformation and the share of technological equipment and software within the total assets stand out as key indicators. Municipalities' main problems in digital transformation are the low number of IT-competence employees and the lack of appropriate training (Lafioune et al., 2023). In contrast, in the Kocaeli Municipality, besides these techno-digital dimensions, open data policy, digital transactions, budget allocated for IT and R&D, and technological resources, the ability of managers to implement digital management strategies in line with business goals, and the accountability and transparency indicators of the institution's digital strategy are fundamental determinants. The need for standardized digital transformation policies and principles poses challenges in transforming municipalities into data-driven organizations (van der Hoogen et al., 2024).

Comparing the digital maturity indicators of the Sakarya and Kocaeli Metropolitan Municipalities reveals some interesting insights into their approaches to digital transformation. Firstly, the presence of common indicators such as data storage cost, digital customer services, IT/digital literacy, and current IT practices indicates that both municipalities recognize the importance of these factors in determining their levels of digital maturity. These indicators reflect the core aspects of digitalization, including the management of digital assets, the quality of digital services provided to components, the level of digital skills among employees, and the adoption of modern IT solutions. However, the differences in the distribution of common indicators and the prominence of specific techno-digital dimensions highlight each municipality's distinct priorities and strategies in their digital transformation journeys. Both municipalities emphasize that the challenges encountered in the digitalization process can be overcome with frameworks that guide the process and a holistic approach encompassing strategic, organizational, and technological aspects (Likhtin, 2022; Van der Hoogen et al., 2024).

The emphasis on the number of specialized trainings provided within the scope of digital transformation in Sakarya Municipality indicates a focus on building internal capacity and expertise in digital technologies. This focus suggests a commitment to investing in human capital development to ensure employees have the knowledge and skills to use digital tools and platforms effectively.
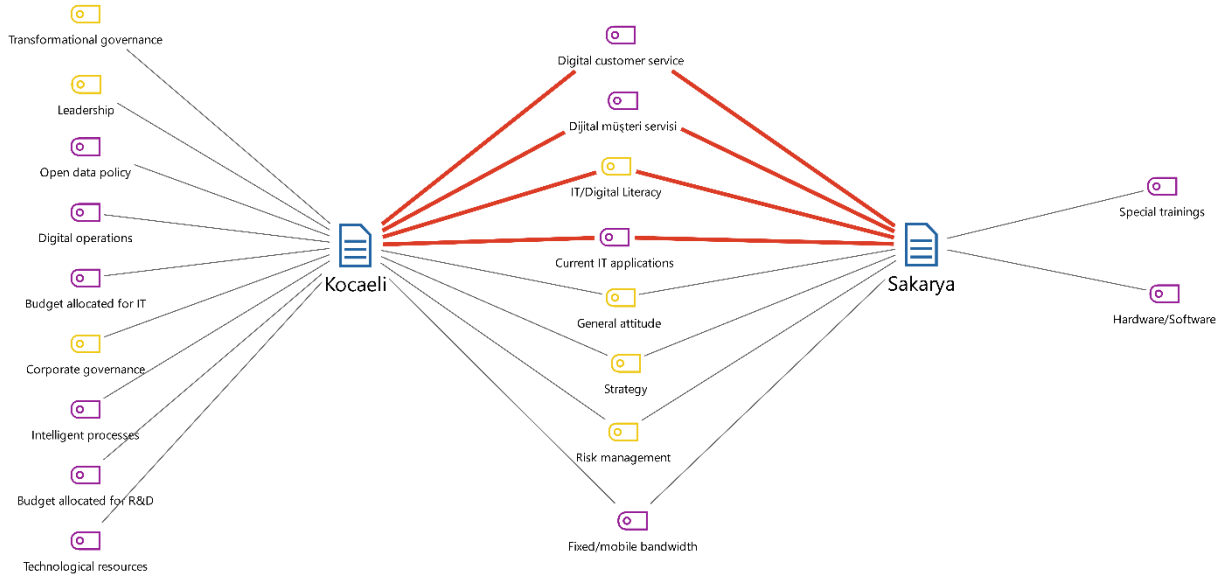
Figure 1. Two-Case Model of Kocaeli and Sakarya Metropolitan Municipalities

Focusing on the proportion of technological hardware and software within total assets underscores Sakarya's emphasis on building a robust technological infrastructure to support its digital initiatives. Conversely, Kocaeli Municipality features a broader range of indicators alongside similar techno-digital dimensions, such as open data policy, digital transactions, budget and resources allocated for IT and R&D, managerial capability in executing digital management strategies, and corporate accountability and transparency in the digital strategy. This points to a more comprehensive and strategic approach to digital transformation, encompassing technological infrastructure and capabilities, governance, strategy execution, and accountability. While both Sakarya and Kocaeli municipalities prioritize similar core digital maturity indicators, the differences in the prominence of specific dimensions and indicators reflect unique strategic priorities and approaches in their digital transformation efforts. Sakarya emphasizes developing internal digital skills and infrastructure, whereas Kocaeli adopts a more comprehensive and strategic approach encompassing governance, strategy execution, and corporate accountability.

3.2. Single-Case Models of Techno-Digital and Socio-Digital Dimensions

In qualitative research, a Single-Case Model refers to a methodological approach that focuses on an in-depth examination of a single case or individual phenomenon to understand its complexities and nuances comprehensively. This approach often involves the intensive investigation and analysis of a specific case through various data collection methods such as interviews, observations, and document analysis. By dedicating themselves to a single case, researchers can uncover unique patterns, contexts, and factors contributing to the phenomenon being studied (Yin, 2014; Stake, 1995).

3.2.1. Techno-Digital Dimension Single-Case Model

When evaluating the indicators related to the techno-digital dimensions determining the digital maturity level of municipalities, it was found that the "digital customer" metric, which expresses the number of calls received and resolved by the solution center, is predominantly highlighted under the "value creation" indicator. Within the "technology" indicator, current IT applications and main products used in the institution, such as intelligent products, artificial intelligence, and data analytics, are prominent. The "IT Department and Infrastructure" indicator contains the most highly emphasized techno-digital criteria. Accordingly, data collection cost, backup frequency, fixed/mobile bandwidth,

and IT personnel metrics have the highest frequency. These indicators provide a comprehensive evaluation framework for assessing the techno-digital dimensions of municipalities as detailed below:

Digital Customer: This indicator focuses on the efficiency and effectiveness of the municipality's customer service operations. By tracking the number of calls received and resolved through the solution center, municipalities can measure their ability to respond to citizens' needs and promptly address issues raised by voters.

Value Creation: Emphasis on the digital customer criterion within this indicator highlights the importance of customer-centricity in creating value for constituents. By prioritizing customer service and ensuring citizens' queries and concerns are promptly addressed, municipalities can enhance citizen satisfaction and trust, ultimately contributing to value creation for the community.

Technology: Emphasis on current IT applications and leading products, such as intelligent products, artificial intelligence, and data analytics, underscores the importance of technological innovation in driving digital transformation in municipalities. Municipalities can improve service delivery, optimize internal processes, and leverage data-driven insights for informed decision-making and innovation by adopting the latest technologies.

IT Department and Infrastructure: This indicator highlights the critical role of the IT department and infrastructure in supporting the municipality's digital initiatives. A well-equipped IT department and robust infrastructure are necessary to ensure the smooth operation of digital systems, protect data security and privacy, and provide technical support to users across the organization.

Data Collection Cost, Backup Frequency, Fixed/Mobile Bandwidth, and IT Personnel: These metrics reflect specific IT management and infrastructure aspects. Data collection cost and backup frequency indicate the municipality's investment in data management and security measures, while fixed/mobile bandwidth reflects the capacity and reliability of the municipality's network infrastructure. The main reason for the differences in the performance of public institutions in implementing their digital strategies is the transaction costs they incur in the data collection and processing process (Venkateswaran & Jyotishi, 2017). The number of IT personnel provides insight into the municipality's human resource capacity to manage and maintain digital systems.

These indicators offer a holistic framework for assessing the techno-digital dimensions of municipalities, encompassing aspects related to customer service, technology adoption, IT management, and infrastructure. By focusing on these critical areas, municipalities can effectively evaluate their digital maturity and identify areas for improvement to advance their digital transformation efforts. Figure 2 illustrates the prominent technical dimensions and their subcomponents in the institutional digital transformation process. Each dimension and its subcomponents represent digital transformation's hierarchical and critical elements. Successful management of these elements plays a significant role in achieving digital maturity within the organization.
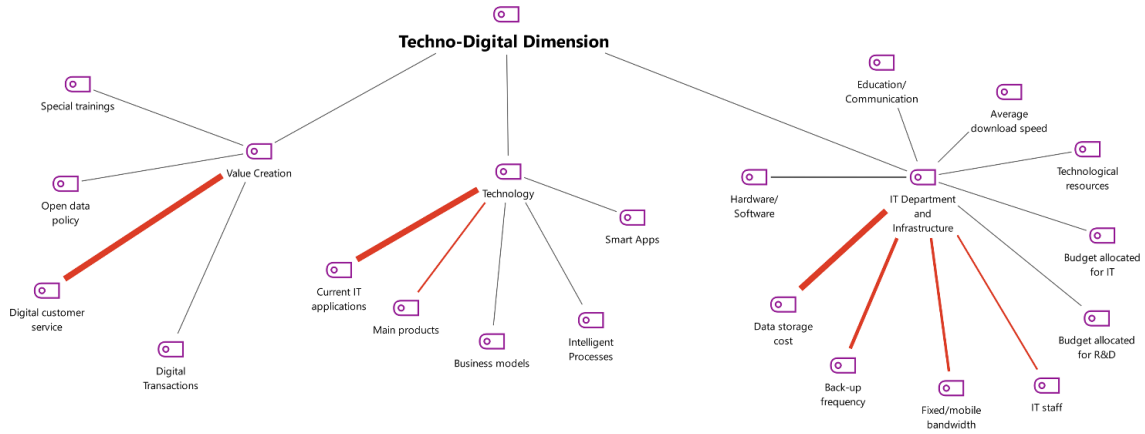
Figure 2. Techno-Digital Dimension Single-Case Model

3.2.2. Socio-Digital Dimension Single-Case Model

When evaluating the indicators related to the socio-digital dimensions that determine the digital maturity level of municipalities, it is observed that within the "organization" indicator, the key determinants include the ability of managers to implement digital management strategies, the identification, analysis, and prevention of risks, the institution's adaptability to technological changes, and the integration of digital transformation strategies. Within the "employee skills and attitudes" indicator, the primary criterion highlighted is the digital literacy of the institution's employees, reflecting their ability to utilize IT. Furthermore, within the "culture" indicator, criteria such as information sharing that increases internal cooperation and transformative governance metrics evaluating the accountability and transparency of the digitalization strategy stand out.

These socio-digital dimension indicators provide insights into the organizational culture, employee skills, and governance structures influencing municipalities' digital maturity levels, as described below:

Organization Indicator: The ability of managers to implement digital management strategies, risk management, adaptation speed, and integration of digital transformation strategies emphasizes the importance of effective leadership and organizational alignment in driving digital initiatives. This indicates that successful digital transformation requires strong leadership capable of effectively formulating and executing digital strategies, mitigating risks associated with technological changes, and fostering organizational agility to adapt to evolving digital environments The problems experienced by municipalities in executing digital strategies directly affect organizational agility and innovation (Venkateswaran & Jyotishi, 2017).

Employee Skills and Attitudes Indicator: Emphasis on employees' digital literacy underscores the importance of investing in human capital development to support digital transformation efforts. Employees with solid IT skills and digital literacy are better equipped to effectively utilize digital tools and technologies, enhancing the organization's overall digital capabilities.

Culture Indicator: The prominence of transformative governance criteria within the culture indicator highlights the focus on fostering a culture of innovation, collaboration, and accountability to drive digital transformation. This involves promoting information sharing and transparency to ensure internal cooperation, facilitating the implementation of digitalization strategies, and holding stakeholders accountable for achieving digital transformation goals. Transformative governance enables the organization to embrace change and continuously evolve to meet the challenges and opportunities of digitalization. To ensure long-term sustainability in digital transformation,

municipalities need to make changes in their management systems and corporate culture by focusing on revising strategic goals (Biryukov & Geokchakyan, 2022).

These socio-digital dimension indicators emphasize the importance of organizational culture, employee skills, and governance structures in shaping municipalities' digital maturity levels. By prioritizing these socio-digital dimensions, municipalities can create an environment conducive to digital innovation, empower employees to adopt digital technologies and establish governance mechanisms that facilitate effective digital transformation.
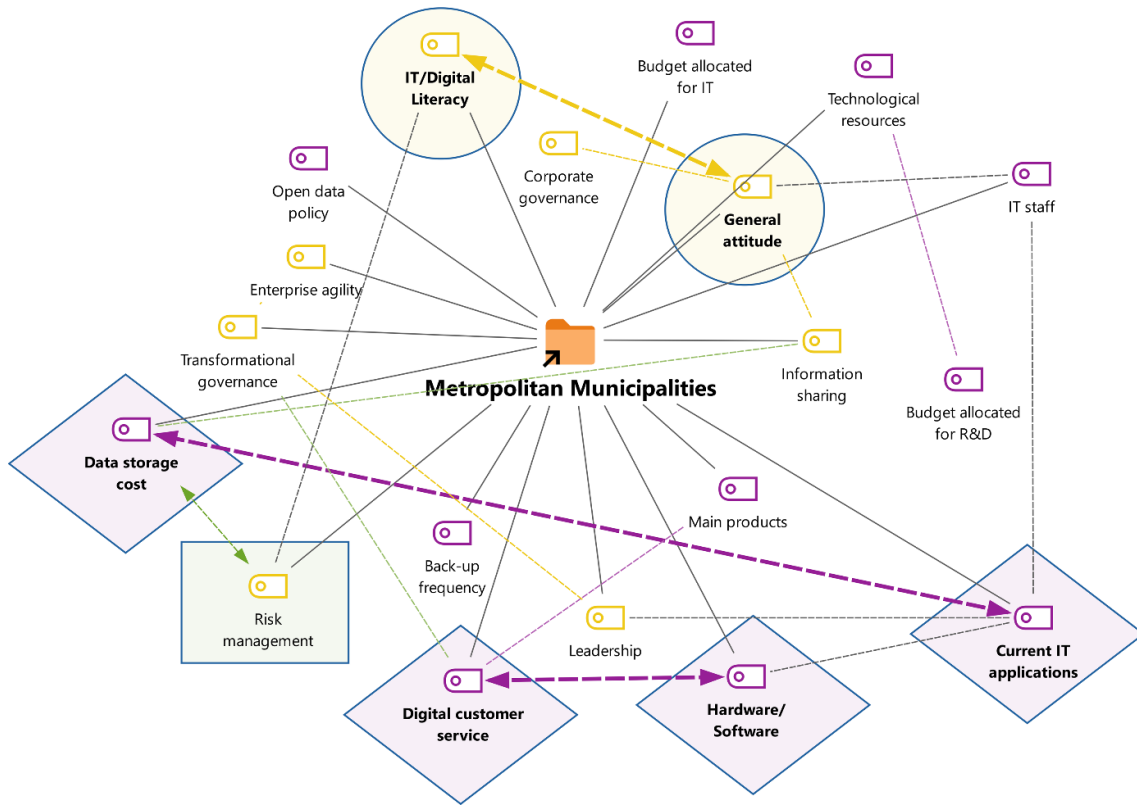
Figure 3 presents the Socio-Digital Dimension Single-Case Model, illustrating the dimensions and subcomponents related to the institutional context in the digital transformation process. By considering this model, municipalities can experience institutional benefits such as enhanced citizen experience and satisfaction, procurement of employees suited to digital business models, and the ability to implement corporate digital strategies more rapidly.
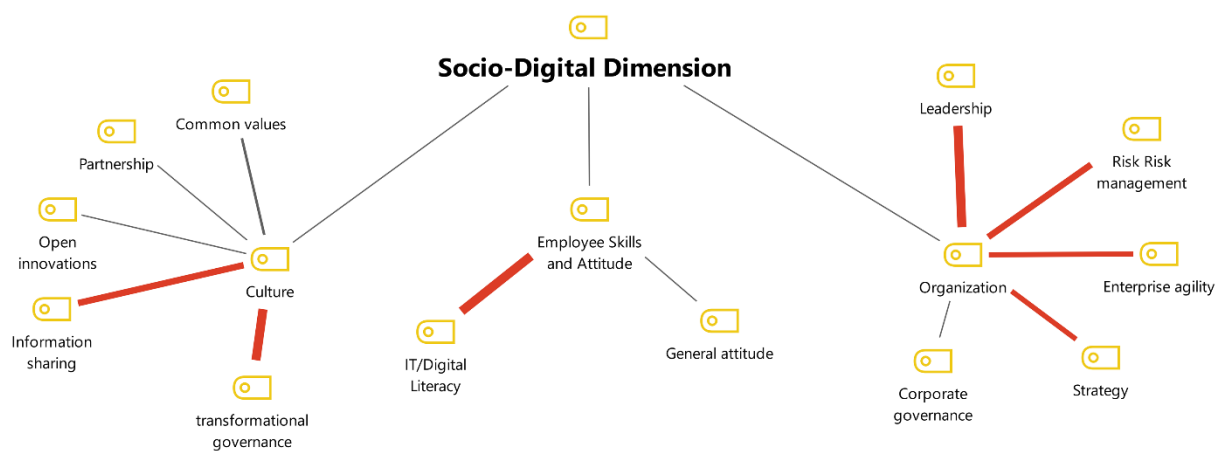
Figure 3. Socio-Digital Dimension Single-Case Model

3.2.3. Interrelationships between Dimensions

When evaluating the fundamental indicators and criteria determining the digital maturity level of municipalities, digital customer service, data storage cost, current IT applications, information/digital literacy, risk management, and overall attitude, components stand out in terms of their weight and rank. When the technical and social criteria determining the digital maturity level of municipalities are evaluated in a relational context, it is determined that the components showing intense relationships within the techno-digital dimension are current IT applications, data storage cost, hardware/software, and digital customer service. The critical indicators of the socio-digital dimension are information/digital literacy and overall attitude components. Additionally, when assessing the interrelationships between techno-digital and socio-digital dimensions, it is found that risk management, data storage cost, transformative governance, and digital customer service exhibit intense relationships simultaneously.

Figure 4. Relationships between Techno-Digital Dimension and Socio-Digital Dimension Components

According to the results of the analysis, the main component that affects the general perspectives of employees in Sakarya and Kocaeli Metropolitan Municipalities towards digital transformation and digital technologies is the competence of the employees of the institution in using IT. Digital literacy, which includes technical and cognitive competencies such as accessing, evaluating, and transmitting information using digital platforms, determines the level of digital maturity by directly affecting attitudes towards digital transformation. Increasing the level of digital literacy increases the rate of access to digital services and narrows the digital gap (Sorokina et al., 2019). For this reason, institutions should carefully analyze competency gaps in digital literacy and support possible gaps with training and development activities. In addition, annual average data storage costs come to the fore as the primary determinant of current information technology applications such as intelligent products, artificial intelligence, and data analytics used by metropolitan municipalities in their business processes and services. Another component where average annual data storage costs are effective is the risk management component, which includes identifying, analyzing, evaluating, controlling, and preventing irreversible risks. Another intense relationship between the components is seen between the share of technological resources in total assets and the digital customer service component, which shows the number of calls resolved by the call center.

4. Discussion and Conclusion

Investigating digital maturity in metropolitan municipalities, such as the examples of Sakarya and Kocaeli, underlines the critical role of digital transformation in improving urban management and service delivery. The comprehensive model used in this study, which evaluates various dimensions such as infrastructure, digital services, data management, and cybersecurity, provides a solid framework for understanding the components of digital maturity in the municipal context. The diagrams highlighted the complex relationships between different digital components and their collective impact on municipal operations. For example, significant investments in digital infrastructure, including broadband networks and innovative city technologies, form the backbone of

digital transformation efforts (Yıldız, 2021). These infrastructure investments enable a wide range of digital services that increase citizen participation and streamline service delivery processes. Effective data management emerges as a crucial element where municipalities use data analytics to monitor urban systems, predict maintenance needs, and optimize resource allocation (Yıldız, 2021). Integration of robust cybersecurity measures increases trust in digital systems by ensuring the protection of digital assets and the confidentiality of citizen data.

Leadership and strategic vision are identified as critical drivers of digital transformation. Municipal leaders' commitment to digital innovation and ability to adapt to new technologies are necessary to achieve digital maturity (Yıldız, 2021). This study emphasizes the importance of promoting a culture of continuous improvement and innovation in municipal institutions to maintain digital maturity. As a result, the digital maturity of metropolitan municipalities is a multifaceted structure that requires a holistic approach covering technological infrastructure, service innovation, data management, cyber security, and leadership. The Sakarya and Kocaeli examples show that municipalities that invest strategically in these areas can significantly increase their operational efficiency and residents' quality of life. As cities grow and face new challenges, pursuing digital maturity will be instrumental in shaping sustainable and resilient urban futures.

As we move forward, municipalities must continue to invest in digital infrastructure, promote digital skills among employees, and embrace a culture of innovation. By doing this, municipalities can position themselves as leaders in the digital transformation environment and achieve sustainable success in the digitalization process. Digital maturity encompasses several aspects, including technology adoption, digital strategy, corporate culture, skill sets, business outcomes, and the ability to leverage digital tools to support innovation. Enterprise digital maturity, which encompasses various aspects of an organization's digital capabilities, including its digital infrastructure, processes, culture, skills, and strategies, also refers to its ability to embrace and navigate the digital environment effectively. It includes adopting digital technologies and broader aspects such as culture, processes, and people (Ochoa-Urego et al., 2021). These aspects of digital maturity require a holistic approach across the entire organization. Leaders, employees, and processes all play a role in achieving digital transformation. A digitally mature organization fosters a culture of continuous learning, adaptability, and openness to change. Employees are empowered to use digital tools effectively (Minh & Thanh, 2022).

As a result, the digital environment is rapidly transforming the overall vision of metropolitan administration. Achieving digital maturity is no longer a choice but necessary for municipalities that want to deliver efficient services, encourage citizen participation, and build trust. As shown in conceptual models, a holistic approach is crucial for success. Each element plays a critical role, from solid technological infrastructure and data governance practices to user-friendly e-government services and a digitally competent workforce. While challenges such as traditional systems, resource constraints, and the digital divide exist, the potential benefits of digital maturity are undeniable. Municipalities can overcome the complexity of digital transformation by creating a comprehensive digital strategy, prioritizing user-centered design, and encouraging collaboration with various stakeholders. Successful journeys through the digital transformation process include not only the adoption of technology but also a citizen-centered approach, continuous improvement, and a willingness to adapt to the ever-evolving digital environment. With a well-defined roadmap and a commitment to inclusive digital growth, metropolitan municipalities can unlock the transformative potential of digital maturity and build a connected future for their citizens.

In these aspects, the relationship between the digital maturity level and digital transformation strategies, as well as areas related to digital inequality that affect digital service accessibility, have

come to the fore. Future research addressing these areas can provide insight into the dynamics that support municipalities' digital transformation journeys and increase their overall digital maturity.

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