



# Smart public goods: A smart bench does not necessarily make a smart city in the Czech Republic

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## Abstract

Our paper summarises the results of a study conducted at the turn of 2021 and 2022 on the awareness of the existence of smart benches in the public space of Czech cities and municipalities. Smart benches represent one of a number of smart features that are implemented as part of the practical application of the smart city concept into the real environment of these municipalities. As our research has shown, the experience and awareness of smart public goods, specifically Smart benches, is currently at a rather low level among the public in the Czech Republic. This finding may trigger a discussion on their public justification in the context of their acquisition costs, but also, on the other hand, accentuate the need for their greater promotion.

## Keywords

- smart city
- smart public goods
- smart bench
- Czech Republic

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## Introduction

Awareness of the nature of public goods has its origins in the founders of classical political economy such as David Hume, Adam Smith or John Stuart Mill. Contemporary economic thinking is aware of the existence of goods that do not bring any profit, but are necessary for the life of civil society, the development of the economy and the support of the social system (Varadzin, 2016). The systematic investigation of public goods on the basis of contemporary standard economics is associated with the name of P. A. Samuelson, who relates two key properties to public goods, i.e. rivalry and excludability (Samuelson & Nordhaus, 2010). Thus, public goods, both tangible and intangible in nature, are now traditionally, and in the context of economic theory, characterised by irreducibility of consumption and non-excludability from consumption, which is complemented by the zero marginal cost condition (Buchholz & Sandler, 2021; Mankiw, 1999). Given the objective limits of these strict “pure public goods” conditions, public goods have been further categorised into mixed or club goods (see Sandler, 1998; Varadzin, 2017). In practice, then, varying degrees of excludability and rivalry apply to public goods. In our conception, we thus define a public good as “a product or service that is available to all those who subjectively want or objectively need it, in a rational quantity immediately or in sufficient numbers over a longer time horizon” (Turečková et al., 2022). Returning to our definition of public goods, the condition of non-excludability is reflected in “available to all” and non-diminishability in “a rational amount ... or a sufficient number ...” (Turečková & Nevima, 2022). Smart public goods are then specific pure public goods that have innovative specific characteristics and functions, thus creating additional utility added value that distinguishes them from conventional public goods (Turečková et al., 2022). Common smart public goods include, for example, smart public transport stops, dimmable lighting, sensor waste containers, smart parking systems or smart benches (Alizadeh & Irajifar, 2018; Slavík, 2017; Turečková & Nevima, 2022). The latter smart public asset, the smart bench, is the object of our research, which is presented in this paper.

Smart public goods form an important part of the implication of the tangible elements of the smart city concept into the public space of cities and municipalities. The question remains whether the society in question is (currently – now) confronted with them in a desirable way and has an objective and subjective need to use their additional functions. This is what we have tried to find out on the example of smart benches by means of a questionnaire survey, and it is the conclusions of our research that are presented in this article. Thus, the political and economic justification for the acquisition of these “fashionable” public goods may have an additional financial dimension – the cost dimension, where smart benches in the Czech Republic are up to twenty times more expensive than conventional benches

(Turečková et al., 2022). Thus, we encounter here the rationality, efficiency and limits of the economy of public finances (Wildasin, 2021).

The paper is conceived in a traditional way reflecting standard scientific texts. The Introduction is followed by a chapter on the definition of smart public goods, which has been missing in the scholarly sources so far. This notion of smart public goods is the authors' own and is based on the concept of the smart city. The object of the research, the smart bench, is also characterised. This is followed by the Methodology and Data, in which the methods used are presented, their justification in relation to the fulfilment of the stated objective, including a description of the data sources used in the text. The questionnaire survey is presented in more detail. The fourth part is fully subordinated to the evaluation of the questionnaire survey in order to clarify the attitudes and knowledge of the respondents towards the existence of smart benches in the public space of Czech cities and municipalities. The last section, Conclusion and Discussion, summarises the most important information presented in this paper, including a discussion reflecting the findings.

## 1. Smart public goods and smart bench

The topic of “smart public good(s)” has not been addressed before in the context of its definition. Our approach to defining smart public good(s) is thus based a priori on the concept of smart city, based on the logical and factual link between the public good and the public sector (municipality or city) that provides or finances the public good(s), reflecting the changes brought about by the fourth industrial revolution (for more see for example Brynjolfsson & McAfee, 2014; Chauhan et al., 2021; Ross & Maynard, 2021; Skobelev & Borovik, 2017) and the transformation of society (Society 4.0) and its demands, attitudes and needs (Kamensky, 2017; Mazali, 2018).

The concept of the smart city started to develop in the late 1980s (Anthopoulos & Vakali, 2012), but it was first described professionally only in 1998 (Mahizhnan, 1999; Van Bastelaer, 1998). A smart city can be defined as a city in which all sectors (public, private and non-profit) are actively connected and implement actions and activities to positively influence the quality of urban life (Manville et al., 2014). Such a city is technological, interconnected, sustainable, convenient, active and safe (Sansaverino et al., 2014). The smart city concept integrates elements of the concepts of smart and innovative cities, circular economy, sharing economy, Industry 4.0 (more also Angelidou, 2014; Caragliu et al., 2011; Dominici, 2012; Kourtit & Nijkamp, 2012; Kumar, 2017; Lee et al., 2014; Lom et al., 2016) and the concept of sustainable development (MacGregor Pelikánová et al., 2021;

Turečková & Nevima, 2018), whose underlying purpose is social responsibility (Pakšiová, 2016) with the aim of deepening the well-being and satisfaction of citizens while preserving cultural, historical and social traditions and ties (Turečková & Nevima, 2019) and the concept of resilience, e.g. in the context of economic, climatic, technological, security, health and migration risks (Vaňová, 2021), with the aim of ensuring the competitiveness of the city itself (Borseková et al., 2017). A smart city should provide better and higher quality services for its residents and visitors, a better environment, a more modern industry based on social and environmental responsibility that is also more citizen-friendly, smarter infrastructure, open local government, a dynamic, sustainable and innovative economy based on more efficient allocation and effective use of resources (Manville et al., 2014). Residents' satisfaction with life should increase with the quality of life, which in turn should lead to the competitiveness of the city in a globalising environment, also due to the high productivity of manufacturing factors and their compatibility and flexibility. A tangible reference to a functioning smart city concept is the offer of "Smart" public goods that are available in the public space of a smart city.

Reflecting on the smart city concept described above, attaching the term "smart" to any word will emphasise the thoughtful and innovative approach that is generally characterised by the use of highly sophisticated analytical methods, processes, communications and techniques for designing goals, procedures and planning, and applies to the entire field of transferring smart solutions into tangible and intangible innovations (Angelidou, 2014; Borseková et al., 2018). In the context of public goods, a smart good will be considered as one that, beyond its traditional and generally expected function, offers "something additional" that is reflected in technological and technical innovation, offers added value in terms of ecology, sustainability or utility, and/or has characteristics that promote the creation of additional positive externalities. In other words, these smart public goods have specific characteristics and utility-user functions, thus creating additional added value that distinguishes them from conventional public goods. Thus, the adjective smart in the context of public goods refers to the fact that the product or service has an additional – new – dimension that adds to the existing public good with "additional externalities, innovative and functional aspects offered and consumed in a responsible way and with a positive impact on society". By combining the above, smart public goods contribute to the quality of life of residents while increasing the satisfaction of non-residents and visitors (Turečková et al., 2022).

Based on the above, and in combination with our definition of public goods, we then define smart public goods as goods "that are available to all who subjectively want or objectively need them, in reasonable quantities immediately or in sufficient quantities over a longer time horizon, and which have (compared to standard public goods) additional externalities, innovative and functional aspects offered and consumed in a responsible manner and with a positive impact

on society” (Turečková & Nevima, 2022). We are not able to critically confront this conception of smart public goods with other definitions because, as already mentioned, we have not found any other specific economic definition of smart public goods. Let us add that smart public goods and their implementation in cities and municipalities are not conditioned by the application of the smart city concept in the respective municipality, i.e. even municipalities that do not label themselves as smart cities can have smart public goods available in their public spaces. In the context of smart public goods, we have chosen smart benches as the object of our research.

Smart public benches differ from the standard ones (see Fig. 1) in additional features, renewable energy use, material, design and price. Apart from the possibility to sit down, i.e. the basic seating function, smart benches usually have innovative features such as solar panels and a battery that can charge a phone or laptop via USB, conventional power sockets, a hotspot for local Wi-Fi, are equipped with LED lighting (dimmable and motion-sensitive), can include a small weather station (measuring temperature, humidity, air pressure, etc.), a station for recording the noise level, specific sounds (gunshots, breaking glass, calls for help and other) or the concentration of airborne dust or CO<sub>2</sub>. They may also have sensors to measure the use of public space and the number of people, built-in LCDs for



**Figure 1. Two smart public benches in Prague and “standard” benches in the Czech Republic**

Source: smartprague.eu; lupa.cz; own; own (clockwise).

advertising or other information (e.g. via QR codes), and may include bike racks for cyclists, air compressors or chargers to recharge them. Some benches also have heat-regulated seats or a wireless charging system.

The smart benches are made energy-independent through built-in solar panels and batteries that enable them to operate even on days without sunshine; they are made of durable materials, easy to maintain, environmentally friendly, fulfilling the principles of social responsibility, supporting the local design character and reflecting the urban aspects of the metropolis. It is often stated that smart benches are a 100% self-contained system that operates 24/7 in all weather conditions and situations. As a matter of interest, let us add that prices of smart benches range from 100 thousand CZK (4,000 EUR) upwards (the usual price is about 200 thousand CZK, i.e. 8,000 EUR). The price of standard benches ranges between 5,000–10,000 CZK (200–400 EUR) (Turečková et al., 2022).

## 2. Methodology and data

The theoretical part is based on the synergy and synthesis of scientific knowledge from the research of expert sources on the issue of public goods, which are inductively combined with knowledge related to the concept of the smart city in order to innovatively define the concept of “smart public goods”. This part is complemented by primary research carried out in the form of a questionnaire survey and a final summary, which is again inductive in nature with the aim of generalising the findings from the analysis of the questionnaires toward finding answers to the general experience of respondents with smart benches in the public space of Czech municipalities. The key for us in the implementation of the questionnaire survey was to “look” at the existence of these benches also from the perspective of rationality, functionality and effectiveness. In the introductory, theoretical part, the method of description is traditionally used, while in the analytical part, it is mainly the methods of analysis, comparison, synthesis and induction. Let us add that the number of publications and studies on smart public goods is still very limited, and we will therefore draw mainly on our own scientific experience in this area, which is based on our published outputs, see Turečková et al., 2022; Turečková and Nevima, 2022. The research is based on the confirmation of established hypotheses, but the main research question is the following: “What is the awareness of smart benches among the inhabitants of the Czech Republic?”

The survey was conducted online via Google Forms between November 2021 and April 2022 and was primarily addressed to university students in the Czech Republic and their family members. The method of online distribution and the pri-



mary choice of the respondents (university students) was deliberate, as it is proven that young people are the most knowledgeable about modern technologies, smart products and innovative features and naturally seek these goods (Wahler & Tully, 1991). A total of 390 respondents completed the questionnaire, with 246 young people aged 19–25. It should be added that the questionnaire contained a total of 10 questions, one of which was completely open-ended, and for three questions the respondents had the opportunity to add their opinion under the answer “other”. In these cases, however, the respondents did not answer or did not give their opinion (except for 4 people whose answers are not objectively relevant). There was only one identification question and it concerned the age of the respondents. The dataset of the selected responses to the survey is available in absolute and relative terms in the Appendix.

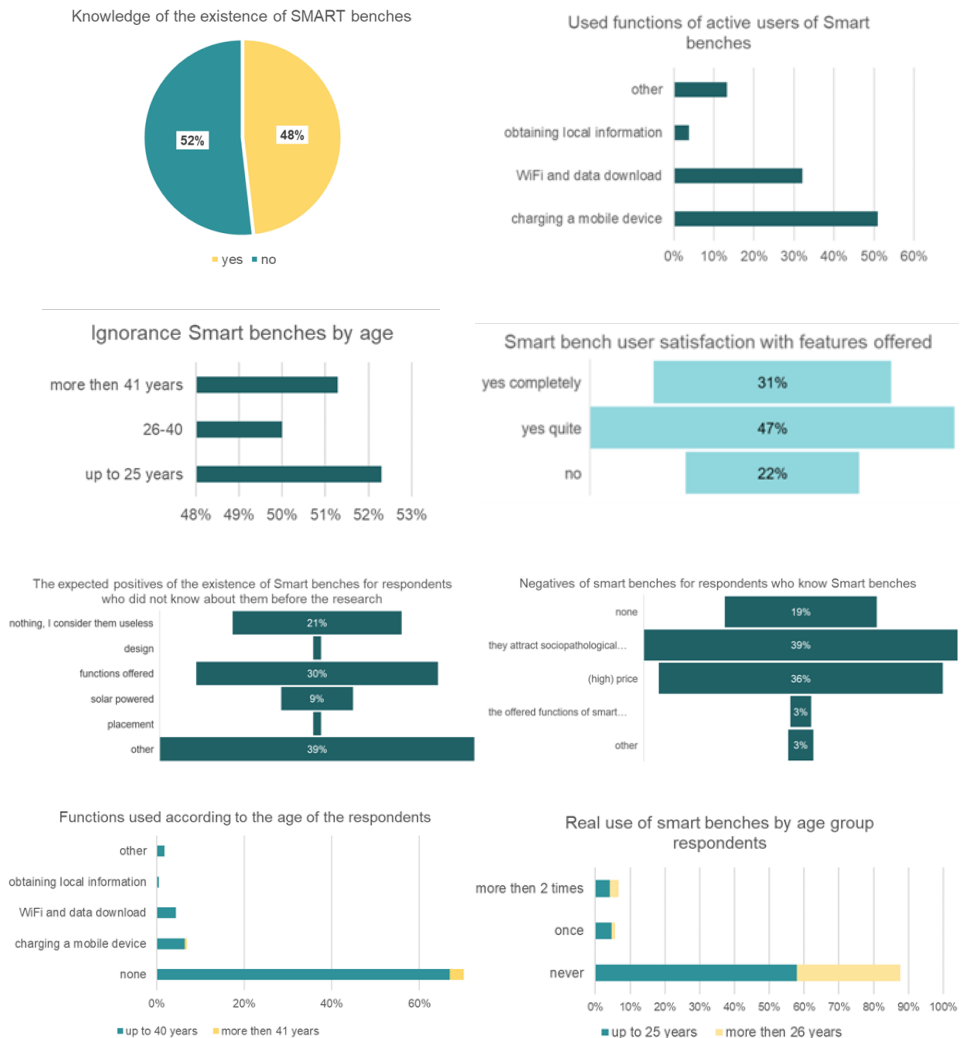
### 3. Does the Czech public know smart benches?

According to the results of our research, 52% of Czechs are currently unfamiliar with smart benches, i.e. they have never encountered this term and before the research, they did not know what a smart bench is and in what additional features it differs from a conventional bench. In this context, it is interesting to note that even respondents under the age of 25, who make up 67% of the total number of respondents (260 people), are not familiar with smart benches in the same percentage (136 people; 52%). The familiarity with smart benches is also not significantly better among respondents with a higher age limit, where the result is only 1–2% more positive (see Figure 2 or the data in Appendix).

The questionnaire survey showed that only 48 respondents, i.e. 12%, actually used the smart bench, most often for recharging mobile devices (51%) and for connecting to Wi-Fi or downloading data (32%). If we analyse the functions used according to the age categorisation of the respondents, then people over 40 years of age (76 people) practically did not use the functions at all (only 2 people recharged their mobile devices). This shows that the additional functions are actually used by younger people under 40 years of age. 31% of the users were completely satisfied with the additional functions of the smart benches, 47% of them had minor objections to the additional functions and 22% of them condemned the functionality of the smart benches.

The time spent using the smart bench features was generally minimal or non-existent. 91% of the respondents (353 people) had never used the features, 29 people (7%) had used them for less than 15 minutes and only 8 respondents had used the smart bench features for about an hour. Similarly, the question on the number

of times the smart bench had been used by respondents can be evaluated. 88% of them (342 persons) stated that they had never used it (i.e. in layman’s terms, they never sat on it), 5% of the respondents had used it once, 6% had used it a maximum of five times and only 2 persons had used it repeatedly, more than 6 times. More frequent use of smart benches is widespread among the younger generation of people under 25 years of age. 18 of them (i.e. 5%) have used the smart bench



**Figure 2. Selected answers to a questionnaire survey on the use of smart benches in the Czech Republic**

Source: own study.



once, while only 4 respondents over 25 have used it. Furthermore, 16 persons under 25 and 10 persons over 25 used the bench repeatedly.

The last presented conclusions from the questionnaire survey concern the perceived positives and negatives associated with the existence of smart benches. The positives of smart benches include mainly the functions offered (48%) and solar power (17%). 18% of the respondents (61 persons) do not perceive any positives of smart benches at all and consider them as a completely unnecessary element of public space. The situation is slightly different if we look at the answers of the respondents who did not know about smart benches before this survey. In this group of respondents, 21% considered them unnecessary, 30% appreciated the features offered, solar power was addressed by 9% and 39% mentioned “others” without further specification. This particular answer refers to the actual ignorance of the respondents towards smart benches. As for the perceived negatives, these are most closely tied (37%, 146 persons) to sociopathological phenomena (homeless people, alcoholics, drug addicts, etc.) that are concentrated around or naturally seek out smart benches. This is also associated with more disorder and vandalism. The second most accentuated negative is the high cost, which is perceived negatively by 27% of the respondents. 69 respondents (18%) see nothing wrong with smart benches, 12% of people mentioned “others”, and 22 respondents (6%) are concerned about their non-functionality. The respondents who were already familiar with smart benches before the survey were more specific on this question. In this group of 188 persons, 39% were concerned about the effects associated with sociopathological phenomena, 36% disliked the high price and 19% of the respondents chose no negatives. Only 6% gave a different answer.

The results of the 2021–2022 questionnaire survey point to the fact that citizens in the Czech Republic are largely unfamiliar with smart benches (52%), 88% have never used them and 86% have not used their functions. In general, they consider the integrated additional functions to be the biggest advantage of smart benches and, on the contrary, they are aware that smart benches are (potentially) a place of concentration of sociopathological phenomena, they attract more vandals and there is more clutter around them. More than a quarter of the respondents are bothered by their relatively high price. An interesting, and surprising finding from the research conducted is that ignorance of the existence of smart benches is not related to the age of the respondents.

## Conclusion and discussion

The presented paper focused on smart public goods, the use of which should enhance the user experience by combining a greater number of otherwise sepa-

rate functions or by being environmentally friendly. These smart public goods and their provision should be the backbone of the smart city concept, which, however, must be constrained by the requirement for cost-effectiveness in their acquisition and the public need to use these public goods. The definition of the term smart public goods is quite new and innovative, and our concept has a reference to the smart city concept.

The aim of the paper was to present the results of a questionnaire survey to determine the attitudes and experiences of respondents towards smart benches, which are now gradually “settling” in the public space of cities and municipalities across the Czech Republic, and which are significantly more expensive than traditional benches. Is it therefore in the public interest to acquire them? In response to the evaluation of our research, we must conclude that at present it is rather not. The citizens of the Czech Republic to a greater extent do not know them at all (52%) and do not use them (88%), regardless of age. Better promotion, media coverage and information would be beneficial to increase awareness of smart benches. A real and potential problem is the interest in these smart benches from homeless people, drug addicts or alcoholics, for whom the additional functions of smart benches are more attractive. Smart benches are nowadays more of a fashionable thing, which in the future seems (from our point of view) rather uncertain due to technological innovations, which are reflected e.g. in technical parameters of mobile devices (battery life) or general availability of public Wi-Fi. Thus, these most valued functions of smart benches (mobile device charging, Wi-Fi usage and data downloading) will face new innovative challenges in the future.

However, let us add that the opinion presented by us about the temporary unpreparedness of the inhabitants of the Czech Republic to fully use the functions of smart benches is based on research, which is limited by the number and structure of respondents (see Appendix).

It is also proposed to integrate smart benches into “smart kiosks” (e.g. in the form of roofed buildings), which will combine other smart elements – smart information platforms and boards, lighting and heating, contactless charging, waste bins, various sensors, etc., e.g. in combination with public transport stops.

The presented conclusions from the conducted research could be an argument for strengthening communication between public sector institutions and citizens in terms of awareness of the implementation of changes within the smart city concept and the setting of urban marketing in terms of the promotion of innovative elements implemented in the public space of cities and municipalities.

Since the topic of smart public goods or smart bench research is not supported by other publications, critical discussion and confrontation with other publications are not possible. It would certainly be interesting to carry out similar research in countries with a deeper implementation of the smart city concept into the functioning of the public sector, where the experience with smart elements is

greater, or to make a correlation between the practical implementation of smart city activities and citizens' attitudes towards smart public goods in general or on a specific level, possibly across regions or countries. Additionally, objective assessment of the effectiveness of the acquisition and maintenance of a smart bench on the background of cost-benefit analysis would be more than interesting from the perspective of the economy of public finances.

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## Appendix

### Data sources

Question		Absolute and relative number of responses (%)	
1	Age of respondents		
	• up to 18 years old	14	4
	• 19–25 years old	246	63
	• 26–40 years old	52	13
	• 41–65 years old	60	15
	• more than 65 years old	18	5
2	Knowledge of the existence of smart benches		
	• yes	188	48
	• no	202	52
3	Real use of smart benches by respondents		
	• never	342	88
	• once	22	5
	• 2–5 times	24	6
	• more than 6 times	2	1

Question		Absolute and relative number of responses (%)	
4	Time spent using the functions of the smart bench		
	• no time	353	91
	• within five minutes	14	3
	• within fifteen minutes	15	4
	• to one hour	8	2
5	Used functions of smart benches		
	• none	337	86
	• charging a mobile device	27	7
	• Wi-Fi and data download	17	4
	• obtaining local information	2	1
	• other	7	2
6	Satisfaction with the functions used		
	• yes completely	15	4
	• yes quite	23	6
	• no	11	3
	• functions were not used	341	87
7	Perceived pros of smart benches		
	• nothing, I consider them useless	61	18
	• design	10	3
	• functions offered	171	48
	• solar powered	62	17
	• placement	54	15
	• other	32	9
8	Perceived negatives associated with smart benches		
	• none	69	18
	• they attract sociopath logical phenomena, face vandalism more often and there is a bigger mess around them	146	37
	• (high) price	105	27
	• the offered functions of • smart benches do not work	22	6
	• other	48	12

Source: own questionnaire research,  $n = 390$ .