

# Digital Transformation Patterns of Smart City Strategic Plans of Greek Local Government Organizations\*

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## Abstract

The large smart city initiatives undertaken by many local government organizations all over the world drive significant digital transformations of them, and this makes their implementation difficult and risky. However, this digital transformation perspective of the smart city initiatives of local government organizations has been only minimally researched. This paper contributes to filling the above research gap. It investigates the 'digital transformation patterns' of the projects included in the smart city strategic plans of Greek local government organizations, which have been approved for funding by the Ministry of Digital Governance: we examine what types of digital transformation of the local government organizations they drive. Initially a methodology is developed for this purpose, which is based on the analysis of the documents of the relevant administrative approval and funding decisions, having as theoretical foundation and analytical lens a comprehensive conceptualization of government digital transformation developed in previous research. Using the above methodology an analysis is conducted of the documents of the administrative decisions concerning the approval and funding of the smart city strategic plans of 121 Greek local government organizations, which include 996 projects in total. It is concluded that the dominant type of digital transformation that these projects drive is the digital transformation of the internal processes of the local government organization (71,9% of the projects), indicating an 'inward-looking' orientation of these strategic plans, followed by the digital transformation (enrichment) of the services provided to the citizens (30,1% of the projects). Furthermore, we have found that about half of these projects (46,7%) involve more than one type of digital transformation, which indicates a high complexity from a digital transformation perspective, and therefore high levels of implementation difficulties and risks.

## Keywords

digital transformation, government transformation, smart cities, strategic planning.

## 1. Introduction

Smart cities 'are utilizing digital technologies, communication technologies, and data analytics, to create an efficient and effective service environment that improves urban quality of life and promotes sustainability in rural areas' [1]. In this direction many local government organizations all over the world undertake significant smart city initiatives, and make large investments for them, in order to address the inherent problems caused by the high concentration of people in limited spaces. These initiatives usually include several projects, which concern various different functions and infrastructures of modern cities, aiming at making them 'smarter' and more efficient and effective.

The high importance of these smart city initiatives for the lives of millions of people, in combination of the high magnitude of the investments made for them, have generated a strong research interest in the smart cities' domain; comprehensive reviews of this research are provided in [1-9]. However, the digital transformation perspective of these smart city initiatives and

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projects, i.e. what types of digital transformation they drive in local government organizations, has not been investigated (see section 2), despite the importance of developing awareness and understanding of them, as well as of managing them effectively, for the success of smart city initiatives and projects; so, extensive further research is required in this direction.

These smart city initiatives drive significant digital transformations of local government organizations, meant as substantial changes in important elements of them, such as the services they offer to citizens, the channels of interaction with them, as well as their internal processes [10]. This makes the implementation of smart city initiatives difficult and risky, as it is necessary in addition to the technological development actions:

a) to take appropriate promotion actions, in order to persuade the citizens - potential users to make use of the new services and interaction channels, as well as to provide training and support to them, or else the acceptance and use of these new services and interaction channels will be limited;

b) and also to take appropriate actions for training the public servants who will use the new systems developed as part of these smart city initiatives, in order to ensure the smooth and efficient operation of them, and overcome possible resistances, and also to make the required changes in the structure of local government organizations (e.g. create new units for the management of the new systems, as well for the utilization of the large quantities generated by them).

This paper contributes to filling the above research gap concerning the digital transformation perspectives of the smart city initiatives. It investigates the 'digital transformation patterns' of the projects included in the smart city strategic plans of Greek local government organizations, which have been submitted to and approved for funding by the Ministry of Digital Governance: so, our main research question is:

RQ: 'What types of digital transformation of the local government organizations drive the projects of these smart city initiatives?'.

For this purpose, initially a methodology has been developed, which is based on the analysis of the documents of the administrative approval decisions of these smart city strategic plans, having as theoretical foundation and analytical lens a comprehensive conceptualization of government digital transformation from previous research [9]. From this analysis the digital transformation pattern of each individual project of these strategic plans is determined, which includes the main types of digital transformation of the local government organization it drives. These patterns are then processed, in order to identify the main types of digital transformation these smart city initiatives drive, as well as their complexity from a digital transformation perspective. This methodology has then been applied for the analysis from a digital transformation perspective of the documents of the administrative decisions concerning the approval and funding of smart city strategic plans of 121 Greek local government organizations, which include 996 projects in total.

We expect that the findings of our study will be valuable for elected officials and public servants of local government organizations who are responsible for the design and implementation of smart cities initiatives and projects, as well as ICT and consulting firms active in this area. Also, the methodology we have developed can be of wider usefulness for the extensive future research required about the digital transformation aspects of smart cities' initiatives and projects.

It should be mentioned that our study has been conducted in a quite interesting national context: in Greece, which is an EU country belonging to the Euro zone that has however lower 'digital development' in comparison with the other EU countries (as indicated by its low ranking in (as indicated by its low ranking in the 'Digital Economy and Society Index' (DESI) (<https://digital-strategy.ec.europa.eu/en/policies/desi>)); furthermore, it has experienced a strong economic crisis between 2020 and 2018 [11-12], which has led to a drastic reduction of government expenditures, including the ICT-related ones.

Our paper consists of five Sections. The following section 2 presents the background of our study, and then in section 3 its methodology and data are described. In section 4 the results are presented, while in the final section 5 the conclusions are summarized, and future research directions are proposed.

## 2. Background

The digital transformation of organizations represents an advancement towards a more mature paradigm of ICT utilization: while the previous paradigm aimed at the automation and support of the existing elements of an organization (e.g. processes, products and services, sales and distribution channels), this new paradigm aims at a substantial transformation of them, which leads to a drastic improvement and enrichment. Initially this new digital transformation paradigm started being adopted in the private sector, and gradually became of critical importance for the competitiveness and even for the survival of firms, so it has attracted strong research interest; comprehensive reviews of this research on private sector digital transformation are provided in [13-16]. In [13] a review of the existing definitions of digital transformation is conducted, and then a semantic analysis of them, which led to the development of a synthetic definition of it, as ‘a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies’ (this ‘entity’ can be a firm, a public organization, an industry or even a society); as the main ‘properties’ that are changed significantly using ICTs have been identified the value proposition (products and services), the value creation process, the sales and distribution channels, as well as the value networks (cooperations with other firms).

The adoption of this digital transformation paradigm in the private sector, along with its first positive results, as well as the increasing demands by citizens, motivated the public sector to start adopting it, with appropriate adaptations to its objectives, orientations, challenges and specificities, aiming at drastic improvement of both the efficiency of its internal processes and operations, and also the services offered to the citizens. In [10] based on experts’ interviews a conceptualization of government digital transformation has been developed, which includes its main dimensions, which concern the transformation based on the use of digital technologies of a) internal processes of government organizations, b) public services provided to the citizens, c) as well as products, d) relationships with citizens and with other government organizations, e) technology and f) business models.

The digital transformation of government, due to its importance for the economy and society, has attracted considerable research interest, however it is still much less compared to that in private sector’s digital transformation; comprehensive reviews of the research that has been conducted on government digital transformation are provided in [17-18]. The review of government digital transformation research presented in [17] has identified three main research areas, which concern the drivers of digital transformation, its implementation as well as its outcomes. It has been concluded that the main drivers of government digital transformation are citizens’ demands, pressure and support of the political system, technological advances, legal requirements as economic situation needs. With respect to its implementation, it has been concluded that it faces big difficulties and challenges, it is significantly affected by organizational factors, such as size, financial resources, culture and existing ICT infrastructure, and relies on the effective collaboration with other government organizations as well as ICT equipment and software providers. Finally, with respect to the outcomes of digital transformation it has been concluded that they are multi-dimensional, and include transformations of the organization, the services it provides to citizens, its relationship with stakeholders and with society in general.

There has been particular research interest in the implementation of government digital transformation, due to big difficulties and challenges it faces as mentioned above, because of the size of government organizations, the complexity of their internal processes, services and legal frameworks, and the lack of capacity for implementation of such complex and transformative ICT-based interventions [19-24]. In [19] are analyzed the complexity elements of government digital transformation projects concerning the dimensions of organization, technology and innovation, as well as the interplay between them, while [20] is dealing with the difficulties and complexities generated by hierarchical bureaucracy contexts in digital transformation implementation, and ways of addressing them and creating the required flexibility. In [21] the problem of lack of the required

knowledge for implementing digital transformation in local government is analyzed, and then a model for the acquisition of this knowledge is developed. The implementation of collaboration and co-production approaches for the design and implementation of government digital transformation, which include various stakeholders, such as other government organizations, firms and citizens, is analyzed in [22]. A quantitative study, based on structural equation modeling, of the driving as well as the impeding factors of local government digital transformation is presented in [23]. In [24] there is an interesting discussion on the digital transformation of local government, which concludes that it is much slower and more difficult than that of the central government, due to the lack of resources, specialized staff and organizational capacity in local government.

Furthermore, there have been some interesting studies examining the impact of some particular important external disruptions on government digital transformation, such as the COVID-19 pandemic [25-27] and the recessionary economic crisis of 2008 [28-29].

However, as mentioned in 2.1, the impact of smart city initiatives and projects on the digital transformation of local government organization has not been investigated in previous literature, though the former are highly important and severe disruptions for the latter, and their success necessitates good understanding and effective management of the digital transformation of the local government organization they drive. Our study contributes to filling this research gap by investigating the 'digital transformation patterns' of, i.e. the types of digital transformation driven by 996 smart city projects included in 121 smart city strategic plans of Greek local governments, based on a novel methodology, having as theoretical foundation and analytical lens a comprehensive conceptualization of government digital transformation from previous research [10], we have developed for this purpose.

### **3. Methodology and Data**

So initially we developed a methodology that allows a reliable and comprehensive investigation of the impact of smart city initiatives and projects on the digital transformation of various elements of local government organizations. The most reliable source of information about the smart city initiatives and projects are the relevant administrative documents concerning their approval and funding, as they are signed by the highest-level elected and administrative officials of both the local government organizations and the competent ministry, who have strict legal obligations concerning the accuracy and the completeness of these documents. For this reason, we have adopted a 'content analysis' approach [30-31] in our methodology. According to [31] content analysis is one of the most important research techniques in social, political and management sciences, defined as 'analysis of the manifest and latent content of a body of communicated material (such as a book or film) through classification, tabulation, and evaluation of its key symbols and themes in order to ascertain its meaning and probable effect'.

Each of these administrative documents concerns the approval and funding of a smart city strategic plan of a local government, which includes a number of individual smart city projects. So, the description of each of these projects in these documents is analyzed and coded with respect to the types of digital transformation of the local government this project drives. For this purpose, we use as theoretical foundation and analytical lens the conceptualization of government digital transformation proposed in [10], which includes the main dimensions of the digital transformation of a government organization: they concern (as mentioned earlier in 2.2) its internal processes, services, products, relationships with citizens and other government organizations, technology and business models; each of them corresponds to a different type of digital transformation, with quite different characteristics, challenges and change management requirements. So, we developed our coding scheme through an adaptation and elaboration of the above conceptualization. In particular, we eliminated the digital transformation dimensions/types related to products (as local government organizations provide only services and do not offer any products) and business models (as smart city projects do not change the business model of the local government organizations, which is defined by law). Also, we elaborated and expanded the digital transformation dimension/type

concerning the relationships with citizens and other organizations into five sub-dimensions/subtypes corresponding to different kinds of relationships; with respect to the relationships with citizens, as they include on one hand transactions and on the other hand consultations, we defined three digital transformation sub-dimensions/subtypes concerning the development of new transaction channels for the existing services, new transaction channels for the new services (that are introduced through the specific smart city project) as well as new consultation channels; with respect to the relationships with other organizations we defined two digital transformation sub-dimensions/subtypes, which concern the processes of collaboration with other public organizations and the procurement processes. Our coding scheme is shown in Table 1.

**Table 1:** Coding scheme (dimensions/types of government digital transformation)

digital transformation of internal processes
new digital services
new digital transaction channels for the provision of the existing services
new digital transaction channels for the provision of the new services (introduced through the specific smart city project)
new digital consultation channels
digital transformation of procurement processes
digital transformation of the processes of collaboration with other government organizations
new digital infrastructures of improvement of existing ones

Using the above coding scheme for each smart city project included in a smart city strategic plan of a local government organization we extracted from the corresponding administrative document the ‘digital transformation pattern’ DTP of the project, which is an 8-dimensional vector, with each component of it corresponding to one of the above 8 dimensions/types of government digital transformation of our coding scheme (see table 1):

$$DTP = (DTP1, DTP2, \dots, DTP8)$$

Each of these components is a binary variable, which takes value 1 if this project is driving the corresponding dimension/type of government digital transformation, or 0 if this does not happen (e.g. for a smart city project that develops a new digital service and a digital channel for its provision its digital transformation pattern will be (0, 1, 0, 1, 0, 0, 0, 0)).

After determining the digital transformation patterns of all the projects of the examined smart city strategic plans we proceed to their processing. Initially, the relative frequencies of the above eight types of government digital transformation have been calculated across all projects: it is equal to the number of the projects driving this type of government digital transformation divided by the total number of projects of the examined smart city strategic plans; this can be viewed as the ‘overall digital transformation pattern’ of these smart city strategic plans (i.e. of the projects they include), and enables identifying the main digital transformation orientations of them. Then we calculate the same relative frequencies for different size classes of local government organizations, in order to examine whether this overall digital transformation pattern varies among different classes of organizational size.

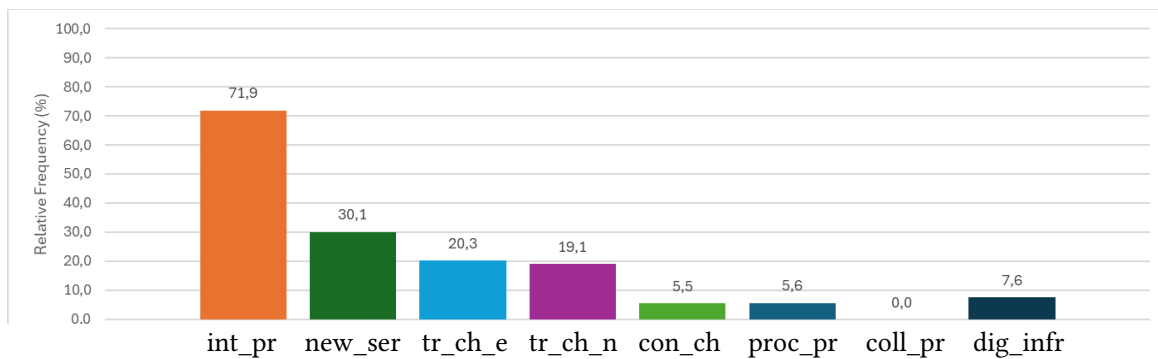
Then the complexity of these smart city projects from a digital transformation perspective has been examined; for each project the number of types of digital transformation it drives has been calculated as a measure of its digital transformation complexity (it ranges from 1 to 8). Next the

relative frequencies of these numbers of digital transformation types driven have been calculated across all the projects.

We used the above methodology in order to analyze from a digital transformation perspective the smart city strategic plans of 121 Greek local government organizations, including 996 projects in total, which have been approved and funded by the Ministry of Digital Governance of Greece, as part of the largest smart city program ever implemented in Greece. This program has initially defined 38 smart city projects, and local governments organization have been invited to formulate their own smart city strategic plans by selecting/prioritizing an appropriate subset of these projects, based on their specific needs, problems and economic activities of their cities, and then submit them for approval and funding. In order to conduct the above analysis, we utilized the administrative documents concerning the approval and funding of these smart city strategic plans, which we downloaded from the website of the Ministry of Digital Governance.

## 4. Results

Initially we extracted/determined the digital transformation patterns (vectors with 8 binary components) of the 996 smart city projects included in the above mentioned 121 smart city strategic plans of local government organizations, through analysis and coding of the corresponding administrative documents; from them the relative frequencies of the eight main dimensions/types of government digital transformation in these smart city projects were calculated and are shown below in Fig.1.



**Figure 1:** Relative frequencies of the main digital transformation dimensions/types in the smart city projects

We can see that 71,9% of the projects that Greek local government organizations prioritized and selected to include in their smart city strategic plans drive digital transformation of internal processes of them, which seems the dominant type of digital transformation driven by these projects. Also, 30,1% of these projects drive digital transformation enhancement of the services provided to citizens by local government organizations by introducing new digital services. Then follows the digital transformation of the channels of transaction with the citizens: 20.3% of the projects create new digital transaction channels for the provision of the pre-existing services of the local government organizations, while 19.1% of the projects create new digital transaction channels for the provision of the new services that are introduced by the same smart city project. Quite limited is the presence of the other four examined dimensions/types of digital transformation in the smart city projects prioritized and selected by the Greek local government organizations: the ones concerning their channels of consultation with citizens (only in 5.5% of the projects), their procurement processes (in 5.6% of the projects), their digital infrastructures (in 7.6% of the projects) and their processes of collaboration with other government organizations (in none of the projects).

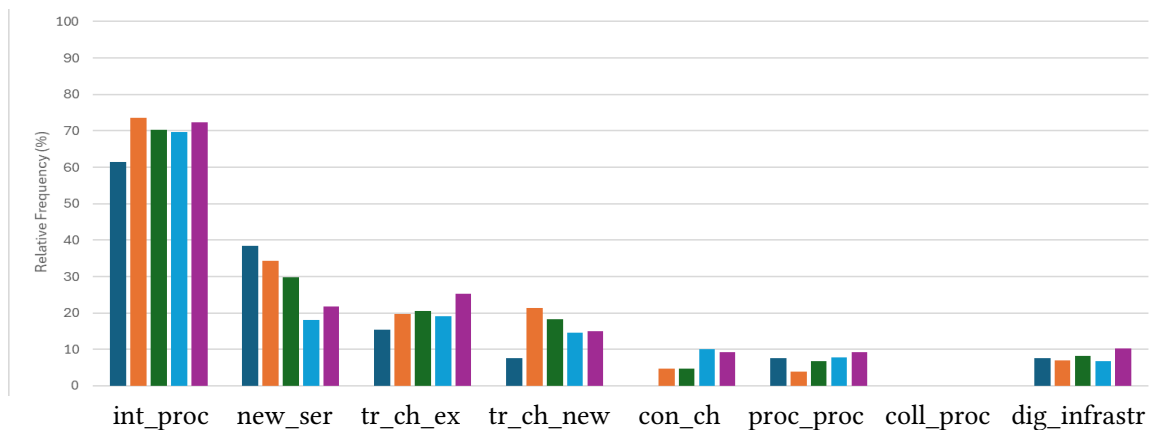
The above results indicate an ‘inward-looking’ orientation of these smart city strategic plans of the Greek local government organizations; though the smart city concept emphasizes mainly digital interventions outside the local government organization, in the main city functions and

infrastructures, the Greek local government organizations seem to prioritize ‘internal’ (intra-organizational) digital interventions, aiming at the improvement of their internal efficiency, focusing mainly on the development of the ‘smart governance’ dimension of the smart city. In particular, they prioritize and select smart city projects that include:

- either exclusively digital transformation of internal processes, such as the ‘Digital Organization of Movement Office and Management of Municipal Vehicle Fleet’, appearing in 42.1% of the examined smart city strategic plans, and the ‘Documents’ Electronic Management and Digital Signatures System’, appearing in 27.3% of these strategic plans,
- or in combination with other types of digital transformation, such as new digital services or new digital transaction channels, such as the ‘Platform for Management of Children Care Centers and Parents’ Information’, appearing in 19% of these smart city strategic plans.

This strong focus on ‘inward-looking’ projects, which drive efficiency-enhancing digital transformation of internal processes, can be explained taking into account the Greek national context in which this study has been conducted. As mentioned in the Introduction Greece has been traditionally characterized by lower ‘digital development’ in comparison with the other EU countries, as indicated by its low ranking in the ‘Digital Economy and Society Index’ (DESI) (<https://digital-strategy.ec.europa.eu/en/policies/desi>), which may also apply for the local government; this has deteriorated due to the strong economic crisis that hit Greece between 2020 and 2018 [11-12], which has led to a drastic reduction of government expenditures, including the ICT-related ones, for all layers of government (central, regional and local) [32-33]. For this reason, local government organizations have probably prioritized and selected smart governance projects that address more basic ‘digital needs’ and mitigate these pre-existing ‘digital deficiencies’, promoting efficiency-enhancing digitalization and digital transformation of important internal processes. So, they placed higher priority on these simpler projects over more sophisticated smart city projects that enable improvements in important city functions as well as in the management of important city infrastructures, based on the installation of high-tech sensors in various points, and transmission of the data they collect in central systems of the local government; also, such projects might seem more difficult to design and implement than the simpler internal digitalization and digital transformation ones.

Furthermore, we calculated the relative frequencies of the eight main dimensions/types of government digital transformation in the projects of the smart city strategic plans of five size classes of local government organizations: very large (with population more than 100,000 citizens), large (30,000 – 100,000 citizens), medium-sized (10,000-30,000 citizens), small (3,500 – 10,000 citizens), very small (less than 3,500 citizens); they are shown in Fig.2 (for each type of digital transformation the first bar from the left corresponds to the very large local government organizations, the second bar to the large ones, etc.).

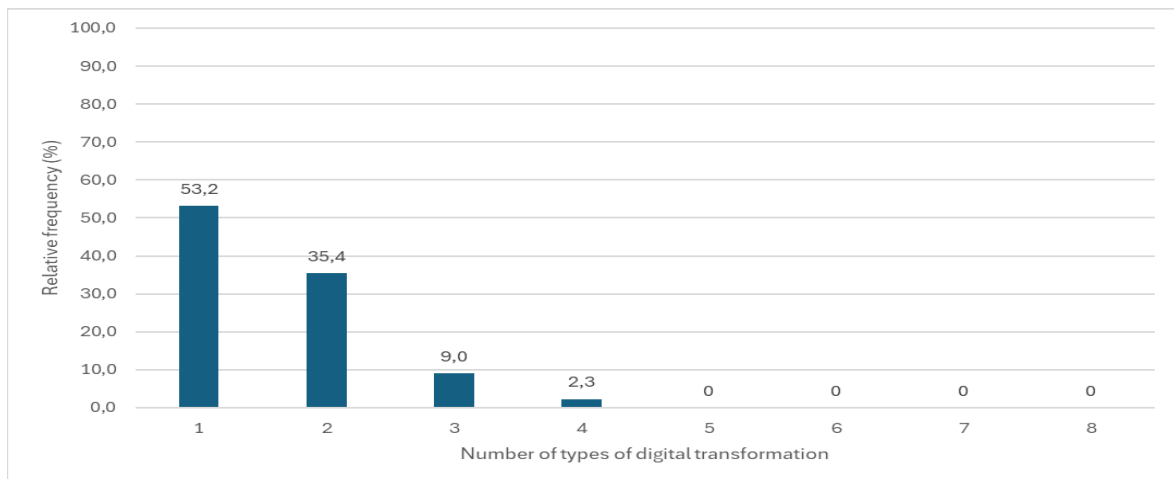


**Figure 2:** Relative frequencies of the main digital transformation dimensions/types in the projects per size class



We can see that in the very large local government organizations the percentage of the projects that drive digital transformation of internal processes is lower (61%) than in the smaller ones; this is probably due to the lower ‘digital deficiencies’ (concerning digitalization and digital transformation of internal processes) of the very large local government organizations in comparison with the smaller ones. Also, in the very large local government organizations the percentage of the projects that create new digital transaction channels for the provision of pre-existing services is lower than in the smaller ones, as they probably already provide more pre-existing services through digital channels. On the contrary, the percentage of smart city projects of the very large local government organizations that drive digital transformations in the services provided to the citizens by creating new digital services, is higher in comparison with the smaller ones. Therefore, we can conclude that the very large local government organizations are characterized by lower ‘inward-looking’ orientation in their smart city strategic plans, having higher ‘outward-looking’ orientation, in comparison with the smaller ones.

Finally In order to investigate the complexity of the projects included in the examined smart city strategic plans from a digital transformation perspective, for each project we calculated as a measure of this complexity the number of digital transformation types it drives (based on its digital transformation pattern); from them the relative frequencies of the numbers of digital transformation types driven (ranging from 1 to 8) by these projects were calculated, and are shown in Fig.3.



**Figure 3:** Relative frequencies of numbers of digital transformation types driven by the projects

We can see that 53.2% of these projects are simpler from a digital transformation perspective, driving only one type of digital transformation, but the remaining 46.8% of the projects are more complex, driving more than one type of digital transformation: 35.4% drive two types of digital transformation, and 9% are even more complex driving three types of digital transformation. The above results indicate that a significant share of the projects included in the examined smart city plans are characterized by significant digital transformation complexity, which makes their implementation difficult and risky, given the lower levels of capacity for implementing such complex and transformative ICT-based interventions of the local government organizations [21, 24].

## 5. Conclusions

In the previous sections a study has been presented of the smart city initiatives and projects from a novel perspective that has not been examined in previous literature: the digital transformation of local government organizations they drive. In particular, we investigated the digital transformation



patterns of the smart city initiatives and projects, which include the types of digital transformation they drive, as well as their complexity from a digital transformation perspective.

For this purpose, we have developed a comprehensive and reliable methodology, which adopts a 'content analysis' approach [30-31]; it is based on the analysis of the most reliable source of information about smart city initiatives and projects: the administrative decisions for the approval and funding of smart city strategic plans of local government organizations. These important documents are analyzed and coded, having as theoretical foundation and analytical lens a comprehensive conceptualization of government digital transformation from previous research [10]; this leads to the determination of the digital transformation patterns of all the individual projects they include, which are processed in order to identify the main types of digital transformation these smart city initiatives drive, as well as their complexity from a digital transformation perspective.

This methodology has been applied for the analysis of 121 smart city strategic plans of local government organizations that include 996 individual projects, which have been approved and funded by the Ministry of Digital Governance, as part of the largest smart cities program ever implemented in Greece. It has been concluded that 71.9% of the projects of these smart city strategic plans drive digital transformation of the internal processes of the local government organization, which is the dominant type of digital transformation driven by these projects; 30.9% of them drive digital transformation (enrichment) of the services provided by the local government organization, by developing and introducing new digital services; furthermore, 20.3% of the projects create new digital transaction channels for the provision of the pre-existing services of the local government organizations, while 19.1% of them create new digital transaction channels for the provision of the new services that are introduced by the same smart city project. On the contrary, much smaller is the share of the projects that drive digital transformation in the channels of consultation with the citizens, the procurement processes, the processes of collaboration with other government organizations and the digital infrastructures. The above results indicate an 'inward-looking' of these smart city strategic plans, which is however lower in the ones of the very large local government organizations (that are more 'outward-looking'). Another important characteristic of these smart city projects is that a significant share of them (46.8%) drive more than one types of digital transformation, having a higher complexity from a digital transformation perspective, and therefore being more difficult to implement and risky.

The main limitation of our study is that it has been conducted only in one country, so the results might be influenced by specific characteristics of this national context; so further research on this topic is required in other national contexts with different levels of technological development. Another limitation is the binary assessment of the types of digital transformation driven by a smart city project; so further research can be conducted on this topic using a more detailed ordinal scale to assess the extent of different types of digital transformation driven by smart city projects (however, for this the analysis of administrative documents might not suffice, so it might have to be combined with other quantitative or/and qualitative research methods).

## **Declaration on Generative AI**

The authors assure that no generative AI tool(s) was used during the preparation of this study.

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