Public Procurement of Innovative and Technological Solutions in the EU

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Abstract - **Smart cities should identify and procure the best technical solutions for their communities and companies while at the same time demonstrating the local economic benefits of public procurement. Whenever possible, the procurement process should increase innovation in sustainability. Public procurement of innovative solutions can contribute to the economic recovery of the EU, especially after the crisis caused by COVID-19 with the help of better and more technologically accessible public investments. It is a means of stimulating the transformation of European economies into digital economies. This paper seeks to explain the use and advantages of public procurement of innovative solutions. The contracting authority acts as the first customer (launch customer) of innovative goods or services that are not yet widely available commercially and are technologically acceptable. Instead of buying a finished product, service or process, the contracting authority acts as the first user and buys a product, service or process that is new to the market and has significant new features in terms of innovation and technological achievements. Therefore, this paper will try to identify how various stakeholders can use innovative and technology-aware public procurement systems procedures and contribute to the accelerated development of digitalization mandated by the European Commission.**

Keywords - public procurement of innovative solutions; smart city; pre-commercial procurement; innovation partnership; procurement of digital solutions

I. INTRODUCTION

This paper sets out to explain how innovative procurement can improve the EU's economic recovery after the COVID-19 crisis while using smart public investments. It is also the primary tool for fostering the transformation of the European economy as a whole towards a green and digital economy [1].

Innovation is a key driver of sustainable growth, recovery, and resilience. Public purchasing power can make a significant contribution as an important means of increasing value for money when it comes to public services, which is government's responsibility.

Public authorities in the EU spend around 14% of their gross domestic product (GDP) on purchasing services, works and goods annually, which amounts to around €2 trillion per year [2]. In Croatia, the share of the total value of public procurement in GDP for 2020 is 18.99% according to Croatian Ministry of Economy, Entrepreneurship and Crafts [3].

When considering innovation within the public procurement perspective, Article 2(1) of the 2014 Directive on public procurement refers to innovation as the implementation of a new or significantly improved product, service or process, including but not limited to production, building or construction processes, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations inter alia with the purpose of helping to solve societal challenges or to support the Europe 2020 strategy for smart, sustainable and inclusive growth [4].

Despite policy interest and positive outlook on innovation and digitalization, there is little empirical evidence on the implementation of such policies when it comes to optimal utilization of available tools relating to public procurement. Therefore, the aim of this paper is to draw the attention to policy makers and experts to the existing but underused possibilities of purchasing innovative and digital goods and services, especially for developing smart cities.

The study is exploratory and interpretative in nature. Data used for this research is primary and secondary: the authors analyse prior research in the field of innovation procurement, published documents from the European Commission (EC), regulations, and case studies.

It is necessary here to clarify exactly what is meant by innovative public procurement. Innovative public procurement or public procurement of innovative solutions is defined as purchasing and/or interacting with economic operators during the process of innovation, i.e., research and development with innovative goods, services or works as outcomes, or buying the outcomes of already developed or

near-market developed innovations. However, public procurement of innovative solutions is not carried out in isolation from other policies. It develops better when supported by other sectoral and horizontal policies that enable innovation. Therefore, this research examines the framework, development, and implementation of public procurement of innovative solutions to determine its benefits, challenges, and best practices for its successful application, especially from a bottom-up view in relation to smart cities in the EU.

The article is organized as follows. After the introductory section, section II. provides an overview of the EU legislative and policy framework related to innovative policies. Section III. analyses the question of underuse of public procurement of innovative solutions and its advantages. Section IV. reviews different cases of using public procurement of innovative solutions in smart cities and Section V. draws conclusions.

II. LEGISLATIVE AND POLICY FRAMEWORK

The 2014 Public Procurement Directives adapted the public procurement framework to the needs of public purchasers and economic operators arising from technological development, economic trends and the increased focus of society on sustainable public spending [5].

Although digital innovations are a fairly recent trend, the ideas and tendencies for using public procurement as a valuable tool for providing the most innovative and sustainable solutions to contracting authorities was discussed already in the 1970s, when authors concluded that public procurement procedures should be insulated from political considerations which usually have a short-term perspective and are risk averse. Conversely, they further concluded that innovation-oriented procurement can provide new products, at least in terms of stimulating major technological changes, or stimulate mainly incremental innovations to mature products [2, 6, 7]. Literature review indicates that, initially, the tension in public procurement regulation existed between stimulating competition through innovation and using innovation to some extent as a possibility for preferential treatment for national economic operators or related models of suppressing competition to favour local suppliers [8, 9].

Some authors concluded that the (prior) legislative framework in the EU was not suitable enough to stimulate innovative procurement [10, 11], even labelling it as being innovation unfriendly [12]. The 2004 Public Procurement Directive did, in principle, regulate in Article 16 that it shall not apply to public service contracts for research and development services other than those where the benefits accrue exclusively to the contracting authority for its use in the conduct of its own affairs, on condition that the service provided is wholly remunerated by the contracting authority [13].

That direction was followed and enhanced with the 2014 Public Procurement Directive, which improved the framework for innovations to the needs of contracting authorities and economic operators in line with technological developments, tendencies and increased focus on sustainable and socially aware public spending [4]. In that sense, it further clarifies on the 2004 Directive provisions, firstly by confirming in Recital 35 that the Directive applies only where there is no co-financing of R&D projects and where the outcome of the R&D activities go to the contracting authority concerned and that this should not exclude the possibility that the service provider, having carried out those activities, could publish an account thereof as long as the contracting authority retains the exclusive right to use the outcome of the R&D in the conduct of its own affairs [4].

The 2014 Directive emphasizes in Recital 47 that purchasing innovative products, works and services plays a key role in improving the efficiency and quality of public services while addressing major societal challenges and contributes to achieving best value for public money as well as wider economic, environmental, and societal benefits in terms of generating new ideas, translating them into innovative products and services and thus promoting sustainable economic growth [4]. In line with the abovementioned Recital, Article 14 opens the door for pre-commercial procurement of innovative solutions by removing such procurement from the Directive's scope unless the benefits accrue exclusively to the contracting authority for its use in the conduct of its own affairs, and the service provided is wholly remunerated by the contracting authority [4]. Therefore, public procurement of R&D services in principle does not fall within the scope of the Public Procurement Directive, which contributes to facilitating public procurement of innovation and helps Member States in achieving the Innovation Union and eco-innovation and social innovation as primary drivers of future growth as included in the Europe 2020 strategy for smart, sustainable and inclusive growth [15, 16].

Pre-commercial procurement (PCP) is a specific approach which consists of procuring research and development services (fundamental research, industrial research, experimental development) via competitive development in phases at advantageous conditions from several economic operators and is in principle exempt from the Procurement Directive [4, 17, 18, 19] in cases where the contracting authority does not reserve all the benefits from the research and development service contract exclusively to itself, but shares them with the economic operators under market conditions. Such procedures (or projects) should be rather limited in duration, include development in phases of prototypes, test versions and near-market innovative products and services in non-commercial volumes. On the one hand, PCP is useful for public authorities as it enables them valuable input for public procurement of innovations by developing and managing ideas from more candidates and usually offers them an option to terminate the procedure if results of prototypes don't meet their expectations. Figure 1 is showing the PCP which identifies the best solutions that the market can develop by comparing the solutions of different technology vendors in parallel. On the other hand, developers and creators can use this procedure to put forward an innovative solution which the market doesn't address and offers them an entrance to the (public) market of their preference, potentially at a faster rate than developing the product or service within the PCP

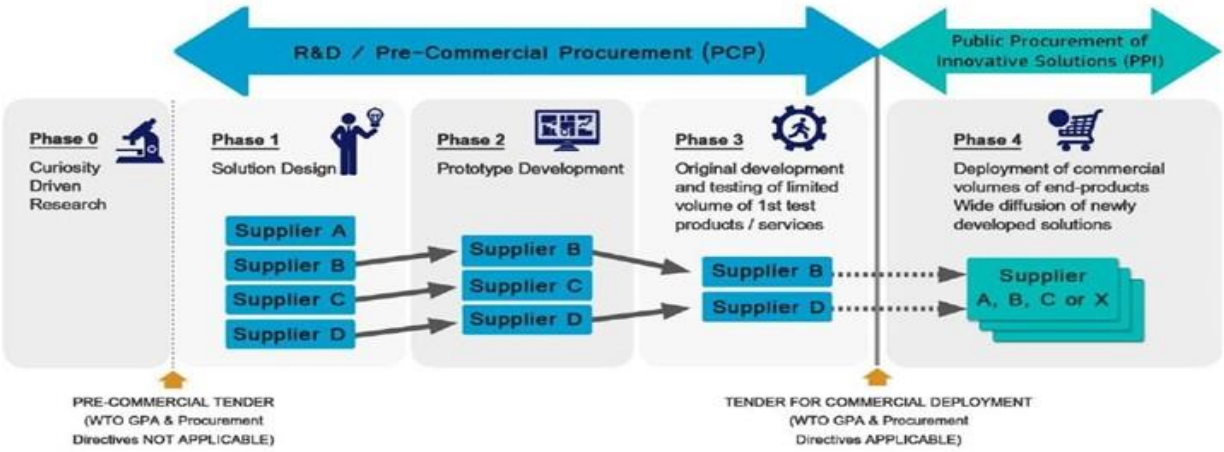

Figure 1. Overview of a phased pre-commercial procurement process [33]

procedure, which is beneficial for innovative start-ups or SMEs willing to receive first potential customers.

Economic operators can commercialise their solutions to other public or private buyers or on other markets. As for contracting authorities, apart from the right to use and license the solution in a follow-up public procurement to deploy solutions, i.e., public procurement of innovations phase, they may save on costly registration and maintenance process that result from the ownership of intellectual proprietary (IP) rights [1]. It should be noted that, at a policy level, the European Commission already provided strong support to pre-commercial procurement of innovative solutions already in 2007 [20].

PCP is often confused with another policy instrument, namely public procurement for innovation, also mentioned in literature as public procurement of innovative solutions [21]. Public procurement of innovative solutions (PPI) is a procurement procedure where contracting authorities act as first customers of innovative goods or services which are in near-market phase or already available on a small-scale commercial basis, including solutions based on existing technologies used in an innovative way [22].

With regards to procedures, PPI can be implemented in all types of procedures envisaged in the Public Procurement Directive. However, innovation-friendly procurement procedures are innovation partnership, competitive procedure with negotiation and competitive dialogue [4].

It is interesting to analyse the use of those three procedures within the EU. Table I. provides the results obtained from the analysis of contract award notices for the three years regarding the three innovation-friendly procedures. According to available data, innovation partnerships ended with awarding contracts 79 times in 2019, 73 times in 2020 and 50 times in 2021in the EU, in comparison to competitive dialogue, which was successfully used 608 times in 2019, 566 in 2020 and 605 in 2021. Interestingly, competitive procedure with negotiation is the most widely used procedure out of the three, with it leading to contract awards 12,118 times in 2019, 11,044 in 2020 and 11,300 in 2021 [23].

In Croatia, public authorities used the competitive dialogue once (1) and competitive procedure with negotiation twice (2) in 2019, both procedures were used only once (1) in 2020, whereas innovation partnerships have not yet used as procedures in 2019 and 2020 [24]. Data for 2021 is not available. Overall, these results, which encompassed all contract award notices irrespective of them being innovative procurements or not, indicate that innovation partnerships are largely underutilized, competitive dialogue procedures are also underused to an extent, while the competitive procedure with negotiations should be further researched whether if that is the procedure most optimal for procuring innovative solutions.

To improve these results, some Member States included innovative procurement related reforms and investments in Recovery and Resilience plans to enhance the public procurement framework and align it with EU best practices. Reform titled "Innovative Procurement" aims to encourage the use of innovative public procurement products and services, which shall contribute to greater transparency in public procurement processes, attract more private stakeholders and finally create a fairer and more competitive public procurement system in Croatia [25].

Smart city decision makers and contracting authorities should also be aware of state aid and IP regulatory and practical risks which come with innovative procurement. Regulation of ownership and sharing of IP rights between public authorities and suppliers when acquiring innovative digital solutions can lead to challenges such as lack of flexibility and ability to adapt to future needs which can create an external dependency or even vendor-lock-in, lack of interoperability and risk of premature contract termination [35, 36]. It should also be underlined that PPI is not exclusively connected with using innovative partnership or competitive dialogue procedures. By utilising PCP and prior information notices, contracting authorities can obtain valuable data, feedback from economic operators and innovative product samples which can be indispensable resources to initiate an open or restricted procedure for obtaining innovations.

TABLE I. USAGE OF INNOVATIVE-FRIENDLY PUBLIC PROCUREMENT PROCEDURES IN THE EU [23]

Procedure type	2019	2020	2021
Competitive procedure with negotiation (Art. 29 2014/24/EU)	12,118	11,044	11,300
Competitive dialogue (Art. 30 2014/24/EU)	608	566	605
Innovation partnership (Art. 31 2014/24/EU)	79	73	50

III. WHY PUBLIC PROCUREMENT OF INNOVATIVE SOLUTIONS IS NOT USED AND WHAT ARE THE ADVANTAGES?

The importance of public procurement of innovations can be observed through stakeholders involved in the process itself. Namely, the beginning of the procedure consists of the need of a public authority to solve a certain problem or need. The public authority is aware of the specific factors of the problem or need, but it cannot reach a solution on its own. The existing legal framework offered an option, instead of established products from long-standing suppliers, it is possible to procure an innovation instead of a generic product. The COVID-19 pandemic scenario brought the future of large public investments, and the PPI is one of the tools that can be used on a large scale to stimulate innovation and act as a strategic driving force for public contracts.

A. Benefits

Why is PPI a convenient way to purchase goods and services? Since the perception of public procurement is the spending of public money for the needs of public authorities, the possibility of using PPI provides for an "out of the box" approach. The application of public procurement rules that regulate PPI means taking advantage of the opportunities they provide and achieve innovative solutions. Instead of buying a finished product, service or process, the contracting authority acts as the first user and buys a product, service or process that is new to the market and has significant new features in terms of innovation, sustainability, and technological achievements.

Previous research has identified main approaches to linking innovation and public procurement. Innovative public procurement is perceived as a lever for the development of new products and, as a more flexible approach, tries to open space for innovation and not for the procurement of existing products [26].

After all, what would be the main benefits of using PPIs? For public authorities, these are certainly the development of knowledge, skills and techniques, opportunities to apply for local, national or EU funds related to innovation and cost savings (long-term, medium-term or short-term). For suppliers, it is certainly about the benefit of access to valuable clients from the public sector, and the opportunity to concretize and commercialize their ideas [27]. When highlighting the benefits, one should not overlook the impact of public demand for innovation on the industrial sector. If public demand for innovation increases significantly, industry investment in innovation is also expected to increase. In this way, new innovation cycles are launched, therefore both industrial and innovative sectors are encouraged to rethink public authorities as a good place to set innovative goods and services [22].

Through this type of public procurement, the entire defense sector in Croatia could be launched. According to Directive 2009/81/EC on the coordination of procedures for the award of certain works contracts, supply contracts and service contracts by contracting authorities or entities in the fields of defense and security [37], and the Croatian Decree on Public Procurement for Needs of Defence and Safety [14] in addition to military equipment, works of goods and services, security-sensitive equipment, and security-sensitive works and services can also be procured. Meaning that public procurement procedures, according to the Regulation, can be of interest to a very wide range of public bidders - for example, those who provide common services, construction, or similar services and works, and need to be performed in a security-sensitive facility. It would allow companies to deal with new technological solutions in the field of the defense sector, and military production and then sell their conceptual and technological solutions through a simplified process of public procurement of innovative solutions (a good example is Đuro Đaković Group d.d., as a company engaged in these activities).

B. Challenges

It is important to point out that for some public authorities, shifting the focus to PPI can (and will) pose a significant challenge to defined procurement procedures and practices within an organization. For this reason, the growing interest in PPI has resulted in a relatively modest development of innovation [10]. Part of the difficulties that hinder the wider use of PPIs include poor prior communication about the problem that the client would like to solve by procuring an innovative solution. This poor communication usually does not improve during the process, which leads to the conclusion that the lack of quality interaction between process participants is a significant obstacle [22].

However, the reduced use of PPI has no basis in the existing legal framework. Public procurement of innovative solutions requires increased activity and knowledge when planning. Therefore, experts should conduct mandatory trainings focused on relevant challenges. By learning about best phased purchasing approaches (e.g., PPI and PCP), regulating IP rights and developing needs-specific solutions, experts could strike a balance between purchasing innovative, interoperable solutions and reliance on overly complex, custom-made products. Also, detection and prevention of vendor lock-in and corruption risks related to customization of technical specifications can be achieved by using life cycle costing, functional criteria and standards in tender documentation and contracts.

Some authors indicate that time consumption and complexity embody significant hindrances to the successful realization of innovation procurement practices in the public sector. Time required for procurement innovation is longer than in any corresponding standard procurement process. The main reason is the increased amount of engagement in identifying requirements as a prerequisite for successful procurement of innovation (such as market research or prior information notices). Although, complexity arises through a strictly regulated process and the interaction of the various participants involved in the process [11].

IV. SMART CITIES AND PUBLIC PROCUREMENT OF INNOVATIVE SOLUTIONS

This chapter will explain how innovative and digital solutions can be created while using instruments within the EU regulatory framework. Such solutions could help improve a smart city by using public funds to provide the best possible solutions for smart city residents.

As mentioned in the paper by Milenković, Rašić and Vojković: “the local governments sequence of events in the development of smart cities largely depends on the mayors” [28]. During this research on public procurement of innovative solutions, it became apparent that the implementation of such solutions would be necessary to start at the level of the local self-government unit concerning the fact it is easier to conduct public procurement of innovative solutions in cities than initially at the state level.

For example, these could be solutions such as the invention of smart software that will enable faster and more efficient urban and/or long-distance road connectivity which is intended to be used specifically to reduce costs for long-distance services and goods, such as connected transport solutions, renewable energy use for utility companies, therefore more cities could use the same solution.

Such examples have been analysed in the model of the city of Koprivnica and some other cities in the EU that will be mentioned in this chapter. Koprivnica launched market research for the pilot project "Extensive Transformation of a Prefabricated Building" which aimed to deliver a replicable solution for the external, internal, and functional transformation of a building and implement a solution on a prefabricated kindergarten building. Key performance indicators were significant improvement of energy efficiency, indoor space functionality, childcare, and educational quality. The procurement was a part of the Interreg Mediterranean programme, co-financed by the EU which focuses on the public procurement of innovation to stimulate the development of innovative technology solutions, and also their market uptake [29, 30].

Another example is the City of Bologna which has also taken advantage of innovative solutions to link e-procurement and social and green public procurement. Bologna has been striving to raise awareness among contracting authorities and suppliers about the importance of innovation and consequently raise awareness in the procurement process. It concerned e-procurement with a municipality that wanted to raise awareness and provide information to SMEs, especially on connectivity options through electronic marketing tools. Emphasis was placed on the two organizations and their tools. Between Consip, a company of the Italian Ministry of Economy and Finance which had a mission related to the program of streamlining public procurement and focusing on the use of information technology and innovative instruments, and Mercato elettronico della pubblica amministrazione, a tool that allows contracting authorities to make a direct catalogue purchase below the EU threshold. In this case, they succeed on the strong history of public-private partnerships to enable more socially responsible practices [30].

It is important to emphasize that the public procurement of innovative solutions was not initiated only by EU legal mechanisms, but already by the analysis of the Sfinno database, which collected data on all innovations commercialized in Finland between 1984 and 1998, showed that 48 percent of all projects led to successful innovation was initiated by public procurement [31]. Recent literature on public administration has recognized the importance of public procurement for improving public infrastructure and services and has focused on the relationship between procurement methods and innovative solutions and products and analyses the role of public-private partnerships (PPPs) in fostering innovation [31]. It also emphasizes that PPPs promote local economic growth, employment opportunities and enable the public sector to transfer risks related to the construction, financing and operation of projects to the private sector and reduce public sector budget deficits while increasing innovation [31]. As stated by Carbonara and Pellegrino regarding the technological perspective: "innovation in public procurement occurs when completely new products, services, goods, or systems that do not yet exist are delivered (radical innovation), as well as when the delivered product is an adaptation and/or combination of existing goods or services in a specific context in which it has not been used before (incremental innovation)".

How are smart cities and public procurement of innovative solutions interconnected? Smart cities must be able to identify and procure the best technical solution for their communities, their citizens and their businesses, while the local community benefits economically from such procurement and such procurement processes are intended to be used to increase innovation in sustainability. The objective of this paper is to highlight the characteristics that a public procurement process needs to have to ensure it is in line with smart city investment needs. Accordingly, procurement processes need to address the whole lifecycle costs and benefits, rather than only the basic investment costs [32].

In order to create a correlation between the process of public procurement of smart solutions and their implementation into smart cities, the following is required:

a. Strong engagement with the market to procure sustainable solutions,
b. Public enterprises should identify, via technical dialogue, prior information notices or by other means, what is available on the market, before deciding what to purchase,
c. Public enterprises should be working with private companies that will deliver the service or product so that they can translate their needs, and companies can therefore offer a more tailored service that meets the needs of cities,
d. Both companies and the market must understand the city’s objectives, strategies, and vision and should be able to turn them into successful business projects, and
e. The procurement must consider the engagement of end-users, where becomes essential to inform citizens about the benefits and their involvement in the overall strategy [32].

If smart cities are to utilise public procurement of innovative solutions, local (and regional) governments units should educate public procurement professionals on how to specify and procure smart sector-specific goods and services; Create a set of tools that will enable the public sector to procure goods and services from companies primarily in the innovation sector; Disseminate those tools to ensure that the knowledge is embedded in the purchasing practices of public authorities; Promote collaborative public procurement of innovative solutions between smart cities;

Set up centralized public procurement for the level of cities, regions, agencies, and different public authorities in order to hire suitable experts in tender procedures, especially for common challenges cities face; Involve the market and citizens in the city's strategic processes, vision and future priorities as the future success of cities not only depends on public authorities but on private companies as well, where private companies and citizens make an effort to provide what cities need, rather than vice versa [32, 34].

V. CONCLUSION

This research paper set out to explore how buying innovative products, works and services plays a key role in improving the efficiency and quality of living in smart cities and addresses major economic, environmental and societal challenges. Public procurement of innovation contributes to achieving best value for taxpayers as well as economic, environmental, and societal benefits. Contracting authorities can encourage innovation among established market participants and provide key opportunities for SMEs and new innovative companies that may have solutions to unmet needs but face difficulties in bringing them to market. By acting as the lead customer, contracting authorities can provide innovative companies with the opportunity to test new solutions in real conditions.

The goal of spending taxpayers' money efficiently is gaining new dimensions, which go beyond merely meeting the basic needs of public bodies. In any public procurement, the public should know not only whether the procurement solution is formally in line with the conditions and rules, but also whether it brings the best added value in terms of quality, cost-effectiveness and social impact, as well as environmental impact, and creates opportunities for suppliers. Public procurement of innovative solutions solves all these problems because it achieves better quality and more efficient solutions with benefits for the environment and society, greater cost efficiency, as well as new business opportunities for companies.

This study has found that, for innovative solutions to succeed, awareness raising, capacity building, well set conditions, procedures and incentives starting from the local level (bottom-up) are necessary if smart cities are to be developed. Naturally, this can be strengthened by national and EU policies and incentives. This paper indicates that public procurement of innovations, irrespective of them being PCPs, PPIs or not, are largely underutilized, and it should be further researched whether such procedures are optimal. For the future research these procedures could be further explored to determine whether they are most suitable for public procurement of innovative solutions.

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