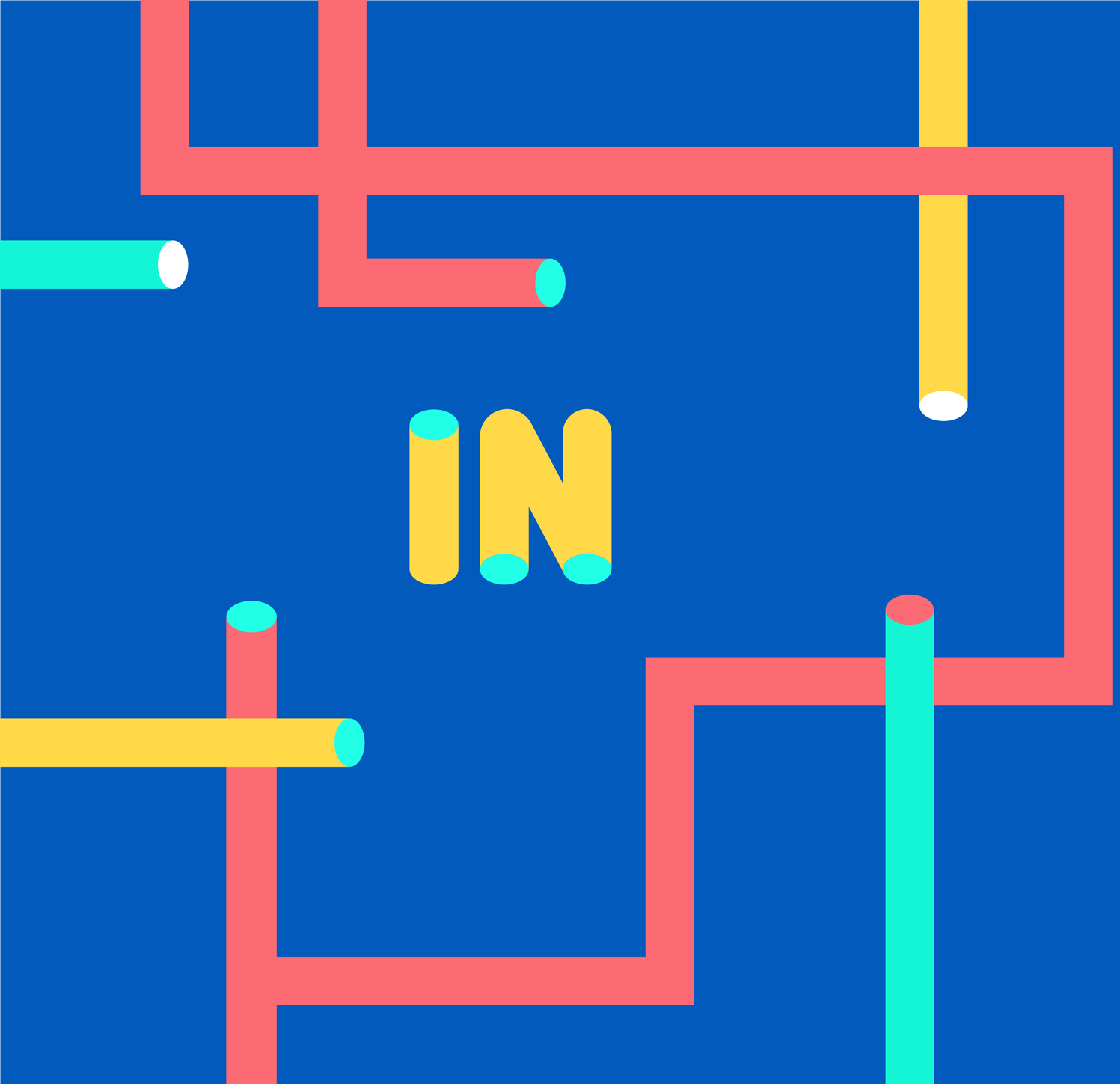


Bratislava
Innovation Team

Urban Innovation Strategy

Innovation as a tool for a sustainable, resilient and liveable city

Petra Dzurovčinová, Alexandra Posypanková

Executive Summary

The City of Bratislava has great potential to develop its innovation skills, and the Urban Innovation Strategy serves as a tool for innovation management, development and its implementation in the future. This document analyses the city‘s strengths and weaknesses in terms of its innovation capabilities. It also defines solutions to enhance the city‘s ability to innovate.

The first step is to analyse the current state of the city in relation to innovation. Bratislava has a strong economic position in terms of macroeconomic indicators. Bratislava is also home to many businesses that contribute to the development of the economy. On the other hand, Bratislava‘s entrepreneurial ecosystem was rated average (5.61 out of 10) and the innovativeness of SMEs is at a low level. Businesses are only marginally involved in the running of the city and do not have an existing relationship with it. There is a concentration of academic and research institutions and university students in the city, which raises the quality of the city. Nevertheless, universities fail to meet the needs of employers regarding the quality and number of graduates.

The creation of a quintuple helix cooperation is one of the tools that will support the building of the city‘s innovation capabilities. Quintuple helix collaboration is an innovation system that highlights the need for cooperation across the public, private, academic and civic sectors. All potential ideas and innovations that emerge from this collaboration must take into account their social and environmental impacts. The city can act as a neutral player in this cooperation, supporting the exchange of knowledge and experience in order to increase the chances of a successful solution to common problems.

The Bratislava City Lab serves as a safe space for testing innovations in the form of controlled experiments and pilot solutions. Outputs from quintuple helix collaborations can be tested on a small scale before their full implementation. The projects within the Bratislava City Lab are aligned with thematic research and innovation areas such as efficient urban mobility, climate change adaptation, energy efficiency and neutrality, and data-driven decisions.

The digital transformation of Bratislavais a separate thematic area that the city wants to address as a priority. The city should offer its residents services they are used to receiving from the private sector and in an easily accessible, fast, efficient and convenient way. The transformation of digital services is based on the real needs of users. This will be achieved by using designthinking processes as the primary tool for this transformation.

We believe that the innovation potential of Bratislava should focus on improving the lives of its residents through new technologies and economic opportunities. Bratislava should be a city that is attractive to live in and that can adapt to future technological andclimatic changes.

Introduction

As the capital city, Bratislava is the economic, cultural, academic and political centre of Slovakia. Bratislava is a city of opportunities, but it has not yet managed to fully develop its innovation potential and take advantage of the presence of key players from the economic and academic worlds.

Cities have the ideal size for testing and bringing innovations into everyday life. Their smaller administrative apparatus and proximity to residents allows them to respond more flexibly and create meaningful collaborations based on shared needs and goals. The growing importance of cities is also recognised by international institutions such as the Organisation for Economic Co-operation and Development (OECD) Champion Mayors sustainable growth initiative[1] and the Leipzig Charter of the European Commission[2]. The diversity of competencies of the City of Bratislava allows for the offer of comprehensive services to its residents which should reflect the level of modern cities and the expectations set by the private sector.

What is the aim of the Urban Innovation Strategy in Bratislava?

The abstract nature of innovation can be difficult to grasp when measuring its impact. The aim of the Urban Innovation Strategy is to analyse the current state of Bratislava as the capital city in relation to innovation and the innovation skills of the cityitself, its partners and its citizens. Based on this analysis, the challenges and problems that the city is currently facing or will face in the future are subsequently identified.

Although innovation can affect every aspect of the lives of residents, the Urban Innovation Strategy in Bratislava defines thematic areas that the city should focus on in the period from 2022to 2030 in terms of innovation. The selected thematic areas are in line with national priorities. The defined areas also delimit the scope of the Urban Innovation Strategy.

The above-mentioned definition implies the primary role of this document, which is to set out the processes and vision for the development and implementation of digital services and new technologies that are available on the market for both digital and physical environments (including smart city technologies). Another role is to measure the impact and use of these technologies. Last but not least, this document describes solutions and methods that will help the city build its innovation skills and open its ecosystem in the creation and development of innovation.

1 http://www.oecd-inclusive.com/
2 https://ec.europa.eu/regional_policy/en/information/publications/brochures/2020/new- leipzig-charter-the-transformative-power-of-cities-for-the-common-good

Methodology

The Urban Innovation Strategy is based on qualitative and quantitative data collected during 2019 and 2020. Relevant findings from these data sources are presented in the analytical section of this document. In preparing the document, we have drawn on the recommendations of the European Commission's Joint Research Centre (JRC)[3] on the topic of local innovation and the role of the city in its promotion and development.

Definition of urban innovations

Urban innovations in the context of this document represent technological and process innovations that relate to or improve the urban environment. Urban innovations can refer to gradual or radical changes in urban services and internal processes that add value to users compared to their previous situation. In the short term, we focus on digital innovation and pilot projects that combine software and hardware components. In the medium and long term, urban innovation can help address social, environmental and infrastructure challenges.

Global context at the local level

The concept of urban innovation builds on existing capital projects and strategies, and it contributes to those that will be developed in the future. The concept of urban innovation was inspired and based on individual strategic documents at various administrative levels:

→ Projects and initiatives under the Urban Innovation Strategy aim to fulfil the global agenda of the Sustainable Development Goals (2030 Agenda)[4] which was adopted at the United Nations in 2015.

→ In cooperation with the European Commission's JRC, we are working to develop innovation competences and deepen cooperation. Bratislava also serves as one of the pilot sites for the new Local Sustainable Development Goals Voluntary Local Review (VLR) manual, which includes the mapping of available data sources and the identification of indicators.

→ The strategy is also based on smart specialisation strategies at the national and regional levels in the previous period from 2014 to 2020. The document is also linked to the recent Smart Specialisation Strategies for 2021 to 2027 at the national and regional levels.

→ There is an analysis of existing and available materials at the national level on digitisation, e.g. the Digital Transformation Strategy of Slovakia 2030[5] and the National Strategy of the Informatisation of Public Administration (NCIPA)[6].

→ Bratislava is an integral part of the Bratislava Self-governing Region, which we consider Strategy to be an important partner. We participated in the commenting of the new Programme for Economic and Social Development (PHRSR BSK) in order to unify our activities in the territory.

→ There is coordination at the City level in order to link thematic and strategic documents, including inputs for the Bratislava 2030 city-wide strategic document.

Data sources

As we are trying to make evidence-based decisions, we have used the following data sources in the preparation of the document:

→ Quantitative research in the form of the Global Entrepreneurship Monitor: a representative survey among the residents of Bratislava with a sample of 512 respondents that was conducted in August 2019.

→ A quantitative survey on the needs of the business environment in Bratislava that was conducted in cooperation with the Profesia portal with a sample of 178 companies from 28 industries in September 2020.

3 https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation-
4 https://www.mirri.gov.sk/sekcie/investicie/agenda-2030/index.html

5 https://www.mirri.gov.sk/sekcie/informatizacia/digitalna-transformacia/strategia-digitalnej-transformacie-slovenska-2030/
6 https://www.mirri.gov.sk/sekcie/narodna-koncepcia-informatizacie-verejnej-spravy-nikvs/

→ A representative survey on technology and communication with municipal institutions with a sample of 1038 Bratislava residents that was conducted in cooperation with Median in October 2020.

→ Quantitative and qualitative research among university students and a proposal of recommendations to improve the quality of life of university students that was organised in cooperation with the Nexteria non-profit organisation in March 2020.

Examples of good practice and lessons from other cities

While preparing this document, we did not just stick to data and documents. We wanted to be inspired and learn from other cities that have already gone through a similar process.

Vienna – a sustainable and modern city

The Austrian capital has set itself the goals to be both smart and resilient. One example is urban planning, where they use artificial intelligence developed in cooperation with the Austrian Institute of Technology[7] to make new neighbourhoods and existing brownfields resilient and meet the needs of future residents. The modelling produces a new neighbourhood design in seconds, highlighting both positive and negative design phenomena such as a lack of sunlight, poor airflow, overheating potential, and so on. The city's approach to creating Aspern as one of the largest new neighborhoods is similar. The inspiration for Bratislava is precisely the integration of technology and data into more traditional sectors of urban planning.

Brno – a city of students

The second example is the city of Brno, whose partnership within the South Moravian Innovation Centre (JIC)[8] celebrated fifteen years in 2019. The main goal of the JIC has been to create a strong academic, entrepreneurial and innovation ecosystem in Brno, attracting students, researchers and international technology companies. After seventeen years of cooperation between the city of Brno, South Moravia, four key universities (Masaryk University, Mendel University, the University of Veterinary and Pharmaceutical Sciences and the Brno University of Technology) and the business sector, they have created one of the most innovative ecosystems in Central Europe.

7 https://www.ait.ac.at/blog/stadtplanung-2-0/
8 https://www.jic.cz/

An investment of one Czech crown by public institutions has resulted in six Czech crowns being reinvested in applied research. The local government in Brno has understood how important it is for the city to create highly skilled jobs in local companies that push for better quality services. Brno has purposefully built the #brnoregion brand as a student and technology city[9] and has succeeded in attracting top-quality Slovak students and international companies, fostering the growth of local firms and even opening the European Space Agency accelerator. The city's focus is on space technology, IT and agriculture. Success has also been brought about by the ability of key players to effectively draw on European financial resources and combine them with private capital. The next phase is dedicated to soft skills development through business mentoring programmes, incubators, accelerators and the use of the Fab Lab to pilot new ideas. The lesson here for Bratislava is the importance of cross-sectoral cooperation and a clear vision for the city that all key players can work together to deliver over the long term.

Revolutionising the industrial city

A final relevant example for Bratislava is Eindhoven. In the early twentieth century, it served as the headquarters of Phillips and, along with new factories, it attracted tens of thousands of new residents. As the factories began to close and move abroad, the city began to decline, unemployment and crime grew, and neighbourhoods became run-down and even abandoned. (Bratislava and Slovakia are currently in a similar situation to the Eindhoven of a century ago, given the heavy dependence on the car industry). Historically an enterprising and creative people, the Dutch turned a potential economic disaster into an opportunity. They decided to build upon the technological legacy of the inventor of the light bulb, and they created an innovation and technology hub of the future. Together with academic, research and technology partners, the city created the Brainport initiative,[10] attracting more than 5000 companies to the city and creating more than 13,000 high-skilled jobs. Indeed, up to 40% of the Netherlands' spending on science and research comes from Brainport. Innovation permeates the whole city. Eindhoven has created a series of living labs in and around its streets where it is researching the most suitable forms of smart lighting, new forms of sustainable housing in resilient neighbourhoods and new sustainable mobility technologies. This recipe for success was created by the city's decision to stimulate this process with its efforts and initial investments in collaboration with researchers and entrepreneurs and with an attractive offer for talented students and skilled workers. The city has used a combination of private and European Union investment to improve the quality of life for all its residents through quality public transport, education and affordable housing. As a result, Eindhoven has been recognised by FDi Intelligence as Europe's third best city of the future.

9 https://brnoregion.com/
10 https://brainporteindhoven.com/

Analysis of the current situation — Where is Bratislava today?

Bratislava is considered one of the richest cities in Europe. Macroeconomic indicators point to the high economic importance of the Bratislava region at the national level. A strong economic base allows for economic growth which can build the region's and city's resilience to future change and influence Bratislava's attractiveness. But this analytical view is somewhat distorted. In calculating gross value added (GVA) per capita, the statistics do not include non-residents. Indeed, Bratislava has no accurate data on the size of this group. The number of residents using municipal services is not reflected in the expected quality of life. Furthermore, we are already seeing the negative effects of the pandemic, especially with rising unemployment.

Despite the pandemic, Bratislava can continue to grow and develop if it focuses on supporting local innovative companies. These are knowledge economy employers which can benefit from the proximity of research institutions, the abundance of students and a well-educated workforce. However, the data also shows a clear trend of declining interest in Bratislava's higher education institutions and a declining quality of students attending these schools. The declining number of students in Bratislava may indeed cause the local workforce to be unable to meet the needs of businesses.

The strong suburbanisation of the area puts particular pressure on the transport infrastructure. Higher housing costs coupled with lower supply on the real estate market, population growth, the ageing of the population and the lack of affordable housing are all factors that may negatively affect the economic development of the capital city.

Nonetheless, the cultural, social and sporting activities that Bratislava provides can have a positive effect. Casual meetings, conversations and inspirations at events can be the engine of new ideas. These ideas are often not created at the office desk or in the laboratory but rather in informal occasions which innovators can develop further.

Socio-economic indicators

The selected socio-economic indicators in the strategy of urban innovation are intended to present the current state of Bratislava, which may have a positive or negative impact on in the city's innovativeness. The indicators have also been selected based on the Voluntary Local Review (VLR[11]) and the progress of the 2030 Agenda for Sustainable Development, which is part of Bratislava's efforts to meet the Sustainable Development Goals (SDGs).

Economic indicators

Table 1: GDP per capita in euros (at current prices) in the Bratislava region and in Slovakia

	2015	2016	2017	2018	2019	2020
Slovak Republic	14,710.91	14,924.40	15,543.61	16,435.06	17,212.72	16,862.49
Bratislava Region	36,163.80	36,646.22	37,520.18	39,126.39	39,704.46	38,894.34

Source: Eurostat - Gross domestic product indicators

Gross domestic product (GDP) per capita increased year-on-year in the observed period for both the Bratislava region and Slovakia. In the Bratislava region, GDP per capita in 2019 was two to three times higher than in Slovakia itself. Overall, the GDP of the Bratislava region corresponds to 27% of the national GDP despite the fact that only 11% of the overall population lives in this region. The limitation of this data is that they do not take

11 https://www.local2030.org/vlrs

into account natural economic migration and the number of residents who do not reside in Bratislava but who work in the city or wider region.

Data on macroeconomic indicators (GDP or GVA) is collected at the national level and not at the city level. In this analysis, we present data at the regional level; as the capital city and the place where the economic activity of the region is concentrated, it can be assumed that Bratislava is responsible for a significant part of the macroeconomic indicators.

Table 2: GVA per employee in euros in the Bratislava region and in Slovakia

	2014	2015	2016	2017	2018	2019
Slovakia	30,966	31,660	31,429	31,947	33,264	66,158
Bratislava Region	45,316	46,917	46,647	47,242	48,620	97,166

Source: OECD.STAT - Regional economy, GVA

GVA per employee increased year-on-year over the indicated period (except in 2016, when there was a slight stagnation for the Bratislava region and for Slovakia). Overall, GVA is more than 46% higher in the Bratislava region compared to Slovakia as a whole.

Table 3: Unemployment rate (%) by sex in the Bratislava region and in Slovakia

	BA 2015	BA 2016	BA 2017	BA 2018	BA 2019	BA 2020
Men	5.3	3.6	4.8	3.7	2.5	2.6
Women	6.2	6.7	3.5	2.0	2.2	4.2
Total	5.7	5.1	4.2	2.9	2.4	3.4

Source: Eurostat - Regional unemployment

The overall unemployment rate in the Bratislava region fell year-on-year to 2.4% in 2019. The region was characterised by a lower unemployment rate for women than for men, but this changed in 2020. The pandemic caused the unemployment rate for women in the Bratislava region to double from 2.2% in 2019 to 4.2% in 2020. This may be due to the fact that women are more likely to care for their families and work in the service industries that suffered the most from the impacts of the pandemic.

Tabuľka 4: Vnímanie lokálneho pracovného trhu

	2006	2009	2012	2015	2019
Strongly agree	8.2	3.8	11.0	16.0	18.6
Slightly agree	47.3	37.1	40.0	46.0	46.5
Slightly disagree	22.2	29.3	32.0	19.0	18.7
Strongly disagree	14.2	16.0	15.0	12.0	9.9
Do not know/ No answer	8.2	13.8	2.0	7.0	6.3

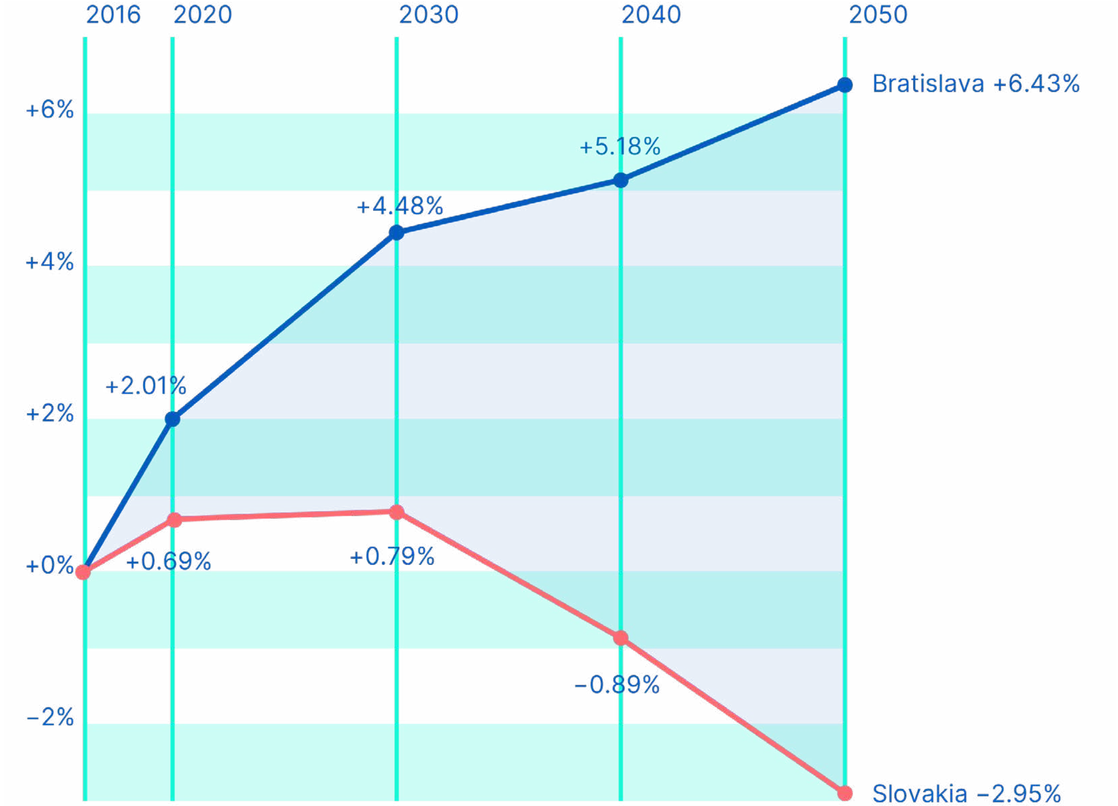
Source: Eurostat - City statistics, Perception survey results

In terms of satisfaction with the work situation for Bratislava residents, 65.1% of residents in 2019 strongly agreed (18.6%) or moderately agreed (46.5%) with the statement that they were satisfied with their current work situation. This proportion has increased by 3.1% since the last measurement in 2015. The proportion of residents who are not at all satisfied with their work situation was 9.9% in 2019. Compared to 2015, this share has decreased.

Based on these economic indicators, Bratislava can be considered to be the strongest economic region in Slovakia. In calculating these indicators, the statistics do not include non-residents as Bratislava does not have accurate data on the size of this group. Experimental data to approximate the size of this group are analysed in the next section of the document. In addition, all indicators except labour market perceptions are only measured at the national level. Data at the municipal level is not currently available.

Sociálne ukazovatele

Graf 1: Projekcia populácie (v %) pre bratislavský kraj a Slovenskú republiku



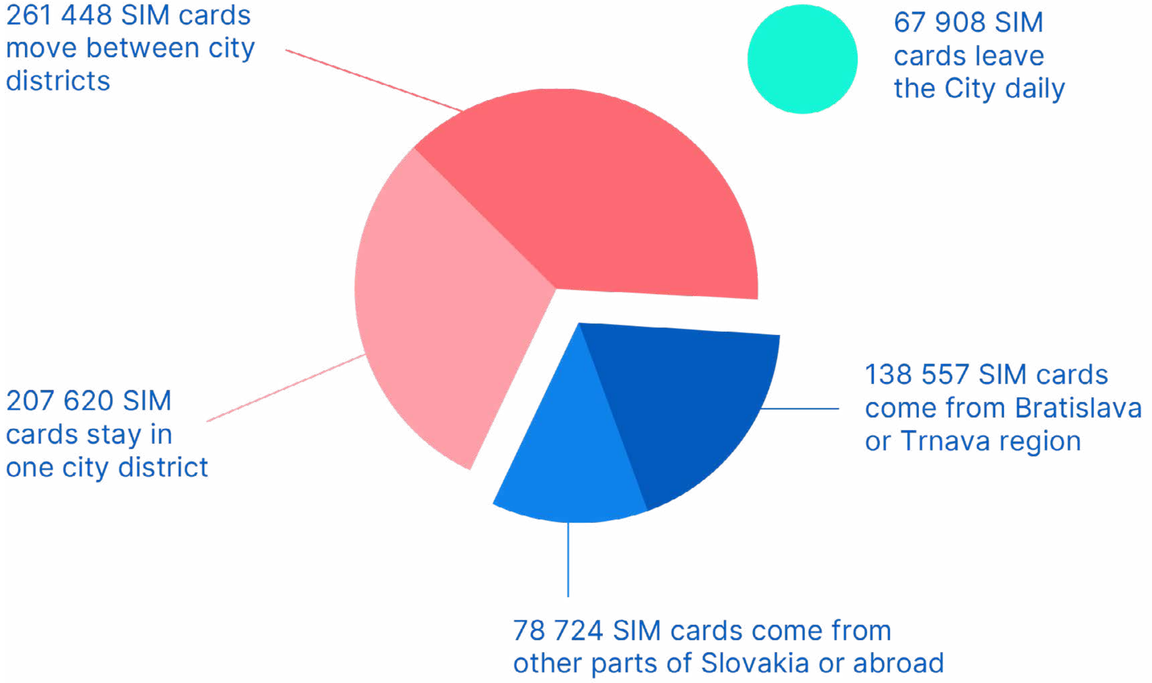
Population projection (%) for the Bratislava region and Slovakia

Source: Humans of Bratislava, Eurostat

The population of Bratislava has been growing since 2005 and is expected to continue to increase. This has put pressure on the city's infrastructure and services, but it also creates potential for the business environment. The high cost of living discourages young people and scientists from staying to study and live in Bratislava. As many as 59% of households in the Bratislava region report that they have difficulties in paying everyday expenses such as housing costs (82.1% report that paying these costs is burdensome for the household), loans, leases and hire purchases (90.8%).

Graph 3.1: Commuters to Bratislava

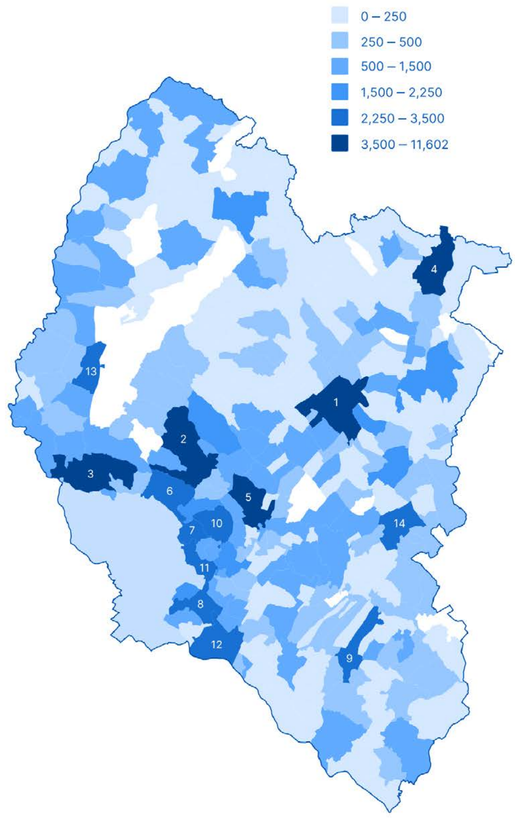
Almost a third of SIM cards connected in Bratislava during the day come from outside the city.



Source: Humans of Bratislava, MarketLocator

Graph 3.2: Commuters to Bratislava

138 557 SIM cards arrive daily from the Bratislava and Trnava regions, 57,953 of them come from fourteen towns and cities



Source: Humans of Bratislava, MarketLocator

Data from the Suburbanisation book published by the Slovak Academy of Sciences shows the economic pull of the capital city from the perspective of western Slovakia and the Bratislava region. People commute to Bratislava for work, especially from adjacent municipalities, but this trend also applies to the city of Trnava as well.

Education

Table 5: Number of students (ISCED levels 5–8) by gender in Bratislava and Slovakia

	BA 2015	BA 2016	BA 2017	BA 2018	BA 2019	SK 2019
Men	28,108	25,401	23,630	21,713	21,441	57,853
Women	42,720	37,506	35,563	32,503	32,220	89,256
Total	70,828	62,907	59,193	54,216	53,661	140,809

Source: Eurostat – City statistics, Education; authors' own elaboration

The number of students in Bratislava and in Slovakia as a whole is decreasing. There is a higher number of women studying than men, with there being one third more female students than males ones in 2019. Overall, students in Bratislava accounted for 38% of the total number of students in Slovakia in 2019.

Table 5: Number of graduates by discipline (ISCED levels 5–7) in Bratislava and Slovakia

	BA 2014	BA 2015	BA 2016	SK 2016
Education	1,035	1,030	1,098	7,217
Arts and humanities	1,386	1,430	1,418	4,079
Social sciences, journalism and information	12,102	10,361	9,190	18,876
Business, management and law	1,848	1,865	1,571	3,362
Natural sciences, mathematics and statistics	1,060	1,196	1,119	1,789
Information and communication technologies	674	668	706	1,452
Engineering, manufacturing and construction	3,345	3,335	3,073	7,647
Agriculture, forestry, fishing and veterinary medicine	48	52	20	1,776
Health and care	3,249	3,263	3,184	4,581
Services	251	244	229	2,646

Source: ETER – European Tertiary Education Register; authors' own elaboration

In terms of fields of study, the number of university graduates in 2016 only increased in the fields of education and information and communication technologies. Indeed, information technology has seen a steady interest from students. By contrast, other fields have seen a year-on-year decline in graduates, which is also in line with previous findings that the overall number of graduates is declining despite the increased interest in the two fields mentioned above. Within Slovakia, Bratislava has the highest proportion of graduates in health and care (70%); followed by natural sciences, mathematics and statistics (63%); and social sciences, journalism and information studies, and information and communication technologies (49%).

The number of students and graduates in each field of higher education is an important factor in the development of businesses in Bratislava. Developing businesses need to have a workforce of sufficient quality in order to meet their goals. Although the number of graduates in information and communication technologies is positive, it is questionable whether they will be able to meet the needs of enterprises in this industry. An important ingredient for long-term success is the ability to retrain the workforce and learn new skills and knowledge. This form of training can be provided by training institutions in cooperation with the business sector in the form of shorter and targeted training that leads to new job opportunities or which is a part of existing jobs.

Business environment

A stable and strong business environment built on locally founded companies will ensure Bratislava's growth and resilience to external shocks such as the COVID-19 pandemic. The business environment – especially innovative SMEs – has the potential to export its knowledge abroad and expand its operations while also being able to flexibly adapt to upcoming changes in the labour market.

ESI index

The Global Entrepreneurship Monitor (GEM) is considered to be the most comprehensive academic study on entrepreneurship in the world. The Entrepreneurial Ecosystem Quality Composite Index (ESI) is a tool that provides a structure for analysing any subnational ecosystem. The GEM was conducted in Bratislava in 2020 as part of the Survey and Assessment of the Entrepreneurial Ecosystem Using the GEM EES Methodology Project.[12]

12 Survey and assessment of the entrepreneurial ecosystem in Bratislava using the GEM EES methodology, Output 1: Comprehensive analysis of the main indicators of the implemented GEM APS ESI and GEM RES ESI surveys and identification and interpretation of the main findings, p. 1

Table 6: Entrepreneurial ecosystem indicators

Code	Indicator/index	
N	Networking	System conditions
L	Leadership	
T	Talents	
K	Knowledge	
S	Supporting services	
D	Demand	
G	Formal institutions	Framework conditions
C	Business culture	
P	Physical infrastructure	
F	Financing	
ESI_FC	Framework conditions	
ESI_SC	System conditions	
ESI	Business Ecosystem Index	

Source: authors' own elaboration

The ESI consists of ten indicators which are given in Table 6. The framework conditions represent the main enabling conditions for the functioning of the entrepreneurial ecosystem. Systemic conditions are the „heart" of the ecosystem, i.e. the elements whose presence and interaction are key to its success. Finally, both sub-indices feed into the entrepreneurial ecosystem index as the main indicators of quality in the entrepreneurial ecosystem.[13]

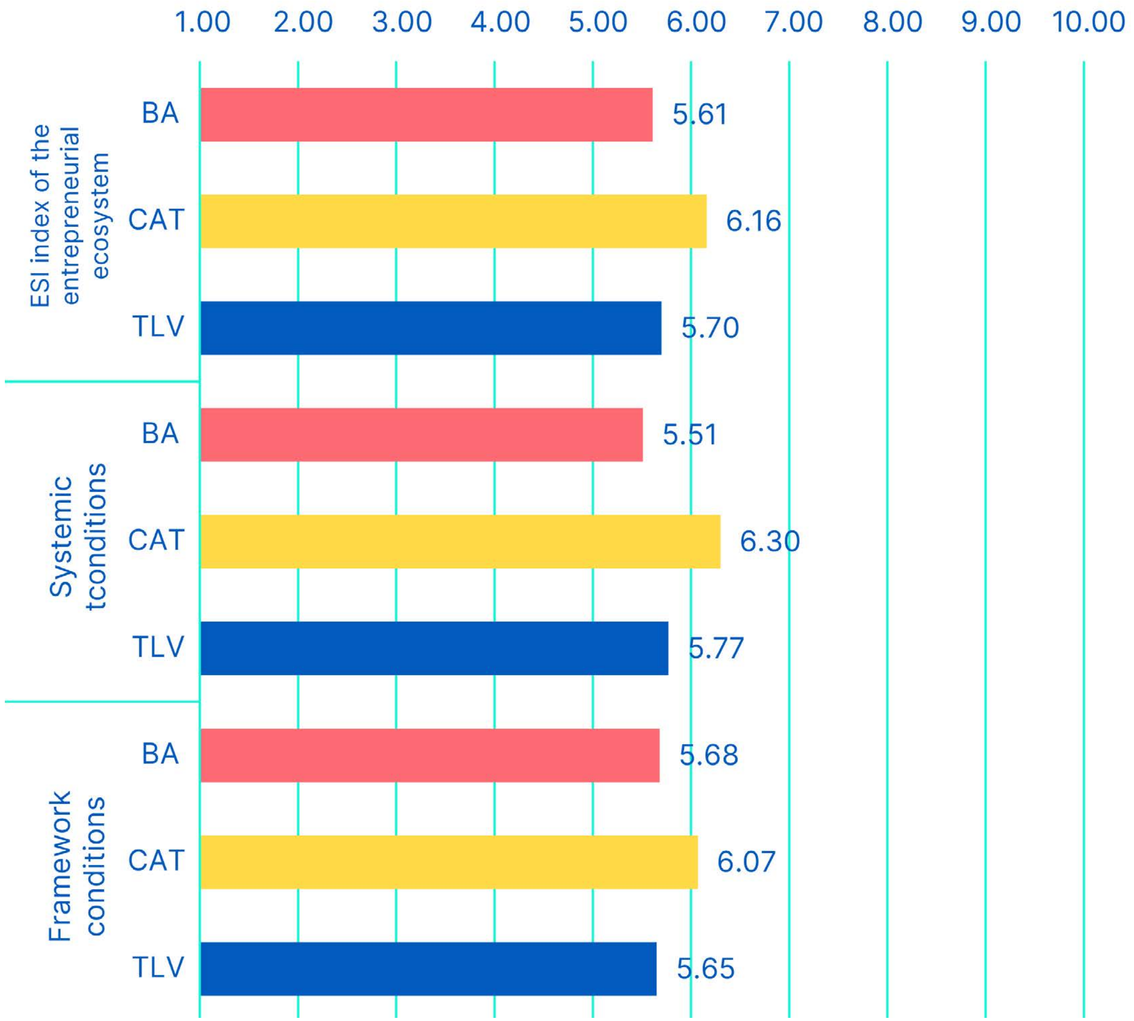
13 Survey and assessment of the entrepreneurial ecosystem in Bratislava using the GEM EES methodology, Output 1: Comprehensive analysis of the main indicators of the implemented GEM APS ESI and GEM RES ESI surveys and identification and interpretation of the main findings, p. 8

Bratislava scored 5.61 out of 10 on the ESI. This value indicates an ecosystem of average quality and significant room for further improvement. In terms of the individual ESI indicators, we can consider physical infrastructure (6.87), entrepreneurial culture (6.57), networking (6.37) and the demand for products and services (6.03) as strong pillars. The weaknesses of the entrepreneurial ecosystem in Bratislava can be seen to a high degree in formal institutions (3.97), which had the lowest value of all the pillars. This is followed by support services (4.65) and leadership (4.76). Selected pillars are described in more detail in the following sections of the document. The shortcomings that are perceived from a public administration perspective can be addressed by Bratislava in running its operations more efficiently.

Comparison of the ESI

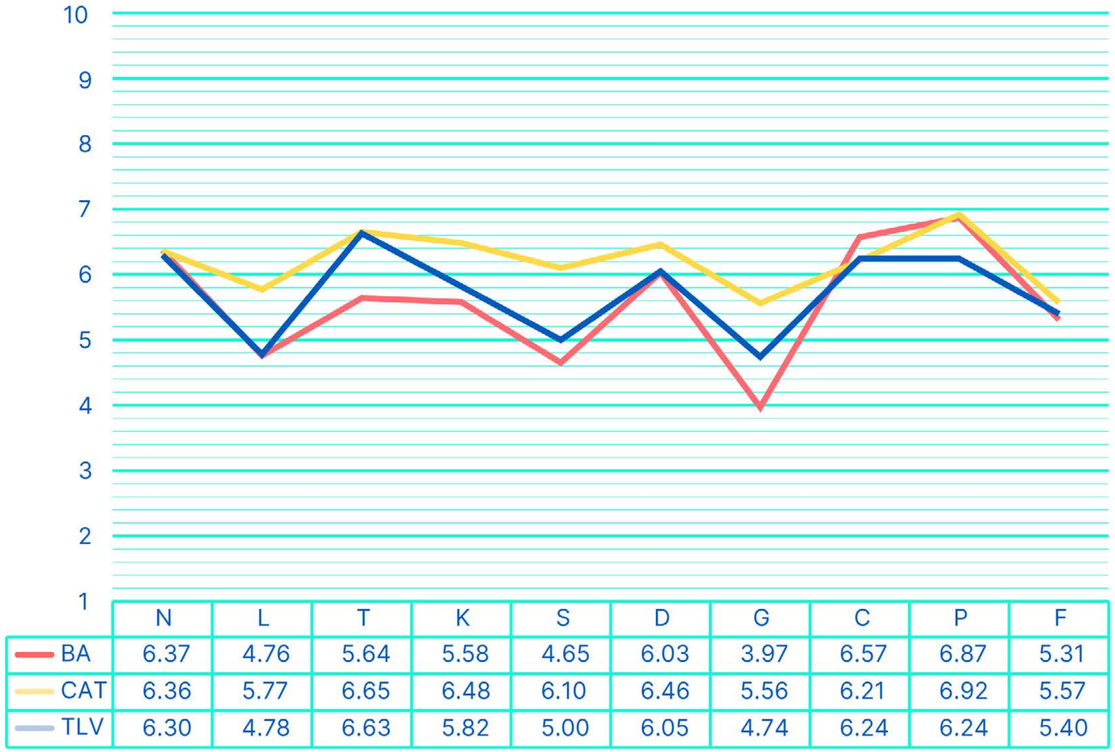
The ESI score for Bratislava was compared with the entrepreneurial ecosystems in Tel Aviv and Catalonia (Barcelona). In this way, we can more closely identify the strengths and weaknesses of Bratislava in comparison with similar places that also participated in the Survey and Evaluation of the Entrepreneurial Ecosystem Using the GEM EES Methodology Project.

Graph 4.1: ESI and sub-indices – Bratislava, Catalonia and Tel Aviv



Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

Graph 4.2: Assessment of the pillars of the entrepreneurial ecosystem – Bratislava, Catalonia and Tel Aviv



	N	L	T	K	S	D	G	C	P	F
BA	6.37	4.76	5.64	5.58	4.65	6.03	3.97	6.57	6.87	5.31
CAT	6.36	5.77	6.65	6.48	6.10	6.46	5.56	6.21	6.92	5.57
TLV	6.30	4.78	6.63	5.82	5.00	6.05	4.74	6.24	6.24	5.40

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

Bratislava lags slightly behind Tel Aviv in the overall ESI measurements and only a little more behind Catalonia. The most significant disadvantages for Bratislava can be observed in the pillars of talent and formal institutions. The availability of highly-skilled workers is limited in Bratislava due to the outflow of young people due to the state of the universities, which are currently unable to compensate for this outflow. Within the formal institutions pillar, business-related regulation and bureaucracy are negatively assessed as is the weak support for new and growing businesses in government policies. The entrepreneurial culture pillar was rated higher in Bratislava than in the other ecosystems. This suggests that entrepreneurs in Bratislava have access to a sufficient number of start-up events, that large enterprises do not block the growth of new ones, and that the adult population in the city has a positive attitude towards entrepreneurship.

Entrepreneurial potential

Table 7: Business potential and intention to start a business in Bratislava in 2019

	Early-stage entrepreneurs (%) 2019	Established entrepreneurs (%) 2019	Adult population (%) 2019	Non-entrepreneurs (%) 2019
Perception of opportunities	49.2	53.1	38.8	35.5
Self-assessment				
Perception of abilities	84.5	89.0	50.3	40.7
Fear of failure (% of those who perceive business opportunities)	40.8	30.1	47.0	51.0
Intention to start a business among those non-entrepreneurs who perceive opportunities for entrepreneurship				16.0

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

Total early-stage entrepreneurial activity (TEA) refers to the period immediately preceding and immediately following the start of a business. It includes starting entrepreneurship (% of the population aged 18 to 64 years who have taken steps to start a business that is less than three months old) and new entrepreneurship (% of the population aged 18 to 64 years who are owners or managers of a new business that is less than 42 months old).[14]

It is natural that entrepreneurs perceive entrepreneurial opportunities at a significantly higher rate than the general adult population. Non-entrepreneurs perceive the fewest opportunities (35.5%) whereas established entrepreneurs perceive opportunities at the highest rate (53.1%). This is also reflected in how different groups perceive their capabilities related to entrepreneurship. More than 80% of both early-stage and established entrepreneurs perceive their business-related capabilities positively. Both groups show less fear of failure than the adult population in general or non-entrepreneurs. Only 16% of non-entrepreneurs who see an entrepreneurial opportunity had the intention to start a business.

14 Survey and assessment of the entrepreneurial ecosystem in Bratislava using the GEM EES methodology, Output 1: Comprehensive analysis of the main indicators of the implemented GEM APS ESI and GEM RES ESI surveys and identification and interpretation of the main findings, p. 36

Table 8: Business potential and intention to start a business in Bratislava in 2019

	Early-stage entrepreneurs (%) 2019	Established entrepreneurs (%) 2019	Adult population (%) 2019	Non-entrepreneurs (%) 2019
Social attitudes towards entrepreneurship				
Egalitarianism (a preference for the same standard of living for all)	41.5	29.0	45.6	47.5
Entrepreneurship as a suitable career choice	47.5	53.8	40.9	38.9
Perception of entrepreneurs and their social status	44.9	56.9	47.1	46.9
Media attention paid to entrepreneurship	56.1	54.5	52.4	51.5
Starting a business is easy	53.5	66.1	50.6	48.7
Knowing someone who is an entrepreneur	80.0	69.3	62.5	58.4

Source: GEM APS ESI 2019 a GEM RES ESI 2019, authors' own elaboration

Almost half of the non-business and adult population would prefer the same standard of living for all. Only 38.9% of non-entrepreneurs see entrepreneurship as a suitable career choice. Regarding the perception of entrepreneurs and their social status, we can state that the adult population and non-entrepreneurs almost equally (47.1% and 46.9%) perceive that entrepreneurs are people with a high social status. All groups perceive the increased media attention given to entrepreneurship at a relatively high level. All groups except non-entrepreneurs mostly agree with the statement that starting a business is easy; however, the proportion is not that low for non-entrepreneurs either (48.7%). Early-stage entrepreneurs have the most developed network of contacts – up to 80% know at least one other entrepreneur. Established entrepreneurs have a less developed network (69.3%) compared to early-stage entrepreneurs.

Societal attitudes towards entrepreneurship can positively or negatively influence an individual's decision to engage in entrepreneurial activity. The fact that only 38.9% of non-entrepreneurs perceive entrepreneurship as a suitable career choice may be the reason for the low level of intentions to start a business.

Table 9: Motivation to start a business

Motivation to start a business		
To make a difference in the world (%TEA)	34,9	40,7
To build great wealth or a very high income (%TEA)	42,5	33,9
To continue the family tradition (%TEA)	20,9	28,1
To earn a living because there are few job opportunities (%TEA)	52,3	63,3

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

The most important factor motivating early-stage entrepreneurs is to earn a living because of the low supply of job opportunities. The motivation to build great wealth or a very high income is often characterised by the low growth and innovation potential of the created enterprise. This indicator is relatively high for entrepreneurs in Bratislava (42.5%).

The sustainability of entrepreneurship

Table 10: Business activity in Bratislava and Slovakia in 2019

Category	BA 2019	SK 2019
Starting entrepreneurs (%)	11.2	9.2
New entrepreneurs (%)	5.0	4.2
Established entrepreneurs (%)	6.3	5.9
Total entrepreneurial activity (%)	21.5	18.9
Business interruption: business closed (%)	2.0	2.7

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

Established entrepreneurship is defined as the % of the population aged from 18 to 64 years who are owners or managers of established businesses that are older than 42 months. The total entrepreneurial activity is the % of the adult population who are engaged in emerging or established entrepreneurial activity. An individual can be simultaneously engaged in established entrepreneurial activity while also starting a new business. The final stage of the entrepreneurial process is business interruption, which represents the % of those who have discontinued or closed a business they had owned or managed in the last twelve months without resuming operations.[15]

21.5% of the adult population is engaged in entrepreneurial activity, with the highest proportion being early-stage entrepreneurs. Although Bratislava has a higher proportion of entrepreneurs than the rest of the country, Bratislava businesses are less likely to go out of business; indeed, only 2% of them do so.

Table 11.1: The intention to start a business and total early-stage entrepreneurial activity by gender in Bratislava in 2019

Phase of the entrepreneurial process	Women (%)	Men (%)
	2019	2019
Intention to start a business (among non-entrepreneurs)	17.0	10.6
Starting entrepreneurs	7.5	15.1
New entrepreneurs	2.9	7.2

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

Table 11.2: Early-stage entrepreneurial activity (TEA) and established entrepreneurial activity (EB) in Bratislava in 2019

Bratislava	Age groups				
	18 – 24	25 – 34	35 – 44	45 – 54	55 – 64
TEA 2019	8.2	18.5	16.2	21.3	8.9
EB 2019	0.0	7.3	6.7	6.4	6.8

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

15 Survey and assessment of the entrepreneurial ecosystem in Bratislava using the GEM EES methodology, Output 1: Comprehensive analysis of the main indicators of the implemented GEM APS ESI and GEM RES ESI surveys and identification and interpretation of the main findings, p. 37

Table 11.3: Early-stage entrepreneurial activity (TEA) in Bratislava in 2019

Bratislava	Education 2018 (%)		
	Primary and secondary level without school-leaving certificate	With school-leaving certificate and post-secondary level	University education
TEA 2019	23.8	12.4	17.7

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

The demographic profile of entrepreneurs found that women have a significantly higher intention to start a business. Men make up twice as high a proportion of starting entrepreneurs and a significantly higher proportion of new entrepreneurs. Those aged 45 to 54 years (21.3%) are the most likely to engage in early-stage entrepreneurial activity. Engagement in established entrepreneurship is fairly even across age groups (except for those aged 18 to 24 years). In 2018, people with primary or secondary education and without a school-leaving certificate were mainly engaged in early-stage entrepreneurial activity. This supports the previous finding that the adult population engages in entrepreneurial activity mainly due to a lack of employment opportunities.

Table 12: Business Sustainability in Bratislava in 2019

Phase of the entrepreneurial process	Women (%)	Men (%)
	2019	2019
The "death" index (starting/new)	2.57	2.10
TEA	10.1	21.6
Established entrepreneurs (EE)	3.6	9.3
The "survival" index (EB/new)	1.23	1.29
The "establishment" index (EB/TEA)	0.36	0.43
Discontinuation of business	3.3	4.3

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

The "death" index is higher for women than for men. This may be due to a lack of support, such as a lack of training, informal contacts or access to funding. Overall early-stage entrepreneurial activity is twice as low for women as it is for men. There are almost three times more established entrepreneurs who are males than there are females. Nonetheless, the "survival" index is almost the same. For the "establishment" index, there were no

significant differences between the sexes; however, men were more likely than women to discontinue their business.

Although women are more likely to have the intention to start a business, only a small proportion of women will actually do so (see Table 12). This suggests that women face some barriers that prevent them from fully realising this intention. If a woman does fulfil her entrepreneurial intention, she is more likely than a man to then become an established entrepreneur (as measured by the survival index). However, women have been hampered by the COVID-19 pandemic and the need to care for family alongside the inability to operate a business, especially in the catering and service sectors.

Although Bratislava has a higher overall early-stage entrepreneurship rate (21.5%) than Slovakia (18.9%), all indices are lower than or equal to those in Slovakia, suggesting that the conditions for entrepreneurship are better in Bratislava than in Slovakia as a whole. This is mainly due to the number and diversity of opportunities available in the city.

Table 13: Business discontinuation and associated reasons in Bratislava and Slovakia in 2019

Category	BA 2019	SK 2019
Business interruption: business continues (% of population)	1.8	1.3
Business interruption: business has ceased (% of population)	2.0	2.7
Total business interruption (% of population)	3.8	4.0
Reasons:		
Opportunity to sell the business (%)	4.2	1.1
Business was not profitable (%)	11.2	20.6
Problems with funding (%)	11.4	13.0
Another job/business opportunity (%)	9.2	25.8
Cancellation planned in advance (%)	4.0	3.6
Retirement (%)	6.8	5.6
Personal reasons (%)	18.7	19.3
Consequences of an unexpected event (%)	26.2	3.8
Government/tax policies/bureaucracy (%)	8.2	7.3

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

The most common reasons for business interruption in Bratislava are the consequences of an unexpected event (26.2%) and personal reasons (18.7%). In Bratislava, it is less common for entrepreneurs to discontinue a business due to another job opportunity or because the business was unprofitable. A relatively high proportion of businesses go out of business because of barriers erected by the government, tax policies or bureaucracy.

Table 14: Comparison of the financing pillar and its components

	Bratislava GEM RES ESI 2019	Slovensko GEM NES 2019
New and growing companies have sufficient access to equity financing (f4)	4.60	4.56
New and growing firms have sufficient access to debt (e.g. credit) financing (f5)	4.48	6.25
New and growing firms have sufficient access to government subsidies (f6)	3.38	3.80
New and growing firms have sufficient access to financing from business angels (f7)	4.30	4.17
New and growing companies have sufficient access to venture capital funding (f8)	5.13	4.44

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

Bez dostatočného prístupu k financovaniu, môžeme očakávať pomalší rast a rozvoj podWithout sufficient access to finance, we can expect slower growth and development of businesses in Bratislava. The ESI financing pillar gave Bratislava a score of 5.31 out of a possible 10. New and growing firms in Bratislava have better access to venture capital financing; however, access to debt financing was rated much more negatively.

Innovativeness of enterprises

In the long term, the low innovativeness of SMEs makes them more vulnerable and unprepared for future unexpected events such as pandemics or competitive threats from international companies. It is therefore important to monitor the innovative potential of Bratislava's businesses.

Table 15: Innovativeness of entrepreneurs in Bratislava and in Slovakia in 2019

Category	Innovativeness (TEA)		Innovativeness (EE)	
New product	**BA 2019**	**SK 2019**	**BA 2019**	**SK 2019**
It's not a new product or service	55.6	63.3	68.2	60.3
New to the people in the area where you live	19.5	17.6	9.4	8.9
New to people in your country	18.0	14.5	17.8	16.8
New in the world	6.9	4.6	4.5	14.0
New process				
Not a new technology or process	64.8	63.6	65.7	59.0
New to the people in the area where you live	12.1	20.0	18.1	9.3
New to people in your country	17.5	10.7	16.2	21.2
New in the world	5.7	5.7	0.0	10.4

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

Graph 5: Corporate objectives over a ten-year period

Source: Representative survey of entrepreneurs' needs

The majority of people starting businesses in Bratislava said that their product, service or process was not new. This trend was also found among established entrepreneurs and in even higher numbers. The largest number of new products and services that were created by beginning entrepreneurs were directed at people in the area where the entrepreneur lived (19.5%): i.e. in Bratislava. In terms of new processes, only 17.5% of those created in Bratislava were new to people in the country at large. The results of the survey on the needs of entrepreneurs show that 65.2% of enterprises plan to develop new products and services with a higher added value. Developing employees and their skills, which is a goal of up to 66.9% of enterprises, can contribute in developing new products and services. Only 24.7% of the respondents would like to cooperate with innovative companies in the future or would like to deepen cooperation with research and academic institutions (12.9%).

High-growth businesses (scale-ups)

Table 16: Number and share of high-growth enterprises (HGEs) in sectors in Bratislava

Sector – SK NACE section	HGEs 2018		HGEs 2017		HGEs 2016	
	Number	Share	Number	Share	Number	Share
Agriculture, forestry and fishing	7	15.6%	4	9.8%	5	14.3%
Mining and quarrying	1	7.7%	2	15.4%	2	16.7%
Industrial production	48	9.0%	67	13.0%	66	14.6%
Energy	10	4.8%	12	6.3%	6	3.4%
Water and waste	9	19.1%	10	21.3%	5	13.2%
Construction	194	22.2%	169	22.4%	159	24.1%
Wholesale and retail	361	12.6%	375	14.0%	312	13.2%
Transport and storage	72	15.4%	70	16.4%	53	14.6%
Accommodation and catering	42	11.3%	56	17.1%	39	15.0%
Information and communication	130	15.2%	122	16.1%	117	17.5%
Finance and insurance	24	18.2%	15	12.7%	18	15.9%
Real estate	81	9.5%	87	11.0%	62	8.9%
Professional, scientific and technical activities	225	14.0%	248	16.9%	198	15.7%
Administrative and support services	112	16.3%	89	14.9%	75	14.5%
Public administration, defence and social security	0	0.0%	0	0.0%	1	14.3%
Education	8	15.4%	6	13.3%	15	15.0%
Health and social assistance	22	15.5%	16	13.3%	15	15.0%
Arts, entertainment and recreation	16	12.4%	18	15.0%	16	17.0%
Other activities	8	12.3%	7	13.2%	6	14.0%
Total	**1370**	**13.8%**	**1373**	**15.1%**	**1158**	**14.6%**

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

Enterprises with an average annual growth rate over three periods (t to t-3) of more than 20% are considered to be fast-growing. In line with the OECD manual, we excluded companies that were established in the year t-3 and later. We also excluded enterprises with revenues in year t-3 of less than 200,000 euros. (We chose this criterion as an alternative to the recommended threshold of ten employees because the data on the number of employees tended to be inaccurate or completely unavailable for a significant part of the sample.)

The highest share of high-growth businesses operates in the construction (22%), water and waste (19.1%) and finance and insurance (18.2%) sectors. In particular, the highest number of such enterprises are active in wholesale and retail trade (361); professional, scientific and technical activities (225); and the business and construction (194) sectors. The total number of high-growth businesses did not change significantly between 2017 and 2018; indeed, it fell by less than 1%. But the trend changed after 2016, when the number of these businesses increased by 16%. Almost every fifth enterprise in the Bratislava region was a high-growth one. In the same year, more than a quarter of these businesses were based in Bratislava.

Table 17: Structure of high-growth enterprises (HGEs) in Bratislava by industry

Sector – SK NACE section	Share of HGEs		
	2018	2017	2016
Agriculture, forestry and fishing	0.5%	0.3%	0.4%
Mining and quarrying	0.1%	0.1%	0.2%
Industrial production	3.5%	4.9%	5.7%
Energy	0.7%	0.9%	0.5%
Water and waste	0.7%	0.7%	0.4%
Construction	14.2%	12.3%	13.7%
Wholesale and retail	26.4%	27.3%	26.9%
Transport and storage	5.3%	5.1%	4.6%
Accommodation and catering	3.1%	4.1%	3.4%
Information and communication	9.5%	8.9%	10.1%
Finance and insurance	1.8%	1.1%	1.6%
Real estate	5.9%	6.3%	5.4%

Sector – SK NACE section	Share of HGEs		
	2018	2017	2016
Professional, scientific and technical activities	16.4%	18.1%	17.1%
Administrative and support services	8.2%	6.5%	6.5%
Public administration, defence and social security	0.0%	0.0%	0.1%
Education	0.6%	0.4%	0.3%
Health and social assistance	1.6%	1.2%	1.3%
Arts, entertainment and recreation	1.2%	1.3%	1.4%
Other activities	0.6%	0.5%	0.5%

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

NThe largest share of high-growth enterprises is active in wholesale and retail trade (26.4%) followed by professional, scientific and technical activities (16.4%), construction (14.2%) and information and communication (9.5%). When looking at the information and communication sector, the share of high-growth enterprises increased by 0.6% year-on-year from a percentage of 9.5%. Its further growth in the Bratislava region is foreseen due to the high GVA and the high number of micro-businesses which can potentially expand into small and medium-sized businesses. In terms of dynamics, the decline in the number of high-growth businesses in the "Other Research and Experimental Development on Natural Sciences and Engineering" segment is particularly interesting (from 5 in 2017 to 1 in 2018) as is the increase in their number in the "Other IT and Computer-related Services" segment (from 36 to 38 and then to 48 businesses in the three-year period under review).

High-growth businesses are considered the engine of the economy. They show their potential for growth and expansion by multiplying their turnover, and usually they operate in higher value-added sectors. It is the intellectual wealth of these companies that can be a successful export commodity. These businesses should therefore face a minimum of barriers as they develop. Moreover, rapidly growing businesses reflect the structure of the workforce, its deficiencies and the strengths of sectors of the local economy. Their number is relatively stable in Bratislava. Research in the United Kingdom has confirmed the key role of local high-growth businesses in the economic strength, stability and future development of the country. This has been a mainstay of economic policy focused on domestic market potential and opportunities to export higher value-added services and products as well as a major source of employment.[16] The combination of supporting high-growth businesses in the identified research areas (RIS3) can significantly boost Bratislava's economic growth.

Relationship with the city

Table 18: The formal institutions pillar and its components

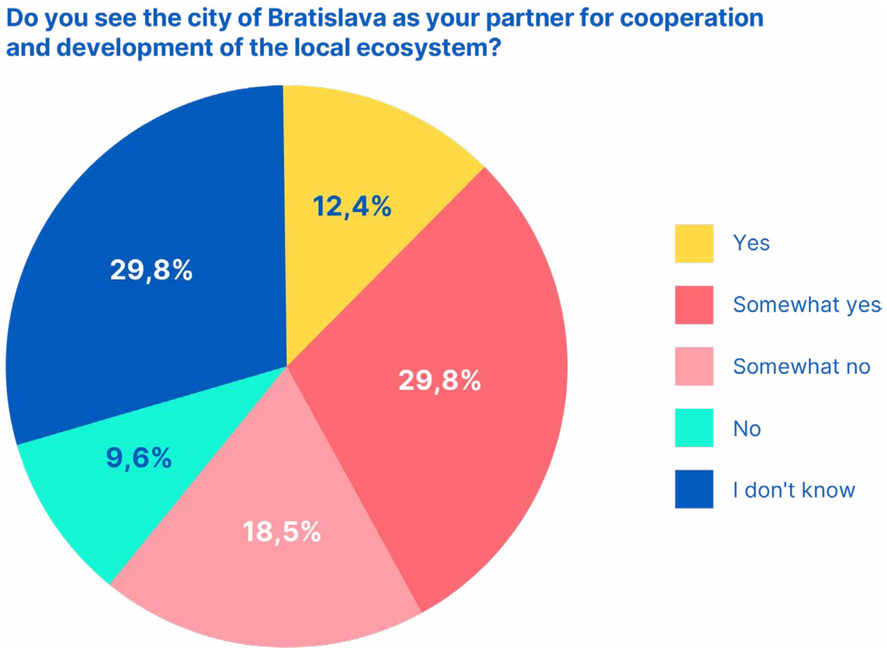
Factor	Description of the indicator	Average score (1–10)
G1 (EES)	Start-up entrepreneurs: bureaucracy and regulations are not a serious problem when starting a business.	5.01
G2 (EE2)	Owner-managers: bureaucracy and regulations were not a serious problem in starting a business.	4.37
G3 (RES)	Government policies take into account support for new and growing firms.	2.63
G4 (RES)	Supporting new and growing firms is a high priority within the city's policies.	4.22
G5 (RES)	Supporting new and growing businesses is a high priority for chambers of commerce (craft, trade, industrial, etc.).	3.86
G6 (RES)	Supporting new and growing companies is a high priority for educational institutions.	4.01
G7 (RES)	Coping with bureaucracy, regulations and requirements is not extremely difficult for new and growing companies.	3.79
G8 (RES)	Almost anyone who needs help from a government business programme can find what they need.	3.64
G9 (RES)	Government entrepreneurship programs significantly increase the chances of survival and success for the businesses they support.	4.18

Source: GEM APS ESI 2019 and GEM RES ESI 2019; authors' own elaboration

The ESI's formal institutions pillar gave Bratislava a score of 3.97 out of a possible 10 points overall. Regulations and bureaucracy associated with doing business are rated as a significant obstacle for entrepreneurs. In addition, government policies do not sufficiently take support for new and growing businesses into account. Support for new and growing businesses is more pronounced in the city's policies, but there is still room for improvement.

16 https://www.scaleupinstitute.org.uk/reports/the-scale-up-report-2014/

Graph 6: Business perception of the city as a partner



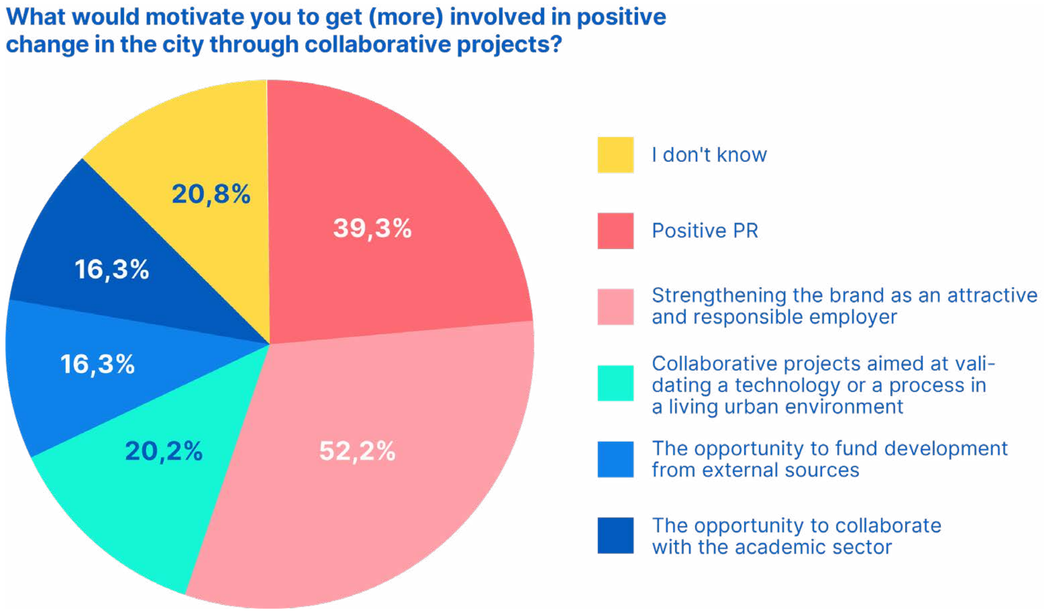
Source: Representative survey of entrepreneurs' needs

Graph 7: Involving businesses in the running of the city

Source: Representative survey of entrepreneurs' needs

In the survey, 42% of entrepreneurs said that they perceived the city, even if only partially, as their partner for collaboration and development of the local ecosystem; however, as many as 29.8% of entrepreneurs were unaware of this possibility or had not considered it. This was also reflected in responses where up to 47% of entrepreneurs stated that they were not involved in any activities to improve the city or neighbourhood where they were based. If a company was involved in this sort of thing, it was most often in the form of financial donations to specific organisations (31%) or by supporting the local community through the Pontis Foundation's Naše mesto[17] initiative and similar programmes (17%).

Graph 8: Motivation for business involvement in the city



Source: Representative survey of entrepreneurs' needs

Factors that would motivate businesses to cooperate with the city include brand reinforcement as an attractive and responsible employer (52.5%), positive PR (39.3%) and joint projects with the city that would allow businesses to test new technologies in a live environment (20.2%). On the other hand, one fifth of respondents did not know what would motivate them to get more involved in the running of the city.

17 https://www.nasemesto.sk/

Graph 9: Plans for businesses to get involved in the running of the city

Source: Representative survey of entrepreneurs' needs

47.8% of respondents who are not currently involved in activities related to the running or improvement of the city, only 9% indicated that they did not plan to be involved in the future. If businesses were planning to become involved in cooperation with the city, or continue their existing involvement, this was mostly in the case of support for planting greenery (27.5%), supporting the local community (23%) or providing expert cooperation (17.9%). More than one third of businesses (33.14%) did not know if they had plans to get involved in the cooperation with the city. The majority of companies surveyed had been operating in Bratislava for more than ten years (64%). In the light of the current pandemic situation, they were interested in developing their employees, increasing their qualifications and thus creating new products and services with a higher added value. At the same time, only a small number of companies operating in Bratislava were interested in potentially moving to other EU countries or abroad.

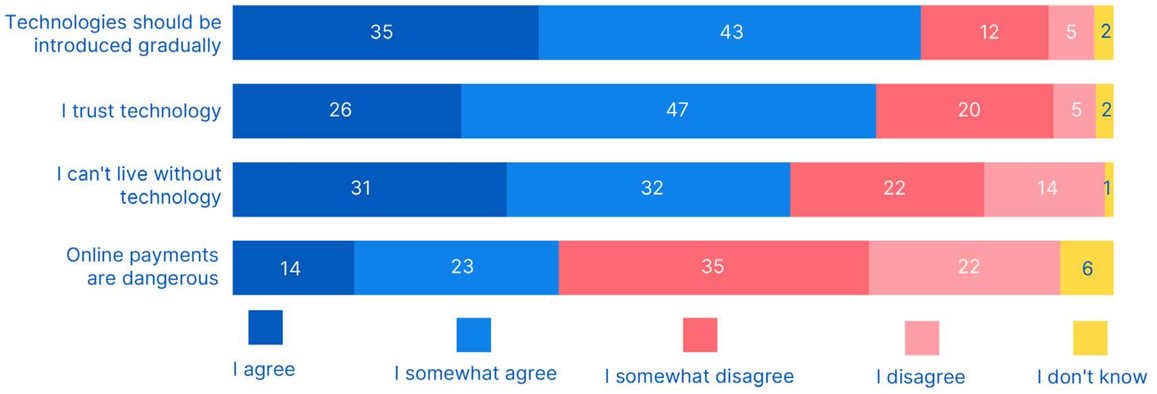
There is a lot of untapped potential in establishing cooperation with these companies, and it is important that companies perceive the city as their partner. The growing trend of corporate urban responsibility shows that businesses and their employees can positively influence the city they live in and address strategic challenges if there is a transparent and long-term collaborative partnership. Despite a marked passivity, there is an interest among companies to participate more actively in the city. By providing the right added value from the city, we can potentially motivate businesses to get involved.

Digital behaviour

The digital behaviour of the city's residents should shape the digitalisation of the city in the future. A representative survey conducted in November 2020 surveyed city residents' attitudes towards technology and their preferred ways of interacting with the city's institutions.

A significant majority of households (80%) have access to the internet. This proportion is expected to increase even over time as up to 86% of households without internet access were planning to purchase an internet connection in the near future.

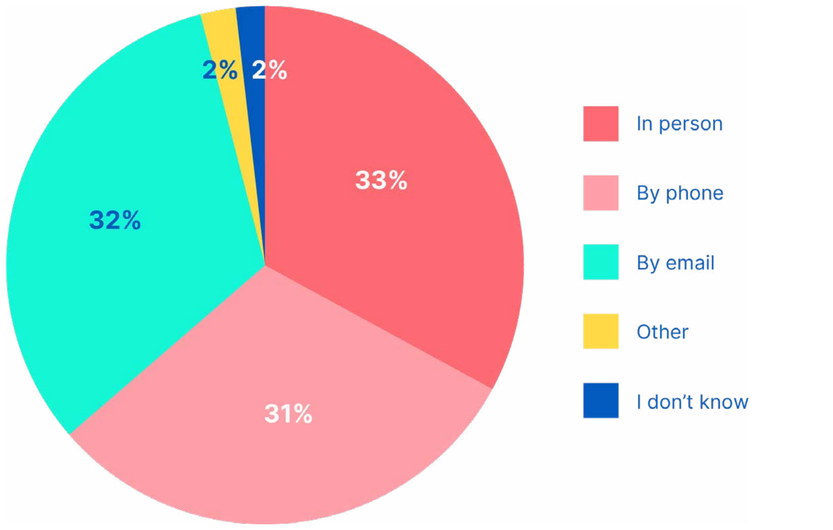
Graph 11: The relationship to technology among the inhabitants of Bratislava



Source: 2020 representative survey on technology and communication with urban institutions

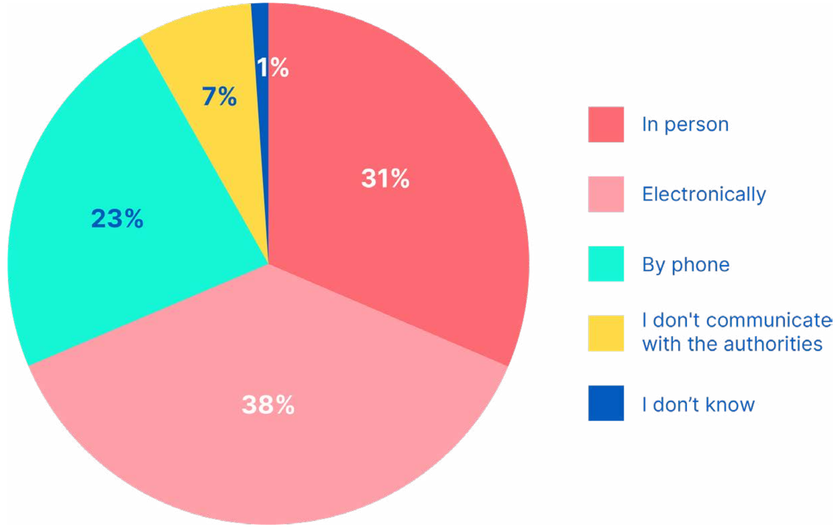
Residents are accustomed to technology and consider it a normal part of life. More than half of Bratislava residents (53%) trust technology and 63% cannot imagine life without it. On the other hand, up to 78% of residents agree that "technology should be introduced gradually". This serves as a good indicator that the digitalisation of the city should be gradual and not sudden.

Graph 12: Preferred methods of communication with public institutions among Bratislava residents



Source: 2020 representative survey on technology and communication with urban institutions

Graph 13: The ways in which Bratislava’s residents communicate with the city’s institutions



Source: 2020 representative survey on technology and communication with urban institutions

When it comes to communicating with public institutions, 38% of residents prefer to communicate with the authorities electronically. At the same time, a similar proportion (31%) of residents prefer personal contact; these were older people. When it comes to physical ways of communicating with municipal institutions, up to one third of female and male residents preferred a personal visit. The second most frequent way of contacting municipal institutions was by telephone even though this method was not significantly less preferred. Up to 32% of residents currently communicate with municipal institutions by email.

Findings from the representative survey suggest that residents see technology as a normal part of their lives. The majority of households now have an internet connection. Residents expect municipal institutions to be able to communicate quickly and reliably through electronic means.

Risks and needs analysis

Women’s intention to start a business is higher than among men, but fewer women are able to fulfil this intention.

→ In Bratislava, the intention to start a business is higher among women (17%) than it is among men (10.6%) while in Slovakia it is the opposite.
→ Although the intention to start a business is significantly lower among men, 15.1% of emerging entrepreneurs (businesses that are not more than 3 months old) are men and only 7.5% are women
→ The „death“ index is almost the same for both sexes (2.6% vs 2.1%). This suggests that women are no less successful in entrepreneurship than men but that women face greater barriers to starting a business.

Business innovation in Bratislava is weak because companies do not use new technologies to improve processes and do not launch new products or services on the market.

→ Up to 55.6% of early-stage entrepreneurs and 68.2% of established entrepreneurs did not bring a new product or service to the market in 2019.
→ Businesses do not use new technologies in their processes either. Up to 64.8% of early-stage entrepreneurs have not implemented a new technology or process. For established entrepreneurs, the figure is 65.7%.
→ The highest share of patent applications in the International Patent System was in the field of information and communication technologies; however, this share dropped significantly between 2014 and 2015.

Many businesses in Bratislava are not involved in improving the city or its surroundings.

→ Up to 47.8% of businesses are not involved in any form in the improvement of the city in which they operate (e.g. by providing expert or development cooperation, financial donations, support for planting green spaces or support for the development of public spaces or local community).
→ Businesses said that they lacked a contact person to turn to if they had a problem or that they expected the city to take the first step.

Businesses have a negative perception of the transport infrastructure and expect the city to ensure its smooth operation.

→ The transport infrastructure is perceived by businesses as below average (4.43 points out of 10).
→ As many as 54.5% of businesses identified the insufficient number of parking spaces in the vicinity of their workplace as a problem.
→ A majority of enterprises (53.4%) also lacked completed bicycle routes.
→ 64.6% of businesses expected the city to provide smooth traffic flows.
→ 59% of businesses expected the city to provide sufficient parking spaces around the workplace.
→ 48.3% of businesses expected the city to provide bicycle routes.

Public institutions do not provide sufficient support to the business sector. On the contrary, they often act as a barrier.

→ According to the ESI, businesses in Bratislava do not have sufficient access to programmes that support emerging business activities such as acceleration or incubation programmes. This component was rated more negatively by business managers/owners than for start-ups (2.88 points vs. 3.9 points).
→ Bureaucracy and regulations were identified as a rather serious problem, especially for start-ups.
→ Support for new and growing businesses in city policies was rated more positively than in government policies but was still below average (4.22 points out of 10).

There is a decreasing number of university students every year.

→ The total number of students is decreasing every year. Between 2014 and 2018, the total number of students decreased by almost 25%.
→ Approximately 38% of all students in Slovakia study in Bratislava.
→ There are currently 50% more women than men studying in Bratislava.
→ The total number of graduates decreased by 13% between 2014 and 2016.

There is a labour shortage in the information and communication technologies sector despite the increasing number of graduates in this field.

→ Despite the declining overall number of graduates, the number of graduates in ICT has increased, indicating an increased interest in these two fields.
→ According to the Ministry of Education, Science, Research and Sport, there is still an insufficient number of graduates in this area.

The predominant factor influencing the outflow of students abroad is the better reputation of foreign schools.

→ Up to 86.5% of students from Bratislava who study abroad indicated that the primary reason for studying abroad was their better reputation compared to Slovak HEIs.
→ More than half of the students started studying abroad based on recommendations (55.1%), an interest in living abroad (53.2%) or better conditions for scientific and creative activities (54.5%).

A lack of job opportunities and low salaries discourage students from returning to Slovakia.

→ Up to 75.0% of students are discouraged from returning after graduation by the low remuneration.
→ 73.7% of students have a negative perception of the level of corruption and cite this as a reason that discourages them from returning.
→ Last but not least, 65.4% of students living abroad think that there are not enough job opportunities for them in Bratislava. This is despite the fact that the labour market is perceived positively by Bratislava residents themselves.

Slovakia does not sufficiently support research institutions.

→ Bratislava is the centre of academic research in Slovakia with more than 13,800 scientists.
→ Despite this, Slovakia has one of the lowest levels of investment on science in Europe at only 0.88% of GDP compared to the EU average of 2.06% of GDP in 2017.

University students in Bratislava expect the city to be able to create a good place for them to live in.[18].

→ Thematic areas that are important to students are in the following order of importance: studying, transport, eating out, social life, culture, sports, and extra-curricular education.
→ In terms of what the city can provide, students are interested in sustainable forms of transport (especially ways to commute by bicycle and safe cycling routes), enhanced

18 Student Needs Survey in collaboration with the student education organisation Nexteria on a sample of 698 university students

public transport at peak times, public spaces that are open for students, cultural and social activities, and spaces for 24-hour studies and education in city libraries.

→ Students from Bratislava who study abroad are discouraged from moving back due to the perception of low salaries (75.0%) and lack of job opportunities (65.4%).[19].

SWOT analysis

Strengths	Weaknesses
• Bratislava's strong economic position based on high GVA and GDP per capita • a positive attitude towards the city by businesses that have been operating in Bratislava for a long time • low unemployment and high satisfaction of inhabitants with their employment situation, • entrepreneurship being rated as a suitable career choice among residents	• the average ESI index (especially for the formal institutions pillar) • businesses not perceiving the added value they could gain from working with the city • the business sector not systematically collaborating with the academic sector to develop innovative solutions • the majority of residents preferring in-person communication, suggesting that residents do not trust city services • the high cost of living for students, young graduates and lower income groups
Opportunities	**Threats**
• a high concentration of university students • interest from businesses in building a relationship with the city if given the right motivation and a systematic approach • estimated population growth • positive attitudes among residents towards technology • a demand for innovative products and services with local origin • the potential for the creation of new businesses and the growth of existing businesses and their support by the city	• the city being unable to offer digital services at the level of the private sector • the low innovativeness of enterprises • the continuously decreasing number of students and graduates from universities • the local workforce not being able to meet the needs of businesses • the city not being able to offer suitable and barrier-free conditions for entrepreneurs • the city's non-existent relationship with the business and academic sectors

19 The To dá rozum (Learning Makes Sense) survey with a sample of 1404 students attending universities abroad

Part 2 — Where should Bratislava be in the future?

The aim of the proposal of the Urban Innovation Strategy is to describe our view of the future and to present new tools, processes and thematic areas that the city can implement in order to develop its innovation potential. Each section is only part of a jigsaw of solutions. Their individual implementation will not have the desired effect unless these tools are linked into an effective mix of innovation development and management.

Defining the thematic research and innovation areas will be the cornerstone in setting the strategic objectives of the newly developed tools and processes. The thematic research and innovation areas that Bratislava will address in the framework of innovation are based on the cross-cutting research priorities defined at the national level for the period from 2021 to 2027. Four thematic areas have been identified: two of these (energy efficiency and neutrality) Bratislava can directly contribute to and the other two (adaptation to climate change and efficient urban mobility) are currently of concern to residents. Closely linked to these thematic areas are the principles of implementation of emerging technologies. These principles are based on the London Charter for Emerging Technology.[20]

The first tool that will be presented in this chapter is the setting up of strategic cooperation with key partners of the city. Such cooperation, also known as „quintuple helix collaboration", brings together people working in different fields and can combine knowledge and expertise in unexpected ways. Sharing knowledge can often bring new and innovative ideas for solving complex problems in the context of new technologies and in the context of addressing social or environmental challenges. The joint action of the City of Bratislava, the Bratislava region, and socio-economic cooperation in the Partnership Council for the programming period from 2021 to 2027 will serve to develop joint cross-cutting projects in the region.

A tool that will also create space for implementation for strategic partners is the effective management of the Bratislava City Lab. This City Lab enables the city of Bratislava to implement innovations and technologies available on the market. Successful implementation depends on an environment that allows small-scale testing of innovations and technologies, which in turn provides the opportunity to prioritise and select suitable projects without large financial investments and costs. It also serves as a tool for efficient and innovative public procurement, which is one of the tools for fostering a local innovation ecosystem.

Thematic research and innovation areas

Based on the cross-cutting research priorities defined at the national level for the period from 2021 to 2027, the priorities for Bratislava are based on:

- → **Efficient urban mobility** stemming from a strong automotive industry, associated research and the growing connectivity of innovative businesses in Bratislava.
- → **Adaptation to climate change** as one of the priority research areas of the Slovak University of Technology and Comenius University (adaptation to climate change as a key theme for Bratislava, which has started developments in this area through European projects and strategic documents)
- → **Energy efficiency and neutrality** as one of the key priorities at the level of the European Union – including within the framework of the Renewal Fund
- → **Knowledge-based decision-making,** data collection and data handling as a thematic area that Bratislava has defined on its own initiative based on smart cities principles which are used by other cities in the EU
- → **Digital transformation** – the subject of a special section within the Bratislava Urban Innovation Strategy

20 https://www.london.gov.uk/publications/emerging-technology-charter-london

Efficient urban mobility

Mobility is considered to be a key issue for a large number of the city's residents. New mobility trends will change the face of cities, and it is important that this city is able to implement and adapt them. It is essential that the city proactively prepares for these changes and identifies appropriate scenarios. We drew on the Sustainable Mobility Plan of the Bratislava Self-governing Region and on information gained from participatory meetings with representatives of the academic and business sectors.

We identified the following objectives within the framework of effective mobility:

→ making the use of public transport easier and more pleasant
→ supporting the development of micro-mobility
→ developing an effective parking policy with a focus on data collection and analysis
→ promoting shared modes of transport
→ preparing the city for autonomous vehicles, including public transport vehicles
→ exploring the potential and needs of electric and hydrogen cars

Adapting to climate change

Climate change is the greatest threat to our way of life today, and it requires comprehensive and systematic solutions. Technological and innovative approaches to this issue can bring new and more effective solutions to adaptation. This area has been selected as a priority within a consortium of academic institutions (the Slovak Academy of Sciences, the Slovak University of Technology and Comenius University) which are already looking for and developing solutions.

We have defined the following objectives in the framework of adaptation to climate change:

→ searching for ways and opportunities for climate change adaptation with strategic partners within the framework of quintuple helix cooperation
→ creating a sensor network and automated collection of up-to-date environmental data in the city
→ seeking solutions in areas that affect the quality of life (air quality, water quality and public spaces including green and blue infrastructures)

Energy efficiency

A responsible approach to non-renewable resources is one of the biggest priorities and challenges for the future. This is reflected in the Recovery Plan with a total financial allocation of almost €750 billion for science, research and innovation. The EU's New European Bauhaus initiative and the European Commission's EIT Climate KIC portfolio of solutions are also addressing the topic. These initiatives focus on a holistic approach to solving complex challenges, engaging key partners and creating a series of controlled experiments. These experiments then lead to positive changes in legislation, technology, resident behaviour and the baseline condition of a given locality.

We have defined the following targets within the framework of energy efficiency:

→ actively contributing to reducing emissions
→ promoting efficient energy management in public and private buildings
→ creating energy neutral and positive urban neighbourhoods

Evidence-based decision-making

Evidence-based decision-making and data-driven decision-making are among the core themes of modern and sustainable cities. Such decisions depend on the effective collection and evaluation of relevant data. To work with data, a data policy directive[21] was created in 2019. Each innovation activity focuses on the collection of relevant data within a given theme. It then evaluates this data and builds a base of data-backed decisions.

Since 2019, Bratislava has been a signatory of the Cities Coalition for Digital Rights, which shares case studies, recommendations and experiences in working with new technologies and citizens' data. Cities are sensitive to the impact of new technologies and recognise the need for early regulation and a proactive approach and knowledge that protects the interests of both residents and cities. Examples include an ethical approach to artificial intelligence, avoiding prejudice against social discrimination in its use, and data protection under European legislation.

We have defined the following objectives within the data policy:

→ actively monitoring and managing the ownership of the collected data
→ publishing relevant data while enabling the academic and business sectors to work with the data
→ making data-driven decisions

21 https://opendata.bratislava.sk/page/data

Hackathons as a new view of the city

Hackathons have long been perceived by both the private and public sectors as creative events that can bring new perspectives to the challenges and problems set by the organisers. For cities, it is also a tool to connect key players more deeply and engage residents in the search for solutions. Active engagement creates positive relationships and a deeper understanding of complexity, and it encourages active citizenship as well. Bratislava joined the international Climathon initiative in 2020 and 2021. This is organised by the European initiative Climate KIC each year and involves more than 100 cities from 60 countries in finding solutions to climate change.

The first Climathon in Bratislava was marked by the COVID-19 pandemic, which only allowed a virtual meeting of participants. Over a weekend in November, more than 150 people in 26 teams came together to brainstorm ways to help Bratislava prepare for climate change and to inform and motivate residents towards sustainable forms of mobility. During the 48-hour virtual event, 25 technology and design proposals were created. The winning solution offers residents the opportunity to participate in mitigating urban overheating by mapping heat islands and tracking the most effective solutions – from rainwater harvesting to planting trees and shrubs. The Climathon was supported by private companies such as Swiss Re, Civitta, Hub-Hub, the Slovak University of Technology's inQb incubator and the Ministry of the Environment.

After the positive experience of the first edition, the city prepared a second edition with more than 120 participants who brought fifteen proposals for solutions on urban mobility, the mapping and mitigation of the impacts of climate change and efficient waste management. It is also important to find effective mechanisms to develop and integrate solutions into the running of the city, be that through urban lab pilot projects or integration into existing digital solutions. Following the first edition, the city successfully developed an urban multimodal application with the winning team.

Principles for implementing emerging technologies

The definition of thematic innovation and research areas and the subsequent implementation of new technologies that will be the output of a strategic collaboration or an urban laboratory require effective management. Dynamic changes in technology and the robustness of public institutions are often two worlds that are difficult to reconcile. The implementation of emerging technologies in an urban environment requires explicitly set principles.

The principles for implementing the emerging technologies that inspired this report are based on the Emerging Technology Charter for London[22]. Like Bratislava, London is a signatory to the Cities Coalition for Digital Rights, which aims to enable cities to share their knowledge and recommendations.

The principles for implementing new technologies are as follows:

1. Openness
We will be open and transparent when implementing new technologies. We will actively engage with key partners and share our implementation plans with the public. For pilot projects, we will effectively measure the initial status before implementation and post-implementation, which will then evaluate the effectiveness of the new technologies.

2. Respect and diversity
Implemented technologies must serve all residents. If certain groups of residents are excluded from using certain new technologies, the decision shall have clearly defined reasons for this exclusion. The implementation of new technologies will also take into account the social impact on the city's residents.

3. Responsible handling of residents' data
The data that will be collected in the implementation of new technologies must be collected in a way that protects the data providers, who shall be acquainted with the data collection and processing. The data provider must also be given the opportunity to object to the collection of data or to easily opt out of the provision of data.

4. Sustainability
Emerging technologies have a virtual footprint as well as a physical one. New technologies should also be evaluated upon the basis of their environmental impact. Emerging technologies must contribute to adapting to or slowing down climate change and must not negatively affect the environment.

22 https://www.london.gov.uk/publications/emerging-technology-charter-london

A smart urban infrastructure as a tool for development

The upcoming replacement of public lighting is an opportunity for Bratislava to prepare for fundamental changes in mobility, the digitalisation of services and the use of sensor networks in the city. More than 40,000 light points across the city form the basis of the future smart city infrastructure. In the medium to long term, we see its transformational role in these key areas:

→ Electromobility and preparation for the smart grid
  ↘ The EU forecasts that 30 million electric cars will be on the road by 2030. New mobility trends require an adaptation of infrastructure and public space management models. In densely populated urban areas, long-term one-way charging stations in car parks and streets are needed alongside fast charging options with a bidirectional current. The public lighting infrastructure allows for the creation of an efficient network of charging points during upcoming renovations and reinforcements. Several JRC experimental studies have shown the possibilities for storage and standby energy from electric cars for strategic infrastructure during power outages.
→ A sensor network and the collection of up-to-date data on the urban environment
  ↘ Collecting relevant and up-to-date environmental data will enable quick and responsible decisions to be made, and residents shall be proactively informed about changes.
→ An urban optical network and next-generation 5G networks
  ↘ The creation of a city-wide fibre-optic network will prepare for the increased demands on communication, enabling the smooth operation of the sensory and security aspects of the city.
→ Security and CCTV systems
  ↘ A dense network of public lighting connected to a constant electrical current and with a fibre-optic network will open up opportunities for preventive security, semi-automated decisions and a more efficient allocation of municipal police resources.
  ↘ In several cities, camera systems serve as a complement to parking policies and as an effective tool for enforcing static traffic rules. (Having said that, Slovakia lacked legislative regulation for this in 2020).

Cooperation as the first step for success – Quintuple helix collaboration

Quintuple helix collaboration refers to collaboration between the academic, business and public sectors in order to address common challenges in line with the environment in which they operate. We consider the creation of quintuple helix cooperation between key partners and the establishment of its processes and strategy to be a key priority for Bratislava. Sharing knowledge can bring new and innovative ideas for solving complex problems in the context of new technologies and in the context of addressing social and environmental challenges. Building this cross-sectoral collaboration can help Bratislava build its innovation skills.

The city aims to take advantage of its opportunities, which include interest from businesses in building a relationship with the city and the high concentration of academic and research institutions. In this way, the city can avoid the threat of weak links with the business and academic sectors, which could reduce the city's innovativeness in the future. The creation of a quintuple helix of cooperation is considered a good tool to build an innovation ecosystem.

The quintuple helix is an innovation system that highlights the need for collaboration between the public, private and academic sectors to address common problems and challenges in a manner consistent with and respectful of the environment in which they are situated. The model points out that all innovations arising from this collaboration must take into account social and environmental impacts. This innovation model suggests that if the different sectors develop effective cooperation that enables the exchange of knowledge and experience, all stakeholders will have a better chance of successfully solving complex problems.

Strategic cooperation and a metropolitan innovation agency

In addition to the already existing cooperation agreements between the city and academic partners, we propose the creation of an umbrella organisation (an innovation agency) which will serve as a tool to develop the innovation ecosystem both internally and externally. From international experience, we can see that the targeted development of innovation through strategic collaborations and investment increases the number of local high-growth companies that emerge from academic research and that practically apply this knowledge in the commercial environment. These companies increase the share of skilled labour, and their support in the initial stages has multiple positive effects. The

South Moravian Innovation Centre in Brno has been operating for almost twenty years; they have found that one Czech crown invested by the public sector in innovation vouchers to support research results in six Czech crowns of investment by private companies in applied research. In addition to the positive impact on innovation, Brno has also seen an increase in the quality and number of businesses providing services ranging from catering to accommodation. The COVID-19 pandemic has caused a decline in the number of people spending time in the city and using its services. This decline has put pressure on the service sector and has reduced the number of informal gatherings. Casual and informal encounters create opportunities for the exchange of ideas and the development of innovation. These lead to higher productivity, which is also reflected in financial indicators. The innovation agency will offer a space for an innovation ecosystem and private–public partnership of key actors from three sectors. In addition, the agency will serve as a communication and pro-export tool targeted at potential customers for local companies and as an attraction for the workforce.

The objectives of the innovation agency are:

→ retaining and stabilising talent compared to 2019 – students, researchers and a highly skilled workforce
→ supporting the emergence of new businesses in key innovation areas defined in the RIS3 strategy – vertical specialisation
→ the implementation of joint applied research projects addressing common challenges – particularly Horizon Europe and an increase in the number of ERC grants
→ the development of Bratislava's brand as an attractive place to live
→ supporting the pro-export activities of high-growth companies

CEVIS Association

One example of strategic cooperation is the newly established cooperation of the Slovak University of Technology, Comenius University and the Slovak Academy of Sciences within the CEVIS Association, which is based on the model of Brno's CEITEC23. Within the framework of cooperation, there is a proposal for the creation of an innovation agency that would develop and deepen the objectives set by the partners for the development of the innovation ecosystem. These objectives include an increase in the number of Horizon Europe projects, a stabilisation in the number of students and a growing number of high-growth enterprises in priority areas mentioned in the introduction and based on the national smart specialisation document.

The Nová Cvernovka Foundation

The Nová Cvernovka Foundation was created by creative, technical and artistic professionals in an abandoned building at a thread factory on Páričkova Street. After the sale of the building, the community came together and sought to preserve their creative potential by acquiring a new space. The community eventually managed to agree with the Bratislava Self-governing Region on the use of a former building of a high school and boarding school. On a 2.6 hectare site with unused buildings, they then created an area for creative industries, a public space with a community garden, a park made of recycled rubble, a playground and social spaces that all have an eye on circularity and social inclusion.

The building's unique composition of residents from the creative industry (architects, graphic designers, photographers, and filmmakers) forms the basis of a successful mix that includes technological talent and scientific professionals. Several new projects have been created at Nová Cvernovka through joint efforts and diverse views on issues.

The facilities of Nová Cvernovka also welcome parents with children, homeless people and senior citizens. These spaces are used for discussions, festivals and screenings. Openness is one of the principles of attracting diverse users.

Nová Cvernovka has helped produce several successful and patented solutions. One of these is SPEAR hydro, which is a unique turbine for generating electricity that can be placed on old boats along with storage batteries. Boats moored on city quays can thus serve as charging stations and urban parks.

Nová Cvernovka is aiming for comprehensive sustainability and the creation of a pilot space for energy efficiency and smart buildings in high schools and dormitories. Its solutions combine intelligent control, rainwater harvesting, shading and cooling. The Eco Board project is a collaboration of figures from the world of start-ups, academia, architecture and art. The IoT platform allows users to control energy consumption and actively and passively optimise energy consumption, rainwater harvesting, recycling and the reuse of grey water alongside other efficient waste management.

City Lab

The City Lab is an open innovation platform that creates a safe space for testing innovations through controlled experiments of pilot solutions. The City Lab searches for, adopts and implements technologies that meet strategic objectives in prioritised thematic areas. It

also allows new technologies to be tested on a small scale and prior to full implementation, ensuring that the technologies will meet the needs, requirements and stated objectives.

The pilot projects of the City Lab will allow Bratislava to:

1. Correctly grasp and name the problems that need to be addressed
2. Define these problems as key challenges in line with the strategic documents.
3. Select the project partner through a transparent selection process according to predefined criteria
4. Test several solution alternatives or several partners for the same problem.
5. Initially test the solution on a small scale before subsequent procurement.
6. Credibly evaluate the effects of the solution based on the data collected.
7. Identify potential failures and fix them if possible – if there insurmountable obstacles, find another solution.
8. Scale the project further if it is judged successful.
9. Promote trust of residents and increase transparency.

Urban Laboratory Processes

The process of implementing pilot projects within the City Lab consists of six steps:

→ Identifying gaps, needs and challenges in the city.
  ↘ Identifying the problem and the key step to finding the right solution.
→ Identifying key partners.
  ↘ The target groups affected by the problem are then identified because these groups also become our key partners. Key partners can be citizens or other external partners from the academic or business sectors within the quintuple helix of cooperation.
→ A definition of challenges.
  ↘ In this process, the definition of challenges serves as a brief for potential project partners. To define a challenge, it is important to have an in-depth understanding of the problem.
→ A public call and evaluation of selection criteria.
  ↘ A public call is developed based on the call defined in the previous step. The selection of a potential partner is based on criteria that point to the added value of the proposed solution, ease of implementation and the amount of financial resources needed.
→ A selection of the partner and the time horizon.
  ↘ The selection of the partner is made by a selection committee that follows set criteria. The time horizon for the pilot projects is set based on the complexity of the problem and its solution.
→ Implementation and evaluation.
  ↘ The solution is implemented and its success is regularly measured by set measurable indicators.

Public procurement as a tool to support innovative firms

Public procurement can be a strategic tool for achieving environmental protection objectives while developing the economic ecosystem and fostering innovation. At the same time, public procurement is a key pillar in the operation and development of public institutions, which has a major impact on the quality of life and service delivery in areas ranging from energy efficiency to the wellbeing and health of residents. According to an OECD report, public procurement accounted for up to 12.6% of GDP in OECD countries in 2019. The Urban Laboratory serves as a tool to validate new approaches (test before invest). It can also serve as a tool for innovative procurement (public procurement of innovative solutions) and the procurement of solutions before their commercial launch (pre-commercial procurement), which can change the traditional approach of selecting specific services or goods identified as solutions. This approach can open up new opportunities and support local companies that develop and offer solutions to the problems and challenges faced by cities. Another simple tool is the publication of planned procurements to allow transparency and market dialogue.

What do we want to achieve?	Measurable indicators
Establish a governance structure (an innovation agency) for planning strategic projects in the city	Creating the innovation agency by the end of 2022
Define cross-cutting projects and their measurable indicators	Within the framework of the innovation agency, defining at least five cross-cutting projects with a view to 2030 which will fulfil the defined thematic innovation and research areas
Enable the development of innovation within the Urban Laboratory	Testing and evaluating at least two potential solutions per year until 2030
Increase the perception of the city as a partner among businesses	Increasing the perception of the city as a partner by businesses from 29.8% to 45% by 2030
Motivate businesses to get involved in the running of the city	Increasing business involvement in the city from 53% to 65% by 2030

Table 19: Measurable indicators, Source: authors' own elaboration

Digital transformation

The private sector has paved the way for digital services that are relevant, popular and now standard for most people. Bratislava should provide its residents with the same high quality services that residents are already accustomed to.

Digital transformation in large organisations such as cities can bring many challenges. We believe that Bratislava can operate flexibly enough to meet these challenges. Design thinking as a primary tool for digital transformation can help a city respond quickly to challenges and build flexibility in response to the complications and issues that arise during digital transformation. Design thinking is so flexible as a model that even organisations that are less risk-resistant can work with it. Design thinking leaves enough room for innovation for these organisations as well.

Principles of digital transformation
A city should be able to create digital services that are fast, efficient and convenient for residents to use. For Bratislava, this transformation will mean reduced long-term costs and increased efficiencies.

In order for the city to experience the benefits of service transformation and for residents to make full use of the services, the creation of services must be guided by certain principles. In the following section, we analyse residents' approaches to technology and digital services underpinning the underlying principles of transformation.

Cities are like living organisms that are constantly changing. In order to be able to adapt to the current situation and provide services at the level of the private sector, they need to continuously evolve. While we say that a city is constantly changing, it must only do so in accordance with the specific needs and wishes of its inhabitants. Therefore, the principles of digital city change are based on an analysis of the current relationship between residents and technology.

1. Inclusive transformation of digital services
To a significant extent, the digital behaviour of residents depends on their age and their education. Digital transformation should result in simple services that are in line with the abilities of less digitally skilled residents. This approach will ensure that no residents are excluded from digital transformation and that the transformed services are accessible to everyone.

2. Transformed digital services will be regularly tested on a small sample
Despite residents' trust in technology, a significant number of them believe that technology should be introduced gradually. To ensure that services are not introduced in a haphazard and forced manner, transformed services will be tested on a small sample of users. At the same time, a smaller group of selected services will be used as a pilot to make sure that digital transformation makes sense for residents and city employees. After this has been achieved, the rest of the services will be modified based on feedback and then made available to the general public. In this way, we can avoid any unwanted or unnecessary aspects of services being felt by residents and city employees.

3. Create services that increase the preference of residents to digitally interact with municipal institutions
Despite the fact that residents are open to digital solutions, a significant number of them still prefer to communicate with municipal institutions in person. We attribute this to the fact that residents and city employees alike often lack confidence in those digital solutions that have been implemented by the city in the past. The digital transformation should reduce the need for face-to-face communication and reassure residents that the use of digital services is as reliable as personal contact.

4. Raise awareness of digital service
Last but not least, it is clear that there is a significantly low awareness of the city's current digital services. We will systematically direct residents to the transformed services through the channels that are natural to them. We believe that if we direct residents to functional and transformed digital services, their awareness of them and their interest in them will increase.

Design thinking as a tool for digital transformation
When designing new solutions, or when modifying existing processes in connection with the transformation and development of digital services, Bratislava will use design thinking and related processes. Design thinking is a methodology that encompasses the full spectrum of activities related to the development of innovations and solutions to complex problems. A key characteristic of this innovation model is its user-centred focus. Whereas standard innovation models collect initial feedback from users of a new product or service just before its completion, design thinking engages users and implements their feedback from the beginning. By using this model, we can ensure that the city delivers services that meet residents' needs. These transformed services will be developed in collaboration with users and relevant partners.

Using these processes can also help to develop a portfolio of solutions to previously identified problems. Part of this process involves brainstorming and developing multiple solutions to a specific problem. Even if some of the solutions are not used at the time, they can be „shelved“ and used in the future.

Design thinking is also characterised by the following features:

→ It is an interactive process.
  ↘ The design thinking process is characterised by the fact that it is a non-linear process, and thus it is repeated several times until the participants in the process find a suitable solution. This allows for continuous improvement of the solution without high financial investment.
→ It is user-centred.
  ↘ The whole process is based on the needs of the users, which guarantees that the final product or service will be attractive and functional for its users.
→ Evxperimentation.
  ↘ In the process, it is important to experiment and not be afraid to fail. Every piece of feedback, even if it is negative, moves the whole process forward.
→ Prototyping.
  ↘ Last but not least, the process is characterised by intense prototyping. The prototype precedes the final product or service. Prototyping prevents unnecessary financial investment in a solution whose functionality is unproven.

Design thinking consists of five phases:

→ Empathize
  ↘ The first phase of the design thinking process is to identify and understand the needs of potential service users. In this process, it is very important to try to understand both the hidden and the explicit needs of the users. This can be achieved through a variety of methods, including in-depth interviews, observation, focus groups, and shadowing.
→ Define
  ↘ The purpose of this step is to define the hypotheses and basic problems where we want to find a suitable solution at the end of the process. These problems are identified based on an analysis from the previous understanding phase.
→ Ideate
  ↘ This phase focuses on discussing different potential solutions to the defined problem. This step is more about the quantity than the quality of ideas. The aim of the phase is to identify as many potential solutions as possible, which will be further shaped in the next phase.
→ Prototype
  ↘ Once the most suitable solutions to a given problem have been identified, prototypes are then created. Prototypes can take many forms (be it a simple sketch on paper or a synthetic product with basic functionality). It is important that prototypes are as simple as possible and that they evolve gradually. This will allow the financial investment in the solution to be made only when we are sure that the solution meets the needs of the users.
→ Test
  ↘ The prototype is then tested among users. During testing, valuable feedback is collected, which informs how the prototype is to be redesigned and retested. The process continues until a prototype is developed that meets the needs of the users. The prototype is then transformed into a real product or service. The multiple testing of prototypes ensures the success of the solution and its popularity among users.

Table 20: Measurable indicators

What do we want to achieve?	Measurable indicators
Transformation and development of digital services	Delivering the digital transformation of twenty key city services by the end of 2022
	Transforming and digitising all relevant city services by 2023
Raise the awareness of digital services and direct residents to the functioning and transformed services	Increasing the penetration of digital services from 15% to 45% by the end of 2022
Implementation of design thinking processes	100% of transformed services will be based on specific user needs and will be supported by research findings
Adapt the city‘s website to properly direct residents to the information they are looking for	Reducing the immediate exit rate from 67% to less than 45% by the end of 2022 and less than 30% by the end of 2030
Motivate residents to use digital services	Increasing the number of residents who prefer electronic contact with municipal institutions from 35% to 55% by 2030

Zdroj: vlastné spracovanie autorov

Digital property tax

In 2016, Bratislava took the opportunity to digitise its services for residents through European funding. More than 140 e-services were intended to make it easier for residents to access local government. After four years of operation, however, we recognised several shortcomings and decided to improve our services.

In collaboration with Bloomberg Philantrophies, Bratislava received expert support from FutureGov (a United Kingdom-based consultancy) as a part of the Digital Transformation for European Cities programme. The digitisation of the United Kingdom's public administration is a successful example that many countries and cities in Europe are trying to replicate.

As a first step, it was necessary to identify the problems that citizens had with e-services and to understand the legislative boundaries and technological possibilities. The collaboration with FutureGov has been built on the principles of design thinking, which achieved the following during the eighteen-month project:

- identifying the most important e-services from the perspective of residents – for Bratislava, this is the payment of property tax (from more than 200,000 taxpayers) and the filing of property tax returns (approximately 45,000 tax returns per year)
- mapping the problems, challenges and demands of residents and municipal representatives
- understanding national and European legislation
- creating a list of technological options — especially in the area of the authentication of citizens, given that this is one of the barriers in the active use of electronic ID cards
- verifying the feasibility of the proposed prototypes with key city employees and residents in several phases

The pilot project will result in a portfolio of property tax transformation initiatives that will enable rapid change and long-term improvements. These solutions shall be pilot-tested on a selected group of residents and subsequently put into operation. Certainly, the transformation of one service overlaps with other e-services. Understanding the needs, expectations and technological and legislative possibilities will enable the improvement and adaptation of other digital services that Bratislava either already provides or is planning to provide.

First digitalisation of the city's sports grounds

Together with the Innovation and Digital Services Department, STaRZ decided to digitise Bratislava's sports grounds in 2021. Bratislava swimming pools were the first to undergo this transformation. Visitors to these swimming pools had often experienced unpleasant surprises upon arrival due to waiting for long periods in order to buy a ticket.

In recent years, attendance at Bratislava's swimming pools has reached more than 200,000 entries during the summer season. Given the COVID-19 pandemic situation, which restricted travel, there was an expectation that the number of visitors would increase. We reached the conclusion that the online purchase of swimming pool tickets would make it easier for city residents to visit these facilities and similar ones, thus reducing the pressure on employees. STaRZ sought to introduce a similar system in 2020. This system was introduced during the season, which meant that visitors could not properly familiarise themselves with the service beforehand and make full use of getting an online ticket. One aim of this year's cooperation was to launch this service in advance of the start of the season. Thanks to consistent and persistent work, this goal has been achieved.

We designed online ticketing so that everyone can use it – from young people growing up with technology through to residents still getting to grips with it. Based on testing with regular and occasional visitors, we identified four types of ticket that best fit visitors' needs. We have also provided online customers with the following benefits based on our research:

- Single-use tickets can be used at one or more swimming pools in a single day.
- There are discounted admission fees for those who purchase tickets online versus those who purchase at the gate.

In the 2021 summer season, the share of online tickets was 12% of total sales — with a turnover of more than 85,000 euros. Up to 97% of visitors said they would use this service again.

After the end of the season, we collected feedback from visitors to the swimming pools in the form of a questionnaire. This feedback will be acted upon in order to provide a better experience with online ticket purchases. At the same time, we will use this feedback to digitise other venues in the city.

Sources

Analýza prieskumu podnikateľských potrieb, Oddelenie inovácií a digitálnych služieb, Magistrát hlavného mesta SR Bratislava 2020

Analýza reprezentatívneho prieskumu o technológiách a komunikácií s mestskými inštitúciami, Oddelenie inovácií a digitálnych služieb, Magistrát hlavného mesta SR Bratislava 2020

Austrian Institute of Technology, Stadtplanung 2.0: Corona-Krise zeigt, wie Kooperation funktioniert. [cit. 2021] URL:
<https://www.ait.ac.at/blog/stadtplanung-2-0>

Brainport Eindhoven. [cit. 2021] URL:
<https://brainporteindhoven.com/int/ >

Brno region. [cit. 2021] URL:
<https://brnoregion.com/ >

Central European Institute of Technology. [cit. 2021] URL:
<https://www.ceitec.eu>

Coutu, S., The Scale-up Report 2014, Information economy council London 2014 [cit. 2021] URL:
<https://www.scaleupinstitute.org.uk/reports/the-scale-up-report-2014/>

DATAcube, Regionálny hrubý domáci produkt na obyvateľa (v bežných cenách). [cit. 2021] URL:
<http://datacube.statistics.sk/#!/view/sk/VBD_SK_WIN/nu3002rr/v_nu3002rr_00_00_00_sk>

Eurostat, Perception survey results. [cit. 2021] URL:
https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=urb_percep&lang=en>

Eurostat, Unemployment rate by NUTS 2 regions. [cit. 2022] URL:
<https://ec.europa.eu/eurostat/databrowser/view/tgs00010/default/table?lang=en>a

Holienka, M., Pilková, A., Mikuš, J. Prieskum a hodnotenie podnikateľského ekosystému v Bratislave metodikou GEM EES, Výstup č.1: Komplexná analýza hlavných ukazovateľov realizovaných prieskumov GEM APS ESI a GEM RES ESI a identifikácia a interpretácia hlavných zistení, Univerzita Komenského v Bratislave, Fakulta managementu, Bratislava 2020

Holienka, M., Pilková, A., Mikuš, J. Prieskum a hodnotenie podnikateľského ekosystému v Bratislave metodikou GEM EES, Výstup č.2: Porovnávacia analýza – Bratislava a Slovensko, Univerzita Komenského v Bratislave, Fakulta managementu, Bratislava 2020

Holienka, M., Pilková, A., Mikuš, J. Prieskum a hodnotenie podnikateľského ekosystému v Bratislave metodikou GEM EES, Výstup č.3: Porovnávacia analýza – Bratislava a vybrané ekosystému (Katalánsko a Tel Aviv), Univerzita Komenského v Bratislave, Fakulta managementu, Bratislava 2020

Holienka, M., Pilková, A., Mikuš, J. Prieskum a hodnotenie podnikateľského ekosystému v Bratislave metodikou GEM EES, Výstup č.4: Analýza finančnej a inovačnej výkonnosti firiem v Bratislave, Univerzita Komenského v Bratislave, Fakulta managementu, Bratislava 2020

Jihomoravské inovační centrum. [cit. 2021] URL:
<https://www.jic.cz>

Joint Research Centre, What is Smart Specialisation. 2021 [cit. 2021] URL:
<https://s3platform.jrc.ec.europa.eu/what-we-do>

Local 2030 – Localizing SDGs, Voluntary Local Reviews. [cit. 2021] URL:
< https://www.local2030.org/vlrs >

London Gov, An emering technology charter for London. [cit. 2021] URL:
<https://www.london.gov.uk/publications/emerging-technology-charter-london>

Metropolitný Inštitút Bratislava, Ako porozumieť mestu a jeho ľuďom?, Bratislava 2021 [cit. 2021] URL:
<https://mib.sk/publikacie/>

Šveda, M., Barlík, P. Daily Commuting in the Bratislava Metropolitan Area: Case Study with Mobile Positioning Data". Papers in Applied Geography, 2018 [cit. 2021] URL:
<https://doi.org/10.1080/23754931.2018.1540357>

Eurostat, Students enrolled in tertiary education by education level, programme orientation, sex and NUTS2 regions. [cit. 2022] URL:
<https://ec.europa.eu/eurostat/databrowser/view/educ_uoe_enrt06/default/table?lang=en.%20Cit%2002.%20február%202022>

Ministerstvo investícií, regionálneho rozvoja a informatizácie Slovenskej republiky, Agenda 2030. [cit. 2021] URL:
<https://www.mirri.gov.sk/sekcie/investicie/agenda-2030/index.html >

Ministerstvo investícií, regionálneho rozvoja a informatizácie Slovenskej republiky, Stratégia digitálej transformácie Slovenska 2030. [cit. 2021] URL:
<https://www.mirri.gov.sk/sekcie/informatizacia/digitalna-transformacia/strategia-digitalnej-transformacie-slovenska-2030/ >

Ministerstvo investícií, regionálneho rozvoja a informatizácie Slovenskej republiky, Národná koncepcia informatizácie verejnej správy (NKIVS). [cit. 2021] URL:
<https://www.mirri.gov.sk/sekcie/narodna-koncepcia-informatizacie-verejnej-spravy-nikvs/>

Naše mesto. [cit. 2021] URL:
<https://www.nasemesto.sk/>

OECD, About Champion Mayers. 2021 [cit. 2021] URL:
<http://www.oecd-inclusive.com/champion-mayors/about/>

OECD.Stat, Regional economy – Gross domestic product, Large regions TL2. [cit. 2022] URL:
<https://stats.oecd.org/Index.aspx?DataSetCode=REGION_ECONOM>

Prieskum potrieb študentov, Nexteria 2020

To Dá Rozum, Analýza zistení o stave školstva [cit. 2020] URL:
<https://analyza.todarozum.sk>

AHOJ

Inovations
of Bratislava

9 788057 037842