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EUROPEAN COUNTRIES' EXPERIENCE REGARDING PRIVATE PARTNERSHIP IN TERMS OF DIGITALIZATION

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ABSTRACT

Analyzing the fundamental factors of strengthening the significance of partnership management configurations in the economy determine that partnership interaction between the state and business is an efficient instrument for economic development; public-private partnerships (PPP) basic theories are mutually supportive and continue to expand with PPP development.

One of the principal and most important determinants of socio-economic development, growth, ensuring the competitiveness of countries and their national economies is digitization, which means the active introduction and application of information and telecommunication technologies (ICT) in all aspects of life of society (changes, transformations that emerge in societies when affected by information and telecommunication technologies – digital transformations).

KEYWORDS

Partnership management, public-private partnerships (PPP), economic development, competitiveness, digitization, information and telecommunication technologies (ICT), digital transformation, national economies.

In recent years in the European Union, public-private partnerships have expanded the spectrum of their activity, some of them traditionally focusing on agreements in the mobility sector.

Public-private partnerships started to be used with the construction of public institutions and their equipment (hospitals, schools) and while providing various communal public services (sewerage and water supply), eliminating threats to environmental safety (desert advancing control, etc.).

Also, the experience of public-private partnership has become more diverse across countries. After Great Britain, which is the leader in terms of the number of completed PPP agreements, some other countries have created developed PPP markets (France, Germany, Spain); others have showed interest and began developing PPP programs.

Some EU Member States have either limited or no experience of public-private partnerships.

The experience of EU countries in the development of PPP projects can be useful for Ukraine as well, where this type of economic relations is just beginning to develop.

An important contribution to the study and research of scientific problems associated with the development of public-private partnership was made by such domestic and foreign scientists as: O. Besedina [1], O. Boiko [2], A. Cherep [3–5], M. Adamenko [3], O. Cherep [3, 6], I. Dashko [3, 5], R. Korolenko [3], O. Kornukh [3], P. Gudz [4], P. Ileva-Naydenova [4], L. Oleinikova [4, 6], O. Honcharenko [7], E. Klijn [8], D. Laponoh [9], N. Lokhman [5], V. Serebrenikov [5], T. Beridze [5], J. Nederhand [8], E. Androsova [6], L. Bexhter [6], O. Korotaieva [6], I. Petrova [10], D. Rogers [11], C. Skelcher [12], H. Sullivan [12], L. Tarash [10], R. Warden [13], R. Warsen [8] and others.

More specifically, L. Tarash studied world and European trends in the development of public-private partnership when determining priority areas of application [14].

It is possible to consider the importance of the practice and theory of private partnership on the basis of digitization, analysis and evaluation, the condition and peculiarities of European countries as the beginning of the era of development of the public-private partnership mechanism in our country.

Under modern market conditions, the rapidity of life is constantly gathering pace; there is speedy progress in the scientific and technological areas, economic and social development of countries. There is bulk information coming out.

State bodies, even in developed democratic countries, are no longer able to fully fulfill their social obligations to citizens and society.

The processes of involvement of non-governmental institutions – private business, local self-governing authorities, self-management of territorial communities, civil society – in the execution of the functions and powers of the state are opening more and more widely, which extremely actualizes the issue of implementing the mechanism of public-private partnership into the sphere of public administration.

Over recent years, the issue of introducing the PPP institute has found its level among the priorities of the governmental strategic development programs as an alternative method to restore and modernize the national economy. International technical assistance agencies, in particular USIAD in Ukraine, which is the originator of the "PPP Development Program in Ukraine", in their research also emphasize the PPP importance as "...a new instrument of state regulation that contributes to economic development" [1].

The experience and level of developed and successful European countries demonstrates that public-private partnership has evolved into an effective and powerful instrument for economic advance and social development both at the local level and at the level of national projects.

During such cooperation between subjects of authority and economic subjects, better results are achieved in the fulfillment of social tasks and requirements, budgetary resources and public property are used more effectively.

During the formation of a partnership form of management in the economy, the state and market (private) sectors of the economy are transformed, forming marginal forms – quasi-state and quasi-market sectors of a mixed economy, which results in the emergence of multi-sector or heterogeneous effects.

Analyzing the findings of the research of the basic theories of public-private partnership, it makes sense to emphasize the necessity to determine the rational relationship between the state and the private sector, which is shown in **Fig. 2.16** [1].

Fig. 2.16 emphasizes the significance of a harmonious combination of interests and efforts of two partners, the state and private (market) sectors, to ensure the development of the economy and overcoming crisis events.

According to the conclusions and results of the research of the place and role of partnership interaction of the state and business in the implementation of the state policy of economic development, the following peculiarities can be stood out: activation of cooperation between the state and private sectors of the economy, modern economy.

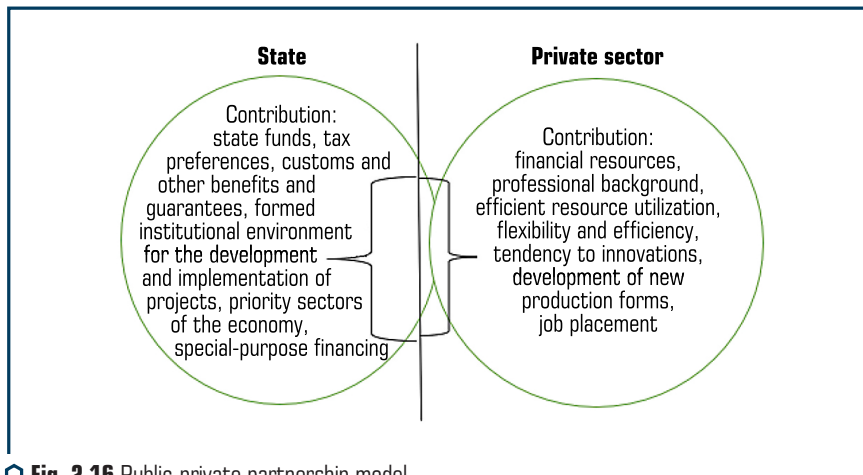


Fig. 2.16 Public-private partnership model
Source: Developed by the authors on the ground of [1]

The efficiency and success rate of the introduction of the mechanism of cooperation between the public and private sectors of the economy is contingent both on the regulation of legislative aspects at the state level and on the results of studying prosperous European theories and practices, and their introduction in the native sphere of public administration.

To make a more complete and accurate analysis of the global experience of PPP development, it is also necessary to consider in which countries PPP is registered at the legislative level (**Table 2.9**).

Consequently, the existence of a PPP law is not always a supposition for the successful functioning of this mechanism. This is confirmed by the experience of the Netherlands or Turkey, which, as it is possible to see above, are top performers in the European PPP market [15].

On the other hand, the practice and theory of project implementation in France, which is the leader according to quantitative and value indicators of the development and advancement of cooperation between the state and business [15], shows a different way.

It has been determined that in countries where there is no special legislation on PPPs, laws on public procurement or concession legislation are an alternative. Another means of regulating PPP relations is the option when laws on concessions contain only general provisions, and detailed regulation is implemented through the adoption of special laws in a certain sector of the economy.

● **Table 2.9** Legislative framework in the PPP field in the countries of the world

No.	Country	Availability of a legislative measure	Year of adoption
1	France	Law "On PPP"	2004
2	Great Britain	Non-available	—
3	Germany	Law "On PPP Development"	2005
4	Turkey	Non-available	—
5	Netherlands	Non-available	—
6	Ireland	Law "On Public-Private Partnership"	2002
7	China	Non-available	—
8	USA	Non-available	—
9	Canada	Non-available	—
10	Kazakhstan	Law "On Public-Private Partnership"	2015
11	Ukraine	Law "On Public-Private Partnership"	2010

Source: Constructed by the authors according to data [15–18]

In Ukraine, the public-private partnership procedure is regulated in sufficient detail by the Law of Ukraine "On Public-Private Partnership" (as amended dated July 27, 2023)

and a number of regulations thereunder. In this Law, public-private partnership is specified as cooperation between institutions of state power and legal entities exclusive of state and public utility services, institutions, organizations (private partners) [19].

Signs of a public-private partnership are the creation and construction (overhaul, reconstruction, restoration, new construction and technical re-equipment) of a public-private partnership object and management (use, operation, maintenance) of such an object; longtermness of the relationship (from 5 to 50 years); transfer of part of the risks to a private partner in the process of implementing a public-private partnership; private partner's investment in a public-private partnership object. Art. 4 of the above Law of Ukraine defines the spheres of application of public-private partnership [19].

The Law of Ukraine "On Concession" opens the form of implementation of public-private partnership and provides for the transfer to the concessionaire of the majority of the operational risk, which encompasses the risk of demand or the risk of supply [20].

The resolution of the Cabinet of Ministers of Ukraine "On the Approval of the Methodology for Identifying the Risks of Public-private Partnership Implementation, their Assessment and Determining the Form of their Management" affirms that during the preparation of public-private partnership projects, all risks are subject to determining, assessment and distribution between public and private partners. Certain recommendations are provided [21].

The analysis of scientific sources and the regulatory environment afford an opportunity to formulate our own vision of the essence of the definitions, namely: partnership is an activity (mainly entrepreneurial) that involves the aggregation of resources of several business entities, their joint management to achieve strategic objectives and joint responsibility for the result. Public-private partnership is a certain interaction of state and business structures to solve socially significant tasks with modalities of mutual satisfaction.

The research showed that one or another option of PPP regulation in the country depends to a considerable extent on the political willpower and interest of the country's government. Thus, not only the improvement of regulatory and legal support, but also the creation by the state of appropriate conditions for the institutional development of PPPs remains important in the direction of the development of PPPs.

Since the process of relations between PPP partners is quite complex, many countries in which specialized legislation for the development of PPPs has been created or is absent create bodies to support the development of public-private partnerships – a specialized division of PPPs – PPP Agency or PPP Unit [22–24].

This unit is authorized to effectively manage PPP projects, promote their implementation, evaluate planned PPP projects, stimulate the involvement of private partners, conduct negotiations, perform the functions of control and monitoring of the

implementation of PPP contracts, and provide support for digital and innovative technologies for business processes.

Also, the important functional responsibilities of the PPP Unit should include the development of a PPP development strategy, improvement of legislation in the PPP field, coordination of all processes related to the implementation of the PPP project, provision of advice to investors and assistance to the state partner in negotiating the terms of the PPP contract, etc. [25]. PPP Agencies can operate at different levels (national, sub-national, regional) and in different sectors.

At the same time, the spheres of activity and functions of PPP agencies differ significantly in different countries and at different levels. Such divisions may be established within the line ministry or as a separate institution or as a separate economic entity with partial state ownership.

Let's believe that industry-specific PPP agencies mostly belong to the industry ministry. So, for example, the sectoral ministries of France have considerable autonomy in matters of organizing the PPP process in such sectors as justice, health care, higher education, railway transport.

Academic research has shown that in Germany, a specialized agency for PPP development in the road sector was created on the basis of the Ministry of Transport [9]. Such subdivisions are not mandatory, but, as international experience shows, they contribute to the country's quick and high-quality adaptation to PPP processes.

Research of institutional and state structures for the development of PPPs performed by the Organization for Economic Cooperation and Development (hereinafter – OECD) in 2010 [26] and the updated findings of the research by the World Bank (2020) [27] showed that almost all OECD member countries created PPP Units [26].

In particular, PPP Units have been formed in 29 OECD member countries, including: Australia, Belgium, Great Britain, Greece, Denmark, Estonia, Israel, Spain, Ireland, Italy, Canada, South Korea, Latvia, Lithuania, Mexico, Germany, New Zealand, Netherlands, Poland, Portugal, Slovakia, USA, Turkey, Hungary, France, Czech Republic, Chile, Sweden, Japan.

However, only in 8 countries (Austria, Iceland, Luxembourg, Colombia, Norway, Slovenia, Finland, Sweden) this specialized PPP units have not yet been created.

Consequently, the number of countries with specialized bodies for PPP support is increasing, which indicates the growing interest of state governments in the development of the PPP mechanism.

PPP's organizational and technological basis is actively influenced by the processes of the economy and society digitization.

In 2015–2020, the EU made significant progress towards increasing digital competitiveness, increasing the level of the economy and society digitization.

The DESI index (The Digital Economy and Society Index reflects the efficiency of digital transformations in Europe, the dynamics of digital competitiveness of EU member

states), for EU countries increased on the average by 13.7 points (from 38.9 points in 2015 growth to 50.7 2021 growth, however, in 2020 it was even higher: 52.6 points), which indicates a change in the gap between the expected and actual level of EU digitalization (GAP) [11] (**Table 2.10**).

The European Commission has published the results of 2022 Digital Economy and Society Index (DESI), which monitors the progress that EU member states have made in digital technologies. The Renewal and Resilience Fund allocated approximately 127 billion EUR to reforms and investments in the EU's digital technologies sector.

● **Table 2.10** Dynamics of EU countries digital transformation

Country	DESI											
	2015			2020			2022			Δ		
	Index	Rating	GAP**	Index	Rating	GAP**	Index	Rating	GAP**	Index	Rating	GAP**
European Union	38.9	–	61.1	52.6	–	47.4	50.7	–	49.3	11.8	–	–11.8

Note: **GAP – gap, difference between exact (actual) and standard (desirable) values (standard value – 100)

Source: [25]

The results show that the introduction of main digital technologies by enterprises, such as artificial intelligence (AI), is low. It is demandable to intensify efforts to provide the complete deployment of the connection infrastructure (including 5G) necessary for innovative services and applications. Digital technology is another important area where EU member states need to make more progress.

DESI shows where it is necessary to strengthen efforts, for example, stimulating digitization of the economic activity branch including small and medium-sized businesses. The EU deals with the task of having the best available digital solutions and access to the digital connection infrastructure of the international standard.

It provides the member states a framework to assume common responsibilities and generate multipartner projects that strengthen their collective forces and resilience in global terms.

Digital transformation is a modern legal and socio-political substantiality that defines the contemporary world. It is the main catalyst of the economic advance for any country. Analyzing the values of the Digital Economy and Society Index (DESI) for 2022, it is now becoming apparent that the progress achieved by the European Union member states. All member states have shown a certain level of development in the sphere

of digitalization, but the overall pattern is a versatile one. Even though there is some convergence, a significant gap between EU leaders and countries with very low DESI scores exists. Despite the improvement, all member states shall continue to exert joint reasonable efforts to achieve the objectives set in the Digital Decade Strategy for Europe by 2030.

It has been determined that Ukraine has already launched its way in this new actuality. The fact that we are moving onward is positive, nevertheless there is also a negative aspect – our steps are not always compliant with the standards adopted in the EU countries with which Ukraine aspires to integrate. Ukraine has formed a work group, which includes representatives of the main state authorities, which is intended to work on the incorporation of our country to DESI. Under stewardship of EU4DigitalUA professionals, a report and accompanying analytical materials were generated, through which the current state is evaluated and the necessary steps for Ukraine's accession to DESI are determined. Therewith, a draft resolution of the Cabinet of Ministers aimed at stimulating the creation and development of the DESI ecosystem in Ukraine was launched. This project, together with key ministries, continues the work targeted at creating a favorable environment for the successful integration of Ukraine into the digital market of the European Union.

The introduction of DESI in Ukraine opens up the opportunity to monitor the dynamics and progress of digital development comparing with the digital economies of the EU, and thus will contribute to its inclusion into the EU digital market [72].

It has been determined that the EU is constantly increasing the level of digitalization, and other states, that began with underperformance, are gradually overtaking, moving at a robust pace. The standouts are Poland, Italy, and Greece, which have definitely improved DESI scores over the past five years, investing with emphasis on digital technologies supported by European financing. One of the objectives of the Digital Decade is to ensure that at least 80 % of the population has basic digital skills by 2030. Although 500,000 specialists entered the IT labor market from 2020 to 2022, the 9,000,000 specialists in the EU do not comply with the established EU purpose of 20,000,000 specialists by 2030.

The "Way to the Digital Decade" strategy, proposed by the EU in September 2021, will launch a modernized management mechanism through cooperation between EU institutions and other states to achieve the common purposes and objectives of the strategy. This approach involves monitoring changes using DESI, so the DESI indicators are structured around the four main aspects of the 2030 Digital Compass [26].

The innovation process is taking on new changes, making the transition to a digital society, knowledge economy and digital technologies closer. They are attractive to a private partner as an investor, demanding meanwhile innovative solutions and technologies from the PPP. It is conceivable that the innovative commitment of the PPP will

contribute to a speedy and technologically different solution to the socio-economic challenges of society.

It was settled that the state represents a dual role in the digital economy. As a moderator of relevant relations, it generates and establishes the regulatory standards and principles of digital relations between society and the government at the level of elements, instruments and mechanisms of the digital economy, controls and verifies the methods of their use, directly implements technology shifts.

PPP acts more often as an onlooker and user of the state's digital services at the level of e-governance than as a participant in their formation. Acting as a user of digital mechanisms and resources of the digital economy, the state uses the Internet and information technologies through its structures to provide services in e-government and online trade (tender purchases and assets sales).

Within the framework of digitalization, PPP experiences various innovative technology that open up new interesting and attractive areas for investors:

- a) at the intersection of various types of economic activity;
- b) in consequence of combining of the PPP project innovations of different nature into a single innovative idea (high-tech with socio-economic or ecological ones) [25].

Projects and development of digital infrastructures and digital transformations are an upcoming trend for using the PPP format and resources. The implementation of innovative and digital PPP projects inevitably occurs on the basis of one or another industry segment of the global system of digital networks and communications.

Since the PPP, built on an innovative basis, the nature of which is digitalization (digital nature), is always used in the long- or medium-term contemplation, it as a part of the global system of digital networks throughout the long period of its existence will absorb and process all the innovations that will be born during the introduction of the PPP project, hence building the technological basis for the subsequent self-modernization and self-development of the innovative environment. In other words, it is definite that there exists interactive self-development as a forced and inevitable consequence of PPP introduction, which has an innovative digital technological basis.

The array of instruments, which includes the search for funding sources, methods of their accumulation and application for the public-private partnership project, plays an important main role in the introduction of the project. Depending on the expected participants and types of work, different methods of financing the project can be used (**Fig. 2.17**).

Financing on the basis of specific weight is the most common and expensive method used in the implementation of large-scale projects. Nevertheless, it is often not able to protect participants from risks.

State financing provides full or partial financing of state projects, mainly infrastructure projects, through the state or local budgets, and actually from extrabudgetary

funds. The risks are related to the reduction of revenues of the budget system and the possible reduction or freezing of project financing.

Project financing is a future-oriented method of financing individual projects, which is investment lending. It has come into widespread acceptance in the financing of projects performed under the terms of PPP. It provides money for the cash flow that the project will generate after its completion. It involves aggregation of resources, belonging to many participants, which are accumulated and distributed by a specially formed project company. The risks are stipulated by the fact that, like a classic loan, this loan is risky and undersecured, which creates high risks and problems for lending banks.

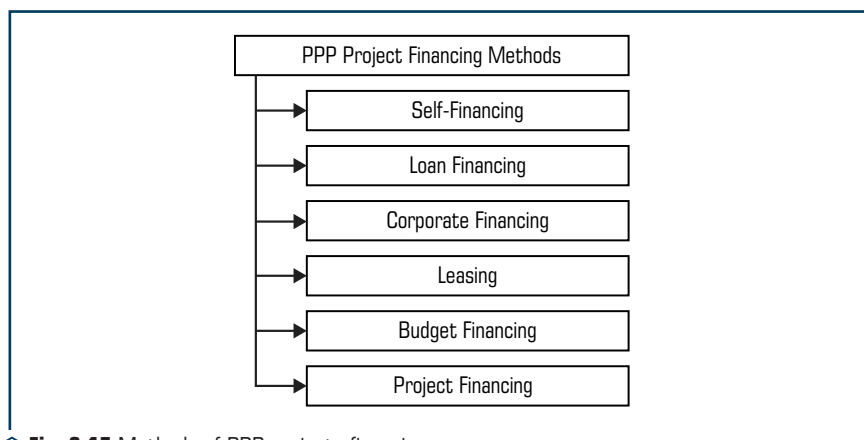


Fig. 2.17 Methods of PPP projects financing

Credit financing is a method often used in medium- and short-term investment projects with a high return on investment. Within the framework of PPP, project lending by individual banks, syndicated lending, financing through the issuance of infrastructure bonds, export credit financing, etc. are used. Risks are associated with the implementation of the project itself as well as with a possible change in the terms of concluding contracts and financing by investors.

Leasing financing mechanism is one of the methods of attracting loan funds for project financing. It is considered as one of the types of contractual loans, which are provided by the leasing company or bank to the lessee in commodity form and are repaid in installments. Leasing cannot always be used for social and some other public-private partnership infrastructure projects.

Mixed financing is a combination of several sources or methods of financing, which were discussed above. This is the most common method of financing that is used in the

implementation of investment projects in the infrastructure sector, primarily in the implementation of PPP projects, which allow to smooth out existing risks.

Consequently, within the framework of projects implemented on the basis of PPP, the choice of a financing profile depends on each specific project and the participants' assessment of the financial benefit from participating in it.

Many regions of the world need to invest money to form modern infrastructure in all sectors. The contemporary practice of implementing PPP projects affords possibility to bring to light that the real set of instruments is very limited. As indicated in World Bank reports, this is mainly equity and credit financing.

Other methods and sources of financing have not been widely developed. Loans from international organizations prevail in state sources.

Nevertheless, the set of methods and instruments that can be used in the implementation of public-private partnership projects may be diverse, which is discussed below.

Furthermore, the structure of possible sources of financing and formation instruments will also differ depending on the phase of implementation of the PPP project.

At the pre-investment stage of the development of the PPP project, the project's funds prevailed over the project initiator's own funds:

- own savings and profit, which can be supplemented in a small amount by budgetary funds (extra-budgetary funds) for the development of project documentation, funds from grants, competitions, angel investors finances, if the initiator is a private person;
- budgetary funds (extra-budgetary funds) provided for the implementation of this project, if the initiator is a public participant.

At the investment stage of the PPP project, the choice of funding sources is somewhat expanded.

At this stage, it is possible to use the following sources:

- own funds of the project participants: savings and profit, funds and reserves created if the initiator is a private person;
- budgetary funds (extra-budgetary funds) allocated for project implementation including guarantees, if the initiator is a public party;
- subject to conditions of co-financing, funds from the issue and sale of shares, other securities; funds involved in project financing;
- loan sources: budget loans, loans from banks and other financial organizations and institutions, loans from international organizations, bond loans, leasing, project financing.

It has been determined that in the course of the work of the project, the choice of funding sources becomes as wide as possible and may include:

- own funds of the project participants: own capital, savings and profit, depreciation charges, development funds and other target funds and reserves (private person);
- budgetary funds or extra-budgetary funds provided for the implementation of the project (public party);

- sources of involvement in the financial market: grants, tenders, funds from commercial investors under co-financing conditions, involved in the project, funds from the issuance of additional shares, other securities; funds received in the frames of project financing;

- funds received as a result of redistribution: insurance reimbursements, funds formed on a share (partial) basis;

- loan sources: budget and tax investment loans, guarantees, loans from banks and other financial organizations, syndicated loans, loans from international organizations, bond loans, factoring, guarantees.

At the final (liquidation) stage of the project, the choice of funding sources is again significantly reduced. These are going to be:

- own funds of the project participants: owners' equity, savings and profit, depreciation deductions, development funds and other target funds and reserves (private person);

- funds received through the reissuance and mobilized on the financial market: insurance reimbursements, limited budgetary and extra-budgetary resources involved in the project on a targeted basis;

- funds from the sale of securities; funds received from the sale of superfluous, unused, obsolescent fixed assets;

- loan resources: bank loans are limited; it is possible to receive funds as part of project financing.

The world trends in the development of PPPs are:

- a) the qualitative growth of PPPs in the world and in the EU (the number of projects and the total volume of investments in them);

- b) branching of the PPP market according to states and sectors of the economy;

- c) infrastructure orientation of PPPs, when countries implement important projects with the help of PPPs, which results in an increase in the quality and quantity of infrastructure services;

- d) state support for the development of a certain type of PPP or in a certain industry or trend;

- e) PPP development in the sphere of innovative activity.

PPP projects bring a different amount of investment to the respective sphere, as they have different investment capacity. Transport is still the most investment-intensive [11].

At the same time, digital PPP projects along with investment in information and communication technologies, accounting for only 0.8 % of their total number of transactions, Innovative aspects of institutional transformations bring 1.7 % of investments. The investment capacity of PPPs on an innovative and informational basis, calculated for PPPs in the field of "information and communication technologies", is 2.1. The only PPP investment capacity in relation to airports is much higher than it [28].

One of the most important strategic documents of the EU, which defines digital transformations as the basis of EU development until 2030, is the Digital Compass 2030: the European way for the Digital Decade (2030 Digital Compass: the European Way for the Digital Decade) [26].

Considerable experience of the effective application of the mechanism of public-private partnership has been accumulated in the countries of the European Union (hereinafter – the EU). **Fig. 2.18** presents the dynamics of the number of agreements and investments implemented on the basis of PPPs among the member states of the European Union [29].

As evidenced by the data in **Fig. 2.18** from 1990 to 2020, 2,023 projects with a total cost of 406.3 billion EUR were implemented in EU countries.

Overview of the European public-private partnership market in 2022 is presented in **Fig. 2.18**.

Large public-private partnership projects (500 million EUR or more) as a share of total activity in 2022 [30].

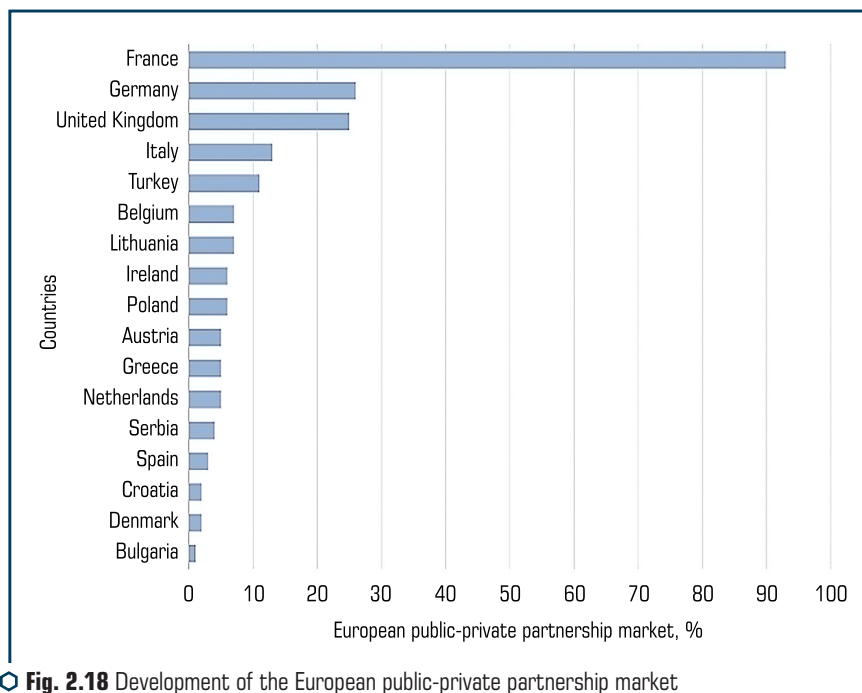


Fig. 2.18 Development of the European public-private partnership market by country (2018–2022)
Source: [27]

Implementation of PPP projects in the countries of the European Union during 1990–2020 is presented in **Fig. 2.19**. In 2022, 20 PPP projects were implemented, of which PPP agreements were concluded for 16 projects, the overall price of which is 12.7 million USD. 3 large projects worth 4.2 billion EUR have been completed. The bidding process for 2 projects worth 2.50 million USD has been accomplished and they are in the process of signing the PPP agreement.

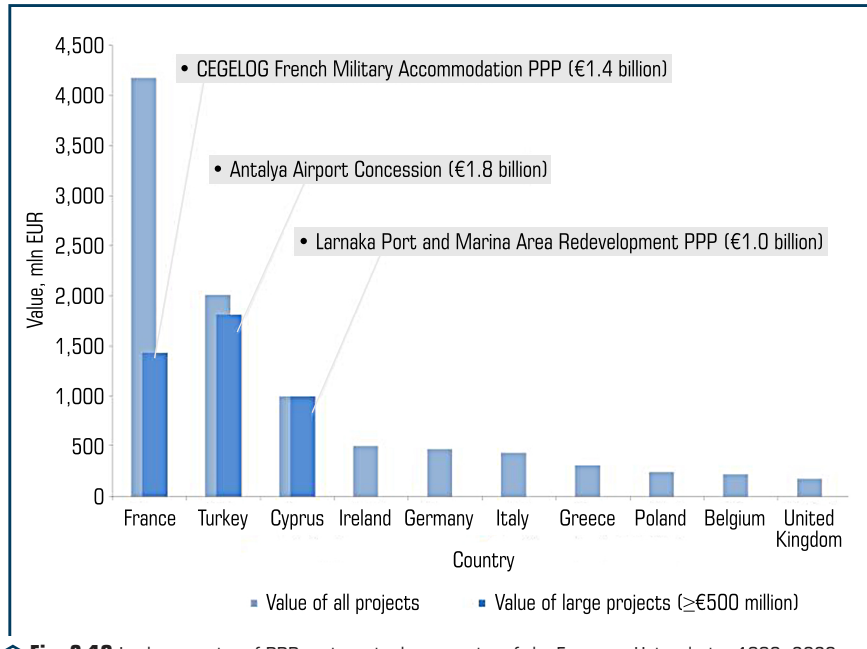


Fig. 2.19 Implementation of PPP projects in the countries of the European Union during 1990–2020

The number of demand/income-based transactions reaching financial closure increased up to 70 % of total transactions in 2022 (66 % – in 2021).

The enhancement in value and number of public-private partnership agreements in 2022 proves that in spite of the uncertainty and instability of construction prices, the public-private partnership is recovering after the coronavirus pandemic (**Fig. 2.20**) [28].

It is important to note that in different European countries the development and level of the PPP mechanism occurs at different speed: if in France, Germany, Great Britain this mechanism is already quite developed, then there are other countries that do not have significant experience in the implementation of PPPs or have just begun to master

and study this cooperation mechanism. Such countries include Denmark, Croatia and Cyprus [28].

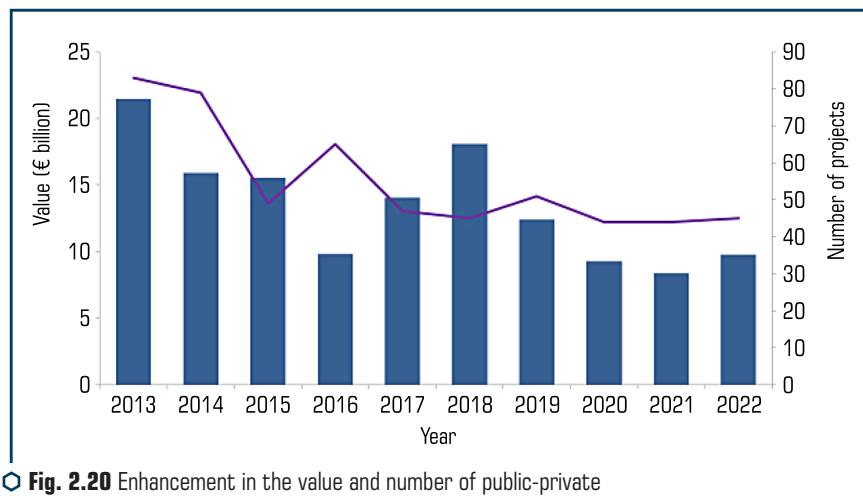


Fig. 2.20 Enhancement in the value and number of public-private partnership agreements
Source: [28]

Analysis of the European market for PPP development over the past 7 years has shown that France ranks the first by quantitative criteria as well as by the value of signed agreements among the EU member states. Likewise, among the countries with a large scope of projects using the PPP mechanism in **Table 2.11**, it is possible to lay emphasis on Great Britain, which during 2016–2020 established itself as a leader among other countries of the world, as well as Turkey, Germany and the Netherlands. Other states have a significantly lower level of indicators both in terms of number and nominal value of projects.

These tables show that in the course of 2022, Turkey has the second largest PPP market in terms of value, with a total of 2.0 billion EUR (1.4 billion EUR in 2021) [32]. When it comes to completed transactions according to the number of projects, Germany was the first and has the second largest public-private partnership market with four completed transactions (seven transactions were completed in 2021). Seven countries concluded no less than two agreements (six countries in 2021), and 4 countries concluded no less than one public-private partnership agreement (compared to 2014 vs 2021).

France and Germany lead the European public-private partnership market concerning the total number of concluded agreements.

In 2022, the total value of EU public-private partnership agreements that reached the phase of financial closure amounted to 9.8 billion EUR, which is 17 % more than in 2021 (8.4 billion EUR).

In the sectoral section, the priority sphere in the countries of the European Union concerning public-private partnership in 2022 according to the number of agreements is transport, environment and telecommunications industries [32].

● **Table 2.11** Dynamics of public-private partnership projects among EU member states from 2016–2020 and in 2022

Country	Number of PPP projects, units, in 2016–2020	Cost of PPP projects, billion EUR in 2016–2020	Number of PPP projects, units, in 2022	Cost of PPP projects, billion USD in 2022	Progression between 2016–2020 and 2022	
					Number of PPP projects	Cost of PPP projects
1	2	3	4	5	6	7
France	67	13.54	25	4.2	–42	–9.34
England	58	10.29	2	0.1	–56	–10.19
Germany	22	6.63	4	0.6	–18	6.06
Turkey	16	12.68	2	2.0	–14	–10.68
Netherlands	11	4.3	–	–	–11	–4.3
Italy	9	4.05	2	0.4	–7	–3.65
Belgium	7	4.05	2	0.2	–5	–3.85
Ireland	7	0.95	2	0.6	–5	–0.35
Austria	5	0.44	–	–	–5	–0.44
Greece	5	1.02	1	0.3	–4	–0.72
Lithuania	4	0.07	1	0.07	–3	0
Spain	3	0.57	–	–	–3	–0.57
Poland	2	0.47	2	0.2	–	–0.27
Serbia	2	0.79	–	–	–2	–0.79
Bulgaria	1	0.88	–	–	–1	–0.88
Finland	1	0.17	–	–	–1	–0.17

● Continuation of Table 2.11

1	2	3	4	5	6	7
Slovakia	1	1.00	–	–	–1	–1.00
Cyprus	–	–	1	1.00	+1	+1.00
Denmark	–	–	2	0.06	+2	+0.06
Croatia	–	–	1	0.03	+1	+0.03

Source: constructed by the authors according to data [31]

Development of the main sectors of public-private partnership according to project number (2018–2022) (**Fig. 2.21**).

The share in the areas of protection, public order and security, recreation and culture, provision of public services and housing and communal services remains insignificant. According to sectoral placement in developing countries, the top performers in the total volume of financing is the electric power sector. For 2016–2020, 176.42 billion USD were invested in this sphere [33].

In 2022, the transport sector continued to be the most important in monetary terms. The transactions amount was 5.2 billion EUR (6.0 billion EUR in 2021). The number of projects increased. 17 transport projects reach financial closure in 2022 (compared to 2016 and 2021).

These are such large projects as four roads (two in France, one in Greece and one in Italy) and four ports (two in France, one in Croatia and one in Cyprus).

The tables data show that 10 projects in the environment sector were completed during 2022 (10 were completed in 2021) with a total value of 1.3 billion EUR (1.1 billion EUR in 2021). It was the second most active sector among the projects.

5 projects were implemented in the field of centralized heat supply – all of them were in France, with a total cost of 576 million EUR. In the education sector, the number of financially completed projects increased from 5 to 8, and the total value rose to 910 million EUR (391 million EUR in 2021). 6 were school projects (3 in Germany, 2 in Great Britain and 1 in Belgium). 3 projects were completed in healthcare (2 in 2021) for a total of 509 million EUR (224 million EUR in 2021). 2 projects in terms of medical institutions (1 in Denmark and 1 in Turkey). In the field of telecommunications, 3 projects were completed (3 in 2021) with a total amount of 231 million EUR (427 million EUR in 2021).

All 3 concerned broadband Internet projects in France [33].

The water supply and drainage sector turned out to be the least attractive among the considered sectors – 15.78 billion USD. In quantitative terms, PPP projects are most

intensively introduced in the field of electricity, as well as in transport infrastructure, which includes the construction and operation of highways, railway transport, seaports and airports [33].

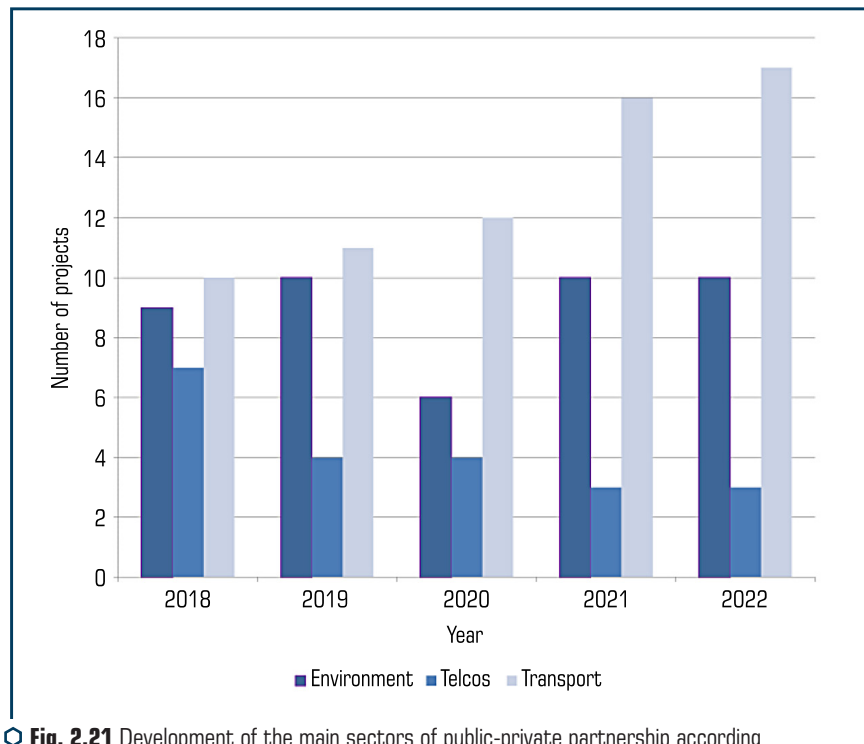


Fig. 2.21 Development of the main sectors of public-private partnership according to project number (2018–2022)

The given statistics show that the public-private partnership is developing quite actively on the international market, which is confirmed by the number of introduced projects and the number of investments. Consequently, this type of cooperation has proven itself quite well and has a basis for further development.

The experience of implementing PPP projects at the local level in the EU is very valuable: the PPPs are an effective and future-oriented instrument for economic and social development at the regional and local levels, as well as a means of financing projects in which national and local authorities wish to maintain control and establish cooperation with investors.

Such cooperation between local authorities and business entities results in the improvement of technical and economic indicators and results of projects, as well as in the effective use of state resources and communal property.

For example, public-private partnership projects have been implemented in the field of water supply and drainage for many years. In France, concessions for the construction and operation of water supply and drainage facilities have been in effect for at least 50 years, which has led to the development of a large and diverse private sector that operates water supply and drainage facilities.

Together with the implementation of the Directive of the European Commission on the quality of potable water and wastewater treatment, the obligations of state authorities to take responsibility for the maintenance and operation of facilities to provide consumers with high-quality potable water have substantially increased.

In order to satisfy the requirements of the Directive, it was determined that many countries will have to diversify their investments in the construction of technically new water supply and drainage facilities or in the reconstruction of existing water supply and drainage facilities. As a result, the countries that previously did not involve the private sector in this public services sector are now considering the possibility of using the technology, expertise and resources of the private sector to fulfill the requirements of the aforementioned Directive.

According to a recent study by the World Bank (Public-Private Partnerships for Urban Water Utilities, 2009), over the past 15 years, 32 developing countries and transition economy countries have implemented water and sanitation projects based on forms of PPP such as management contracts, concession agreements and leases. An overlook of 65 large public-private partnership projects in this sector showed that private operators achieved the greatest success in improving operational efficiency and service quality.

Most of the private operators surveyed by the World Bank have been successful in reducing water losses. The analysis also showed that the involvement of private operators significantly increases the level of collection of payments for services rendered.

Currently, public-private partnership projects have been extended to areas such as waste management, where the financial burden has increased significantly within the traditional responsibilities and functions assigned to the public sector. For economic reasons, as well as for environmental reasons, local authorities are giving less and less consideration to traditional landfills as the only economically viable solution to the problem of waste and pollution. More present-day methods, such as waste-to-energy schemes and sorting stations, require significant investment.

The most comprehensive forms of PPPs are suitable for waste management projects where most of the operational and financial risks are transferred to the private sector. Furthermore, the concession agreement stipulates that the private partner will not only finance the project, but also collect fees for services provided to consumers (according

to the "polluter pays" principle), and also assume the risks associated with the volume of waste.

An effective example of mutually beneficial cooperation between the city and a private investor can be the PPP project implemented in Birmingham (Great Britain). Birmingham has approximately 2,500 kilometers of streets, roads and urban highways, as well as 850 bridges, tunnels and related transport structures. Therefore, the city must provide lighting for 97,000 city-owned streets during the dark hours of the day. In the past, most of the lamps used for lighting were high pressure sodium, mercury or metal halide lamps. Before the PPP project, most of the street lighting was outdated and they need substitution.

The street lighting substitution is part of a larger agreement (117 million USD of the 4.2 billion USD total agreement value) targeted at incremental improvements to the highway network and the maintenance and management of 2,500 kilometers of roads, 4,200 kilometers of sidewalks, 97,000 lights, 76,000 streets, 1,100 traffic lights and more than 850 bridges, tunnels and road structures. The project implementation period is from 2007 to 2035. Projected energy savings – 50 % [31].

The lighting substitution is planned in two stages: the first stage lasting 5 years (the main investment period, 2010–2015), during which 57,404 lamps were substituted with 35,804 posts, 21,402 PhilipsIndalStela LEDs, 14,204 conventional high-pressure sodium lamps and 198 other types of lamps. Most of the capital expenditures (Capex) were made during the capital investment period, from June 2010 to June 2015 [29].

The first stage concentrates on the most problematic issues, specifically:

- improvement of the average condition of roads, carriageways and sidewalks, especially those that were in extremely poor condition;
- substitution of up to 41,000 noncurrent posts, including modernization of equipment in the posts to ensure control and improve the efficiency of electricity management;
- reconstruction of three main tunnels of the city center with up-to-date equipment to improve safety;
- strengthening of bridges so that city roads are able to withstand more load;
- restoration of a large number of old traffic signal regulators to improve the ability to connect traffic control systems with other institutions [29].

The second phase provided operational expenditure (Opex) during the period from 2015 to 2035 to maintain the higher operating indices that had already been achieved as of 2015. Approximately 40,000 fixtures will also be gradually upgraded during this phase.

In the case of Birmingham, the private and public sectors joined efforts using private funds to upgrade the city's infrastructure up to established standards. The partnership also includes the obligation of the private partner to maintain the infrastructure in good keep throughout the duration of the agreement [12].

Since the city and its residents continue to use the infrastructure, the private partner is responsible for the ongoing management and maintenance of the infrastructure and its improvement.

The expected results of the project implementation are:

- improving the quality of light from LEDs, which will improve sight distance and overall road safety by reducing the number of accidents, crimes, and environmental contamination;
- high operational efficiency, reliability and long service life will help save energy and reduce carbon dioxide emissions by 50 % or more;
- reengineering of street lighting systems with control elements and creation of a central control system will provide with the freedom to achieve maximum energy savings;
- ability to adjust the level of power supply of LED lamps will help reduce heating and extend the service life of such devices;
- improvement of lighting will be noticeable to the public and will affect the general perception of roads and their maintenance.

Separately, it will be observed that the agreement allows a private partner to install LED lighting, but does not require periodic updates of the technology.

Along with this, there is a general trend that the service provider actively looks for and studies new technologies for their implementation for the purpose of using the most energy-efficient and progressive technologies for street lighting, thereby increasing the profitability of the project [25].

In 2022, the following important public-private partnership projects in the member states of the European Union achieved financial completion:

1. The second public-private partnership transaction amounting to more than 500 million EUR occurred in Cyprus for the project "Reconstruction of Larnaca Port and the Marina Area" (1 billion EUR) and achieved financial closure;
2. Irish Community Nursing Units (CNU) project (245 million EUR) achieved financial closure in 2022. This is the first public-private partnership for community nursing in Ireland and the second public-private partnership transaction in Ireland since 2016.
3. The public-private partnership project in Greece "Salonica Circular Road" has reached financial closure (300 million EUR). This is the first public-private partnership project in Greece regarding road accessibility. The last road projects in Greece prior to this reached financial closure in 2007.
4. The public-private partnership project "Krakow tram" (186 million EUR) achieved financial closure in Poland. This is the first project based on public-private partnership in municipal transport in Poland.

The successful international and national experience of public-private partnership shows that PPP is an instrument of partnership, equal and mutually beneficial cooperation between the state, the community represented by interested state authorities

and local self-government bodies, and also business, where projects are implemented by joint efforts.

In reliance on the research performed, let's contribute suggestions in terms of innovation-oriented development of public-private partnership, namely:

a) the joint process of creating innovative value by the state, a private partner and society includes finding a compliance between existing necessities and the possibilities of their satisfaction (science, engineering, technology, knowledge and competence), between which there may be contradictions;

b) further optimization of the internal innovation environment of the PPP according to the old approaches is practically impossible, since the existing methodological approaches have drained themselves as a consequence of two technological revolutions (computer, biotechnological ones) and the development of integrator technologies of the 1st and 2nd generations.

The latter combine the 4Ss:

- smart technologies;
- smart environment;
- smart production;
- smart products.

These technologies and the outcome of their combinations and integration, contribute to the growth of productivity and competitiveness of certain sectors of national economies in the process of creating new markets and industries.

The PPP digitization mechanism is ambivalent in nature. Primarily, it is the use of digital financial instruments in the investment process of PPP projects (financial component of the PPP mechanism), and secondly, the use of digital platforms to integrate the interests of PPP project participants (organizational and communication component). World ranking of digital competitiveness, 2022 (Top-30) listed on the **Fig. 2.22**.

This approach, along with the development of organizational and financial instruments, allows to conclude that in the implementation of PPP projects in European countries, digital instruments are used, which allow for more effective interaction between national and municipal authorities, special information and analytical systems and technological platforms.

Therefore, the digital environment creation within the state and the private sector, open data, services and instruments for their use forms an information infrastructure for business communities, countries and their people including within the framework of public-private partnerships.

This approach makes it possible to get closer to the system of digital transformation of the PPP mechanism based on a combined array of instruments, which is noted in the form of general and digital financial instruments in the process of project implementation, as well as to face the detection of all parties through a digital platform.

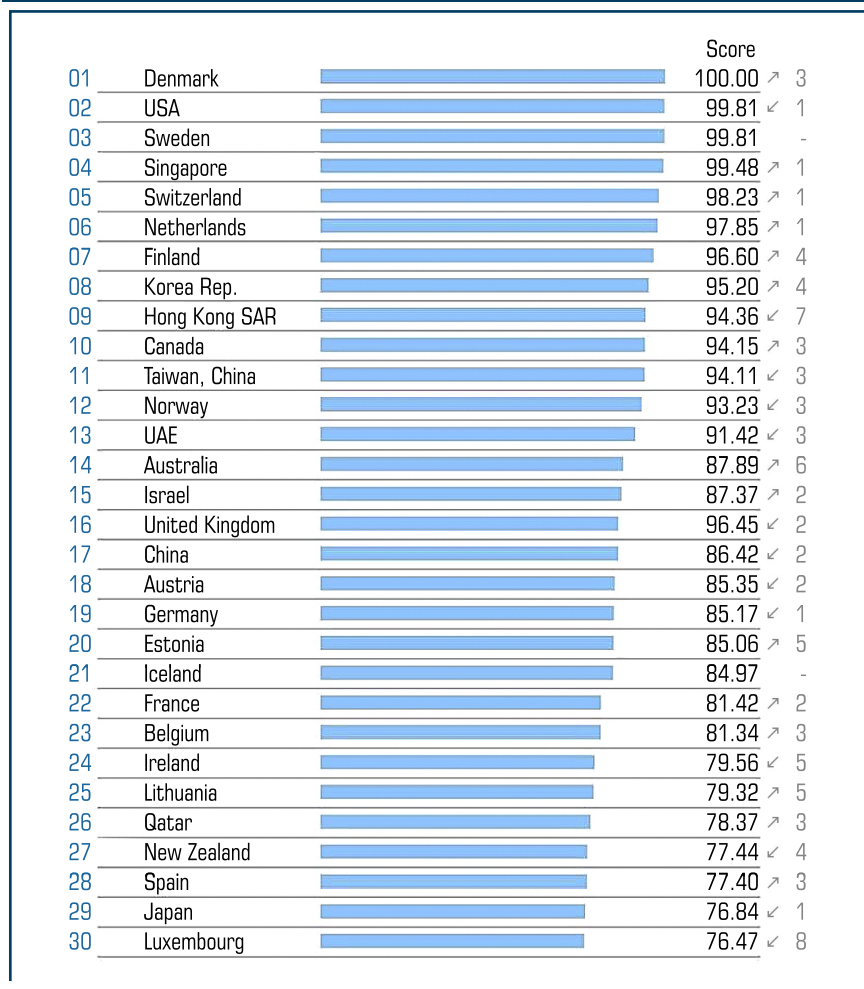


Fig. 2.22 World ranking of digital competitiveness, 2022 (Top-30)
Source: [27]

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