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Identifying patterns in smart initiatives' planning in smart cities. An empirical analysis in Spanish smart cities

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ABSTRACT

The smart city (SCs) movement has emerged to face urban challenges. Nonetheless, the complexity and dynamic nature of cities makes them context-dependent in their strategic planning processes concerning smart initiatives, which can lead to different solutions and outcomes of cities' development. With the growing number of smart initiatives implemented in SCs, it becomes important both to consider how such initiatives are planned and organised, and to address the complexity and context-dependent dynamic in which such initiatives are implemented. Therefore, this study is a comprehensive analysis of number of initiatives in 12 Spanish SCs (1635 smart initiatives) to identify the relations between key characteristics of the cities (cities and citizens' profiles) and the planning of SC strategies. Findings suggest that formal strategic planning is mainly performed in SCs with higher qualification of inhabitants, mature-aged population, and top-down strategic planning approach.

1. Introduction

Cities are defined as a complex and dynamic system where aspects such as infrastructure, ecology, society, culture, or economy interaction (Zhang and Li, 2018) requiring governance systems to manage them in an efficient way (Meijer and Rodríguez Bolívar, 2015). By acknowledging the complexity of cities' organization dynamics, the smart city (SCs) movement has emerged to face urban challenges. Although the definition of SCs is still evolving (Mozūriūnaitė and Sabaitytė, 2021; Echebarria et al., 2021) and some theorists caution against focusing only on technological infrastructures (Picon, 2015), there seems to be a general agreement in considering these SCs as a strategic approach using Information and Communication Technologies (ICTs) as a core dimension of SCs (Nam and Pardo, 2011; Lim et al., 2019) enabling socio-technical transition (Kummitha, 2020) aiming at both facing challenges brought by the increasing urbanization trend and improving the quality of life (QoL) of citizens, achieving more resilient and sustainable cities (Alcaide Muñoz and Rodríguez Bolívar, 2021).

The smart city concept is therefore not focused on the simple implementation of ICTs but, mainly, on how this implementation is immersed to both efficiently integrate the different main urban dimensions (technological, human, and institutional -Nam and Pardo, 2011-) and achieve technological affordance for building creative and inclusive urban spaces (Kummitha and Crutzen, 2017; Kummitha, 2020). As Kummitha and Crutzen (2017) indicate, although the use of ICTs may be needed to bring advancement in city level administration, it is not an end in itself to achieve many social objectives. In fact, social construction of technology (SCOT) scholars focused on agency (Orlikowski, 1992, 2000), and those considering also structural considerations (Klein and Kleinman, 2002), argue that the communities shape technologies according to their social context.

This could explain why the way cities use ICTs to facing societal challenges is being different (Alizadeh, 2017). Cities are context-dependent implementing their own smart strategies embedded in a strategic planning process in which a great number of urban characteristics are involved (Dameri et al., 2019). This way, although there are many strategies of smart cities in the world (Silva et al., 2018), some of them lacking clear strategic planning processes and effective planning tools (Korachi and Bounabat, 2019) and others are implementing smart city initiatives as individual strategies, tending to deal with issues as and when they arise, rather than adopting an integrated, holistic approach (Soe, 2018).

Both cases fail on the need of having a common vision, sharing resources, and achieving collective goals, leading to produce operational inefficiency (Korachi and Bounabat, 2019) or the transformation from interoperable to fragmented services (Soe, 2018). In addition, weakly

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integrated projects will not be greatly beneficial for a city without a well-planned coherent strategy (Angelidou, 2017; Rodríguez Bolívar et al., 2020), because it makes difficult to ensure that smart city transitions achieve urban sustainability (Mora et al., 2021).

At this point and with the existing evidence in the previous literature, it makes us think that these differences when addressing a strategic planning of a SC are mainly because there is a tension between the different projects necessary for a city to become smart and the fact that the city already exists as a dynamic organization. Therefore, there is stress between the existence of a previously organised city, and that it must be reorganized in another way to become a SC, for which there are different ways and styles of dealing with this strategic planning that would give rise to different results.

Indeed, different strategic planning approaches can lead to different solutions and outcomes of cities' development (Luque-Vega et al., 2020). According to Angelidou (2015), the formal strategy has a much more integrated outlook, establishes collaboration channels among different levels of economy and governance, and tackle the changing dynamic environment, leading managers, and workers to effective strategy implementation (Alcaide Muñoz et al., 2018). In addition, in municipalities with a horizontal and cross-sectoral approach to mainstreaming the policy development is slower than that in the municipalities with vertical approach to mainstreaming (Rauken et al., 2015). Finally, collaboration of stakeholders and coordination between different departments in public entities are considered key aspects to success (Angelidou, 2014).

This way, recent research has indicated the need for undertaking strategic planning processes embedding holistic vision, collaboration of multiple actors, combining top-down and bottom-up approaches and adopting an integrated intervention logic (Mora et al., 2019). Holistic approach means looking at the system or problem as a whole interconnected entity, understanding the bigger picture. So, holistic strategic planning may be defined as that one that view all components in the process as an integrated whole system, based on the assumption that all the system elements are interrelated and interdependent (Plant, 2009). Concerning top-down and/or bottom-up approaches, it represents the so-called vertical flow of information, power relations and policy transfer, that are important for the functioning of the system (Timms, 2011). A top-down approach is when strategy is led by the government; however, in a bottom-up approach, the promoter is citizenship. In this sense, holistic, collaborative, and integrated strategic planning will help smart initiatives to share knowledge and data, which could be critical to the development of the fully scalable and smart city. These strategic planning processes should be formalized to clearly outline measurable goals, improve collaboration to achieve collective goals and guide the decision-making process providing the main foundations for trading off and selecting options (Alcaide Muñoz et al., 2018).

City governments of SCs should therefore rely on holistic, collaborative, and integrated formalized strategic planning to provide a comprehensive and integrated view of technology, data, process, products, organizations, participants, and services, connecting the different urban aspects (physical, economic, and social spheres) (Schiavone et al., 2020), so needed to build SCs (Guenduez et al., 2018). Only under this frame, we can name the smart initiative as 'smart policy' due to its close relationship with city's policy (Van der Hoogen et al., 2020) which is defined as a conceptual and systematic activity aimed at both identifying and facing major urban development problems (Stawasz, 2019).

In any case, the strategic planning processes in SCs is still largely unexplored (Angelidou, 2015) and much research is needed (Bianchi and Tomaselli, 2015; Yigitcanlar, 2018). Indeed, although prior research has analysed case studies and different kind of approaches in strategic planning process in SCs (Mora et al., 2019), up to now, there is a lack of empirical studies regarding the identification of consistent patterns -defined as streams of public decisions or strategies (Mintzberg, 1979)- followed by SCs when implementing individual SC initiative approaches (informal/formal, vertical/horizontal, collaboration/no collaboration).

In addition, with the growing number of smart initiatives, it becomes important to consider how such initiatives are planned and organised, and to address the complexity and context-dependent dynamics of such initiatives. So that, it is necessary to carry out a comprehensive analysis of number of smart initiatives to identify the relationship between key characteristics of the cities and citizens, and the planning of SC strategies. Therefore, this paper focuses its attention on 1635 smart initiatives disclosed on internet by 12 Spanish SCs with the aim at identifying patterns of public strategies in their strategic planning approaches based on their demographic and citizens' profiles, which are relevant attributes in taking public policies related to the introduction and use of new technologies (Rodríguez Bolívar and Alcaide Muñoz, 2018; Basu, 2019). Concretely, the main research question of this study is: which are the main attributes that characterise formal/informal strategic planning processes into SCs? Are they the initiatives approach, demographical profile, citizens' profile of the SCs or a joint effect of both? The main contribution of this study is thus to be a first approach to provide a framework to identify patterns of public strategies in the strategic initiative approaches in SCs.

The Spanish context has been selected due to both the performance of municipal smart initiatives according to European Union's guidelines aimed at promoting sustainable growth (Serrano et al., 2020) and the greatest number of individual smart initiatives adopted in Spanish municipalities within the European context (Collins et al., 2017; Alcaide Muñoz and Rodríguez Bolívar, 2021).

The remainder of this paper is as follows. The next section presents the background of our research and the hypotheses formulation. Later, data collection and research methods are described, analysing the sample selection, the smart initiatives attributes and the variables examined in this research. Then, main results of our study are presented and, finally, the discussion and conclusions bring the paper to an end.

2. Theoretical background and hypotheses formulation

Nowadays, citizens increasingly push for the development of SCs to improve their quality of life (Rodríguez Bolívar et al., 2020). To respond to this demand, city governments are adopting formalized strategic planning processes (Alcaide Muñoz et al., 2018) and different SC governance styles according to the level of participation, collaboration, and involvement of stakeholders and institutions in public decision-taking processes (Meijer and Rodríguez Bolívar, 2015). According to the European Energy Research Alliance (EERA), the design and adoption of smart strategic planning improves the management of resources and the performance of tasks efficiently allowing the achievement of higher ambitious targets relating to several city areas (EERA, 2018).

Nonetheless, urban contexts influence both the ways in which local governments can undertake different patterns of public strategies in their strategic planning processes and the type of smart city projects implemented (Yigitcanlar, 2018), especially the interaction between vertical/horizontal, collaboration/no collaboration and bottom-up/top-down approaches. This urban context in SCs is not simple, but also entails a high level of complexity (Komninos et al., 2019), which makes us to examine not only the individual effect but also the joint effect of demographical and citizens' profile attributes on strategic planning process in SCs.

2.1. Individual effect of attributes

As noted previously, governments increasingly put their efforts to foster smart projects, although the way/approach they have adopted has been so different. Some cities have embraced smart projects as an isolated case (vertical approach), allowing them to strengthen a certain city area. By contrast, others have formulated a global strategy (horizontal approach) with several action plans aimed at developing multiple city areas, requiring a coordination mechanism since governments think that fragmented and independent efforts can lead to chaotic market

transactions (Komninos et al., 2019). Given the complexity of the implementation of smart projects, even more so when they encompass several areas of the same city (horizontal approach), it is necessary to exercise greater control that allows the parties involved to know if the action lines are being undertaken as planned.

Although it is not necessarily translated into perceived usefulness of strategic planning (Johnsen, 2019), it is widely demonstrated that formalized strategic plans provide a guide for decision-making process, favours the coherence among the involved functional areas (Alcaide Muñoz et al., 2018), and between operations decisions of different functional areas, promoting the efficient allocation of resources among them (Albrechts and Balducci, 2013). Therefore, having a formalized strategic planning allows the parties involved to know the action protocol that they must carry out in their different areas, in such a way that collaborative work between the different areas will allow the integrated implementation of smart initiatives.

This is especially relevant for cross-sector collaboration and partnership with public-private organizations to address public problems (Kettl, 2015), but it is not an easy process (Bryson et al., 2015). When different groups and task forces engage in the implementation of projects or strategies, the role of a formal strategic planning increases, given that it helps to organize not only tasks and resources, but also underrepresented groups (Innes and Booher, 2018). Therefore, the probability of developing formalized strategic plans is higher when multiple agents (organizations, areas, departments, etc.) are involved. In other words, the formalization of strategy acquires greater importance on multidisciplinary and collaborative environments, since all the agents involved need to know the aimed objectives clearly, the person to who reports results or incidents, what the tasks must be developed and what resources are available (Bryson et al., 2015).

In addition, there is not a coherent corpus of literature regarding the approaches to be taken in strategic planning processes. Whereas prior research has emphasized the need of a formalized and centralized top-down strategy to ensure the successful development of SCs (Komninos et al., 2019), where all the weight of the strategy would fall on the shoulders of public organizations, without giving the option to the participation of external agents that could support the actions undertaken by it. Also, recent research claims this approach of SC initiatives is obsolete, requiring a higher involvement of different stakeholders in decision-making and ICT solutions -bottom-up approach- (Lange and Knieling, 2020). In this case, the participation of external agents (citizens, NGOs, companies, etc.) is favoured, although the public organization could adopt a leadership and coordination role.

In any case, when top-down approach is adopted, all responsibilities and decision-making rest upon government and formalized strategic planning is developed disclosing all aspects of projects involved and what government is doing, how and where. It allows citizens to be more insistent in the demand of detailed information and transparency in SCs initiatives. So that, governments feel pressure to formalize strategy for its later disclosure.

Based on these comments, it is expected that SCs with a global strategy, public-private collaboration and top-down approach are most likely to develop and disclose formal strategic planning. So, the following hypotheses are derived:

H1. Based on the information disclosed, the development of horizontal approach in SC initiatives positively affects the probability of developing formal strategic planning.

H2. Based on the information disclosed, the public-private collaboration in SC initiatives positively affects the probability of developing formal strategic planning.

H3. Based on the information disclosed, the adoption of top-down approach in SC initiatives positively affects the probability of developing formal strategic planning.

On another hand, aspects such as demographic urban profile, could lead to different patterns in governing SCs (European Parliament, 2014). Prior research has shown the significant effects of population and its attributes (size, density, age, …) on both the implementation of ICTs and the innovation of city governments to provide public services and promote transparency (Rodríguez Bolívar and Alcaide Muñoz, 2018).

Particularly, in larger SCs committed to promoting ICTs implementation in public services, public managers perceive higher levels of external influence and citizens demands, so they are more pressured to disclose information about smart initiatives (Rodríguez Bolívar and Alcaide Muñoz, 2018). Also, larger cities could have a more dispersed organizational structure which may engage more individuals in decision-making, increasing knowledge and information sharing (Saez-Martin et al., 2017). Conversely, smaller cities often possess their own powerful sense of place together with a more centralized organizational structure, resulting in prompt consensus and collaboration (Bradford, 2004).

In addition, the population's spatial distribution (population density) is a key factor affecting a city's sustainable development (Yang et al., 2020). Therefore, formalized strategic planning would be more needed and useful in high dense cities, given that it may help to coordinate tasks, areas, institutions, and people, in addition to promoting transparency.

On another hand, recent research has emphasized the need of digital awareness of citizens, particularly, in SCs (Guenduez et al., 2018). According to prior research, age is a crucial factor to understand people behaviour on the use of ICTs, mobile system, and apps (Ahmad and Khalid, 2017). Mature people -between 25 and 64 years old- are more likely and active on their visits to e-government platforms (Rosenberg, 2019), and are the main users of government mobility apps (Basu, 2019). In fact, Tjerk et al. (2018) establish that the youngest people do not consume the products municipalities offered, and thus, do not demand them due to their young age.

As city governments are increasingly promoting SCs initiatives favouring the citizens' participation to better meet citizens demands, citizens will be more likely to be engaged in offering useful feedback for public policies and services (Alcaide Muñoz and Rodríguez Bolívar, 2021).

Based on prior comments, high dense cities and higher volume of middle-aged people are expected to be most likely to develop and disclose formal strategic planning. So, the following hypotheses are derived:

H4. Based on the information disclosed, the municipality's density population positively affects the probability of developing formal strategic planning.

H5. Based on the information disclosed, the mature citizens (25–64 years) residing in the municipality positively affect the probability of developing formal strategic planning.

Considering that SC approaches are turning into citizen-centricity projects (Wirtz et al., 2020), it is necessary to get insight in how the citizens' profile could determine different strategic planning patterns in SCs (Woetzel et al., 2018).

Saez-Martin et al. (2017) affirmed that well-educated and higher income citizens demand the implementation of ICTs for improving government information transparency and more efficient public services. Also, high educated people think that ICT use let them to open new opportunities in both the labour market and their academic career, resulting in higher-qualified work positions and higher wages (Al-Shafi and Weerakkody, 2010), which results in both having a proactive attitude towards the adoption of SC initiatives (Winters, 2011) and improving their quality of life (Giffinger and Gudrun, 2010).

Furthermore, Technology Acceptance Model (Davis, 1989) and Diffusion of Innovation Theory (Rogers, 2010) provide guidance on how the adoption and diffusion of new innovations occur in the real word. Rogers suggests that the process of technology adoption involves five

successive stages, one of them is knowledge. In this sense, Rogers stressed that "how-to-knowledge" is the most essential factor in the innovation-decision process. To increase the chances of an innovation being adopted, an individual should possess a sufficient level of "how-to" knowledge prior to trailing the innovation. Additionally, at an early age of technology, Agarwal and Prasad (1999) pointed out that educational level is a key factor for the usage and acceptance of technology, which has been subsequently supported by multiple studies such as Sugandini et al. (2018) or Diharto et al. (2018). These studies reveal that innovation adoption would be slower on community groups which have low level of education, low level of economy, and elderly people.

Based on these prior findings, it is expected that cities with large income per capital, and higher concentration of high-educated citizens (those with secondary and superior education) are most likely to undertake formal strategic planning. So, the following hypotheses are derived:

H6. Based on the information disclosed, the higher citizens' income per capita positively affects the probability of developing formal strategic planning.

H7. Based on the information disclosed, the high educated citizens in municipality positively affect the probability of developing formal strategic planning.

2.2. Joint effect of citizens' profile attributes (income and level of education)

Considering the smart city planning is as a complex process (Deakin, 2015), previous studies have highlighted that SCs tend to create an interactive, participatory, and information-based environments (Alcaide Muñoz and Rodríguez Bolívar, 2021) including for strategic planning processes (Deakin, 2015), which allow to implement structures based on the negotiated involvement of multiple stakeholders and citizens' participation as way of turning governments into more collaborative spaces and closer to the citizenry needs (Alcaide Muñoz and Rodríguez Bolívar, 2021).

Thereby, governments have increasingly sought to collaborate with private sector (Grossi and Pianezzi, 2017), adopting different models from those initially composed by a double-helix structure ("entrepreneurial mode of governance" -government and firms-) to those embedding the intellectual capital in the quadruple-helix structure (collaborative governance models -including government, firms, university, and citizens-). In this regard, both the triple and quadruple helix models are drivers of complexity in the strategic planning processes (Komninos et al., 2019) representing a source of conflicts among the different actors in a same initiative. It might be mitigated by the development of formal strategic planning (Innes and Booher, 2018). Therefore, based on prior research, it is expected that cities with higher income per capita (with higher economic growth) will lead to collaborative models of strategic planning and, in turn, to the development of bottom-up approaches.

In addition, vertical alignment on strategies is told to increase coordination and cooperation into the strategic planning processes (Bowman and Ambrosini, 1997). Particularly, vertical alignment is mainly used under environmental uncertainty contexts, strengthening centralized decision-making processes with the aim at achieving better organizational performance in high-income environments (Andrews et al., 2012). Therefore, it is expected that cities with higher income led to public-private collaboration, the development of vertical SC initiative and the bottom-up approach but, even so, the probability of undertaking formal strategic planning will be higher when SCs initiatives are developed by government. So, the following hypotheses are derived:

H8. Based on the information disclosed, the higher level of income leverages the effects of developing vertical SC initiative on the probability of developing formal smart strategy.

H9. Based on the information disclosed, the higher level of income leverages the effects of developing public-private collaboration on the probability of developing formal smart strategy.

H10. Based on the information disclosed, the higher level of income leverages the effects of developing top-down approach on the probability of developing formal smart strategy.

On another hand, according to Komninos et al. (2019), critical factors of strategic planning processes in smart cities are the knowledge base and the mode of operation. This knowledge base is provided by high educated people in the SCs, which is one key factor of the development of SCs due to their more proactive attitude towards the adoption of SC initiatives (Meijer and Rodríguez Bolívar, 2015; Winters, 2011). These citizens tend to both demand innovative initiatives and be an active part of these initiatives (bottom-up approach) (Schmidthuber et al., 2017), exploring socially accepted and responsible strategies for change within a community (Volman and ten Dam, 2015).

In addition, having a high educated citizenship facilitates the accessibility to labour market which lead to better work opportunities and an increased income per capita (Al-Shafi and Weerakkody, 2010) resulting in higher tax collection. These cities tend to have their main and basic needs satisfied, so they will begin to undertake more personalized and citizen-centred initiatives, undertaking more vertical and individualized projects.

On another note, the digital infrastructure of SCs facilitates entrepreneurship, creativity, and innovative clusters (Grimaldi and Fernandez, 2017; Kraus et al., 2015) offering more efficient services by increasing collaboration among economic actors (Lima, 2020). To achieve this aim, SCs relies on institutions such as universities, knowledge-intensive organizations, and public policy makers, since the development of SCs initiatives based on cutting-edge technology requires a lot of resources and high educated people (Ahvenniemi et al., 2017).

Based on these comments, it is expected that cities with high-educated citizens will result in greater public-private collaboration, the development of individual SC initiatives and the implementation of bottom-up approach, resulting in the development of formal strategies. When citizens are highly educated and motivated to carry out SC initiatives, which must be approved by government, formal strategic planning is a must. So, the following hypotheses are derived:

H11. Based on the information disclosed, the higher level of education leverages the effects of developing vertical SC initiative on the probability of developing formal smart strategy.

H12. Based on the information disclosed, the higher level of education leverages the effects of developing public-private collaboration on the probability of developing formal smart strategy.

H13. Based on the information disclosed, the higher level of education leverages the effects of developing bottom-up approach on the probability of developing formal smart strategy.

Fig. 1 presents a scheme of our research.

3. Data and methodology

3.1. Sample selection

As per a recent report of a European Project (Collins et al., 2017) and academic study (Alcaide Muñoz and Rodríguez Bolívar, 2021), Spain, UK, Germany, Italy, and France have the greatest number of experiences in smart initiatives adopted. Therefore, the analysis and exploration of their smart initiatives could be of special interest to an international audience. This study focuses on the smart initiatives undertaking in large-size Spanish SCs whose economies are highly competitive (Harrison and Donnelly, 2011), as a first approach to analysing the influence of their profile attributes on the management and dissemination of strategic information on smart projects. In these SCs, we can find wider

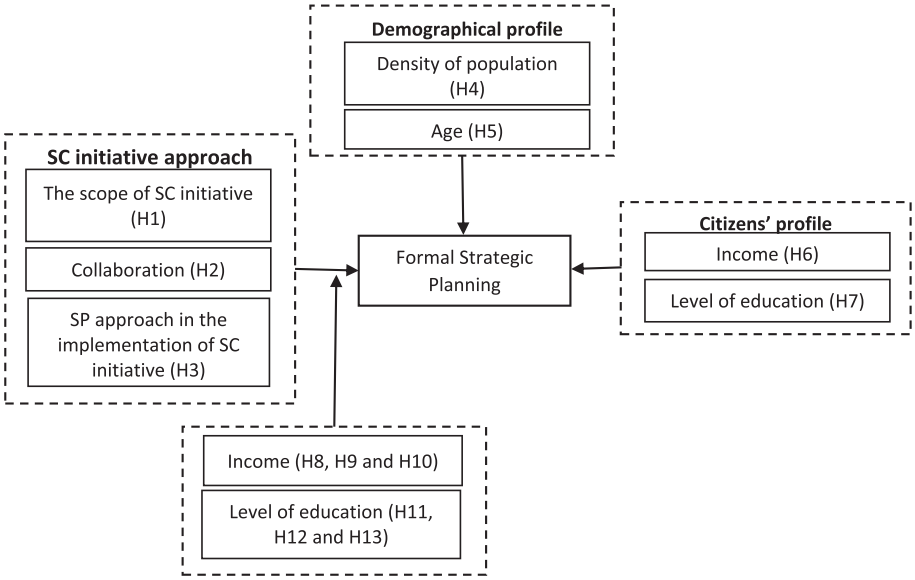

Fig. 1. The direct and joint effects of SC initiative approach, demographical profile, and citizens' profile on the formalization of smart strategy.

spectrum of governance models to deal with urban problems, using new and novel insights of smart solutions brought from other similar cities (Angelidou, 2014), which could provide us relevant findings for other countries concerning the management of SCs initiatives.

Regarding the data collection, it was developed in two stages. First, as there is not a widely agreed definition of "smart city" (Mozūriūnaitė and Sabaitytė, 2021; Echebarria et al., 2021), our sample selection process is focused on large-size Spanish cities -cities from 200,000 to 4 million inhabitants- recognized as SCs in main world rankings according to their requirements. In this respect, these cities are labelled as "smart" by a widely acknowledged European project (see http://www.smart-cities.eu). Based on the criteria reflected in this European SCs ranking (Giffinger and Gudrun, 2010), the authors included seven Spanish SCs into the sample selection. Thereupon, the EUROCITIES network (http://www.eurocities.eu) was analysed to expand sample SCs under study. In such a network, local governments of the major European SCs aim at being innovators in the implementation of new governance models. So, the authors identified five Spanish SCs to include in this study. Therefore, a total of twelve large-size Spanish SCs is our sample selection.

The second stage consisted in determining the method to be used in the inclusion of the strategy documents of sample cities in our research. Based on Yigitcanlar (2018) framework, the authors got access to the official website of the city to obtain the strategy or policy, which have a specific focus on SCs and developed for a specific city. These reports list the department responsible of the project in the smart city, the smart city domain, stakeholders involved, vision, objectives, policies, or strategies on the smart city transformation of the city.

The search was conducted in January–February 2021, just considering online disclosed policies up to the date. By doing so, the authors analysed a total of 1635 cases smart initiatives. In Terrassa, Gijon, Malaga, Seville, Zaragoza, A Coruña and Madrid are deployed most smart initiatives under study, over hundred.

Sample Spanish SCs with the largest population are Madrid and Barcelona (3,182,981 and 1,620,809 inhabitants, respectively) -see Table 1-, with similar population pyramid and income levels (between 28,876 and 27,600 euros). They mainly differ in the percentage of citizens with a secondary and higher education level -Madrid has higher percentages-. Nonetheless, in general terms, Spanish SCs have very similar profiles, only highlighting Malaga due to its lowest percentage of citizens with a higher education level and its lowest level of income. On the opposite side, it should be noted that Bilbao has the highest percentage of citizens with a higher education level and with the highest levels of income.

3.2. *Smart initiatives attributes, variables used and mathematical models*

This study aims at identifying patterns in the strategic planning of the sample SCs, mainly focused on the formal/informal approach used and the influence that the scope of the smart project (horizontal/vertical pattern) (TSP) (H1), the responsible body (city government or greater involvement of stakeholders) (COB) (H2) and the project approach

Table 1
Characteristics of smart cities under study.

City	Population	Density	% age 15 to 24	% age 25 to 64	% secondary education	% superior education	Income per capita
Madrid	3,182,981	5254	9.03 %	56.89 %	15.92 %	32.96 %	28,876
Barcelona	1,620,809	16,504	8.95 %	56.87 %	10.96 %	28.04 %	27,558
Valencia	787,808	5764	9.57 %	56.15 %	11.12 %	24.55 %	22,922
Seville	689,434	4880	9.94 %	56.07 %	10.61 %	20.63 %	22,311
Zaragoza	664,938	683	9.18 %	55.60 %	11.34 %	26.14 %	22,327
Málaga	569,002	1440	10.29 %	56.95 %	10.21 %	19.85 %	20,425
Murcia	443,243	500	11.00 %	56.43 %	10.06 %	20.61 %	20,688
Bilbao	345,110	8338	8.27 %	55.85 %	10.79 %	34.42 %	30,889
Valladolid	299,715	1519	8.50 %	54.10 %	11.30 %	24.85 %	21,784
Gijon	272,365	1499	7.22 %	56.35 %	12.47 %	28.88 %	21,581
A Coruña	244,099	6453	7.74 %	56.04 %	10.29 %	23.93 %	22,273
Terrassa	216,428	3079	9.57 %	56.68 %	10.26 %	26.25 %	21,301

(Source: Own elaboration.)

(bottom-up/top-down) (APP) (H3) have on this approach. All these variables are obtained from the information on smart policies and strategies published by Spanish SCs on their official web pages and are defined as dichotomous variables (see Table 3).

Concerning demographic attributes, we included density of population (DEN) (H4) -population residing in the SC per km^2-, and the age of inhabitants (AGE) (H5) -differentiating two ranges: from 15 years to 24 years and from 25 years to 64 years-. As citizens' profile, we included the income per capita (INCO) (H6) -income in thousand euros per inhabitants- and the level of education (H7) -secondary education (SECED) and higher education (SUPED)- (see Table 3).

Finally, we analysed the joint effects of income and the scope of the smart project application (H8), the responsible body of the smart project (H9) and the project development approach (H10); and finally, the joint effect of level of education and the scope of the smart project application (H11), the responsible body of the smart project (H12) and the project development approach (H13). The conceptualization of the theoretical models can be seen in Table 2.

3.3. Econometric technique for the analysis

This research uses the probit regression model to test the hypotheses posed, since our explanatory variable is dichotomous (Ai and Norton, 2003). In our empirical study we carried out different models: a) to determine the direct casual effects of smart initiative approach with whole of variables (testing from H1 to H7); and b) to analyse the interaction effects between demographic variables and citizen's profile variables on the type of strategic planning (testing from H8 to H13).

A few studies have emphasized the complexity of results interpretation in non-linear models, it demands special attention (Hoetker, 2007; Norton et al., 2004). It is generally accepted that the estimation on the estimated coefficients might lead to misleading analysis, particularly, in the interpretation of interactions. Indeed, the parameters of the probit models are not the marginal effects which make the significance and level of non-linear model coefficients not to provide useful information for the analysis.

The contemporary interactive regressions literature (Tchamyou and Asongu, 2017; Tchamyou, 2019; Asongu, 2020a, 2020b) reveals that in linear models with interaction coefficients, in order to avoid pitfalls documented in Brambor et al. (2006), net effects and/or thresholds involving both the conditional and unconditional linkages should be computed. In case of non-linear models, it is similar. In fact, neither the interaction coefficients nor their sign can be interpreted as meaningful with regards to the magnitude (Anzola-Román et al., 2018). Therefore, based on Anzola-Román et al. (2018), this study focuses on the estimated marginal effects of the independent variables and, the Wald test was also performed to test the significant differences between the effects of the type of the scope of the smart project application (horizontal/vertical pattern) (TSP), the presence of absence of public-private collaboration and the approach of strategic planning (top-down/bottom-up). Average marginal effects (AMEs) explain the effects of the variable average across the sample. In other words, it provides the average marginal effects of a given variable regarding the rest of the independent variables for each of the responses in the sample. The use of AMEs to analyse causal relationship with interaction terms in non-linear models has been encouraged by Ai and Norton (2003) in a seminar work, and this analysis is similar to that of the net effects in linear models.

4. Analysis of results

Tables 3 and 4 show descriptive statistics and the pairwise correlation coefficients (containing significant level) of each variable under study. In this sense, although correlation values among explanatory variables (independent variables) are below the problematic level of 0.75 (Dohoo et al., 1997), some of them are nearby. In fact, the analysis of the variance of inflation factors (VIF) reveals multicollinearity problems with INCO, AGE1524 and AGE2564, since their VIFs −14.04, 32.83 and 28.87- are above the rule the thumb cut-off of 10 (Kennedy, 1985; Neter et al., 1996). So, to test the effects of income and age, a single model is estimated with them (Model 1.1), whose VIF values are so far <10. Likewise, in model 1.2., the highest VIF value is 1.22, thus there are no serious multicollinearity problems in the models proposed.

Regarding the analysis of the casual effects, Table 5 shows the direct effects of variables relating to smart initiatives approaches, demographic city profile and citizen's profile (with corresponding p-values in parentheses). As can be seen, model 1.1. reveals significant and positive estimated coefficients of the explanatory variables TSP and AGE2564, so we cannot reject H1 and H5. The results of the estimation of the AMEs confirm these interpretations because the confidence intervals of the AMEs for TPS and AGE2564 are above zero (see Fig. 2 (a)). Additionally, the effects of younger people are negative and significant. This is consistent with the previous studies, it seems that in the municipalities with working population are mainly the users of both public services and information and, in turn, have a proactive attitude in public issues due to their main role of taxpayers (Tjerk et al., 2018; Alcaide Muñoz and Rodríguez Bolívar, 2021).

Contrary to the related literature, local government are not encouraged to disclosure formal information in municipality with higher income and density, so H4 and H6 are not supported and must be rejected. Additionally, both INCO and DEN have a very weak negative effect because its estimated coefficient is almost 1. These results are confirmed by the estimation of the AMEs of these variables and their confidence intervals (90 % confidence level).

In the model 1.2., we can observe that the estimated coefficient of

Table 2
Models and submodels analysed in this study.

Models	Submodels
$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * INCO_i + \varepsilon i$ (1)	$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * INCO_i + \beta_5 * INCOxTSP_i + \varepsilon i$ (1.1)
	$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * INCO_i + \beta_5 * INCOxCOB_i + \varepsilon i$ (1.2)
	$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * INCO_i + \beta_5 * INCOxAPP_i + \varepsilon i$ (1.3)
$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * DEN_i + \beta_5 * SECEDU_i + \beta_6 * SUPEDU_i + \varepsilon i$ (2)	$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * DEN_i + \beta_5 * SECEDU_i + \beta_6 * SUPEDU_i + \beta_7 * SECEDUxTSP_i + \varepsilon i$ (2.1)
	$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * DEN_i + \beta_5 * SECEDU_i + \beta_6 * SUPEDU_i + \beta_7 * SECEDUxCOB_i + \varepsilon i$ (2.2)
	$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * DEN_i + \beta_5 * SECEDU_i + \beta_6 * SUPEDU_i + \beta_7 * SECEDUxAPP_i + \varepsilon i$ (2.3)
	$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * DEN_i + \beta_5 * SECEDU_i + \beta_6 * SUPEDU_i + \beta_7 * SUPEDUxTSP_i + \varepsilon i$ (2.4)
	$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * DEN_i + \beta_5 * SECEDU_i + \beta_6 * SUPEDU_i + \beta_7 * SUPEDUxCOB_i + \varepsilon i$ (2.5)
	$FSP = \alpha + \beta_1 * TSP_i + \beta_2 * COB_i + \beta_3 * APP_i + \beta_4 * DEN_i + \beta_5 * SECEDU_i + \beta_6 * SUPEDU_i + \beta_7 * SUPEDUxAPP_i + \varepsilon i$ (2.6)

Where i is the number of SC initiatives analysed and ε the unobservable information.

Table 3
Definition and descriptive statistics of attributes analysed in this study.

Attribute	Acronym	Definition	Calculation	Median/ Mean	Std. Dev.	Min	Max
Type of strategic planning	FSP[a]	Approach used for strategic planning into the Smart City	0 = Informal 1 = Formal	1	–	0	1
Scope of smart initiative	TSP[a]	Smart initiatives can involve 1 department (vertical) or, 2 or more departments (horizontal)	0 = Vertical 1 = Horizontal	1	–	0	1
Collaboration	COB[a]	Responsible body of the smart initiative (City government/private sector or public-private partnership)	0 = No collaboration 1 = Collaboration	0	–	0	1
Strategic planning approach	APP[a]	Strategic planning approach when a Smart City initiative is implemented	0 = Top-Down 1 = Bottom-Up	0	–	0	1
Population density	DEN[b]	The measurement of population per unit area.	Population/Km^2	3506.14	3090.41	500	16,504
Level of education	SECEDU[b]	Level of inhabitants with secondary education	Percentage of inhabitants with secondary education	11.14	1.47	10.06	15.92
	SUPEDU[b]	Level of inhabitants with superior education	Percentage of inhabitants with superior education	25.74	3.75	19.85	34.42
Age of inhabitants	AGE[b]	Age of inhabitants	Percentage of age from 15 to 25 Percentage of age from 25 to 64	9.09 56.27	1.06 0.53	7.22 54.10	10.99 56.94
Income per capita	INCO[b]	Income per capita	Income per capita (thousand euros)	22,419.07	2518.81	20,425	30,889

Abbreviation: Std. Dev. (Standard Deviation), Min (minimum) and Max (maximum).
[a] Local Government Website.
[b] National Statistical Institute (INE) (www.ine.es/).

Table 4
Correlation's matrix.

	1	2	3	4	5	6	7	8	9	MODEL 1.1. VIF	MODEL 1.2. VIF
1.FSP	1										
2.TSP	0.288***	1								1.06	1.04
3.COB	−0.041	0.035	1							1.05	1.08
4.APP	−0.110***	−0.016	0.150***	1						1.04	1.04
5.DEN	−0.252***	−0.041	0.085***	0.051*	1					–	1.08
6.SECEDU	−0.399***	0.170***	−0.052**	0.009	0.021	1				–	1.18
7. SUPEDU	−0.207***	0.132***	−0.083***	0.001	0.219***	0.670***	1			–	1.22
8.INCO	−0.529***	0.112**	0.021	0.070**	0.657***	0.605***	0.661***	1		1.46	–
9.AGE1524	−0.125***	−0.158***	−0.008	0.015	−0.081***	−0.434***	−0.560***	−0.192***	1	1.14	–
10. AGE2564	0.103***	0.076*	−0.105***	−0.035	0.178***	0.548***	−0.039	0.104***	0.232***	1.35	–

(Source: Own Elaboration with data from Stata * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.)

Table 5
Probit regression for formal/informal strategic planning.

	Model 1	Model 2
TSP	$3.462^{(0.000***)}$	$1.642^{(0.000***)}$
COB	0.566	0.094
APP	−0.993	$-1.1935^{(0.013**)}$
AGE1524	$-7.752^{(0.000***)}$	
AGE2564	$0.625^{(0.012**)}$	
INCO	$-0.002^{(0.000***)}$	
DEN		$-0.001^{(0.000***)}$
SECEDU		$-0.823^{(0.000***)}$
SUPEDU		$0.112^{(0.000***)}$
Constant	$74.629^{(0.000***)}$	$8.425^{(0.000***)}$
Pseudo R^2	0.603	0.457
Log likelihood	−103.625	−141.646

The p-values (statistical significance of coefficients) are included in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.
(Source: Own Elaboration with data from Stata.)

variable SECEDU is significant and negative, however it is the opposite to SUPEDU, which support H7. It confirms recent research indicating that citizens are required to have technical skills to use computers properly, reading comprehension and the ability to search for, use, interpret and evaluate information (Dhaoui, 2022). In this regard, cities with well-educated citizens are more aware of the benefits of ICT in their life and are interested in public projects, so they demand not only the implementation of new technologies to improve the efficiency of public services (Colesca & Dobrica, 2008; Tran Pham, 2023), but also more detailed information from local government (Colesca & Dobrica, 2008; Nam, 2014). Therefore, local government promoting integrated smart initiatives in SCs with high educated inhabitants have a positive impact on the probability of undertaking formal strategic planning. In brief, when smart initiatives are implemented by governments (top-down approach), there is more probability that citizenry demands formalized strategic information because they want to catch up on the decisions of public managers. Similarly, this disclosed information is more formalized when the educational level of the citizens to whom it is addressed is higher (superior education). However, when the purchasing power of citizens is high, the information disclosed does not tend to be formalized.

As for the analysis of the potential moderating joint effects of citizens' profile - considering the multiplicative effects of income and level of education-, models from 2.1 to 2.3 are estimated and AMEs are calculated for TSP, COB and APP -see Tables 6 and 7 (with corresponding p-values in parentheses)-. Results suggest that in cities with less income per capita, there is higher probability of developing informal strategic planning when strategy just involves one department (vertical approach/scope -Fig. 2a), although formalized information is more

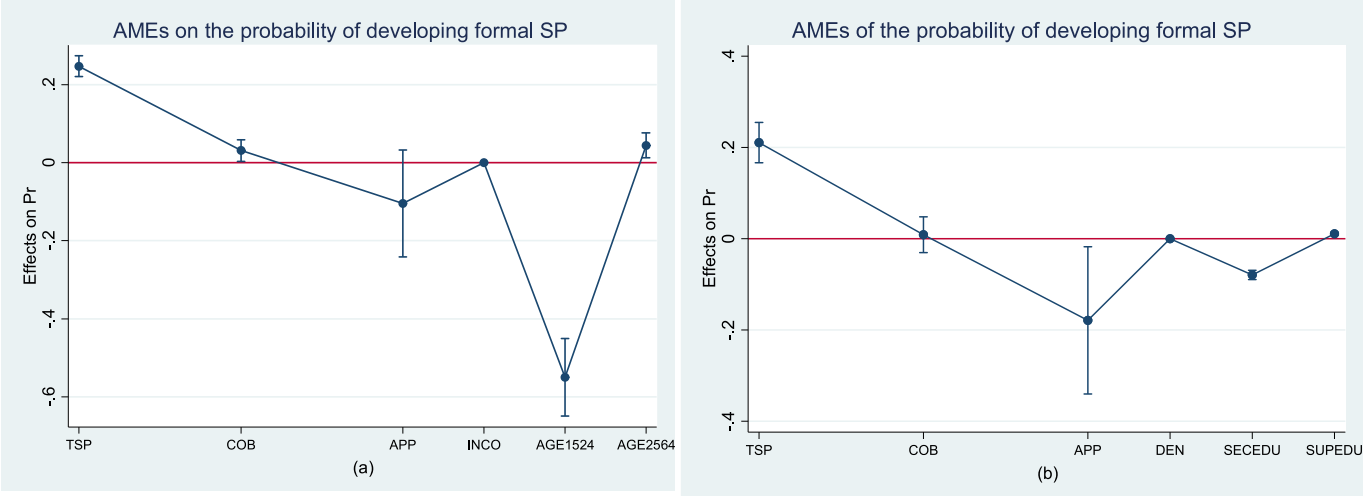

Fig. 2. AMEs for smart initiative approach, demographic city profile and citizen's profile.

Table 6
Probit regression for formal/informal strategic planning with interaction variables for income per capita.

	Model 1.1.	Model 1.2	Model 1.3
TSP	$11.562^{(0.000***)}$	$3.584^{(0.000***)}$	$3.454^{(0.000***)}$
COB	0.625	3.953	0.539
APP	−0.995	−0.805	−2.239
INCO	$-0.001^{(0.000***)}$	$-0.002^{(0.000***)}$	$-0.002^{(0.000***)}$
AGE1524	$-9.074^{(0.000***)}$	$-8.061^{(0.000***)}$	$-7.714^{(0.000***)}$
AGE2564	$0.846^{(0.001***)}$	$0.743^{(0.006***)}$	$0.615^{(0.014**)}$
INCO × TSP	$-0.001^{(0.004***)}$		
INCO × COB		−0.001	
INCO × APP			0.001
Constant	$72.899^{(0.000***)}$	$71.956^{(0.000***)}$	$74.690^{(0.000***)}$
Pseudo R^2	0.608	0.609	0.603
Log likelihood	−102.153	−103.054	−103.578

The p-values (statistical significance of coefficients) are included in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.
(Source: Own Elaboration with data from Stata.)

likely to be disclosed in horizontal approach in cities with higher income (higher than 23,425 euros). Indeed, the confidence intervals of the difference between the AMEs, depending on the scope adopted show that these differences are statistically significant in low and middle income (Fig. 2b), Considering, the previous findings shown in the graphs, H8 is supported.

Regarding public-private collaboration and if the initiative is developed by local government or citizens, the higher income, the higher probability of developing informal strategic planning, regardless of the type of collaboration or who promotes the initiative (Fig. 3c). In fact, it is confirmed by the confidence intervals of the difference between AMEs, depending on the type of collaboration and who leads the initiative, which are not statistically significant (Fig. 3c). So, we cannot accept H9 and H10.

Moreover, analysing the moderating effect of secondary education on the influence of the variables TSP, COB, and APP on the development of formalized strategic planning, we can observe that any interaction is significant (see models from 2.1 to 2.3). However, the AMEs of the concentration of secondary education in the sample SCs, show that when the concentration of secondary education is higher, the probability of developing informal strategic plans increases, just more than one department is involved in the initiative. It is confirmed by the confidence intervals of the difference between AMEs, depending on the scope

Table 7
Probit regression for formal/informal strategic planning with interaction variables for education.

	Model 2.1.	Model 2.2	Model 2.3	Model 2.4	Model 2.5	Model 2.6
TSP	1.602	$1.634^{(0.000***)}$	$1.642^{(0.000***)}$	$7.206^{(0.000***)}$	$1.641^{(0.000***)}$	$1.642^{(0.000***)}$
COB	0.112	2.002	0.093	0.229	0.179	0.079
APP	$-1.189^{(0.013**)}$	$-1.188^{(0.014**)}$	−1.878	$-1.132^{(0.027**)}$	$-1.215^{(0.015**)}$	−2.135
DEN	$0.001^{(0.000***)}$	$0.001^{(0.000***)}$	$0.001^{(0.000***)}$	$-0.001^{(0.000***)}$	$-0.001^{(0.000***)}$	$-0.001^{(0.000***)}$
SECEDU	$-1.094^{(0.062*)}$	$-0.812^{(0.000***)}$	$-0.823^{(0.000***)}$	$-0.652^{(0.000***)}$	$0.824^{(0.000***)}$	$-0.821^{(0.000***)}$
SUPEDU	$0.106^{(0.000***)}$	$0.112^{(0.000***)}$	$0.112^{(0.000***)}$	$0.287^{(0.000***)}$	$0.111^{(0.000***)}$	$0.110^{(0.000***)}$
SECEDU × TSP	−0.308					
SECEDU × COB		−0.179				
SECEDU × APP			0.064			
SUPEDU × TSP				$-0.231^{(0.001***)}$		
SUPEDU × COB					0.012	
SUPEDU × APP						0.036
Constant	11.310	8.301	$8.426^{(0.000***)}$	1.874	$8.454^{(0.000***)}$	$8.455^{(0.000***)}$
Pseudo R^2	0.457	0.457	0.457	0.485	0.457	0.457
Log likelihood	−141.535	−141.616	−141.646	−134.219	−141.632	−141.560

The p-values (statistical significance of coefficients) are included in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.
(Source: Own Elaboration with data from Stata.)

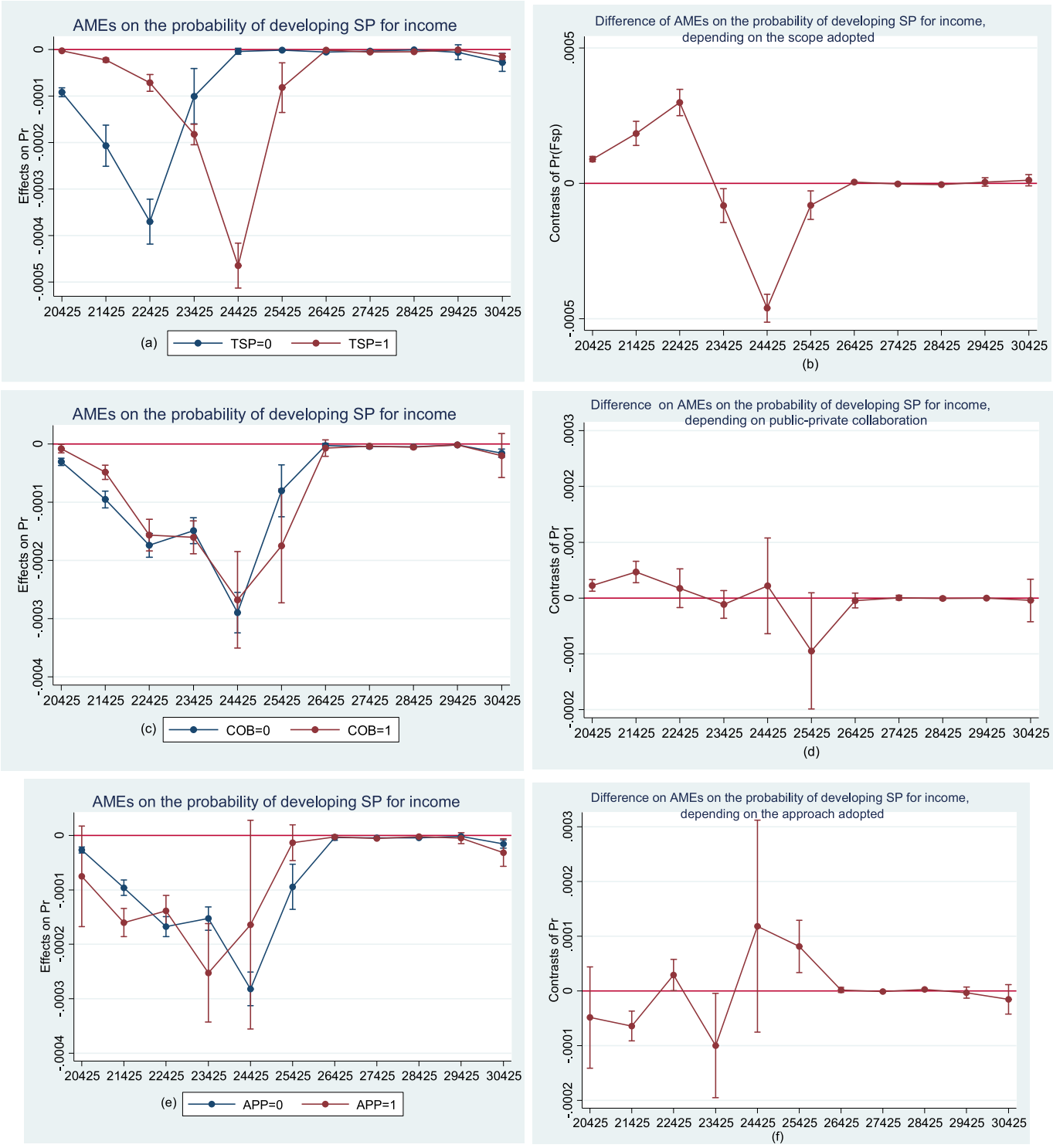

Fig. 3. Contrasting AMEs for income, depending on the scope and approach adopted and public-private collaboration.

adopted (Fig. 4a and b), which is statistically significant with greater concentration of secondary education in the population.

Concerning public-private collaboration and the approach adopted, in the model 2.2 and 2.3, we can observe that the moderating effect of secondary education together with COB and APP are not significant. However, the Fig. 4c reveals that the higher concentration of secondary education in the population, the higher probability of developing informal strategic plans in absence of public-private collaboration. Although, Fig. 4d shows that there is no difference if public-private collaboration exists or not. Similarly, when the concentration of secondary education increases in the population, the probability of developing informal strategic plans is higher when the citizens are not active part of the smart initiatives (top-down). In this case, it is confirmed by the confidence intervals of the difference between AMEs, depending on the approach adopted (Fig. 4e and f), which is statistically significant with both lower and greater concentration of secondary education in the population.

Regarding superior education, just the interaction between the

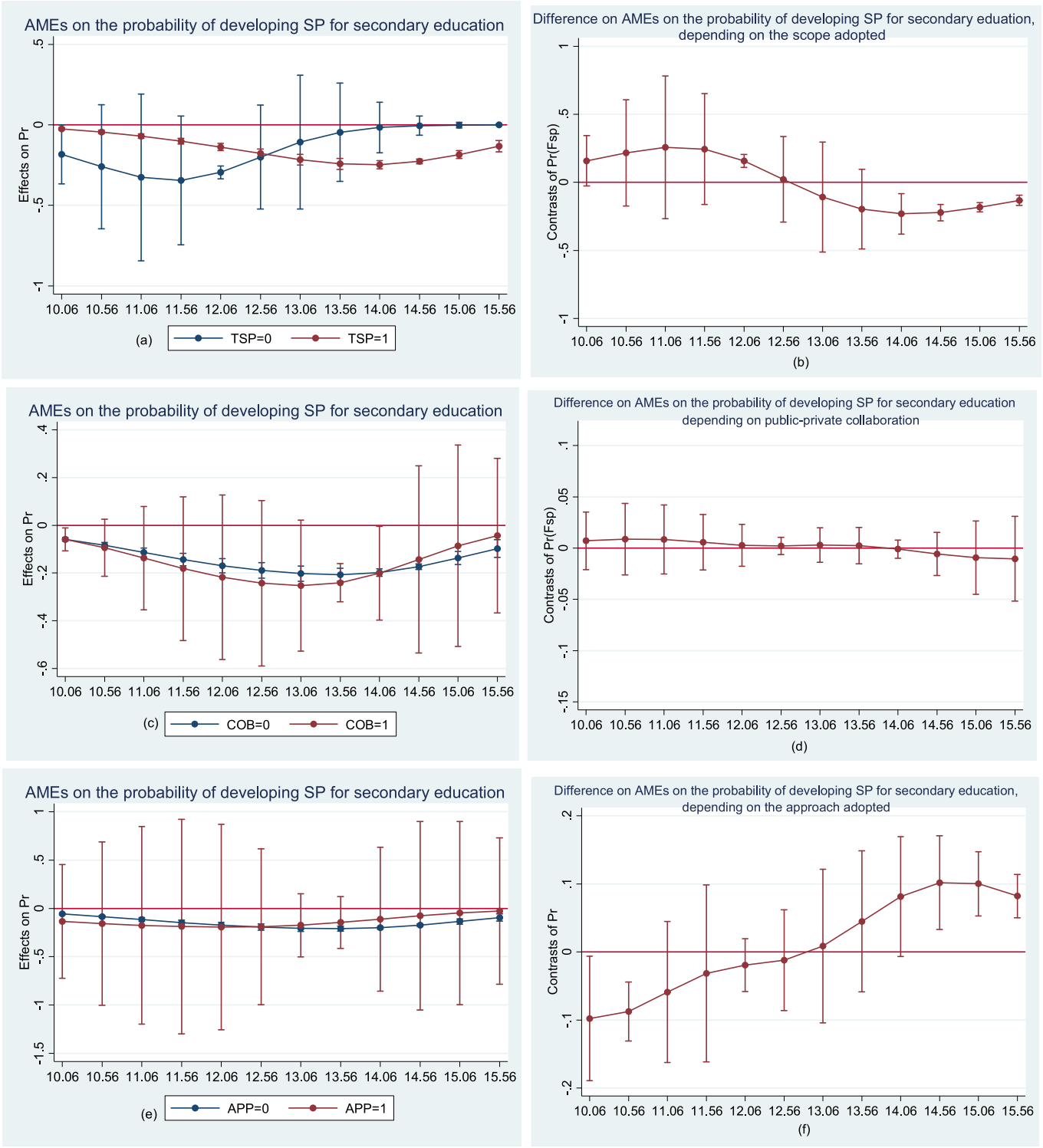

Fig. 4. Contrasting AMEs for secondary education, depending on the scope and approach adopted and public-private collaboration.

variable TSP and superior education is significant (see model 2.4.). In this sense, the of the estimation of AMES (Fig. 5a) shows that in cities with no-educated citizens is most likely to develop formal strategic planning when the scope of strategy is vertical, and this does not vary despite increased qualification of citizens. It is confirmed by the confidence intervals of the difference between AMEs, depending on the scope adopted (Fig. 5b), which is statistically significant. So, considering both the previous analysis related to secondary education and this one, H11 is supported.

Furthermore, Fig. 5c and c reveals that when there is not difference if public-private collaboration exists or not. Finally, we can observe that in cities with high educated citizens, the probability of developing formal strategic planning is higher when the initiatives are led by citizens. It is confirmed by the confidence intervals of the difference between AMEs, depending on the approach adopted (Fig. 5f), which is statistically significant in the percentage of superior education below 31.55. So, after analysing the previous models and AMEs related to secondary education and this one, H13 is supported.

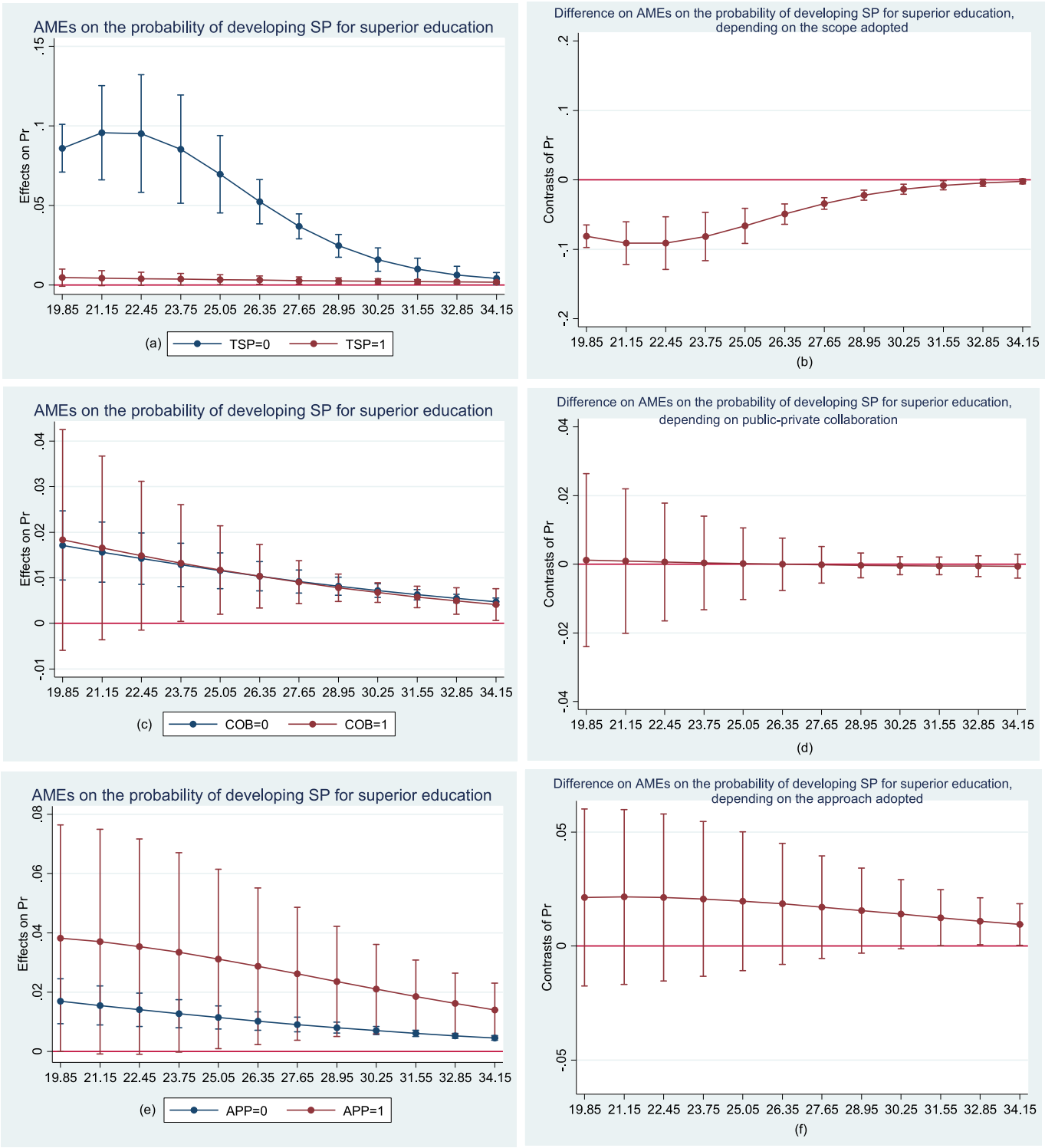

Fig. 5. Contrasting AMEs for superior education, depending on the scope and approach adopted and public-private collaboration.

5. Conclusion and discussions

Although some authors indicate that the use of emerging ICTs (Big Data, Artificial Intelligence, etc.) has brought some negative aspects to the urban area, including its negative impact on security and privacy issues (Lam and Ma, 2019; Fabrègue and Bogoni, 2023), on democracy with new possibilities of control and surveillance moving towards a new totalitarianism (Baločkaitė et al., 2008) -mainly in developing countries-, or even on deriving material footprint in the short and long-terms (Abid et al., 2023), sentiments towards the implementation and use of these emerging ICTs in the urban space are mostly positive (Regona et al., 2022).

Indeed, the negative impact of technologies into SCs is not immersed in the technologies in itself, but in the existent mismatch between the development and adoption of technology (Kummitha, 2020). Exploring bottom-up technology development by offering more avenues for citizens to create necessary technologies for urban living could make to achieve technological affordance and positive outcomes (Kummitha,

2020). In this regard, there are many examples of positive impact of technologies in SCs to achieve more equitable cities from an income distribution point of view (Caragliu and Del Bo, 2022), to implement more efficient and secure automobile systems for urban mobility (Menon et al., 2022; Richter et al., 2022), to achieve more local entrepreneurship development (Manjon et al., 2022; Dana et al., 2022) or to build more environmental-friendly cities (Raharjana, 2019).

The rise of the SCs movement has therefore turned cities into living laboratories where new insights about emerging technologies implemented for better city planning, design, and management can be explored (Geertman et al., 2019). In this context, researchers have made significant efforts in investigating the implementation of strategies for smart city development (Cowley et al., 2017; Mora and Bolici, 2016, 2017; Mora et al., 2019; Schiavone et al., 2020). Nonetheless, most of the municipalities lack integrated strategies and different strategic approaches have been carried out (Selada, 2017; Alizadeh, 2017). In addition, digital strategies are not always aligned with broader strategic thinking in each city (Alizadeh, 2017). Based on the information disclosed, this paper has sought to provide new and novelty insights regarding patterns of public strategies followed in strategic planning approaches based on SCs demographic and citizens' profiles, using direct and joint effects.

Findings suggest that formal strategic planning is mainly performed in SCs with higher qualification of inhabitants, mature-aged population (25–64 years old) and top-down strategic planning approach. Therefore, this research seems to confirm the silos research field embedding determinants of personal, environmental, and behavioural factors within the organization at the time of creating silos in strategic planning processes (Bento et al., 2020). Indeed, the silo mentality supports bureaucratic models in strategic planning based on both the legacy structure and the traditional ways of working in strategic planning (De Waal et al., 2019). Our research confirms this prior research assigning the key role of establishing strategic visions to the local governments -top-down approach- (Selada, 2017).

Nonetheless, this strategic planning model does not work well into a networked governance models embedded into SCs in which both the knowledge and information sharing inside the public entity and the participation, collaboration, and cooperation of all stakeholders in problem-solving issues and innovation are crucial (Meijer & Rodríguez Bolívar, 2016; Rodríguez Bolívar, 2018). Indeed, city governments are creating SC strategies and action plans jointly with stakeholders, making top-down and bottom-up initiatives coexist (Selada, 2017; Mora et al., 2019). Therefore, city governments in SCs should be more open to discuss and incorporate new stakeholders in the integrated strategic planning of the cities. To achieve this aim, they could promote citizen participation and collaboration, as well as they should base on new technologies as main channels for establishing this new form of collaboration.

In any case, no empirical evidence exists to demonstrate what the best-supported collaborative approaches for SC developments (Schiavone et al., 2020). Therefore, future research should investigate the new collaborative approaches raised in SCs and evaluate them from the lenses of the outcomes achieved by these approaches.

Another main finding of our research indicates that higher population density and income level of SCs do not implement formalized strategic documents. Indeed, when the population density and income level is low and horizontal strategic planning approach is used, SCs usually perform formalized information. This finding seems to indicate that people with higher levels of education -those that usually get higher income (Al-Shafi and Weerakkody, 2010)- are more capable to understand the different smart projects implemented into the SCs, which makes them to have a global picture of the public policies implemented by the city governments. This finding confirms that coproduction in certain domains is limited to high-educated citizens (Meijer, 2016), which provides new insights concerning the explanatory importance of socio-demographic profiles in early adopters of any technology innovation, as the Diffusion of Innovations Theory indicates (Rogers, 2010).

Nonetheless, a SC should be a sustainable, inclusive, and democratic city, which means a thoughtful consideration of diverse social groups of age, education level, and region into urban policies (Shin et al., 2021). To achieve this aim and involve people with low income and low level of education in strategic planning processes, a strong leadership of the city government and open disclosure of this strategic planning seem necessary for this people to understand the development of their SCs. This information must be clear and undetailed information, being easily understandable; otherwise, this information will be less attractive for this profile of people. This finding seems to be confirmed by the joint effect of the level of education in our research because findings suggest that formal strategic planning is highly performed when the superior education in the population is high. These citizens have developed critical skills to identify problems and propose resolution initiatives, since they not only "know their place" but also "determine their own position" in the community (Volman and ten Dam, 2015). In addition, they have higher capacity for the continuous learning processes needed to fostering knowledge development, which is indispensable to address the urban challenges and the transition urban processes required by SCs (Tollin, 2015; Hossain et al., 2019). It is recognized as a main principle for creating smart urbanism (Roggema, 2020) and establish a digital democracy and participatory urban planning using urban living labs (Steen and Van Bueren, 2017).

However, as noted previously, the significance of engaging citizens and favouring inclusivity has been recognized by international initiatives for global development, such as the New Urban Agenda (NUA) introduced by the United Nations (UN) (Gil-Garcia et al., 2016; Caprotti et al., 2017). On the one hand, SCs rely heavily on people as a fundamental component (Vinod Kumar, 2015; Caragliu et al., 2011). On the other hand, some scholars claim that the integration of digital technologies that align with a city's sustainable development objectives can positively contribute to social welfare (Hadjikhani et al., 2019; Leite Mota, 2022). In fact, there are studies where the importance of using new technologies to promote social inclusion is highlighted, such as the one developed by García Ramirez et al. (2017), which show the usefulness of new technologies in facilitating mobility for people with disabilities in SCs. In addition, governments tend to adopt more social initiatives in cities where vulnerable groups exist. Thus, the appropriate use of new technologies does not necessarily create social disparities, but rather the opposite (Rodríguez Bolívar et al., 2022). It contributes not only to the economic growth of the SCs, but also to the social well-being (Criado & Gil-Garcia, 2019). In sum, contrary to the early findings of Angelidou (2017), our research seems to confirm recent research that demonstrate the gradual path of strategic planning of SCs seems to be in line with the evolving technologies and opportunities for action, which is shaped bottom-up, gradually, by user engagement and the capabilities offered by volatile technologies (Komninos et al., 2019). Therefore, city governments aimed at increasing collaborative models of strategic planning should invest in implementing emerging technologies and at enhancing stakeholder's engagement in strategic planning processes.

Indeed, our research suggest that different patterns of public strategies in strategic planning processes in SCs could represent different stages of development in governance models of strategic planning processes, from those based on bureaucratic or hierarchical models to those based on smart governance or networked models. Therefore, future research could investigate this issue on SCs in different stages of maturity as well as on SCs in different contexts to test this presumption.

In brief, our research opens new avenues for future research in strategic planning processes in SCs, mainly based on identifying other different attributes influencing patterns of public strategies, analysing outcomes and performance measurement according to the different strategic patterns identified in our research and, finally, identifying different stages of maturity of strategic planning processes into SCs.

Author statement

The smart city strategic plans analysed are available on the official websites of the analysed municipalities and are freely available.

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Declaration of competing interest

The authors report there is no competing interest to declare.

Data availability

Data will be made available on request.

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