GREEN INNOVATION IN CONSTRUCTION INDUSTRY AND IN PUBLIC WORKS PROCUREMENT IN HUNGARY - REVIEW

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Summary

The construction industry is an important industry that determines the national economy of almost every country. Due to its productivity, the number of people it employs, and the number of enterprises involved, it is also decisive for other industries. The facilities completed as a result of public works often outlast their dreamers by decades, so it is very important that the construction industry is open to the innovative development of its operations, products and elements that provide infrastructure for others. The basic hypothesis of our study is that although a rapid regeneration took place in the construction industry after the pandemic situation, which is also supported by the number of public procurement procedures for Hungarian public works, the proportion of procedures using innovative solutions is low, as is the case with sustainability aspects. We also assumed that the share of public procurement procedures integrating R&D results and innovation partnerships is low compared to domestic public procurement.
Keywords: *public works, innovation, construction innovation, innovation partnership, innovation-oriented public procurement*
JEL code: *H57, K32, O21, O52, O31*

ZÖLD INNOVÁCIÓK AZ ÉPÍTŐIPARBAN ÉS A MAGYARORSZÁGI ÉPÍTÉSI KÖZBESZERZÉSEKBEN

Összefoglalás

Az építőipar szinte minden ország nemzetgazdaságát meghatározó jelentőségű iparág. Termelékenységénél, az általa foglalkoztatottak létszámánál, az iparágban megjelenő vállalkozások számánál fogva meghatározó más iparágak számára is. Az építési beruházások eredményeként elkészülő létesítmények gyakran évtizedekkel túlélik azok megálmodóit, ezért nagyon fontosa, hogy az építőipar nyitott legyen a működését, produktumait és mások számára infrastruktúrát biztosító elemeinek az innovatív szempontú fejlesztésére. Tanulmányunk alaphipotézise az, hogy bár a pandémiás helyzetet követően egy gyors regeneráció ment végbe az építőiparban, melyet a magyar építési beruházásokra irányuló közbeszerzési eljárások száma is alátámaszt, azonban a fenntarthatósági szempontokhoz hasonlóan alacsony az innovatív megoldásokat alkalmazó eljárások aránya. Feltételeztük azt is, hogy a K+F eredményeket integráló közbeszerzési eljárások, illetve az innovációs partnerség részaránya is alacsony a hazai közbeszerzésekhez viszonyítva.
Kulcsszavak: *építési beruházás, innováció, építési innováció, innovációs partnerség, innováció-orientált közbeszerzés*

Introduction

Based on a recent EU research, about two-thirds of the European economic growth of the past decades can be attributed to innovation (EUROPEAN COMMISSION, 2022). Based on the 2021 report, Hungary belongs to the group of emerging innovators, improving from last year's 73rd to 76th, and ranks 22nd.

Spending on the global construction industry accounts for nearly 13% of the entire world's GDP, yet despite this significant amount, the sector's productivity has only increased by 1% per year over the past 20 years. By increasing productivity, an additional value of nearly 1.6 trillion dollars could be achieved, which would cover half of the world's infrastructure needs (BARBOSA et al., 2017).

The literature research of recent years clearly highlights the need for new solutions to reduce the environmental impact of the construction industry. In order to reduce the environmental footprint of a building or construction activity, many solutions have been developed and continuously improved. This includes, for example, modular construction as a construction solution (BOROS and TORMA, 2022a), the green retrofit (BOROS and TORMA, 2022b), or the widespread dissemination of the circular economy in the construction industry through new procedures, materials, technologies, and digital solutions (BOROS and TORMA, 2022c).

In its communication on innovative public procurement, the Commission emphasizes that Europe uses only half of the potential inherent in innovative public procurement to boost economic recovery. The Commission has therefore drawn attention to the need to develop innovative solutions in the most important industrial ecosystems, as the rise of innovations in public procurement "paves the way for better quality and more efficient solutions that prioritize environmental and social benefits, greater cost-effectiveness and business opening up new business opportunities" (EUROPEAN COMMISSION, 2022).

In light of this, in our study we examine the role of the domestic construction industry in the national economy, the most important literature sources on construction innovations and evaluate the situation of innovations in domestic public procurement.

Material and methods

For our research, we analyzed the data of various databases, so in particular we carried out a systematic examination of the data of the Public Procurement Authority, the Hungarian National Bank, the Central Statistical Office, and the Hungarian Patent Office.
In order to ensure scientific validity, we conducted a systematic literature search based on the Scopus database in 2022.

Finally, we also used our previous research results, which have not been analyzed from the side of innovative public procurement until now.

In our study, we looked for the answer to what is the proportion of procedures using innovative solutions compared to the number of public works, and whether significant progress has been achieved in public procurement procedures integrating R&D results, and in increasing the proportion of domestic public procurement aimed at innovation partnerships.

Results

1. Characteristics of the Hungarian construction industry

The construction industry also plays a prominent role in Hungary, so it is not surprising that in terms of both number and value, construction investments have been the most significant in public procurement for a long time. The construction industry is one of the most critical sectors that play a vital role in the economic growth of a country (GOLPÎRA, 2020). The construction industry is not only an important sector of the economy due to its productivity, but also a service provider for society and other economic sectors: it provides infrastructure, housing, rehabilitation and public utilities to settlements and micro-level economic units as well (ZUBIZARRETA et al., 2017).

If we want to analyze the current situation of the Hungarian construction industry, it is worth mentioning that until 2019, the Hungarian construction industry was moving on an upward trajectory, thanks to the significant state investment realized from EU and domestic funds. This dynamic development curve was broken by the COVID-19 epidemic situation, the effects of which were continuously felt in the industry from the spring of 2020. However, this crisis did not affect the construction industry as much as some branches of the service sector, such as tourism or hospitality. The construction industry of the European Union expanded by 4.8% in 2021 compared to the previous year. In 2021, production increased in two-thirds of the member countries, the largest increase in Italy (KSH, 2022). According to the data of the Hungarian Central Statistical Office, among the V4 countries, only Slovakia's production continued to decrease. By 2021, a strong consolidation has taken place in almost all construction industry segments in Hungary as well. In the EU as a whole, the construction industry accounted for 5.6% of the added value in 2021, in Hungary and the V4 countries to a greater extent, with 6.3 and 6.4%. It is also worth highlighting that in 2021 the performance value of construction industry investments within the national economy was only 2.5%, the proportion of employed people was 8.1%, and the construction industry accounted for 7.0% of the number of registered enterprises (KSH, 2022), primarily through the large number of micro-enterprises. In connection with the latter, it is also worth pointing out that the Hungarian construction industry has for a long time been characterized by the numerical preponderance of small and medium-sized enterprises, more than 90% of construction companies have fewer than 5 employees. The proportion of large enterprises with at least 50 employees does not even reach 0.5% (KSH, 2022).

In 2021, the number of apartments built was 30% less than in the previous year. The decrease in the number of residential buildings was offset by a significant increase in the construction of non-residential buildings, primarily thanks to the high-value construction and renovation works of industrial, commercial, educational (mainly university) buildings and sports halls.

In 2021, housing construction costs increased the most among EU member states in Hungary (Figure1.) (MNB, 2022).

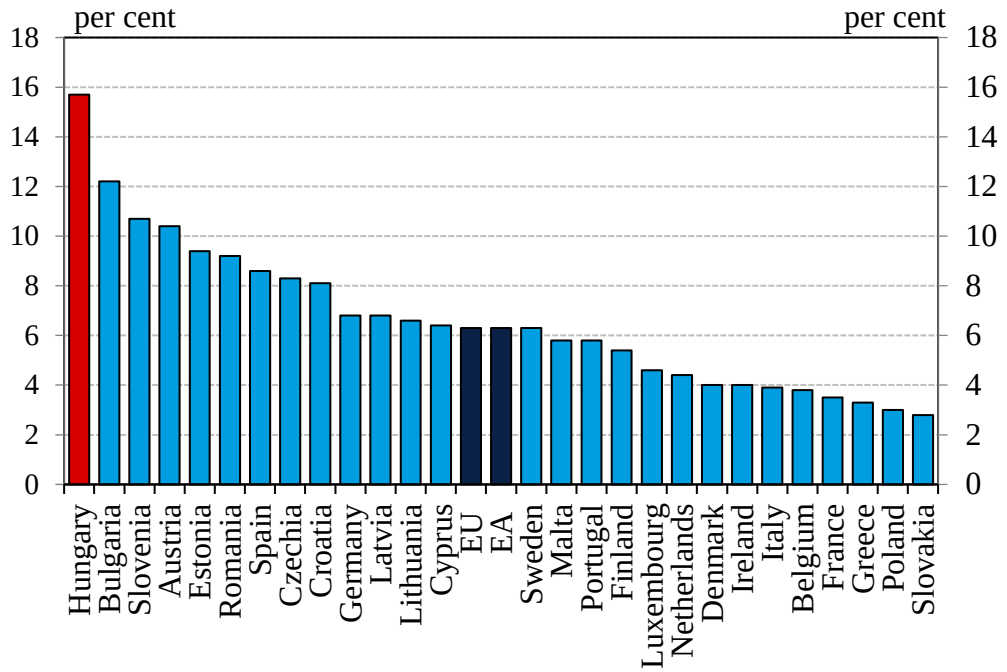

Figure 1. Annual changes in construction costs of residential buildings in EU member countries in 2021

Source: EUROSTAT, 2022.

At the same time, the annual renewal rate of the domestic housing stock is only 0.4%, which is extremely low even in European comparison (Figure 2.).

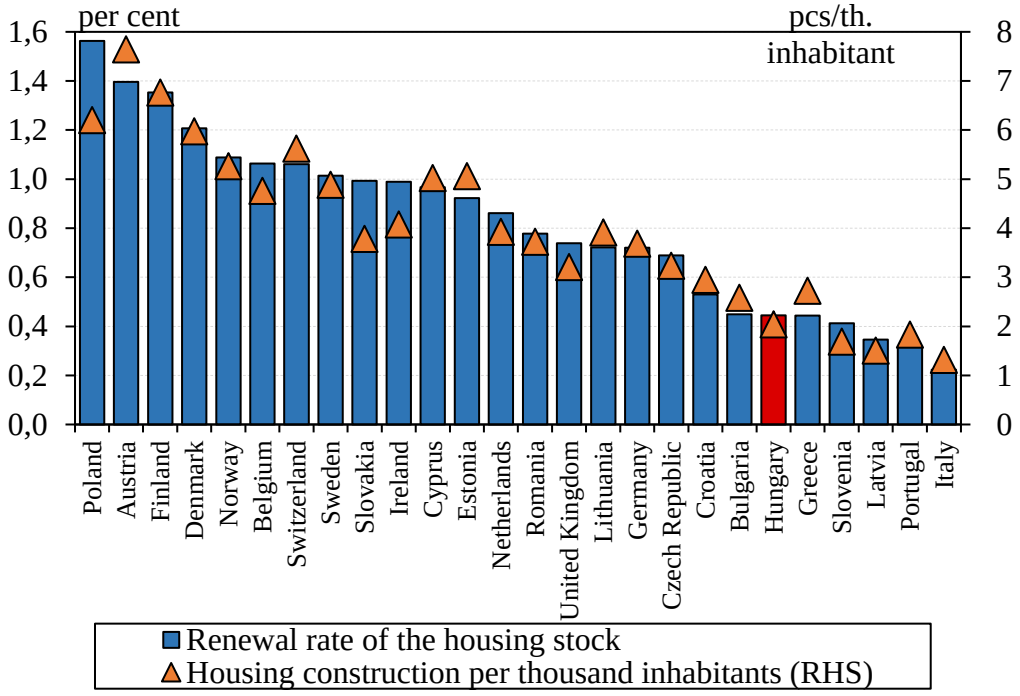

Figure 2. Annual renewal rate of the housing stock and housing construction per thousand inhabitants in Europe

Source: HCSO, MNB 2022.

In order to improve the housing conditions of families raising children, to encourage the renewal of the domestic housing stock and to whiten the construction industry, a non-refundable housing subsidy from the central budget can be used for home renovation subsidies. It is regulated by government decree 518/2020. (XI. 25.) on home renovation subsidies for families raising children Regulated by.

The graph below shows the evolution of the price of products and services related to housing renovation subsidies.

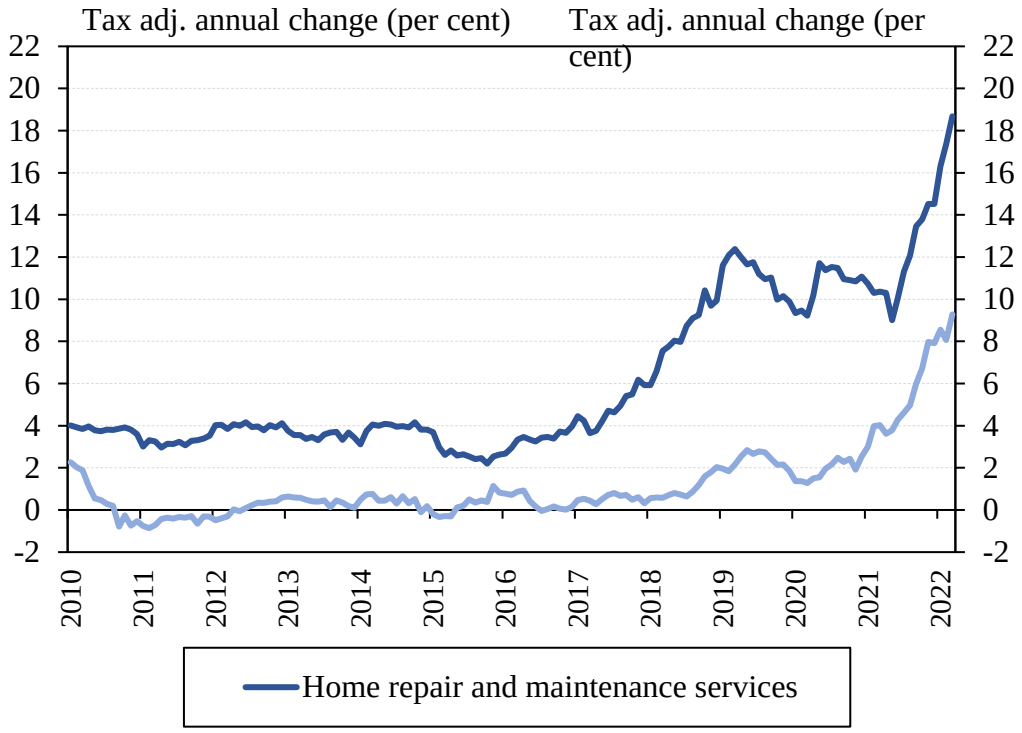

Figure 3. Price evolution of products and services related lake home renovation support
Source: HCSO, MNB 2022.

The Magyar Nemzeti Bank (the Central Bank of Hungary, hereinafter: MNB) highlighted the importance of housing sustainability in its 2021 Sustainability Report. The MNB analyzes this issue primarily from the point of view of the availability of housing and the quality of the apartments (the condition of residential properties and the living conditions of households at home). Following the significant price increase observed in recent years, based on the ratio of real estate prices in the capital compared to national incomes, Budapest has become the 4th least affordable capital in Europe by 2020. Buying a home is also difficult to achieve in the other Visegrád countries: 22 years of average income is required in Prague, 19 in Bratislava, and 16 in Warsaw to buy a typical property. The problem of housing availability can also be observed in the rental market in Budapest. Budapest apartment rental prices are currently the 7th highest among European capitals in terms of net income (MNB, 2021).

According to the Eurostat survey, in 2019, 7.8 percent of Hungarian households lived in severely inadequate housing conditions, which is the 5th highest value among European countries (MNB, 2021). In addition, around 20 percent of domestic households live in overcrowded conditions, which means that although we slightly exceed the average value of the EU 27 countries, we show a better ratio than the average of 29 percent of the Visegrád countries.

According to the MNB's latest Sustainability Report, as a result of the war, raw material and energy prices continued to rise in 2022, and problems affecting supply chains increased, which increases development costs and the uncertainty surrounding construction (MNB, 2022).

The MNB also emphasizes that at the beginning of 2022, the biggest obstacle to the productivity of the construction industry was the labor shortage and the shortage of raw materials (LENTNER – ZSARNÓCZAI 2022).

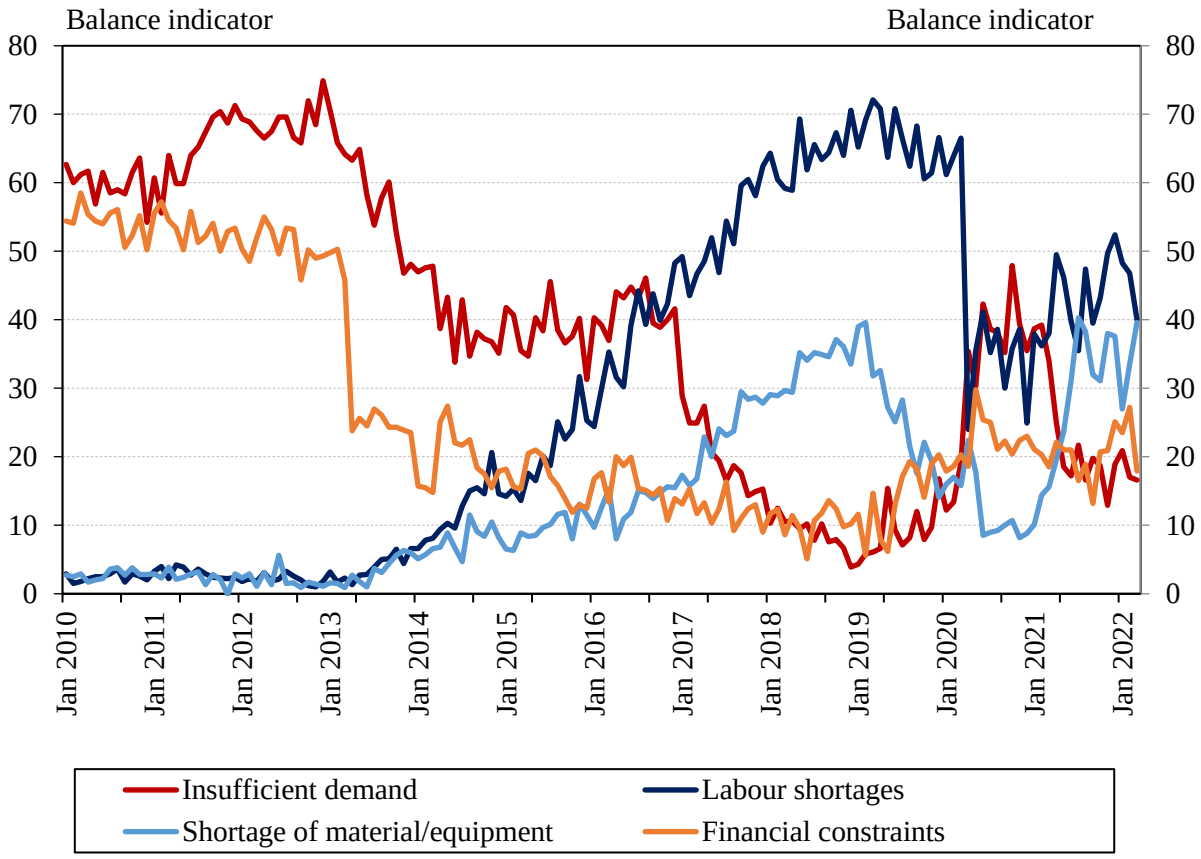

Figure 4. Constraints lake construction output
Source: HCSO, MNB 2022.

In 2020, the public procurement market was no exception to the negative impact of the COVID-19 epidemic on the domestic economy; compared to 2019, there was a decrease in both the number of public procurement procedures and the value of the procedures. Despite a significant - approximately 25% - decrease in the number of procedures and a small - approximately 5% - decrease in their value, by the end of the year, the trend showing an increase in the total value of conducted procedures was already clearly visible (PPA, 2020).

In 2021 in total 7,676 successful public procurement procedures were conducted by the contracting authorities, which is approx. exceeded the 2020 data by two hundred procedures. The value of these procedures exceeded HUF 4,200 billion, which represented a 23% increase compared to the previous year (PPA, 2021). In the field of public procurement, the number of public works has shown a continuous increase in recent years. In the first three quarters of 2022, 38.7% of public procurement procedures and 62% of their value were public works, however, looking at the third quarter of 2022, a decreasing trend was already observed in the value of public works (PPA, 2022).

2. Innovations in the construction industry

In public works, the development and successful implementation of new ideas, products or procedures during the planning and implementation of new construction objects can be considered as innovation (LENDERINK et al., 2020). Due to high investments in the construction industry and the uncertainty of research and development (R&D) activities, the risk factor in the process of technological innovation is quite high (KONG et. al., 2021). That is why, in the case of innovation public procurement, for example, a very important aspect is the mutual agreement between the contracting authority and the tenderer on the way to distribute innovation risks (HARTMANN, 2006). Especially in the case of radical innovations, public clients must act more flexibly in terms of their expectations and acceptance of risks (NYKVIST – MALTAIS, 2022; PENNA et al., 2021).

At the same time, some authors also point out that the pursuit of innovation both in times of crisis and prosperity reflects efforts to gain competitive advantages and to increase the general technical-economic and environmental efficiency of products and systems (TERZIS, 2022).

The literature (e.g. SLAUGHTER, 1998; GARCIA AND CALANTONE, 2002; LENDERINK et al., 2020) distinguishes between incremental innovations (i.e. the further development of existing knowledge, materials, technologies) and completely radical innovations (i.e. the production of completely new things mostly with new technology).

According to SARGENT (2017) , total global research and development (R&D) spending almost tripled between 2000 and 2017. According to data of the OECD (2017) from 2014 to 2016, 60% of the world's patents (at the United States Patent and Trademark Office, the European Patent Office , the Japan Patent Office, the Korean Intellectual Property Office and the National Intellectual Property Office in China) were filed by the two thousand biggest R&D poet. In contrast, the same inventors were responsible for only 3% of the scientific articles published during the same period. This preliminarily reveals an important gap between the two metrics, i.e. patents and scientific performance. According to a comprehensive industrial R&D analysis (SOARES DE ALMEIDA et al., 2019) of the world's 2,500 largest R&D investors, only 61, i.e. 2.44%, are construction and material industry companies, while the corresponding ratio is similar among Europe's 1,000 largest R&D investors (POTTERS and GRASSANO, 2018).

According to the aforementioned Sustainability Report of the MNB 2021, Hungary's innovation performance falls short of the EU average, but is at a level corresponding to the regional average. GDP proportionate R&D expenditures increased from 1.1% in 2009 to 1.5% in 2019, which is more than 0.1 percentage points higher than the V3 average, but significantly lower than the EU average of 2.2%. The research and development workforce accounts for 1.3% of all Hungarian employees, which is a higher proportion than the Visegrad average of 1.1%, but lower than the EU average of 1.5%.

In Hungary, the number of new patents registered each year is significantly lower than the EU and Visegrád averages. The innovation capacity of the Hungarian SME sector is in the last quarter of the EU member states, significantly below the EU average and slightly behind the Visegrad average. The proportion of SMEs pursuing product and process innovation in Hungary (18%) has increased since 2009, but still does not reach the EU average (34%) (MNB, 2021).

In 2020, the number of patent applications filed nationally increased by 1.3 percent, the number of applications for supplementary protection certificates by 1.8 percent, the number of design protection applications by 4.5 percent, the number of samples included in the application by 22.6 percent, and the number of trademark applications increased by 2.4 percent compared to the previous year (POMÁZI, 2022).

According to the 2021 survey of the National Association of Construction Companies, the majority of Hungarian businesses are open to innovation and digitalization, but at the same time, the scarcity of material resources, the characteristics of the market, and the lack of knowledge represent significant obstacles in this regard. Small and medium-sized enterprises are at a disadvantage in terms of innovations. Those interviewed primarily associate the possibilities of innovation with larger companies. According to the interviewed Hungarian companies, there would be a need for integrator companies, which would pull micro and small companies along with them in the field of innovation and training.

The development of innovations in the construction industry is hindered by many factors. In this context, the literature highlights the complexity of the various construction processes of the construction value chain (PRIES and JANSZEN, 1995).

The construction process related to buildings consists of many stages, from the design of the building to the recycling of the building's raw materials (DUBOIS and GADDE , 2002). These stages are mostly different, and can be linked to the activities of representatives of economic interests focusing on the given stage, therefore there are very few innovations that formulate innovations spanning the entire life cycle of investments. That is why the connection of all the stakeholders of the life cycle has a special role, especially for the transfer of knowledge between the companies concerned. This is also important because the fragmented stages –, in the narrower sense of design, construction, operation, reuse or recycling –, allow certain costs and responsibilities to be transferred to those involved in the next stage. Thus, for example, the long-term consequences of inappropriate building materials or energetic solutions are borne by the building's subsequent occupants or operators.

The prioritization of short-term economic goals complicates the planning of medium- and long-term innovation strategies and the creation of innovation ecosystems. According to (GOMES et al., 2018), the innovation ecosystem consists of interconnected and interdependent actors. The actors consist of the central company, customers, suppliers, complementary innovators and external actors. This means that in addition to the life cycle of the innovation ecosystem following a common evolutionary process, the members of the network also experience cooperation and competition. Innovative procurement processes in themselves demand a higher level of cooperation on the part of the tenderer(s) and those involved in the performance (EDQUIST and ZABALA-ITURRIAGAGOITIA, 2012).

Innovation capabilities can also differ from the point of view of which construction companies are involved in each construction stage. In the case of micro-enterprises, the innovation capabilities are generally more limited than in the case of large enterprises. In addition, in construction investment projects, each company participates in only a small part of the entire process, which also makes the innovation process management fragmented.

OVIEDO and HAITO et al. (2014) came to the conclusion that the greater the number of companies participating in each stage, the more fragmented the communication within the stage and within the supply chain.

In addition, it is often very difficult to find a suitable partner for an innovation partnership (PESÄMAA et al., 2009), which has an outstanding role especially when the subject of the innovation is the development of some radical innovation.

In addition, construction projects often last for many years, and product design is often modified in the meantime due to changes in customer preferences (KADEFORS, 2004).

KAPLIŃSKI (2018) collected the innovation trends that have appeared in the construction industry in recent years: these include intelligent 3-4D based printing, BIM modeling, pre-fabrication, energy-saving building systems, smart buildings, integrated mobile solutions and information on construction sites, the use of robotization, automation, unmanned aircraft, and increasing work safety on construction sites.

In public procurement and procurement procedures, the lowest price as a contract award criterion clearly works against innovations that support the integration of new products and processes.

In corporate competitiveness, several innovation evaluation models have been developed. ZUBIZARRETA et al. (2017) identified a total of sixteen different innovation evaluation models. The majority of models (65%) contain less than 50 indicators, ranging from 10 to 50. Only 6% of these models use only qualitative indicators to evaluate innovation, while only 25% use only quantitative indicators. Overall, 69% of the models use both qualitative and quantitative indicators.

The rise of innovations appearing in public procurement procedures is also hindered if the detailed plans and technical parameters are included in the tender documentation, limiting the use of alternative solutions during performance (ROSE and MANLEY, 2012).

Some authors also emphasize that procurement of design-execution of works in one procedure effectively improves the integration of innovations in construction projects. According to ERIKSSON et al. (2019), such integrated contracts provide more opportunities for optimization between planning and project implementation and encourage the incorporation of incremental innovations, reducing the client's financial risks because the responsibilities are clearer if a main contractor guarantees the adequacy of the design and construction (OYEGOKE et al., 2009).

Recent research has focused on green technological innovation efficiency (GTIE), analyzing management innovation, process innovation, product innovation and technological innovation. Green technological innovation (GTI) is considered the key to sustainable development (KUO and SMITH, 2018). ZHANG et al. (2021) highlighted that the construction industry is able to apply technologies in the market and turn them into economic benefits. The authors also point out that in the green technology R&D phase, however, resource investment is usually redundant, and large amounts of R&D investment ultimately do not produce any R&D results. Therefore, the key to the development of GTIE is to improve the efficiency of green technology in the R&D stage.

In TERZIS (2022) study, he examined the most important innovations in the construction industry in a structured based on a literature search and a review of patents. As a result of his research, he established that among the oldest innovations are those that introduced some kind of fiber-reinforced element into existing (mainly masonry) materials. However, in the recent period, this trend has been replaced by the appearance of " nano " and " ultra" additives. Based on literature data on digital and numerical tools in the construction industry and civil engineering TERZIS (2022) pointed to the gradual rise of articles about Machine Learning and artificial intelligence, as well as the increase in the number of researches dealing with recycling, new building materials and the environment.

In order to avoid high environmental protection costs and to maintain competitiveness, the construction industry increasingly moved towards green technological innovation ALPAY and KERKVLIET and BUCCOLA (2002). Some authors believe that the widespread implementation of green buildings is inseparable from the development and innovation of green building technology (CHAN et al., 2017; DARKO et al., 2018; FUERST et al., 2014).

This tendency can also observed in public procurement procedures, as more and more literature deals with the rise of green public procurement and its obstacles (e.g. EDQUIST and ZABALA-ITURRIAGAGOITIA, 2020; RAINVILLE, 2021; ROSELL, 2021; YE et al. , 2022). At the same time, some authors have already shown extremely forward-looking results: according to the study of ORSATTI et al. (2020) a one percent increase in green procurement spending in the United States increased the number of green patents by about 0.05 percent. SIMCOE and TOFFEL (2014) found a correlation between the mandatory green building standards for public buildings in California and private sector constructions: the

innovative green renovation of public buildings stimulated private sector construction investments as well.

Finally, it is also worth highlighting that in the construction industry, it takes a long time for a new material to spread, which is made difficult in addition to the licensing process and standards by the fact that everyone would only install very reliable materials in buildings designed to last for several decades or even centuries (POMÁZI, 2022).

3. The role of domestic public procurement in the transfer of innovations

As we have already indicated, the majority of domestic public procurement is public works. If we look at the number of construction investments, in 2021 home renovation was the most significant (46%). 43% of projects are housing construction and 11% are housing extensions. If we examine the value of construction investments (HUF billion), in 2021, housing construction was the most significant (55%), followed by housing expansion (24%), then housing renovation (20%) (APP, Public Procurement Notice Plus, 2022.).

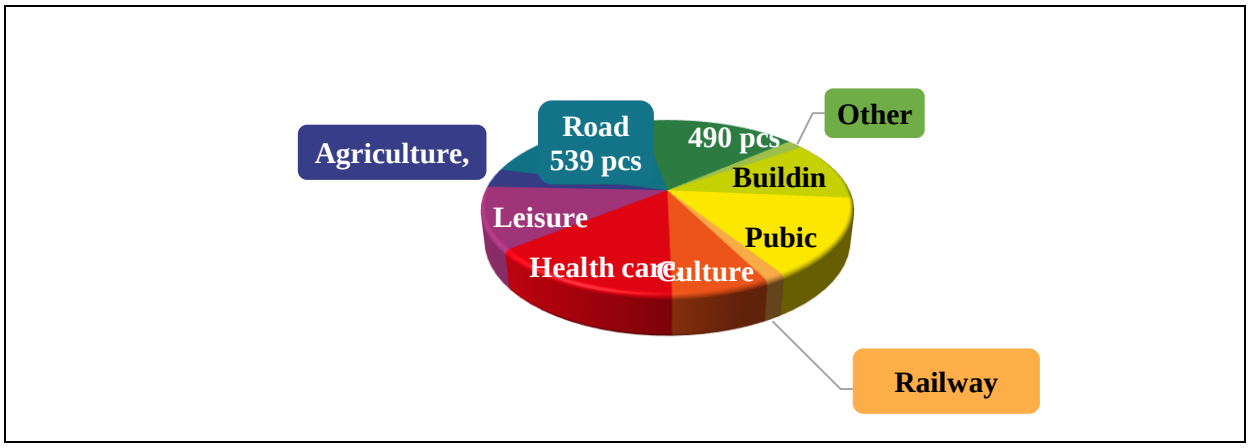

Figure 6. Number of public procurements in the construction industry (pcs) according to the subject of the public procurement in 2021
Source: APP, Public Procurement Notice Plus, 2022.

From the figures above, it can be seen that among the public procurements, the largest number and value of the procedures belonged to road construction (539, HUF 904 billion). Education investments followed with 490 procedures, the value of which was HUF 207 billion. Public utility investments were in third place: 438 procedures worth HUF 299 billion. Although only 44 procedures belonged to the railway construction category, it was in second place in terms of value with a value of HUF 409 billion. In 2021, public procurements announced in the health care and social sector also represented a significant share (435, HUF 143 billion). The number of public procurements related to recreational facilities was 343 in the amount of 274 billion forints, while 213 billion forints were spent on cultural institutions in the framework of 214 procedures. For the construction and renovation of various buildings (public buildings, apartments), 141 billion forints worth of results were announced in the framework of 331 procedures. HUF 32 billion was spent on the development of industrial and agricultural areas during 104 procedures (Figure 6.). For other purposes, in the case of 50 public procurements, results in the amount of HUF 15 billion were announced (KÁLI, 2022).

CZARNITZKI et al. (2022) highlights that the contracting authorities can reduce the information asymmetry between the tenderers and the potential innovation suppliers with properly defined public procurement calls. In addition, due to their size, the projects conducted on the basis of public procurement can already provide a market size that enables investors in

innovations to mitigate the economies of scale, the innovation parameters, and the risks associated with market access.

Regarding the implementation of innovation in construction projects, ERIKSSON and WESTERBERG (2011) developed a number of proposals: these proposals mainly highlight the formations of cooperation between innovation partners, placing great emphasis, for example, on the selection and integration of subcontractors suitable for participation in the partnership, based on the innovation performance, the incentive based on payments, setting up common IT tools, common risk management or even a common project office.

Innovation-oriented public procurement can create new markets or expand existing ones, thereby facilitating adoption and distribution, and speeding up both technological development and the introduction of innovations to the market (UYARRA et al., 2020), which can potentially change the composition of the entire industrial environment, changing the structure of competition, making it more attractive and accessible to new entrants (BLEDA and CHICOT, 2019).

According to point 13 of Article 5 of Directive 2014/23/EU, "innovation: means 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."

In accordance with the EU regulators, the Hungarian Public Procurement Act also regulates the innovation partnership between the types of public procurement procedure. According to our public procurement law, an innovation partnership is a specific public procurement procedure, the purpose of which is the development of an innovative product, service or construction investment, and the subsequent procurement of the resulting goods, services or construction investment, provided that they meet the contractual performance levels and maximum costs in innovation partnership requirements of the parties. The innovation partnership is divided into two stages: the stage of concluding the innovation partnership contract (procedural stage), and then the stage of performance of the contract, during which the development process takes place according to the conditions regulated in the innovation partnership contract (contractual stage).

In the public procurement documents, the contracting authority can define its procurement requirement for an innovative product, service or construction investment that is not available on the market. In all cases, the tenderer must justify the novelty (innovativeness). The tenderer's offer must include a description of the research and development project aimed at fulfilling the needs defined by the contracting authority - which cannot be solved with the existing solutions. The integration of innovations into the public procurement procedure is supported by the provision in our public procurement law, which allows for public works not to submit an unpriced budget, and the evaluation of offers can only be based on a system of criteria showing the best value for money.

The partnership agreement must define the course of the research and innovation process, which must be built up from successive stages and which may include the production of goods, the provision of services and the implementation of construction investments. The partnership agreement must also define the intermediate goals to be achieved by the partner, in connection with which it must also provide for the payment of remuneration.

The Council operating within the framework of the Public Procurement Authority, also issued a guide on certain issues of the application of the innovation partnership. on the basis of Article 183. c) of Act CXLIII of 2015 on public procurement (hereinafter referred to as Kbt.).

The guide highlights that, based on domestic legal regulations, innovative procurement can be carried out without conducting a public procurement procedure in the case of ordering

research and development services of certain subjects. In this regard, the Administrative Code establishes a circle of exceptions, if the conditions of which are met, the procurement is exempted from the public procurement obligation, regardless of its value. These conditions are - in addition to the fact that only R&D procurements with a certain CPV code fall within the scope of exceptions - that the result is not exclusively used by the contracting authority in the course of its activities and/or that the compensation is not fully fulfilled by the contracting authority.

Another way to implement innovative procurement is the use of a special procurement procedure - not public procurement – pre-commercial procurement (PcP), which is dealt with in a separate chapter of the guide, entitled "The relationship between innovation partnership and other procedures". The PcP is therefore not a public procurement procedure, in addition to many features similar to the innovation partnership - it consists of several stages, which are adapted to the phases of research and development, based on predetermined performance levels and costs, the number of participants in each stage can be reduced according to predetermined criteria, in both procedures the a contract must be awarded on the basis of the best price-quality ratio - the main difference compared to the innovation partnership is that the PcP is "limited" to research and development, during the PcP no procurement takes place - apart from the creation of the prototype - for that, a subsequent public procurement procedure is conducted, after the PcP (SZINI , 2019).

During our previous research on domestic innovation-oriented public procurement (BOROS, 2020), we asked two hundred and eighty state-owned companies about the factors that most hinder the integration of innovations into public procurement. Based on this research, the domestic application of innovative technologies in the field of public procurement is mostly hindered by the following issues:

- tenderers generally consider it less risky to purchase well-established goods than to use new, unknown technologies;
- there is insufficient professional competence or experience to conduct these types of procedure;
- public procurement clients generally see the awarding procedure as purely administrative and do not exhaust existing opportunities for increased sustainability and innovation;
- cooperation between contracting authorities cannot be considered a general solution in practice - this makes effective cooperation between contracting authorities and parties interested in research (e.g. universities) difficult;
- advance planning is especially important for innovative procurement; this often fails because, for example, resources must be used in the given financial year, or because there is no possibility to choose this type of procedure due to the administrative time window;
- such procurement procedures can only be based on sound market research: the contracting authority must know each element of the supply chain in order to assess the willingness of the partners involved in the developments to be flexible in terms of innovation, as what risks may arise and which parties should bear them;
- processes of this type require the expertise necessary to develop technical specifications,
- such procurements require the definition of contractual terms that go beyond traditional rules; for example, the correction of errors may also require further development or, for example, it will not lead to success if the enforcement of various rights related to intellectual property is so strictly regulated that the customer refrains from such procedures, since he is only a part of the development on which the innovation in question is based, and hewants to use it later.

Our research also revealed that there was an extremely low number of procedures among the surveyed companies that were specifically aimed at integrating innovative solutions (less than 2%).

In connection with public procurements containing innovative aspects, a comprehensive EU study was published in 2021, which also contains information on the situation in Hungary regarding innovative procurements. The above is supported by the fact that the study, among other things, states that Hungary is among the least performing member states in terms of support for innovative procurement solutions (Figure 7.).

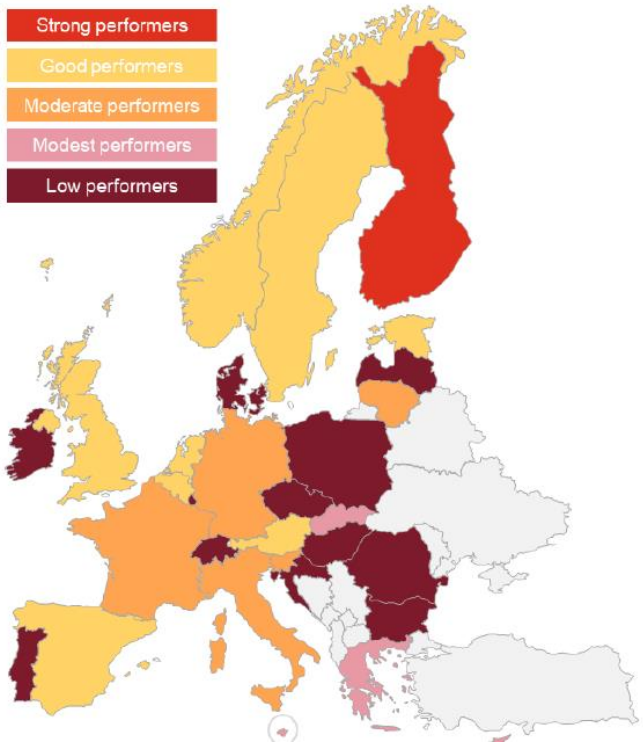

Figure 7. Number of public procurements in the construction industry (pcs) according to the subject of the public procurement in 2021
Source: APP, Public Procurement Notice Plus, 2022.

Conclusions

Overall, it can be concluded that the construction industry is a prominent sector of the Hungarian national economy, which plays a prominent role in green renewal and the integration of innovations.

Based on the reviewed literature sources and analyzed statistical data, it can be established that the proportion of public works procurement procedures using innovative solutions is low in Hungary. The level of public procurement procedures that integrate R&D results, as well as the share of innovation partnerships in relation to the entire vertical of domestic public procurement, can also be considered low.

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