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Assessing the readiness of municipalities for digital process innovation

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ABSTRACT

Pre-adoption phases of innovation are understudied in the innovation literature. This article addresses pre-adoption phases of innovation by running a prospective analysis. We assess the readiness of municipalities for the adoption of a digital tool that brings about process innovation concerning stakeholder management. Through an online survey, we elicit the public managers' attitudes and their adoption expectation towards the tool. By drawing on insights from Diffusion of Innovation Theory and Theory of Planned Behaviour, we investigate which attributes of innovation along with managerial, organisational and environmental factors, contribute to a favourable attitude and an increased likelihood of innovation adoption. Our analysis reveals that while the perceived attributes of innovation such as its relative advantage and compatibility are major determinants of attitude formation and adoption expectation, pro-digitalisation beliefs, innovation-oriented organisational culture and environmental context factors such as high population and rates of new residential growth are critical in translation of positive attitudes to increased likelihood of adoption. Hence, in addition to perceived attributes of innovation and managerial characteristics, our findings also highlight the importance of organisational and environmental factors to the adoption expectation, and thus provide a more nuanced understanding of pre-adoption phases of innovation.

1. Introduction

Innovation is a concept studied by various disciplines. In broad terms, it corresponds to the creation or adoption of new ideas, practices or tools. Prior research has distinguished various types of innovation [1]; for instance, *product* and *service innovation*, which include creation or adoption of new products and services, respectively. *Process innovation* accounts for changes in the organisational or administrative processes including the established procedures, techniques, routines, structures or roles while *conceptual innovation* accounts for generation of new concepts, frames or paradigms to help define the nature of a problem and potential solutions [1,2]. The bulk of innovation research tackling why and how innovation occurs concerns the private sector [1,3,4]. In contrast, comparatively less attention has traditionally been paid to innovation and entrepreneurship in the public sector, which is often considered to be highly bureaucratic [5], with municipalities particularly not typically conceived as fertile grounds for innovation [6]. This represents a common misperception that underlies the bias in innovation literature towards private sector organisations [7].

Municipalities lie at the centre of the innovation as the governing and executive unit responsible for various services [8,9] such as sanitation, waste management, land planning and development and building and maintaining basic infrastructure including roads, parks, squares, etc. For provision of these services, municipalities run numerous environmental and infrastructure-related projects that concern various types of users, organisations and sectors. While the increased quality and efficiency of municipal services are the desired outcome of such projects, their successful realization often hinges upon the management of interactions with stakeholders, which is crucial for the implementation and governance of innovation in complex setting such as urban spaces [10,11]. In this study, we examine the adoption potential of a digital tool, *PlaNet*,[1] which is designed to facilitate stakeholder analysis and

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[1] https://planet.eawag.ch/de/accounts/login/?next=/#

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management. The potential uptake of this tool by municipalities is an example of a process innovation [9,12,13] which can involve or lead to changes in the organisational routines, roles, and practices. Even though digitalisation has become a popular trend in public administration, empirical studies elucidating the determinants of digital innovation adoption are few (some recent examples including [14,15]) and existing research predominantly focuses on the interaction between politics and citizens, for example, through tools of e-government [16], e-voting [17] or the use of social media by advocacy groups [18,19].

In pursuit of tackling this research gap concerning innovation in public sector, especially in municipalities, we asses the readiness of mid-size Swiss municipalities for a digital process innovation by eliciting the public managers' attitude and their perception on the likelihood of adopting the *PlaNet* tool in their municipalities. To explain differences in the readiness of municipalities, we investigate *what individual (i.e. managerial), organisational, technological and environmental factors are associated with a favourable attitude and a high adoption expectation* towards the adoption of the tool. As the empirical case, we focus on Switzerland, where the innovation in public sector including digitalisation lags behind compared to other European countries [20,21].

In addition to contributing to an under-researched area, this study presents a prospective analysis of innovation adoption, which is an underperformed study design in innovation literature. Instead of eliciting the explanatory factors for adoption retrospectively, we assess the adoption potential by studying the critical pre-adoption phases of attitude formation and adoption expectation and elucidate determinants specific to these phases. This leads to the following contributions. First, rather than a single-event phenomenon, we approach innovation adoption as a multi-phase process and assess what phase is most critical for a potential adoption decision [22–24]. Second, we operationalize four types of antecedents and investigate their effects for different phases. As a result, our study provides a more granular understanding of the antecedents specific to pre-adoption phases of innovation [25], which in turn yields novel and valuable insights for developing strategies and potential interventions to promote the uptake and diffusion of innovations. More broadly, the insights acquired from this study can also shed light onto the drivers and barriers of the larger digitalisation trend in public services and administrative processes in municipalities.

The paper is structured as follows. In the following section, we provide an overview of the antecedents of innovation based on various strands of literature drawing from public administration, innovation studies and economic geography. In section 3, we introduce our empirical case and research design. By integrating theory of innovation diffusion and theory of planned behaviour, we derive our conceptual model used for developing and testing hypotheses on the relations between antecedents of innovation and pre-adoption phases such as attitude formation and adoption expectation. We present the results in section 4, followed by a discussion on their theoretical and practical implications in section 5.

2. Innovation adoption process and its antecedents in organisations

Innovation adoption is a complex process involving multiple phases that can be grouped as pre-adoption, adoption and post-adoption [22,26,27] (Fig. 1). The pre-adoption phase, which can also be seen as the initiation phase of innovation, involves defining a need, searching or becoming aware of solutions, forming attitudes and proposing decisions concerning adoption. The adoption phase entails the evaluation of innovation in terms of strategic, economic and technical aspects, as well as the decision to adapt and allocate resources. The post-adoption phase covers implementing the innovation, monitoring its impacts, making technical or organisational adjustments and routinising its use in the organisation. Most of the empirical studies on innovation adoption are retrospective, aiming to explain the factors conducive for adoption. One common limitation of these studies is the appraisal of a multi-event process as a dichotomous single-event outcome: adoption or non-adoption. Furthermore, because they are retrospective, the insights from such studies are not suitable for developing interventions for that particular case. In contrast, a prospective analysis focusing on pre-adoption phases can help to identify where potential bottlenecks for adoption exist and what steps could be taken to address that.

Innovation adoption is also considered as multidimensional given that multiple factors from various dimensions can be influential along different phases of this process [22]. In case of organisations, these dimensions may not only include individual (e.g. managerial) or technological (related to the perceived features of innovation in question) but also organisational and environmental factors that characterize the political, cultural or geographical context conditions an organisation is embedded in Ref. [28].

Municipalities, as public sector organisations, are different from private firms on several grounds. Unlike the private sector, they have public and political mandates that may hinder experimentation and risk taking that may be conducive for innovation. For instance, public managers can be expected to be more risk-averse when they spend taxpayers' money on novel and radical technologies or processes under fiscal constraints [29]. Furthermore, in contrast to firms that may be primarily driven to increase their market share, the motivation for innovation can be quite diverse in public realm and contingent on the local politics and interactions with stakeholders and civil society [6]. On a similar note, while the innovation performance of a company is assessed through its position in the market, the performance evaluation and reward mechanisms in the public sector can be dependent on a more complex array of factors such as politics and public perception. Despite these differences, some scholars assert that municipalities can still be considered akin to private enterprises [30,31]. Features such as size, geographic embeddedness and limited capacity to influence their environment are argued to make municipalities more alike to smaller and medium enterprises than other forms of public administration [6]. This may hold especially true for settings like Switzerland, where municipalities are granted large degrees of autonomy owing to federalism and the subsidiarity principle. As a result, in addition to public administration, we also refer to business and management, innovation studies and economic geography literatures to derive the antecedents of innovation that can also be relevant for municipalities. In the rest of this section, we elaborate on these factors.

2.1. Technological antecedents: perceived attributes of innovation

In his seminal work, [32] defined five perceived attributes of an innovation that are decisive for its adoption. These include relative advantage, complexity, compatibility, trialability and observability. *Relative advantage* refers to the "degree to which an innovation is perceived as being better than the idea it supersedes" [32]. Depending on the type of innovation, the perceived superiority can be related with economic gains, time-efficiency or social benefits. *Complexity or ease of use* indicates how complicated or easy an innovation is perceived to be for use and compatibility indicates the degree to which an innovation is perceived to be aligned with the existing routines or values of adopters. *Compatibility* of an innovation is positively related to its adoption whereas the complexity is related negatively (positively for ease of use). Finally, *trialability* denotes to what degree an innovation can be tried or experimented and observability refers to the extent to which the results of innovation can be observed and communicated to others. Both observability and trialability are positively related to adoption.

2.2. Managerial antecedents

In addition to the perceived features of an innovation, the characteristics of managers as decision makers in the organisations can also greatly affect the adoption process. Managers' age, tenure, education, values, beliefs, vision, and commitment can influence adoption both

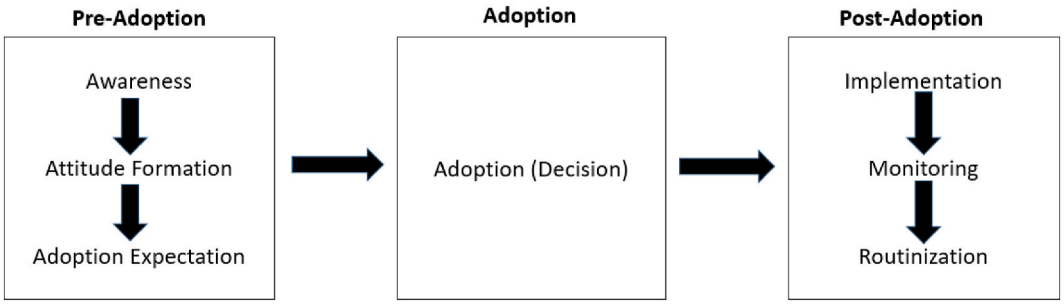

Fig. 1. Innovation adoption process (adapted from [22].

directly and also by moderating the perceived characteristics of an innovation [3]. It has been argued that older managers with longer tenure tend to be less receptive of the innovation as they have more experience and commitment with the routines or procedures they have been operating with over years [33]. On the other hand, the education level is assumed to positively affect adoption as managers with higher education tend to have greater ability to cope with the sense of newness, uncertainty and risks associated with an innovation [27]. Apart from these demographic characteristics, managers' values and beliefs towards innovation can also be critical. Management support and pro-innovation attitude (e.g. toward IT) in general are shown to be positively associated with innovation adoption [34,35] including the IT innovation in hospitals [36] or use of big data [37,38].

2.3. Organisational antecedents

The resources, size, structure, and culture of organisations are deemed to be important factors. One of the most frequently mentioned organisational antecedents in literature pertains to slack resources in terms of personnel or IT facilities [1] which provide the capacity to innovate [34,39]; [40]. There have been various perspectives on the association between size and innovation. While one argument is that smaller organisational structures are more conducive to innovation as a result of their greater flexibility and better adaptive capabilities, the aggregate results from the quantitative reviews indicate that there is a positive association with organisational size and innovation [22]. Larger organisations tend to be more innovative due to increased slack resources, knowledge and broader skills they possess [22,41]. For instance, studies conducted among Italian [42] and Spanish local governments [43] found larger municipalities (with respect to size of population and administration) to be more innovative. In addition to the availability of resources and required skills, larger municipalities are argued to be more innovative due to higher visibility and complexity, which translates into increased social and political pressure from stakeholders and increased workflow that necessitate innovation [42]. Furthermore, organisational structure and culture can also matter [44]. Long established procedures of policymaking and implementation in municipalities tend to be persistent, making public managers to rely on traditions and established "ways of doing things" [45]; [46]). The stable mind-set of any organisation will support only a limited range of product or process innovations [40], and most members of institutions – such as municipalities – will have a difficult time "thinking outside the box" of the dominant ideas of the institution [47]. Concerning the organisational structure, higher formalization and centralisation are argued to hamper innovativeness of organisations, whereas devolved management that delegates higher responsibilities to lower levels fosters it [34,48]; [49]. Organisations superior at external communication and performance management are also theorized to be more innovative [22]; [49]. as well as the ones that nurture an organisational culture favouring experimentation and openness to new ideas, tools or practices [50,51].

2.4. Environmental antecedents

The environmental context in which the organisations operate is also likely to be a major influence by providing opportunities and constraints for innovation [22,28,41,52]. Also mentioned as external antecedents in the literature [9], these may include the societal, political, geographical or market conditions. Review studies of the past research reveal that needs [9] and demands from the public or the political sphere are among the most important external impetus for public sector innovation [1]. Innovation occur as a result of organisations' attempts to adapt to the changes or challenges in their environment and to become more efficient and effective in dealing with these challenges [53]. For instance, urbanisation is argued to pose more complex environments and needs for public organisations to cope with and thus lead to innovative action [22, 41]; [9]. In addition, the regulatory environment, competition with other organisations, and the mimetic isomorphism driven by the influence of networks and inter-organisational interactions are also mentioned as additional environmental antecedents [1].

In the next section, we introduce our empirical case along with our conceptual model and present the hypotheses concerning the influence of the aforementioned factors on the pre-adoption phases that we analyse: attitude formation and adoption expectation.

3. Empirical case and research design

3.1. Empirical case: assessing the potential of a digital process innovation in Swiss municipalities

Municipalities are responsible for realizing numerous environmental and infrastructure related projects such as maintenance of roads and public buildings, river restoration or flood management. As these projects tend to become more complex and involve various sectors and groups of stakeholders including neighbourhood associations, construction companies, local business groups, planning firms, environmental protection groups, and other municipal or cantonal administrative bodies, collaborative and participatory governance become a key aspect for the success of these projects. This requires identification and management of stakeholders that are likely to have competing demands and resolving of potential conflicts. To facilitate municipalities in participatory project management, an online tool, *PlaNet* was developed by the programmers at University of Bern. The tool can typically be used in the planning phase of a project. The users have to answer several questions related to their projects including the potential public and private stakeholders. The output of the tool is a visualization of the network of stakeholders characterized by their potential influence, interest, and attitude towards the project. The tool also provides influence-interest matrix of the stakeholders and thus help users in becoming aware of which stakeholders may pose potential risks or challenges for a project. Finally, users also receive recommendations on how to manage these challenges when setting up the participatory processes. This is particularly important for a country like Switzerland where the participation and information of a broad range of

stakeholders is a mandatory principle introduced by Swiss Confederation and the cantons in many policy fields. Considering that policymaking has become increasingly complex with the involvement of various public and private actors and experts, the careful planning of the participatory process and the inclusion of the right stakeholders at the right moment would reduce these risks, especially in conflict-prone projects [54]. As a free web application, *PlaNet* is designed to provide assistance in systematic assessment of stakeholders and resolving of conflicts that can be crucial for the success of environmental and infrastructure related projects and thus for the quality of municipal services and wellbeing of communities. The potential benefits of digital tools like PlaNet include improvements in transparency, accountability, evidence-based policymaking, learning, efficiency and problem solving [55–58]. Despite of that, the uptake of PlaNet may face several barriers and be contingent to various technological, managerial, organisational and environmental factors elaborated in section 2. Given that PlaNet is least likely to serve for a marketing or window dressing purpose, it allows us to uncover the intrinsic drivers and motivation for digital innovation in local governments more directly.

Our empirical focus on Switzerland has also theoretical and practical relevance. First, although Switzerland is one of the highest ranked countries considering the Global Innovation Index, the innovation in public sector lags behind [21]. Digital initiatives like e-government had only a partial success [20] and according to the Federal Bureau of Economy the progress is slower compared to other European countries [59]. One of the key factors mentioned for this outcome is the federal state structure in which the municipalities have a large degree of autonomy and self-determination [60]. Decentralized governance and the involvement of various stakeholders can cause lengthy processes for reaching consensus [61] and to the increased complexity hampering the progress of digital transformation in Switzerland [62]. Given these challenges, it is worth investigating the factors contributing to the readiness of Swiss municipalities for digital innovation. This is also important in practical sense since municipalities arguably have higher political and societal relevance in Switzerland than most of the other countries. In fact, the majority of Swiss citizens perceive municipalities as the most important political entity in Switzerland [63].

3.2. Conceptual model

As introduced in section 1, we focus on the pre-adoption phase and assess the readiness of municipalities by eliciting the public managers' attitudes towards the *PlaNet* tool and adoption expectation; that is, how likely the manager in charge perceives the tool as being implemented in his/her organisation. Therefore, we treat attitude and adoption expectation as dependent variables[2] and uncover what technological (i.e. characteristics of innovation), individual, organisational and environmental factors influence them. By drawing on the insights from Diffusion of Innovations Theory [32] and Theory of Planned Behaviour [64] we elaborate below on how these factors are related to attitude formation and adoption expectation and derive our hypotheses based on this conceptualization (see Fig. 2).

It is known that managers as influential decision makers play a key role in innovation adoption [22]. We hypothesize that for adoption, a favourable attitude (i.e. a positive disposition) towards the new tool is necessary. In other words, the tool needs to be evaluated positively in terms of its potential benefits. Based on the insights from Diffusion of Innovations Theory [32], we assume the perceived attributes of innovation to have a direct effect on the formation of attitude. Findings from recent studies and meta-analyses reveal that some attributes such as relative advantage, compatibility and complexity are likely to have greater influence on adoption than others such as trialability and observability of an innovation [65–67]. Therefore, in our study we operationalize those more salient attributes and expect the perceived relative advantage and compatibility to be positively associated and complexity to be negatively associated with a favourable attitude. Concerning the relative advantage, we assume two potential benefits of PlaNet as saving time and resources and reducing the conflict potential with and among stakeholders.

H1a. Perceived relative advantage concerning saving time and resources is positively related to a favourable attitude

H1b. Perceived relative advantage concerning reduced conflict potential is positively related to a favourable attitude

H2. Perceived compatibility is positively related to a favourable attitude

H3. Perceived complexity is negatively related to a favourable attitude

Managerial characteristics can also influence attitude formation. Given that PlaNet offers a digitalised alternative of stakeholder management and planning processes, we hypothesize that managers' beliefs about the effect of digitalisation are likely to be an important factor. We expect managers who view the effect of digitalisation on administrative processes positively to possess a favourable towards PlaNet. Furthermore, managers with higher IT literacy are likely to feel more accustomed to using an online tool for their operations. Therefore, we also expect IT literacy to be positively associated with a favourable attitude whereas age to be a negative factor, assuming that older managers tend to feel more comfortable with the existing routines and thus are likely to be more reluctant when it comes to adopting new tools.

H4. Managers' belief about the positive effect of digitalisation is positively related to a favourable attitude

H5. Managers' IT literacy is positively related to a favourable attitude

H6. Managers' age is negatively related to a favourable attitude

In addition to having direct effects on attitude, manager characteristics can also moderate the influence of innovation attributes on attitude [3]. For instance, the impact of the perceived complexity can change depending on the IT literacy of the respondents or the perceived relative advantage with the beliefs held about digitalisation.

H7. Managers' IT literacy and age moderate the complexity-attitude relation.

H8. Managers' attitude towards digitalisation moderate the relative advantage-attitude relation

Although attitude is key for taking an action, it is well documented by behavioural and psychological studies that attitude does not directly translate into behaviour. According to the theory of planned behaviour, subjective norms and perceived behavioural control are also important in determining behavioural intentions [64]. Subjective norms refer to the perception of a decision-maker about others' views or the pressure exerted by others concerning the adoption of a behaviour. Perceived behavioural control accounts for the belief of a decision-maker about the factors facilitating or hindering the performance of a behaviour. For instance, the more resources or opportunities an individual has, the greater perceived control they should anticipate over their behaviour. Projecting this conception to the organisational context, "an innovation can be adopted or rejected in organisations not only due to its expected net benefits but, for example, because of pressure stemming from the environment or because of perceived lack of control over an innovation which are necessary to adopt the new technology" [67].

In our empirical case, perceived behavioural control over the adoption of an innovation can be influenced by the level of organisational resources facilitating or impeding its successful utilization. For example, for the adoption of PlaNet, the organisational IT resources and support can be particularly important. This is operationalized with two measures: presence of an IT specialist in the organisation and a subjective

[2] Due to the sequential phases of innovation adoption process, attitude was also treated as an explanatory variable for the adoption expectation.

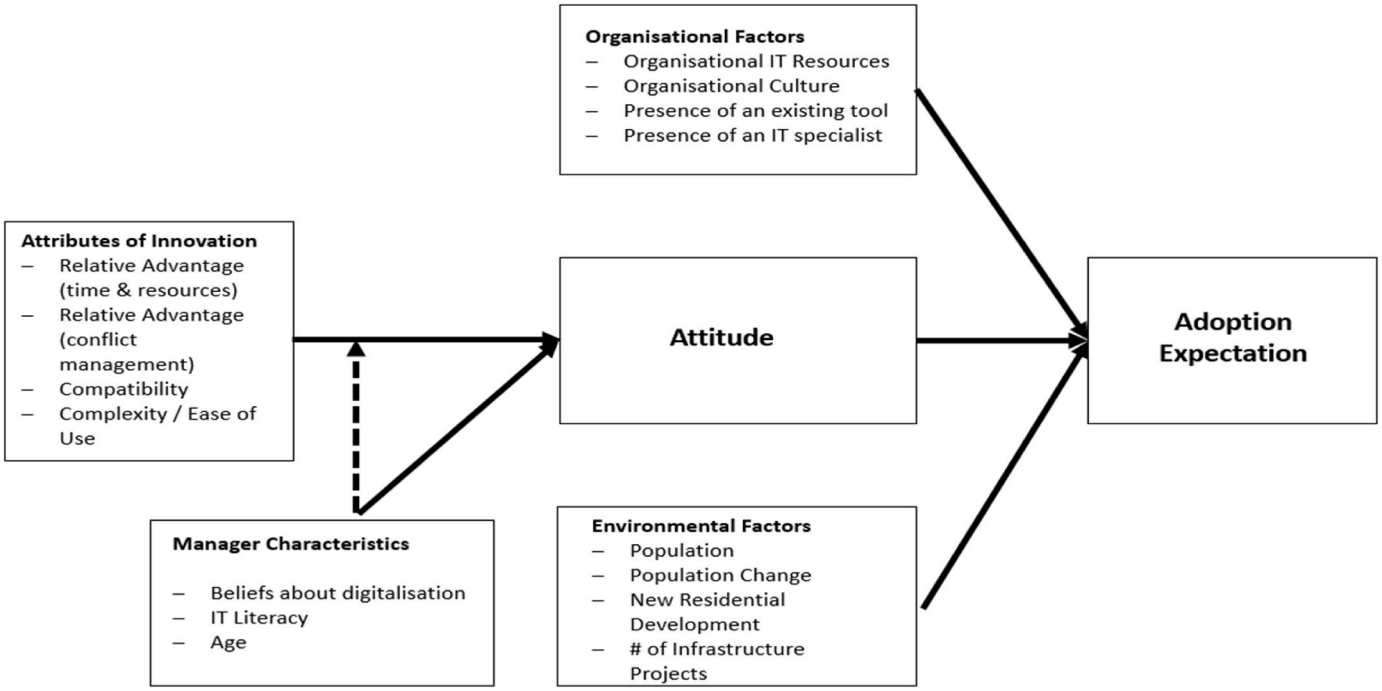

Fig. 2. Conceptual model.

measure eliciting the respondent's perception of adequacy of resources in their organisations. In addition to resources, an experimental organisational culture promoting the testing of new ideas, tools or practices can assure the competence and the experience required for utilizing new tools such as PlaNet. In contrast, we hypothesize the presence of a similar tool in use for stakeholder management to be negatively influencing the adoption expectation.

H9. Positive attitude towards the innovation associates positively with its adoption expectation

H10a. Adequacy of organisational IT resources associates positively with adoption expectation

H10b. Presence of an in-house IT specialist associates positively with adoption expectation

H11. Organisational culture favouring experimentation over the reliance on established tools associates positively with adoption expectation

H12. The presence of a similar tool in use for stakeholder management associates negatively with adoption expectation

In organisational settings, the subjective norms can manifest themselves as demands for or expectations of a certain behaviour. As elaborated in section 2, the environmental context of an organisation plays an important role in creating demand or pressure for innovation. We assume municipalities that needs to deal with larger numbers of projects and stakeholders to be more inclined to use a tool such as PlaNet. Therefore, we also expect municipalities with larger population and growth (including new residential development which requires new infrastructure) to be more likely to be willing to use this tool.

H13. Number of large infrastructure projects carried out by municipalities associate positively with adoption expectation

H14. Population associates positively with adoption expectation

H15a. Population growth associates positively with adoption expectation

H15b. The rate of new residential development associates positively with adoption expectation.

3.3. Methods

Data were collected through an online survey between May–August 2020. The survey was dispatched to 868 municipalities having a population between 2′000 and 20′000. Two reminders were sent approximately a month apart. This population range, corresponding to roughly to 40% of all municipalities in Switzerland, was chosen as the target population after an expert consultation. In Swiss context, they correspond to medium-sized municipalities for which the PlaNet tool is likely to be most relevant. The survey was sent to public managers who are in charge of departments related to infrastructure or construction in municipal administration. In total, 474 respondents took the survey, and 367 completed it, corresponding to a response rate of about 42%.

The survey is prepared in German and French and consists of three sections. The first section includes questions about the infrastructure projects run by municipalities, the type of stakeholders they interact with and the challenges associated. These are followed by questions eliciting respondents' view on the effect of digitalisation in municipal services and administrative processes as well as a question concerning the tools available in their organisations for stakeholder management. Before proceeding with the second section, respondents were presented with a short, introductory 1:30 min long video clip about PlaNet. The video walks the respondents through the main features of the tool (its interface), the type of data that needs to be provided, and the outputs generated. The video was prepared in German, French and Italian. In order to avoid introducing a major bias, we made sure that the narrative maintains a neutral and informative tone. The second section features questions eliciting the respondents' attitude and perception of the attributes of PlaNet as well as their assessment of the likelihood of its implementation in their organisation. These are then followed by questions about organisational factors. Finally, the third section consists of questions about the characteristics of respondents, such as their age and level of IT skills. The entire survey is estimated to take on average 25–30 min to complete. The survey design was made by using Qualtrics and the statistical analyses were conducted with IBM SPSS Statistics 25.0. An overview of the operationalisation of variables included in the empirical analysis is provided in Table 1.

Table 1
Summary table for the operationalisation of dependent and independent variables.

Dependent Variables	Operationalisation
Adoption Expectation	How likely do you see the adoption of PlaNet in your organisation? (1:very unlikely, 2:unlikely, 3: rather unlikely, 4: rather likely, 5: likely, 6: very likely)
Attitude	How helpful do you think PlaNet can be? (1: not helpful at all, …,6:very helpful)
Innovation Attributes	
Relative Advantage (time and resources)	Do you think PlaNet can contribute in saving time and resources? (1: no, not at all, …,6: very significantly)
Relative Advantage (conflict management)	Do you think PlaNet can contribute in resolving or avoiding conflicts with stakeholders? (1: no, not all, …,6: very significantly)
Compatability	How compatible is PlaNet with the existing procedures or routines in your organisation? (1: not compatible et al.…4: very compatible)
Ease of use	How easy is it to use PlaNet? (1: very difficult, …,6: very easy)
Manager Characteristics	
IT Literacy	Which of the following skills do you possess? (the count of the number of skills mentioned) (data analysis using e.g. Excel, R; graphic design; creation and editing of multimedia content; web-design/editing; programming; other)
Age	1: <30, 2: 30–39, 3; 40–49, 4: 50–59, 5:≥60
Belief_digitalisation on services	How do you evaluate the effect of digitalisation on the quality and efficiency of municipal services? (1: very negative, …,6: very positive)
Belief_digitalisation on adm. processes	How do you evaluate the effect of digitalisation on the quality and efficiency of administrative processes? (1: very negative, …,6: very positive)
Environmental Factors	
Population	Swiss Federal Statistical Office
Population Change	Swiss Federal Statistical Office
New Residential Development	Swiss Federal Statistical Office
Amount of large projects	How many large projects (larger than 250′000 CHF) were planned or implemented by your municipal administration in the last 5 years? (1: none, 2: 1–2, 3: 3–5, 4: 6–10, 5: more than 10)
Organisational Factors	
Organisational IT Resources	How do you rate the level of IT resources in your organisation? (1: totally inadequate, …,6: totally adeaquete)
Organisational Culture	Which of the following statements apply to your organisation the most? Rate their relative importance for your organisation by placing the slider along the continuum from −10 to 10. (−10: It is very important in my organisation to experiment with new tools, procedures, …,10: It is very important in my organisation to rely on the established tools, procedures developed over the years)
Any existing tool for stakeholder management?	Is there a specific tool or procedure in your organisation to identify stakeholders and manage their participation? 0: No, 1: Yes
Presence of an IT speacialist	Do you have in your organisation an IT speacialist? (0:No, 1:Yes)

4. Results

The descriptive statistics and correlation matrix are provided in Table 2. The results show that the perceived attributes of innovation and some individual factors such as managers' beliefs about the effect of digitalisation in municipal services and administrative processes correlate significantly with their attitude towards PlaNet. The sign of the correlation coefficients indicates that respondents who find PlaNet beneficial for saving time and resources, managing conflicts and those who evaluate it as easy to use and compatible with their organisations tend to have a favourable attitude. This also applies to respondents who believe that digitalisation has a positive impact on the quality of municipal services and the efficiency of administrative processes, with

Table 2
Descriptives and correlation matrix.

		Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Adoption Expectation	2.78	1.02																		
2	Attitude	3.84	0.94	.60[a]																	
3	Rel. Adv. (time and resources)	3.15	0.99	.62[a]	.67[a]																
4	Rel. Adv. (conflict management)	3.18	1.08	.51[a]	.52[a]	.64[a]															
5	Compatability	2.55	0.75	.54[a]	.38[a]	.37[a]	.34[a]														
6	Ease of use	4.06	0.73	.26[a]	.15[b]	.12[b]	.15[a]	.46[a]													
7	IT Literacy	1.44	1.40	.06	−.01	−.01	.01	.01	.12[b]												
8	Age	3.45	1.00	.02	.01	−.01	−.06	−.04	−.16[a]	−.1											
9	Belief_digi_services	4.83	0.68	.13[b]	.13[b]	.15[a]	.17[a]	.14[b]	.23[a]	.06	−.19[a]										
10	Belief_digi_administratvie processes	4.78	0.76	.18[a]	.19[a]	.18[a]	.19[a]	.16[a]	.19[a]	.07	−.09	.61[a]									
11	Population	6106	4108	.11[c]	−.11[c]	−.08	−.02	.18[a]	.18[a]	.07	−.09	−.07	−.05								
12	Population Change	8.82	7.11	−.04	.03	.03	.04	−.09	−.06	−.01	−.05	.07	.02	.07							
13	New Residential Development	6.39	6.64	.05	.00	−.02	.03	.04	.00	−.03	.04	−.04	.01	.11[c]	.41[a]						
14	IT Resources	4.12	0.98	.00	.02	−.01	.01	−.02	.12[b]	.12[b]	.03	.14[b]	.11[c]	−.07	−.01	−.01					
15	Organisational Culture	−0.23	5.16	−.20[a]	−.09	−.14[b]	−.09	−.22[a]	−.28[a]	−.05	.11	−.16[a]	−.26[a]	−.08	.08	−.02	−.15[b]				
16	Amount of large projects	3.83	0.96	.12[b]	.05	.02	.12[b]	.14[b]	.13[b]	.01	−.11[c]	.00	.01	.46[a]	.02	.02	.11[c]	−.02			
17	Presence of an existing tool	0.15	0.36	.06	.08	−.01	−.04	.08	.00	.14[b]	.10[c]	.08	.11[c]	−.03	−.13[b]	−.03	.19[a]	−.01	.03		
18	Presence of an IT specialist	0.53	0.50	.21[a]	.05	.09	.08	.17[a]	.08	.09	.04	−.06	.03	.36[a]	−.04	.01	.14[b]	−.07	.25[a]	.05	

c. Listwise N = 296.
[a] Correlation is significant at the 0.01 level (2-tailed).
[b] Correlation is significant at the 0.05 level (2-tailed).
[c] Significant at the 0.1 level (2-tailed).

the latter possessing a stronger association with attitude than the former. As expected, the organisational and environmental factors are not significantly related to attitude towards PlaNet. On the other hand, the adoption expectation seem to be not only related to attitude and aforementioned attributes of innovation, but also to some other organisational and environmental factors. Population, number of projects run, the presence of an in-house IT specialist and experimental organisational culture[3] have a statistically significant positive association with the adoption expectation, yet not with attitude as in line with our expectations. Hence, these findings provide a first evidence for our conceptualization of how various antecedents of innovation are specific to pre-adoption phases.

In order to test the effect of each independent variable while accounting for the others we run logistic regression first with attitude and then the likelihood of adoption as dependent variables. Due to no or very little number of responses for some answer categories (e.g. very likely or very negative) we dichotomized the dependent and independent variables measured at ordinal levels by grouping the answer choices such as "rather positive" and "positive" or "rather likely" and "likely" as one category. We also think this is reasonable conceptually since some of the key variables in our study such as adoption of innovation are binary in nature.

For both analysis, we use hierarchical regression in which we enter the variables into the model based on their type and theoretical relevance. For analysis of attitude, we first entered the individual characteristics of managers (Table 3). The resulting model 1 is statistically significant ($p < .05$). Among the individual characteristics, pro-digitalisation beliefs is significantly associated with attitude. Odds ratio indicates that managers who believe digitalisation has a positive impact on the administrative processes are 2.28 times more likely to have a favourable attitude towards PlaNet. Adding innovation attributes has significantly increased the predictive power of the model ($p < .001$). Although these attributes are all positively associated with attitude, relative advantage stands out as the most important predictor confirming the hypothesis 1a and 1b. Both the potential benefits concerning time and resources (p.<0.001) and conflict management ($p < .01$) are statistically significant, with the former exhibiting a stronger association with the dependent variable. In model 2, the pro-digitalisation beliefs are no longer significant when the effect of innovation attributes are accounted for, which yields partial support for hypothesis 4. We finally check for the potential moderation effect of individual characteristics. The inclusion of interaction terms in model 3 did not significantly increase the predictive value and none of the interactions terms are statistically significant. Thus, we did not find evidence for hypotheses 7 and 8 as well as for hypotheses 5 and 6 which proposed positive impact of IT literacy and negative impact of age.

We run the analysis also for adoption expectation first by entering attitude into the model. Model 1 is statistically significant (p.>001) and as expected, attitude is found to be a very strong predictor of adoption potential. The odds ratio suggests that organisations having a favourable attitude towards PlaNet are on average 13 times more likely to adopt the tool (Table 4). While we have strong evidence supporting hypothesis 9, our results also suggest that positive attitude does not directly translate into adoption. Although the majority of the respondents (~65%) have a favourable attitude towards PlaNet; that is, they found the tool helpful for the identification and management of stakeholders, only about 20% see its implementation in their organisation as likely. The results of the cross tabulation (Table 5) suggests that having a positive attitude is perhaps necessary but not sufficient for its adoption [68].

We therefore add environmental and organisational factors that may influence behavioural intentions through norms or perceived behavioural control in model 2 and 3, respectively. As can be seen from Table 5, while the addition of both environmental and organisational factors increased the predictive power of the model, this effect was not significant ($\Delta \chi 2$: 8.29, $p < .10$ for model 2 and $\Delta \chi 2$: 6.95, $p = .138$ for model 3). The result show that hypotheses 11 and 14, proposing a significant positive association of population and experimental organisational culture with adoption potential, are supported. Since the unit of measurement in the variable of population is very small (i.e. individual), we re-scaled it by expressing the population as thousands of inhabitants. As a result, one unit of increase in population, which corresponds to an increase of a thousand inhabitants, increases the likelihood of adoption by 8%. Likewise, municipalities favoring experimental work culture are about 2 times more likely to adopt PlaNet compared to the ones with predominantly conservative work culture. On the other hand, there is partial support for the hypothesis 15b, as new residential development has a weak positive relation ($p < .10$) with adoption expectation. Although both the presence of an IT specialist (hypothesis 10b) and the number of projects (hypothesis 13) conducted by municipalities have significant correlation with adoption expectation, this relation is no longer statistically significant when accounting for the effect of other variables in regression models.

Finally, we tested whether the attributes of innovation have a direct effect on the adoption expectation when controlling for the attitude, population and organisational culture. The results show that both of the relative advantage measures (i.e. time and resources and conflict management) and perceived degree of compatibility are significantly positively related with the adoption expectation while the effect of perceived ease of use is not significant. However, since the direct effects of innovation attributes are reduced (although still significant) when attitude is controlled for, we also run a mediation analysis to check if the attitude is mediating the relation between attributes of innovation and adoption expectation. The mediation analysis was conducted by Hayes' PROCESS v3.5 macro.

We tested the mediation effect of attitude for both the relation of perceived relative advantage and compatibility on adoption expectation (Fig. 3). A general relative advantage score was computed by adding the two relative advantage measures for time and resources and for conflict management. In the first test, we included the relative advantage as the predictor variable with the other attributes, compatibility and ease of use as covariates and attitude as the mediator variable. The first model yields the effect of predictor and the covariates on the mediator. While relative advantage ($b = 0.32$, $t\ (332) = 14.11$, $p < .001$) and compatibility ($b = 0.23$, $t\ (332) = 2.61$, $p < .01$) are found to be significant predictors of attitude, the ease of use is not ($b = 0.08$, $t\ (332) = 0.74$, $p = .45$). The second model features the effect of predictor, mediator and covariates together on the dependent variable. The results show that attitude as mediator variable significantly affects the adoption expectation ($b = 0.91$, $p = .001$). The direct effect of relative advantage was also found significant when attitude as the mediator variable is controlled for ($b = 0.67$, $p < .001$). These findings indicate that the effect of relative advantage on adoption expectation is partially mediated by attitude and this indirect effect is found to be statistically significant ($b = 0.28$, 95% CI [0.35, 0.98]). Repeating the analysis with compatibility as predictor and relative advantage and ease of use of as covariates revealed similar results. Attitude is also found to be partially mediating the relation between compatibility and adoption expectation. However, comparison of the coefficient of indirect ($b = 0.21$, 95% CI [0.04, 0.49] and direct effects ($b = 2.01$, $p < .000$) suggest that the mediation of attitude on the relation between relative advantage and adoption expectation is more prominent than its effect on the relation between compatibility and adoption expectation.

5. Discussion

By investigating the determinants of attitude formation and adoption

[3] Since the scores from 0 to minus 10 indicate preferences towards experimental organisational culture and 0 to 10 the conservative, the negative correlation coefficient indicates that the former is positively related with adoption expectation.

Table 3
Results of regression analysis (Dependent Variable: Attitude).

	Model 1			Model 2			Model 3		
	B (S.E.)	OR	95% CI OR	B (S.E.)	OR	95% CI OR	B (S.E.)	OR	95% CI OR
Manager Characteristics									
Belief.Digi.Adm	0.82**(0.25)	2.28	[1.39, 3.74]	0.36 (0.30)	1.43	[0.80, 2.57]	0.44 (0.35)	1.55	[0.78, 3.09]
Age	0.01 (0.24)	1.01	[0.63, 1.63]	0.33 (0.30)	1.39	[0.77, 2.51]	0.08 (0.40)	1.08	[0.27, 4.26]
IT Literacy	0.04 (0.09)	1.04	[0.87, 1.23]	−0.011 (0.11)	0.99	[0.80, 1.22]	−0.055 (0.27)	0.95	[0.55, 1.62]
Innovation Attributes									
Rel.Adv (time, res.)				2.43*** (0.43)	11.4	[4.93, 26.14]	1.85** (0.71)	6.37	[1.60, 25.46]
Rel.Adv (confl. mng.)				0.80** (0.34)	2.22	[1.14, 4.32]	1.35* (0.61)	3.86	[1.17, 12.73]
Compatability				0.32 (0.30)	1.38	[0.77, 2.49]	0.33 (0.30)	1.39	[0,77, 2.51]
Ease of use				0.54 (0.38)	1.72	[0.82, 3.61]	0.28 (0.72)	1.33	[0.33, 5.45]
Interaction Terms									
Belief.Digi.Adm* Rel.Adv (time, res.)							0.87 (0.89)	2.38	[0.42, 13.52]
Belief.Digi.Adm* Rel.Adv (conf.mng.)							−0.81 (0.73)	0.45	[0.11, 1.85]
Age * Ease of use							0.30 (0.77)	1.35	[0.30, 6.11]
IT Literacy * Ease of Use							0.05 (0.30)	1.05	[0.58, 1.88]
Constant	0.18 (0.28)	1.20		−1.19** (0.45)	0.30		−1.01 (0.67)	0.37	
−2 LL	401.72*			302.98***			301.109***		
Df	3			7			11		
χ2	11.07*			109.81***			111.69***		
Nagelkerke R^2	0.046*			.396***			.401***		
Δ χ2				98.74***			1.88		
Δ R^2				.35***			.005		

Note: *p < .05. **p < .01. ***p < .001.

Table 4
Results of regression analysis (Dependent Variable: Adoption Expectation).

	Model 1			Model 2			Model 3		
	B (S.E.)	OR	95% CI OR	B (S.E.)	OR	95% CI OR	B (S.E.)	OR	95% CI OR
Behavioural Preferences									
Attitude	2.59***(0.61)	13.3	[4.07, 43.56]	2.67***(0.61)	14.4	[4.36, 47.58]	2.68***(0.62)	14.6	[4.36, 48.86]
Environmental Factors									
Population				0.08* (0.04)	1.08	[1.01, 1.16]	0.08* (0.04)	1.08	[1.00, 1.17]
Population Change				−0.02 (0.02)	0.98	[0.94, 1.02]	−0.02 (0.02)	0.98	[0.94, 1.03]
New Residential Development				0.03 (0.02)	1.03	[0.99, 1.08]	0.04† (0.02)	1.04	[0.99, 1.08]
# of Infrastructure Projects				0.06 (0.33)	1.06	[0.56, 2.01]	0.02 (0.34)	1.02	[0.53, 1.97]
Organisational Factors									
Organisational Resources							0.12 (0.16)	1.13	[0.82, 1.55]
Experimental Organisational Culture							0.70* (0.31)	2	[1.10, 3.64]
Presence of an existing tool							0.17 (0.38)	1.18	[0.56, 2.51]
Presence of an IT specialist							0.01 (0.33)	1.01	[0.53, 1.95]
Constant	−3.45***(0.59)	1.20		−4.08***(0.68)	0.20		−5.04***(1.00)	0.01	
−2 LL	292.42***			284.13***			277.31***		
Df	1			5			9		
χ2	36.21***			44.50***			51.33***		
Nagelkerke R^2	0.168***			.203***			.232***		
Δ χ2				8.29†			6.83		
Δ R^2				.035†			.029		

Note: †. p < .10, *p < .05, **p < .01, ***p < .001.

Table 5
Cross-tabulation of attitude and adoption expectation.

		Attitude		Total
		Negative	Positive	
Adoption	Unlikely	114	167	281
	Likely	3	68	71
	Total	117	235	352

expectation our study reveals which factors gain prominence during the oft-neglected pre-adoption phases. The study thereby contributes to a more nuanced understanding of the innovation process. Although the strongest determinants turned out to be the perceived attributes of innovation, specifically the relative advantage and compatibility, certain environmental and organisational factors such as population and organisational culture also show significant effects. In fact, their prominence for innovation adoption can be argued to be even higher considering their influence on adoption expectation, which stands out as the limiting step, given that in most cases a positive attitude does not translate to higher adoption expectation. The importance of perceived attributes of innovation is in line with the work of [14]; who found relative advantage and complexity to be the decisive factors for the adoption IoT (internet of things) solutions in French municipalities. It also supports findings of [3]; who observed innovation characteristics to be predictive of the innovation adoption by local governments in United States beyond the influence of organisational and environmental factors. Similar to their findings, we also did not observe any moderation effect of manager characteristics on the impact of attributes of innovation. However, apart from a relatively weak association of pro-digitalisation beliefs, manager characteristics such as IT literacy or age were found not to have significant direct effect neither on the attitude formation nor the adoption expectation. One potential reason for this outcome can be the simplicity of PlaNet, which does not require qualifications or expertise to utilize.

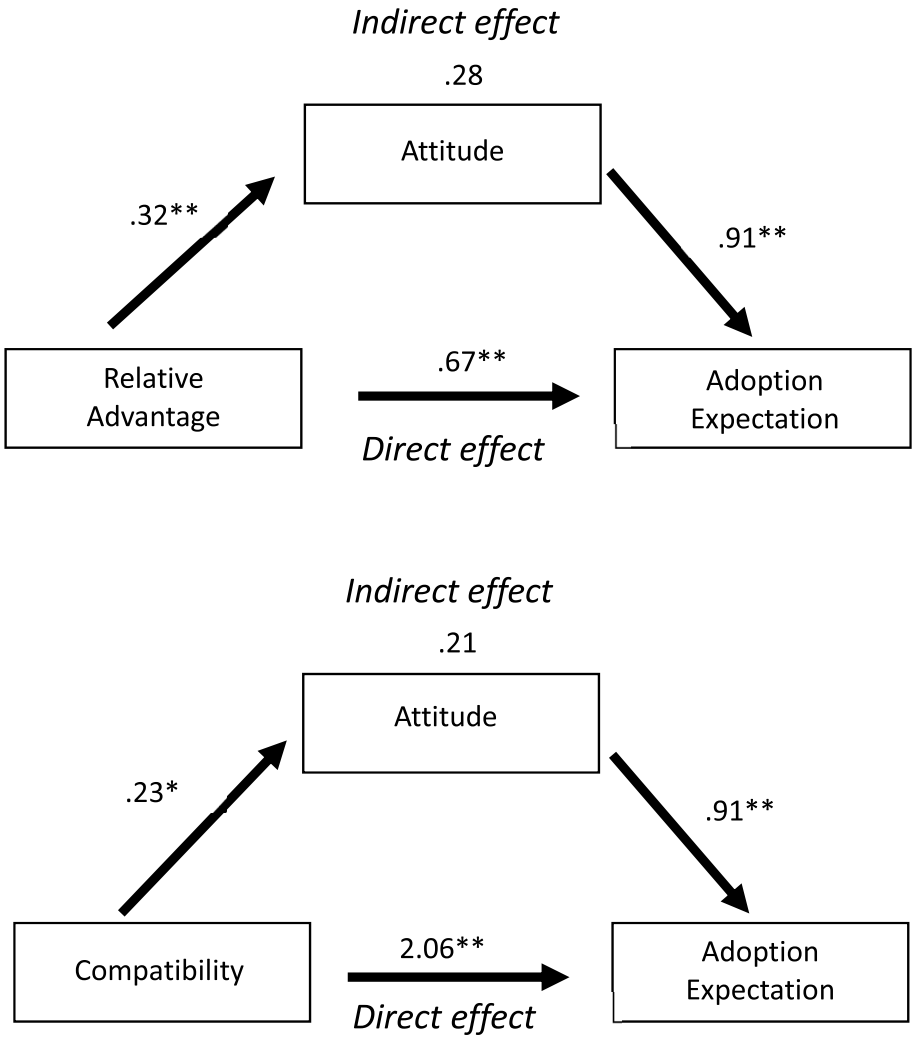

Fig. 3. Mediation analysis.

This same reason can also explain why the perceived complexity (or perceived ease of use as we called it in this study) does not have any significant association with attitude or adoption expectation. Likewise, the organisational resources including the self-rated adequacy of IT resources within the organisation and the presence of an IT specialist are not significant predictors when the other variables are accounted for in the regression models. It is rather the organisational needs (driven by environmental context) and the pro-innovation organisational culture that are associated with the adoption expectation of PlaNet. Population, growth and urbanisation are widely acknowledged in the literature as important drivers of innovation [22,42,69,70] and they can be especially important for the adoption of a tool like PlaNet. Larger population and a dynamic urban environment with relatively fast residential development can present opportunities but also pose challenges. These challenges are due to potentially increased number of projects, new entrants in actor networks and the increasing complexity of interactions among different sectors, which altogether comprise a more complex ecosystem of stakeholders. Our findings suggest that in such settings, the incentive for the implementation of online tools such as PlaNet is likely to be higher.

In addition to the environmental factors acting as external antecedents, internal antecedents [9] such as the presence of an organisational culture favouring innovation are also found as important for the adoption potential. The significance of an innovative or experimental culture can be especially important for digitalisation, as many organisations still struggle to undertake the transition from paper-based management [71]. Other studies have also underlined the organisational culture and specifically the readiness for IT and data-oriented management to be the staple of digital transformation in public sector [69,72] and for utilization of big data in governance and decision-making [38,73,74]. In fact, we also observe in our study a significant correlation between pro-digitalisation beliefs and innovative organisational culture (Table 2). This suggests that even though the effect of pro-digitalisation beliefs is not significant when accounting the effect of innovation attributes, they can still be indirectly influencing innovation adoption through organisational culture. However, the direction of influence can also be the other way around. There can simply exist a higher likelihood of finding managers with pro-digitalisation beliefs in organisations with an established innovative culture.

Overall, our results highlight that the perceived attributes of innovation and the behavioural preferences are linked and that both have an influence on the potential adoption behaviour [67]. Although the indications for the influence of behavioural antecedents like norms or perceived behavioural control were somewhat weaker, attitude is found to be a strong predictor of adoption expectation. It also partially mediates the effect of innovation attributes such as the relative advantage and compatibility on the adoption expectation. The mediation of attitude is more pronounced for relative advantage than for the compatibility. At the same time, the results also show that these two attributes have significant direct effects not only on attitude but also on adoption

expectation, even when the attitude is controlled for. Similar to the meta-analysis findings of [67]; we also found relative advantage to be the most salient attribute for the attitude and attitude as the most prominent behavioural influence on the adoption decision. Therefore, our study concurs with their view that both the theory of diffusion and the theory of planned behaviour have complementary merits in explaining adoption decision, and thus should be used in integrative way.

Apart from contributing to the theoretical knowledge, due to its prospective nature, the insights from our study can be particularly relevant for design and marketing of *PlaNet* and tools alike. The salience of relative advantage and compatibility suggest that the potential benefits of a product should be made explicit while not compromising its compatibility for the target organisations. Our findings hint that the beliefs of users can also be an important antecedent of their attitude. Therefore, in addition to particular design strategies, the framing and communication around innovation can also be a critical aspect for its adoption. On that note, several other factors influencing the belief systems in public organisations such as public pressure, top-down influence from higher levels of governments, achieving a competitive advantage over the similar organisations and learning [75] can be relevant. The learning model seems to be the most likely path for the diffusion of tools like PlaNet in an empirical setting such as Switzerland where municipalities (i.e. local governments) are granted high autonomy. While public organisations with experimental or innovative culture are more likely to be the early adopters, other organisations can still become aware of, learn from, and emulate what they perceive as successful implementation elsewhere [40]. This peer effect can be expected to be stronger when the adopting organisation are in greater geographical or institutional proximity. While mimetic isomorphism [45] can lead to increasing rates of adoption, reaching of a critical mass can further trigger normative isomorphism as the beliefs and professional values accompanying an innovation become prevalent in an organisational field. To study such diffusion processes in more detail, further research can follow a longitudinal approach where they keep track of organisations' behaviour and interactions with their environment across the different phases of innovation. A second line of research can focus on the organisations themselves and uncover the underlying mechanisms linking the antecedents to innovation outcomes. Observational studies can elucidate the motives, challenges and entrepreneurial strategies associated with implementation of innovations within organisations.

6. Conclusion

Innovation adoption can be a long process, as forming opinions and stable preferences or initiating changes in beliefs can take time. This is especially true in organisational settings where decision-making processes can be complex and guided by a variety of logics or interests. Within this larger context, our study is limited to providing a cross-sectional account of potential users' immediate reaction to an innovation stimulus and not their adoption decision. Yet, our focus on the less researched pre-adoption phases also provides novel insights into the readiness of municipalities, the likely bottlenecks in innovation adoption, and the technological, managerial, organisational and environmental factors that are crucial to this process. Thus, in addition to identifying the potential early adopters, our study also enables developing targeted strategies and interventions to promote the uptake of innovation. Further studies can use our findings as a basis to set up a longitudinal or case-study oriented research to uncover the mechanisms underlying the adoption process within the organisations and diffusion dynamics across the landscape of organisations.

Author statement

Mert Duygan: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft, Writing – Review & Editing, Visualization. **Manuel Fischer**: Resources, Writing – Review & Editing, Supervision, Project Administration, Funding Acquisition. **Karin Ingold**: Resources, Writing – Review & Editing, Supervision, Project Administration, Funding Acquisition.

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Declaration of competing interest

The authors have no conflict of interests to declare.

Data availability

The data that has been used is confidential.

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