

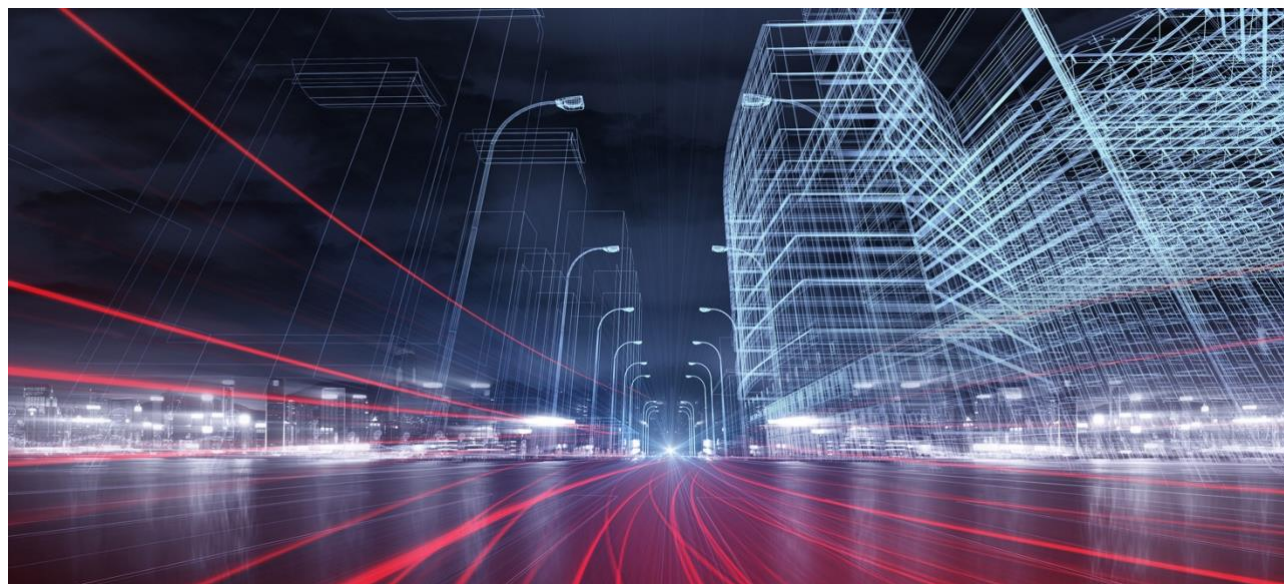


DIGITAL CITIES CHALLENGE

Assessment report for the city of Sofia

A platform for smart growth

July 2019



Digital Cities Challenge

Assessment report for the city of Sofia

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1. Introduction to the Digital Cities Challenge

According to the recent data, 72% of the EU's population lives in cities, towns and suburbs, making them the engines of the continent's economy. Cities generate 85% of Europe's GDP, they also face multiple, interconnected challenges, including energy and climate change, employment, migration, social inequality, and water, air and soil pollution.

However, through advanced digital technologies, Europe has the opportunity to re-invent the way we manage our cities' development and respond to the big societal challenges, such as efficient health management, cleaner environment, green mobility, and offering great-value jobs. Due to their high density, cities are put in a very good position to create innovative ecosystems made up of a wide array of different stakeholders from government, industry, finance, academia, communitarian organisations, social partners, etc. Cities have the capacity to make policies become reality.

In this context arises the **Digital Cities Challenge**, an initiative of the European Commission with the main purpose to support the cities in their path to digital transformation. DCC offers policy advice and support to 15 cities in Europe, namely **Alcoy**, **Algeciras** and **Granada** in Spain, **Arad** and **Iasi** in Romania, **L'Aquila** in Italy, **Kavala**, **Patras** and **Thessaloniki** in Greece, **Sofia** in Bulgaria, **Ventspils** in Latvia, **Grand-Orly Seine Bièvre** in France, **Pori** in Finland, **Rijeka** in Croatia, and **Guimarães** in Portugal. The support to be offered will speed up the digital transformation and the industrial modernisation of cities in order for them to take full advantage of the 4th industrial revolution.



This initiative draws inspiration on the recommendations set out in the "Blueprint for cities as launch pads for digital transformation". In addition, it will reinforce the networking among model

cities, facilitate their participation in on-going European initiatives in similar policy fields, strengthen stakeholder collaboration, cross-regional partnerships and stimulate investments.

The selected Digital Cities receive support in the form of field advisory services to be provided by a group of high level experts and peer reviewers and offer the possibility for city representatives to participate in a series of capacity building and networking seminars. These activities take place in four Academy seminars during which cities share practices, take advantage of peer to peer learning and work together and in thematic groups on the steps of their transformation trajectory.

This document has been developed in the framework of the field advisory services being delivered in the city of Sofia. It represents the main output of the first step of the digital transformation strategy: setting the digital vision and ambition for digital transformation. The assessment report has been developed by the Digital City team on the basis of:

- The results of the Self-Assessment Tool and collection of Key Performance Indicators at the city level which took place during March 2018. A total of 23 valid replies were collected through the SAT.
- A literature review of key documents provided by the local leadership team, including reports, policy documents and project plans (cf. Appendix II for full list of documents consulted).
- An assessment visit which took place from 28 to 30 March 2018.
- A vision and ambition workshop which took place on 9 May 2018.
- Strategy workshops took place on (10 July and 10 September 2018) This document represents the key input to the work to be performed during the forthcoming phases of the digital transformation trajectory (i.e. definition of the city strategy and roadmap).

2. The ICT sector in the local economy

According to the Global Competitiveness Report 2017-2018, Bulgaria is ranked 49th out of 137 countries in the world. For many years Bulgaria has been recognised as a country with strong and competitive ICT industry. The analysis of ICT sector national data presented in the report is meaningful because some 80% of the sector's national activity takes place in Sofia.

While in the 1980s it has been labelled as the Soviet “Silicon Valley”, currently Sofia is growing as one of the most attractive locations for outsourcing in the world. In 2014 A.T. Kearney GSLI ranks Bulgaria 9th in the world in most attractive outsourcing destination and first in Europe. While in 2017 it is ranked 15th in the world and 2nd in Europe. The recognised competitive advantages for ICT location are: (1) close geographical proximity to Western Europe, (2) high-skilled talent pool, (3) low labour and operational costs and stable economy. For 2015, the ICT sector accounted for 3% of the national GDP and is considered the fastest growing sector in the national economy.

Sofia is the main driver for economic growth in Bulgaria and leader in the ICT sector on a national level. The GDP of Sofia municipality is €19.2 billion which is more than 1/3rd of Bulgaria's GDP for 2016 (€48.1 billion) (GDP-National Statistical Institute). The annual turnover for the ICT sector in Sofia in 2016 is €4.6 billion, while in 2007 it has been €2.9 billion (Amadeus database). Respectively, in 2016, over 78% of employed in the ICT sector were located in Sofia (about 78,000). Sofia is ranked 1st place in Europe for outsourcing destination and 3rd for highest number of start-ups in Europe for 2014. This is both an advantage, in terms of employment generation, and weakness in terms of positioning companies at a low level of the value chain.

Data on the ICT sector in Sofia estimates that 80% of the employed in the sector hold university degrees. In terms of remuneration, Sofia keeps the highest average salary in the country, with the average monthly salary in the software companies of about €1375 being one of the highest in the capital in 2015. It is over three times (221%) Sofia's average salary in general and 120% higher than the average salary in the ICT sector in Sofia at whole. Despite the attractive financial conditions in the ICT sector in general and in Sofia – in particular, according to Eurostat 44% of the ICT companies in Bulgaria had difficulty in finding ICT specialists to fill the available positions. Sofia has the advantage of holding most of the major universities, schools,

and research institutes in the country. For the academic year 2016/2017, 11.000 students were enrolled in the IT-related degrees in Sofia. However, the ICT branch associations often note that despite the concentration of academic institutions in the capital, there is an insufficient number of graduates to fulfil the need in the ICT sector.

A sectoral analysis of the economy in Sofia indicates that the ICT sector is one of the most significant, together with the creative industries. The results from a Sales-Profits-Employees analysis within a report of “Vision for Sofia” indicates that for the period 2010-2015 the ICT sector is the second highest sector in profits in the capital with 347% increase, while the construction sector is first (2139 % increase). The ICT sector has experienced a growth in profits by 40% for the five-year period and 24% increase in the number of employees. The analysis indicates also that the ICT sector is not among the leading sectors in Profits to Employees ratio. This can be attributed to the high number of employees in the outsourcing segment of the sector which is low value added and include mostly provision of services than development of products and services.

Looking at the employee profile in the sector, men are over-represented (83% men average for EU), but in Bulgaria, the share of men is lowest in the EU (70% men). According to the National Statistical Institute 33.8 thousand were employed in the ICT sector in Sofia in 2015 of whom 65% (22.1 thousand) are male and 35% (11.7 thousand) are female. More than half of the employed in the sector are in the age group of 25-34. In terms of research and development (R&D) official data shows that 17% of all employed in the ICT sector in Sofia in 2015 are working in R&D. For the period 2011-2015 the R&D expenditure in this sector in Sofia has grown from €179 million up to €317 million, which an increase of 77%. However, independent assessments show that official R&D data is seriously underreported and particularly in the ICT sector the real R&D data is 4 to 8 times higher both in terms of expenditures and personnel.

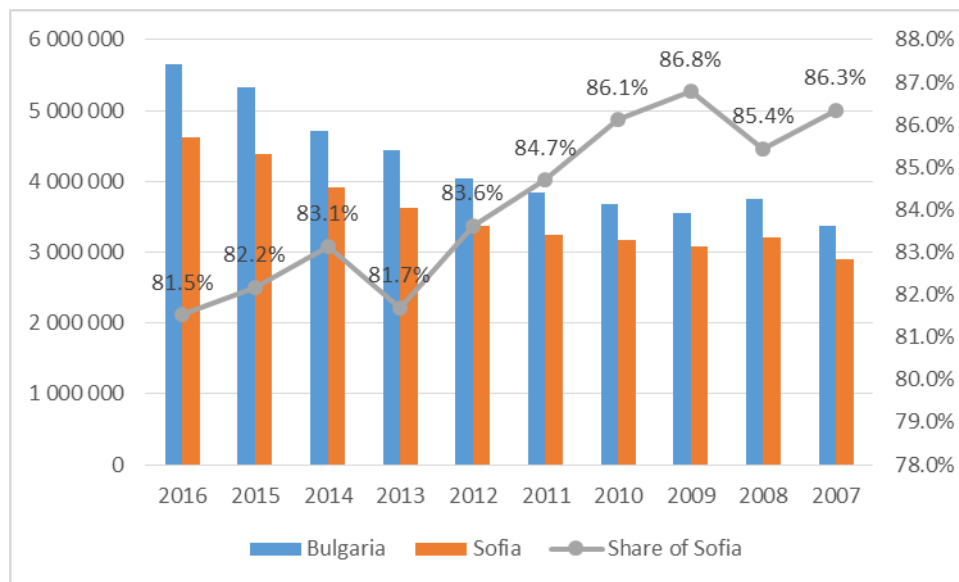
In the last ten years Sofia has become an attractive destination for R&D centres of global ICT leaders such as VMWare, Visteon, SAP, Progress (formerly Telerik), Software AG, etc. Along these relocations, in the capital are located the headquarters of many R&D intensive authentic Bulgarian ICT companies that have become internationally recognised innovative leaders in specific market niches, e.g. Chaos Group, Ontotext, Software Group Bulgaria, Datecs, Interconsult Bulgaria, etc. As a result, the most important feature of the sector, is its role of ‘anchor’ for talent who are not only well paid but also have the sense of being part of the global technological innovation. In many cases, the establishment of new offices of multinational ICT companies in Bulgaria and Sofia follows the model of acquisition of an authentic Bulgarian

company, which has been long-term subcontractor and partner of the multinational one. This has been the case of VMWare, SAP, Progress, etc.

In 2016, Sofia represented 81.5% of the ICT sector in the country in terms of annual turnover and 78.5% in terms of employees (Fig 1 and Fig 2). In the years 2007-2016, the respective shares have decreased mainly due to the development of several other cities as important ICT hubs in the country (e.g. Varna, Gabrovo, Stara Zagora, Bourgas), which attracted new investments, including as places where large Sofia ICT companies open their additional offices.

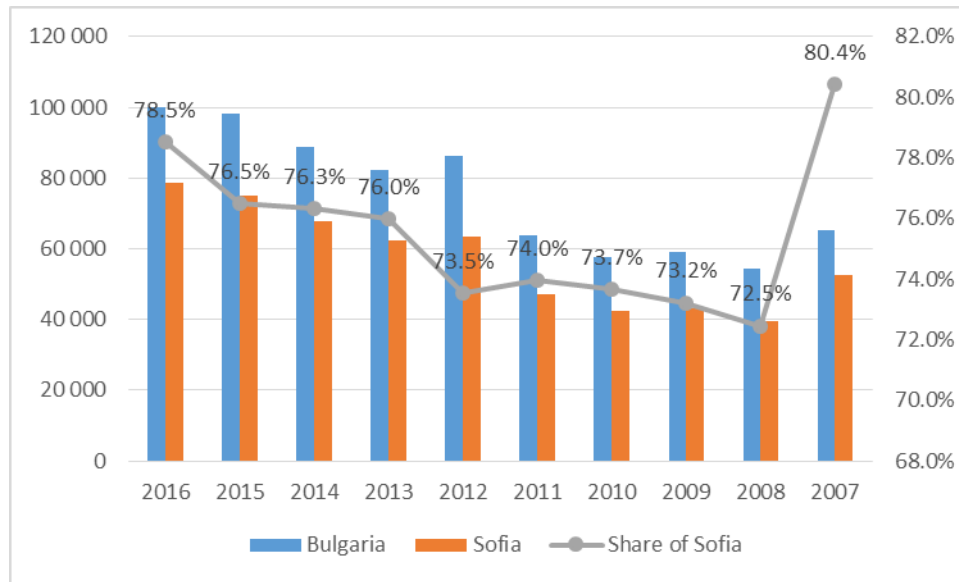
The above brief description of the ICT ecosystem in Sofia indicates a growth trajectory depending of outsourcing, the international orientation of companies, and the selection of Sofia as location of global ICT providers. It is a strong outward looking growth. On the contrary the local market for ICT products and services is not developed and many sectors of the local economy fall behind in the absorption and use of digital services (see also section 9). This is a key problem to address in the framework of the present Digital City Challenge.

Figure 1 Annual turnover of the ICT sector (in thousand EUR)



Source: National Statistical Institute (Национален статистически институт)

Figure 2 Number of employees in the ICT sector

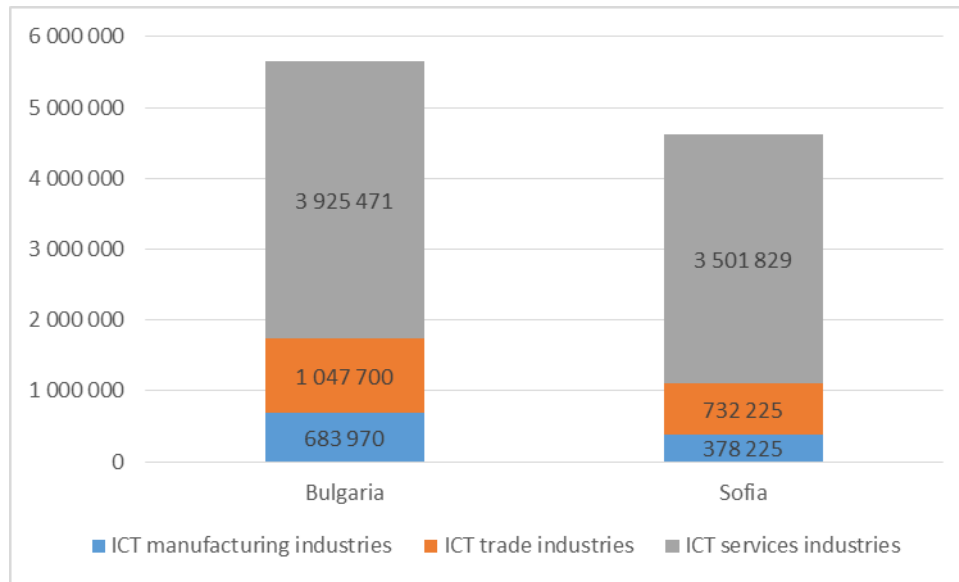


Source: National Statistical Institute (Национален статистически институт)

In terms of sub-sectors, Sofia attracts almost half (47%) of the ICT service industries, 41% of the ICT trade industries and about one third of the ICT manufacturing industries (36%) out of the total ICT sector in the country, measured according to the annual turnover.¹ The prevalence of services is due to the overrepresentation of wireless telecommunication companies and business processes outsourcing companies – mainly call centres, as well as of half of the wired telecommunication companies (Fig 3).

¹ Definition of ICT as used by OECD and Eurostat. See ICT Sector Definition. Transition from NACE Rev. 1.1 to NACE Rev. 2. A Methodological Note. JRC technical reports, 2012. Online at <http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=5919>

Figure 3 Annual turnover in ICT sub-sectors in 2016 (thousand EUR)



Source: National Statistical Institute (Национален статистически институт)

In terms of challenges that are faced by the sector, three major challenges should be highlighted.

- The sector is experiencing a significant shortage of workers. Despite the high number of graduates in Sofia, it remains insufficient for the rapidly growing and demanding sector. The problem of lack of available workforce is also attributed to negative demographic trends and high emigration rates. Sofia is characterised by positive migration from the rest of the country, particularly in the working age of Bulgarian citizens.
- Another commonly mentioned issue for the sector is the need for facilitating and improving the R&D performance. According to the ISSS of Sofia, the ICT sector needs strengthening ties between Science-Education-Business. Despite Sofia produces most of research in Bulgaria, the weak ties with the sector result in limited commercial application and poor science-business links.
- The third commonly occurring issue is the lack of entrepreneurial culture and education, as well as the limited opportunities for venture capital investments, which detain innovation and entrepreneurship in the sector. Currently, most start-ups rely on their own capital or the limited opportunities, offered by two venture capital funds created with the EU support (Eleven and LaunchHub), few private funds (e.g. Nevex) and limited number of business angels.

Companies and associations have actively engaged in tackling some of these issues. In regard to the lack of workforce, a number of academies and internships programs have been initiated by large ICT companies with the purpose of increasing the number of skilled workers in the sector. Some of these initiatives (e.g. Telerik Academy and SoftUni) have become recognised brands with several thousand trained persons per year.

3. Digital maturity level of the city: outcomes of the Self-Assessment Tool and Key Performance Indicators

3.1. Outcomes of the Self Assessment Tool

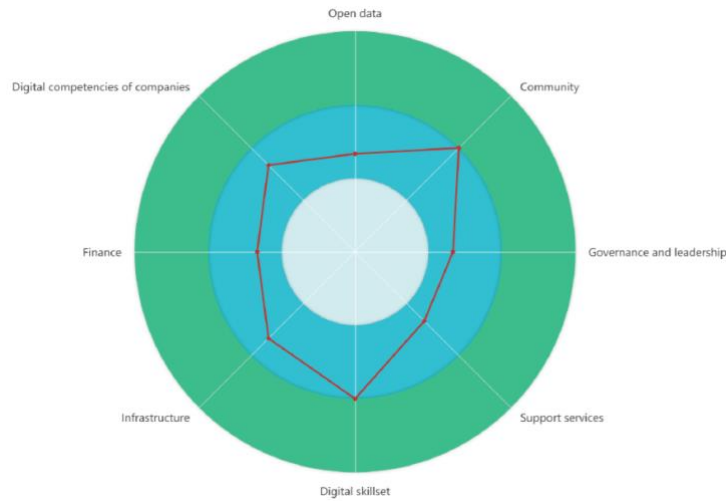
Twenty-three (23) stakeholders from organisations in Sofia provided assessment to the SAT. They come from city authorities (4), education institutions (3), finance (1), industry (13) and utility organisations (2). The data provided allows for assessing the city's digital maturity and define a reference point for the digital transformation strategy for the city.

Digital maturity level

The overall assessment shows that Sofia stands at a mid- to low-level of digital maturity. In two out of the eight dimensions of assessment, community and digital skills, Sofia is placed at mid-level of digital maturity. In the other six dimensions, related to open data, governance, support services, infrastructure, finance and digital competences the city is placed at low level of maturity. This overall assessment indicates an important margin for digital improvement to all dimensions of Sofia.

However, this assessment is not validated by the interviews and the vision and ambition workshop. The opinion of stakeholders is that the city of Sofia is strongly divided. The ICT ecosystem is very advanced and companies in this sector have high digital skills, technology competence, and competitiveness. Equally advanced is the start-up ecosystem and the digital infrastructure, which offers a good level of broadband connectivity. The low level of digital maturity characterises the other sectors of the local economy, both in manufacturing and services. Thus, the digital transformation of Sofia would have limited impact on the ICT firms, start-ups and broadband, if it is not directed to sectors that offer markets to ICT companies.

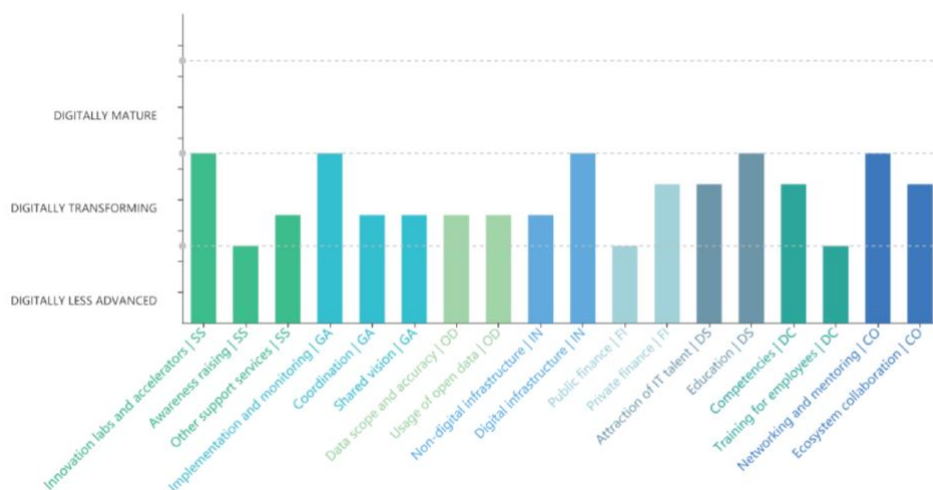
Figure 4 Digital maturity of Sofia based on SAT



Digital maturity per subdimension

Assessment per sub-dimension of the SAT shows a good performance, reaching an entry level of digital maturity, in the domains of innovation labs and acceleration, implementation and monitoring, digital infrastructure, IT education, networking and mentoring. On the contrary, less digitally advanced is awareness raising, public finance, training for employees, data and use of open data. Again, this assessment should be read with respect to the digital divide between ICT and non-ICT sectors. The ICT sector is characterised by the trends showing an entry level to digital maturity (company acceleration, digital infrastructure, IT education, mentoring), while low is the maturity in terms of finance, data usage, and training of employees in the non-ICT sectors.

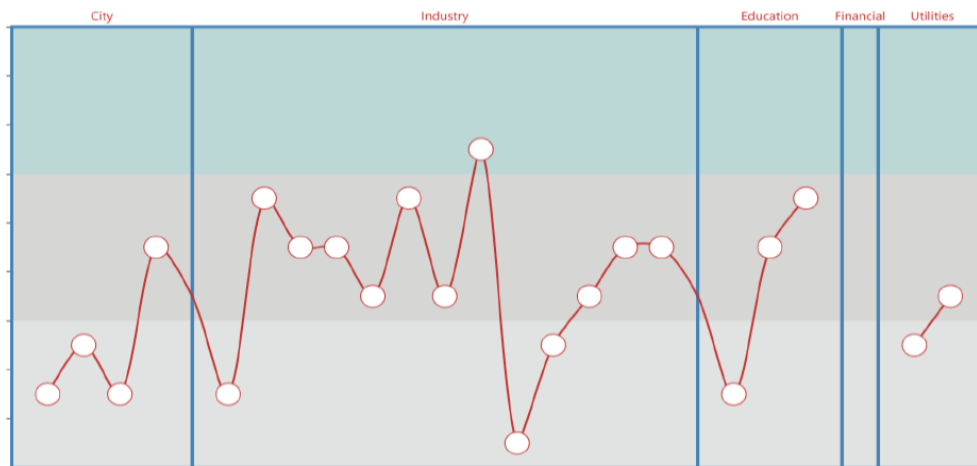
Figure 5 Performance of Sofia per subdimension of SAT



Maturity assessment by type of stakeholders

Most stakeholders that filled the SAT, place Sofia at mid-level of digital maturity. Among the 23 individual assessments, 35% consider that the overall digital maturity of the city is low, while 65% place it at a mid-level of maturity. Stakeholders from industry (70%) assess digital maturity at higher level. This assessment contradicts those concerning the overall digital maturity of the city and its subdimensions. It reveals the divided character of the city between an advanced ICT industry and digitally non-mature other sectors of the local economy.

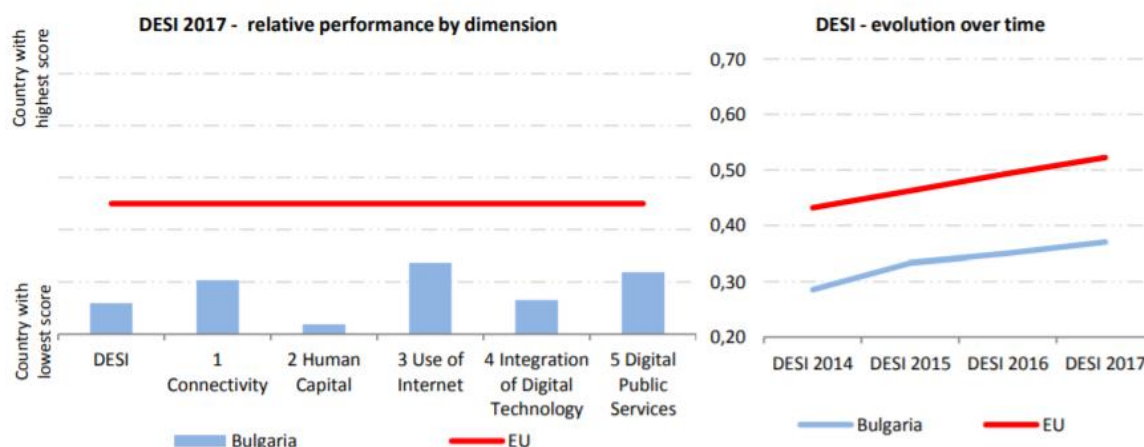
Figure 6 Maturity assessment by Sofia stakeholders – all dimensions



3.2. Key Performance Indicators

In terms of KPIs, Bulgaria ranks 27th in DESI 2017. Compared with last year, Bulgaria progressed in the enhancement of broadband connectivity and use of the Internet and public digital services. Lower performance in digital skills and digitisation of businesses are acting as a brake on the further development of Bulgaria's digital economy and society. This data, however, reflect the country overall, and much of this performance is due to the city of Sofia, of which the performance is at much higher level.

Figure 7 DESI performance of Bulgaria, 2017



Present the KPIs which the city aims to collect, including: KPIs on the digital infrastructure, open data, digital skills, the digital ecosystem and its governance are non-existent for Sofia. As shown in Table 1 some indicators on the Digital Economy and Society are provided by the DESI Index for 2017 and 2018 (Country Report Bulgaria).

Table 1 Key Performance Indicators on connectivity in Bulgaria

	Bulgaria				EU
	DESI 2017		DESI 2016		DESI 2017
	value	rank	value	rank	value
1a1 Fixed Broadband Coverage % households	95% →	23	95%	22	98%
	2016		2015		2016
1a2 Fixed Broadband Take-up % households	57% ↑	27	55%	27	74%
	2016		2015		2016
1b1 Mobile Broadband Take-up Subscriptions per 100 people	82 ↑	13	70	13	84
	June 2016		June 2015		June 2016
1b2 4G coverage⁴ % households (average of operators)	66%	26	NA		84%
	2016				2016
1b3 Spectrum⁵ % of the target	37% →	27	37%	26	68%
	2016		2015		2016
1c1 NGA Coverage % households	74% ↑	22	72%	21	76%
	2016		2015		2016
1c2 Subscriptions to Fast Broadband % subscriptions >= 30Mbps	55% ↑	11	49%	10	37%
	June 2016		June 2015		June 2016
1d1 Fixed Broadband Price⁶	1,7% ↓	20	1,6%	19	1,2%

Even for those indicators available at national level, there is no information on their score at city level. Moreover, a few indicators available at DESI are included into the list of KPIs for Sofia. Table 2 includes a limited number of KPIs that are available at national level, which we estimated for Sofia, taking into account the development gap between Sofia and the country.

Table 2 Key performance indicators (KPIs) for Sofia

ID	KPIs	BULGARIA	SOFIA	Source/definition	Explanation
DIGITAL INFRASTRUCTURE					
3	% of households with internet at home [%]	95%	100%	DESI and estimation for Sofia	Numerator: Number of households with internet. includes dial up, DSL, wired fixed wireless (satellite, Wi-Fi, WiMAX) and mobile wireless (3G/UMTS). Denominator: Number of households.
6	% of people using mobile internet to go online [%]	62%	95%	DESI and estimation for Sofia	Numerator: number of people using mobile internet to go online. Denominator: Population
NON-DIGITAL INFRASTRUCTURE					
17	% of Individuals who used the internet for interaction with public authorities (average for the last three years)	58%	90%	DESI and estimation for Sofia	This indicator is available in Eurostat, NUTS 2 level
DATA SCOPE & ACCURACY					
18	Availability of open datasets [Y/N]	YES	YES	Public administration	To be acquired from public administration representatives.
DIGITAL EDUCATION					
23	% of people who bought or ordered goods or services over the internet in past 12 months [%]	27%	42%	DESI and estimation for Sofia	This indicator is available in Eurostat, NUTS 2
PRIVATE FUNDING					
46	Availability of business angels for digital start-ups [Y/N]		YES	Financial institution	This is a yes or no indicator to be inquired to financial institutions.
INNOVATION LAB & ACCELERATORS					
47	# of innovations labs / accelerators [#]		15	Public administration	This indicator captures the local presence of innovation
48	# of start-ups / companies attached to innovation labs / accelerators [#]		137	Public administration	# of start-ups/companies that have taken their ideas to innovation labs/ accelerators/ incubators.
GOV SHARED VISION					
51	Availability of digital strategy [Y/N]		YES	Public administration	This is a yes or no indicator to be inquired by the relevant public administration
GOV COORDINATION					
52	Availability of clear executive responsible for digital development plan [Y/N]		N	Public administration	Indicator to be inquired to the relevant public administration representatives.
GOV MONITORING					
54	Existence of a monitoring framework for the implementation of the city digital strategy [Y/N]		N	Public administration	This is a yes or no indicator to be inquired to the relevant public administration representatives.

4. The local digital ecosystem: leadership and governance

The ICT sector is recognised by the Sofia municipality as crucial for the economic growth of the capital. Currently, there is no overall shared vision for the digital development of Sofia among the stakeholders. Rather, in place are a number of strategies, published by the Sofia municipality that deal with the development of the ICT sector in the capital. Since 2016, Sofia has its “Smart Specialisation Strategy” (S3), which aims to turn the city into capital of the new digital market and a centre for digital innovation on a regional and European scale.² More precisely it aims at making Sofia a national and regional centre for education, scientific research, innovation and entrepreneurship based on ICT. This is planned to be achieved through the formation of a thorough innovation ecosystem. The major components of the digital ecosystem are: human capital; capacity building and access to markets; funding for innovation; availability of digital technologies; good regulatory environment.

Based on the existing strengths of the ICT sector in Sofia, the strategy points that the main areas of innovation and specialisation in the new digital innovation ecosystem are:

- Technologies of the Future Internet, incl. IoT, wireless sensors, broadband Internet, Cloud technologies, Big Data, and Smart Grid.
- Development and mass integration of applications based on the technologies of the Future Internet, mobile technologies, language technologies (with particular attention on Bulgarian language), data analytics, implementation of ICT applications in the medical and pharmaceutical industries, digitalisation of cultural heritage, and others.
- Electronic infrastructures for experimental digital research and innovation in a diversity of sectors.
- Digital science and e-learning (e.g. Massive Open Online Courses /MOOCs/).
- Digital entrepreneurship.

² “Smart Specialisation Strategy of Sofia”, p. 6 (“Стратегия за интелигентна специализация на София”) https://www.sofia.bg/documents/20182/448750/ISIS_Sofia.pdf/f51fcd5a-2973-4679-89fe-62b3dccb6662

The strategy is also focusing on solving recognised current challenges in the sector:

- Challenges in keeping highly skilled IT specialists in the ICT start-ups in Sofia.
- Not enough developed infrastructure for testing and certification laboratories.
- Need for the development of database of scientific research, which is expecting market realisation.
- Need for use of international and diverse methods for marketing and advertising for attracting investors.
- Need for further development of public-private partnerships in Bulgaria.

The elaboration of the S3 of Sofia has been done with the engagement of government officials, academic experts, representatives from the ICT industry as well as representatives from civil society organisations. The different stakeholders have been involved during the consultation process (i.e. 30 organised events and public discussions). Currently in process of development is a new long-term development strategy for Sofia (named “Vision for Sofia”), which particularly emphasises innovation in the ICT sector. It puts an emphasis on the involvement in the decision-making process of experts from the ICT sector, representatives from the major companies and other relevant stakeholders.

The S3 of Sofia has clearly set goals according to the expected improvements in each of the components of the digital ecosystem, as follows:

- Human Capital:
 - Support for educational institutions in the ICT sector.
- Capacity building and market access:
 - Sofia to be the host of at least one globally recognised annual platform, to which to attract investors, entrepreneurs, government officials, researchers, and inventors.
 - Support for the formation of a centre for excellence in both the ICT and the creative industries.
 - Attracting of leading investors from the sector to invest in R&D
 - Development of scientific and innovation infrastructure.
 - Effective implementation of ICT products in all spheres of social and economic life.
 - Promotion of international collaboration through attracting doctoral students from outside of EU; organisation of international conferences and forums.
 - Creation of centres for innovation which have non-commercial purposes.

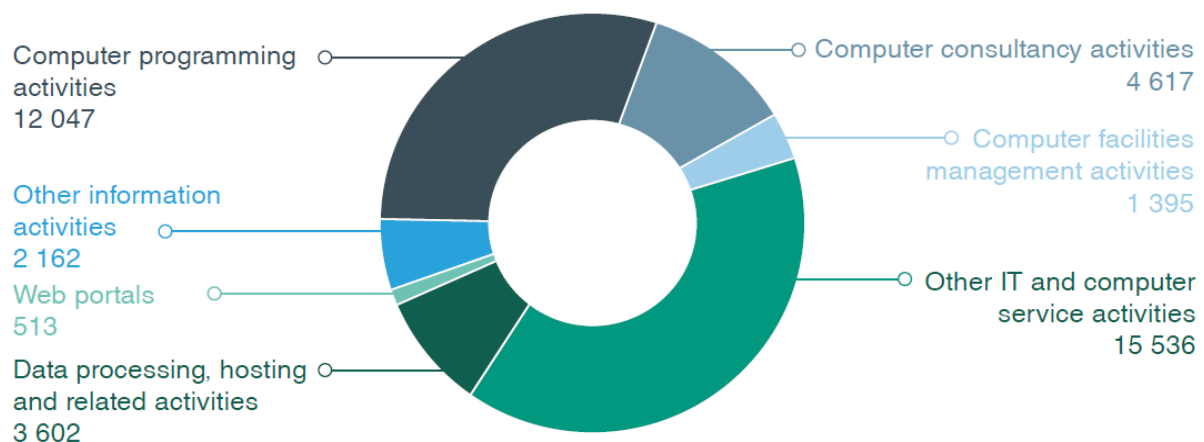
- Financial capital:
 - Establishment of new mechanisms for incubation and financing (particularly in the early stages).
 - Combination of financing with commercial mentoring.
 - Encouragement of international funds for risky capital for investment in Sofia.
- Digital technologies:
 - Development of normative and non-financial stimuli for technological modernisation of the production sector.

In terms of governance and leadership, the S3 is set to be monitored by a Committee for monitoring and evaluation of the innovation potential of Sofia. The Committee is reporting directly to the mayor of Sofia, and consists of government officials, national and international experts in innovation, education, and science. On the other hand, an analysis by the “Vision for Sofia” team on the progress of implementation of the S3 of Sofia indicates that currently there is an absence of reports since the release of the strategy to indicate what progress has been made. This shows that one of the main weaknesses of this current strategy is lack of monitoring on its implementation.

5. Products and services by local ICT companies

Products and services related to outsourcing of IT and business activities are rapidly emerging into a high-promising sector in Sofia. Evidence indicates that in 2016, outsourcing contributed 3.6% in Bulgaria's GDP, and it is estimated that by 2020 this number will climb up to 4.2%. With regards to local production, according to the following figure, it becomes evident that the main products and services offered by local ICT companies include mostly computer-oriented activities, such as programming, consultancy, data processing, hosting, management and other relevant activities (Fig 8).

Figure 8 Distribution of employees in the IT sector in Sofia by type of activity



Source: Sofia Business Guide (2018) and Sofia – State and Development of the IT industry (2017).

A similar picture has been formed during our meeting in Sofia with the local stakeholders, which have highlighted some essential services that are currently being provided by local companies, such as:

- Big data analytics
- Integration of platforms of e-commerce – mobile - security
- Quality engineering
- Cyber security
- Cloud hosting

Digital solutions should be offered also for transportation, decision-making, e-learning to local organisations and government, as well as to markets outside Bulgaria in the field of commerce and B2B solutions.

An essential characteristic of the above-mentioned services is that all of them work complementary to other existing software products. A next step towards strengthening local economic activity would be to promote the production of own software products, instead of outsourcing services, that are placed higher in the global value chain process. To this end, higher complexity and quality of products and services could be achieved by the local companies.

6. Funding for the digital ecosystem of the city

Funding is recognised as an essential challenge for both the local system of innovation (thus the capacity to develop and market new products and services) and the growth of the ICT sector. Currently, most funding for innovation and ICT is provided by the private sector – either own funding from businesses and/or loans from the banking sector. The funding shortage is higher for smaller companies and start-ups which have limited own resources. On the other hand, banks have different policies towards start-ups and incumbent companies in favour of established companies, which can provide guarantees and calculate more accurately funding risks.

Funding for innovation and ICT is provided by private investors and business angels. The Bulgaria Angel Investors lists 24 persons residents in Bulgaria, but many more (2889) are interested in Bulgaria.³ Start-ups can be funded, in return for equity, by the CEO Angels Club, located in Sofia, which is a group of senior executives and entrepreneurs investing their own money in early stage start-ups.⁴ The Bulgarian Association of Business Angels (BABA), an NGO to support and develop the Bulgarian entrepreneurial ecosystem, is active in the EBAN and disseminates best-practices and know-how with the specific needs of the enterprise and business environment in Bulgaria. However, business angels offer limited amounts of money suitable for early-stage business growth only, and overall cannot support efficiently the growth of the ICT sector. Recently, the formation and expansion of the VC community in Sofia has supported more mature start-ups. These VCs include NEVEQ, Black, Peak Capital, Empower Capital, and Rosslyn CP.

Banks do not compete with business angels. In innovative sectors, private funding is more energetic than funding from commercial banks. The latter are reluctant to fund companies with less than 2-3 years on the market. Also, banks demand more guarantees and tangible assets to secure the funding offered.

³ <https://angel.co/bulgaria/investors>

⁴ <https://ceoclub.bg/angels/about-us/about-ceo-angels-club/>

Public funding for innovation, digital infrastructure, and ICT is very limited. Most of digital infrastructure, for instance, wired or mobile, was developed by private companies. No public funding through national funds or EFIS was provided.

All the above show a shortage of funding for innovation and ICT, and the critical priority to address this challenge urgently to accelerate the digital transformation of the city.

7. The state of local digital and physical infrastructure

In terms of digital infrastructure, Sofia is moving fast indicating significant improvements. More specifically, currently there are over 170 free hot spots in city, offering a significant coverage. Some additional details, regarding the existing digital infrastructure, as well as the use of Internet by different household types in Sofia can be found in Figure 9, below.

Figure 9 Existing digital infrastructure in Bulgaria and use of the Internet in Sofia

Data for Bulgaria

96% - 4 Mbps Broadband Adoption (IPv4)



64% - 10 Mbps Broadband Adoption (IPv4)



38% - 15 Mbps Broadband Adoption (IPv4)



Data for Sofia

69.4% of households with Internet access.
Above the national average of 63.5%



75.8% of people aged 16-74 use the Internet



Source: Sofia Business Guide (2018).

Most local stakeholders assess the existing digital infrastructure as efficient and verify its good level. They point out that free Wi-Fi, fibre to the buildings, and competitive prices are some of the key advantages of existing digital infrastructures in Sofia.

Broadband infrastructure was developed by private companies. Mobile phone operators offer cloud-based solutions and communication services by owned networks. They provide fibre-to-the-site and mobile voice and Internet over 3G and 4G networks. In terms of adopting new technologies, such as 5G connection, the market demand is still not very high to justify that type of investments.

There is room for essential improvements, mainly in the field of e-services. For instance, opportunities for e-services exist in the sectors of e-banking, e-commerce, e-distribution and logistics, public transport, and education.

A few initiatives exist in the public sector, while government, security, monitoring, and e-learning services could be offered if there was a demand for such services. Public funding also should be provided by national, local, or EU funds to improve the public digital infrastructure.

Telecom companies have at their disposal enormous amount of data. Such datasets, under regulation, anonymisation, consent for use, may offer opportunities for new services and business development.

The assessment of sectors of the local economy as fields for developing e-services allowed identifying three sectors which represent large potential markets for e-services: (1) government, (2) utility services, and (3) transportation. The markets in the three domains are featured by the key players on their demand and supply sides, specifics of the management and decision-making process in each, and existing or potential new digital products and services to underpin digital transformation.

Government

Key players on the **demand side** are the City of Sofia, Sofia Investment Agency, the City's Urban Planning Dept., State Agency E-Governance (SAEG), commercial enterprises fully or partially owned by the Municipality such as the Metropolitan JSC, Urban Mobility Centre, Green Parks Management (municipality-owned company), end users, etc.

Key players on the **supply side** are primarily companies with their products, e.g. existing or new e-platforms for registries that can be adapted to the city needs and specifics as well as Content Management Systems (CMS) connected to those platforms

The predominant portfolio of administrative services is subject to a digitalisation process that follows a common approach at national level and is led by the State Agency E-Government (SAEG). At Municipal level digitalisation is currently taking place under an initiative for public-private partnership (PPP) for introducing and facilitating e-governance in the municipality, which is implemented with the financial support of the Norway Grants. It is well operational especially in opening municipality-owned data and creating platforms for contacts with and active participation of the citizens, e.g. 'The Citizens' app.

High potential for digitalisation is observed in the area of *education*, primarily kindergartens and schools. The Municipality runs the major platform for application and enrolment in the kindergartens (<https://kg.sofia.bg/isodz/>). However, the platform is not operational in its full capacity and needs important update and development in 2 directions: update of information created by the kindergartens (and incentives for regular updates) and inclusion of payment options into the system. Schools are not covered by this system, which is another big gap to be addressed. Further areas for optimisation via digitalisation are *cultural offering and tourism, ecology (parks, rivers, forests), urban planning, local taxation*.

Healthcare is another area demanding digitalisation, yet it is important to take into account the level at which this area is managed. Even though some hospitals receive funding from the municipality, the digitisation of the health sector likewise follows a common approach at national level, led by the National Health Insurance Fund (NHIF), i.e. leadership is not at municipal level. Currently, an “e-health personal dossier” is being developed and expected to be introduced in the whole health sector by 2019. The main projects are part of the E-Governance roadmap, maintained by the Council of Ministers (CM).

Utilities

When tackling this domain, it is important to consider that the energy and water systems management are closely linked to the urban planning and urban development activities of the City, the latter falling in the above domain of ‘Government’.

Key players on the **demand side** are the City, Water Company Sofi, Ulichno Osvetlenie JSC (Street Lights Company), Heating Sofia JSC.

Key element of the **supply** side in the *energy sub-domain* is the ‘smart meter’ system. Introducing it into its full capacity (usage, monitoring, data collection, etc.) is a slow process related to changing the ‘mindset’ of the national Regulator and the Municipality, i.e. have understanding that investing in smart metering and digitalisation is as important as investing in renewal of pipes. Furthermore, changing the mindset of end-users is another challenge where promotion and explanation of the benefits of ‘smart metering’ is to be made as wide as possible. The GIS software for prediction, monitoring, and analysis is another important element of the supply side. In the *water subdomain* digitalisation at the level of the Sofia municipality could be made with regards to the flow analysis (leakages, etc.) and have it combined with prediction modalities, as well as have it to the ‘green city’ development of Sofia.

While devising digitalisation actions a number of prerequisites are needed to ensure its future efficiency and avoid fragmentation. It is ‘a must’ to have the physical infrastructure development and the digital services infrastructure development go ‘hand-in-hand’ and be made coherent, complementary and compatible. Access to the different systems of energy, electricity and water needs to be in place. End-users are to be offered incentives, with ‘return on investment’ being only one among many others. E-platforms need to address the entire energy mix. Developing the proper business model in this domain is of crucial importance for the process of digital transformation.

Transport

Key players on the transport **demand side** of the market are all providers of public and private services in the transport domain. A key milestone is finding ways of encouraging people to use alternative (to cars) means of transport – by offering services and creating a transport system allowing for using public transport or other alternative types of transport as efficiently or even more efficiently than own cars.

The digitalisation of this market and its overall optimisation requires solutions that measure the integrated traffic flow with all its elements and aspects such as traffic intensity, public transport vehicles, cars, emissions, ‘smart’ parking, ‘smart’ drive-way, etc. Measurements of the vehicles usage show that 95% of the time vehicles stay unused (stay in one place) while only 5% of the time they are mobile/used. Services that enable one’s movement optimal across an area by combining different types of transport have to be introduced. Traffic lights need to be dramatically optimised via digitalised management and services. Efficient management would also require continuous monitoring and data sourcing, e.g. analytical data from the e-ticketing system. Last but not least, all digitalisation measures need to go ‘hand-in-hand’ with measuring user satisfaction of the different types of support services.

The **supply side** is featured by providers of typical optimisation measures such as parking-sharing, vehicle-sharing (car-sharing but also bike-sharing), car-pooling, etc. Currently traffic-monitoring and other digital services are very few, quite fragmented and mainly community-driven, i.e. bottom-up. An example is the ‘Move it’ app, which is insufficient to fill in the gap in its own niche and has room for further expansion, e.g. becoming compatible with Google Maps.

Digitalisation in this domain should go along three main pillars: (i) infrastructure, e.g. air pollution sensors, parking sensors, traffic sensors, control systems, public-private interaction between the City managing traffic lights and private companies providing solutions to both end-users and public authorities; (ii) e-platforms for monitoring and open data on the basis of which private ICT companies can offer solutions, and (iii) proper business models, e.g. on public transport pricing based on indicators such as usage, pollution, etc.

8. Public e-services and digital solutions enabling the business environment

Investment in public e-services has been a central part of digital transformation strategy of Sofia. During the last years, there have been serious efforts in cooperation with the private sector to improve existing digital services. It is interesting to notice that there are already 44 e-services related to public administration, that have been uploaded on the portals of local authorities. Most of the provided services are relevant to companies' needs and offer a user-friendly environment for them. Additional services will be developed in the forthcoming years. Overall, about 250 e-services could be offered by the Municipality. A central Portal should be designed to host all these services.

There are still many steps to be made in Sofia, towards acquiring an efficient and sustainable e-governance infrastructure.

- First, there is a gap of digital skills in the administration level, and digital infrastructure within the Municipality.
- Second, a lot of effort is needed for the digitalisation of the existing archives, that demands time, effort and funding from the local authorities. Datasets could be provided to citizens and businesses.
- Additional effort should be offered by local authorities to promote these services to citizens and companies, trying to change their current mindset towards using online services. This is the most important part for achieving sustainability of this transition to digital services.

Digital solutions could be implemented in many domains. Among those referred in the interviews are those of smart public lighting, waste collection, water management and leakage, traffic management and e-ticket, air quality and air pollution monitoring. Also, e-gov. services, such as construction permit, and public procurement. There is need to improve the connectivity broadband and transportation, with suburbs and villages around Sofia. This will enable the provision of online services to a wider population, decentralisation / living of people in less polluted areas.

All the above demand higher levels of funding, and EU funding should be used towards these directions. According to local authority staff, lack of funding is one of the main obstacles that public authorities encounter throughout this transition process. At the same time, local stakeholders highlight the fact that investing in e-governance is a crucial parameter that could result in less bureaucracy, thus enabling companies to save time and effort. Easier access to services for citizens and payments are two of the most essential characteristics that were pointed out, during our meetings with local stakeholders.

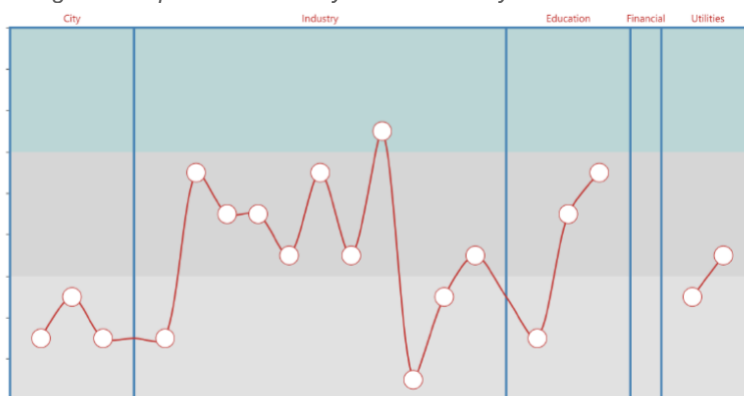
In general, public e-governance should be driven by citizens' and companies' needs. To this end, smart infrastructures in transportation and waste management were mentioned as two important areas of intervention that could be useful for citizens and at the same time could create opportunities for new business.

9. Data-driven innovation

Open data infrastructures are still on a preliminary level in the case of Sofia. There is a lack of trust and transparency between companies and the public sector in relation to open data policies. Data availability is still very restricted, as the access is not very easy, and someone must pay to get data from the government. In many cases, data is not standardised or given in machine readable format (excel, csv). So, it is difficult to work with them. To this end, a change in the existing mindset is essential, towards the creation and use of open data.

Significant progress has been made with the opening of data portal (<https://opendata.government.bg/>). It is a central web-based public information system that allows publishing and management of reusable information in an open, machine-readable format. Data are freely available and can be used for commercial or non-commercial purposes, as well as for applications development based on them. There are currently over 1700 datasets from about 50 national and regional administrations and agencies, and the system supports a variety of formats. The records include data on public procurement, the education system, healthcare facilities, regional public transport facilities, transport data, lists of schools and kindergartens, information about air pollution, registers of employment agencies, public non-profit organisations (European Commission, 2018).

Figure 10 Open data maturity assessment by stakeholders of Sofia



In the interviews we identified some areas in which open data could provide solutions, such as mobility management, waste management, air quality and pollution. These areas constitute fields where smart infrastructures, such as sensors, wireless connection and mobile applications, could have a twofold effect. On the one hand, they could positively affect quality-

of-life through management improvements. On the other hand, they could provide extremely useful datasets to local authorities and academics. By using data, authorities could develop solutions leading to a more effective strategic planning for Sofia.

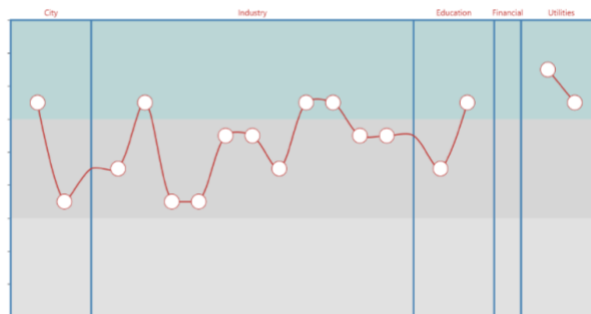
In general, access to public and private data, always following the new GDPR privacy framework, might be an effective way to create new services offered by the local businesses. Until now, existing datasets are mostly used for internal purposes for building customer profiles. Therefore, the promotion of an open data culture might work as a facilitator towards enabling interactions between companies in Sofia, and thus, innovative interventions could emerge through this type of collaboration and knowledge exchange.

10. Skills and entrepreneurial culture

According to local stakeholders, existing digital skills in the city of Sofia are at mid to high level (Fig 11). Most demanded are skills related to data analytics, computational analysis and software engineering. These areas concentrate the highest demand by ICT companies.

Figure 11 Digital skills in Bulgaria and assessment of digital skillset of Sofia

	Bulgaria				EU DESI 2017 value
	DESI 2017		DESI 2016		
	value	rank	value	rank	
2a1 Internet Users % individuals	58% 2016	↑ 27	55% 2015	27	79% 2016
2a2 At Least Basic Digital Skills % individuals	26% 2016	↓ 28	31% 2015	27	56% 2016
2b1 ICT Specialists⁹ % of employed individuals	2,3% 2015	↑ 22	1,9% 2014	25	3,5% 2015
2b2 STEM Graduates Per 1000 individuals (aged 20-29)	14 2014	→ 22	14 2013	22	19 2014











The share of ICT specialists in the workforce is rising. However, the number of STEM (science, technology and mathematics) graduates remained the same (1.4% of graduates) posing some risks for Bulgaria's capacity to fulfil increased demand for ICT skilled specialists.









Most of the digital skills are being developed in Sofia by higher education institutions and universities. Sofia hosts 23 out of 51 universities of Bulgaria. Among them, 8 universities offer IT, engineering, mathematics, economics, and business-related majors. At the same time, there is an emerging trend of company-driven training in fields of programming, under private academies. Over 10 private software academies offer educational programmes (6-18 months) in programming, web design, data management. Local stakeholders have highlighted that despite the education offered to students by local universities and private academies there is still room for improvements of digital skills and mainly the mindset towards learning, which is more important than learning itself.

Although there is a great supply of digital skills in Sofia, there seems to be a lack of highly experienced software engineers, with specialisation in specific sectors of the ICT market. Both the banking and the data analytics sector are experiencing difficulties in finding highly experienced employees, due to the lack of highly specialised candidates. According to the local stakeholders, the most demanded types of jobs in Sofia include (1) software engineers, (2) data scientists and analysts, and (3) java developers.

Despite investments being made towards strengthening the digital skills of the local labour market, there seems to be a lack of entrepreneurial culture in Sofia, specifically among the youngest working population. The rising number of start-ups does not seem to go hand in hand with the entrepreneurial skills of the local actors, leading to lower effectiveness in terms of producing sustainable start-ups and SMEs. Additional effort towards strengthening that type of skills could lead to positive effects on the overall business environment of Sofia.

11. Digital transformation SWOT analysis

	Strengths	Weaknesses
 Infrastructure	<ul style="list-style-type: none"> > Extended FTTH network at housing & businesses > Extended 4G network 	<ul style="list-style-type: none"> > Very limited coverage of public spaces by Wi-Fi, around 100 hotspots in the entire city
 Access to data	<ul style="list-style-type: none"> > No strengths in any domain of data access 	<ul style="list-style-type: none"> > Low Open Data awareness and culture > A few Open Data repositories and data centres > Low public engagement and policy
 Digital skillset	<ul style="list-style-type: none"> > Strong interest of young people in digital subjects > Additional education and training in digital skills are provided by the IT sector 	<ul style="list-style-type: none"> > Digital skills in non-digital sectors are limited
 Companies' digital competencies	<ul style="list-style-type: none"> > High use of digital processes in companies driven by senior management 	<ul style="list-style-type: none"> > Limited awareness for industry 4.0 concepts > Limited access to local IT solution providers > Rather limited use of cybersecurity solutions and privacy measures by companies
 Community	<ul style="list-style-type: none"> > Strong IT tech-community in the city > Frequent networking events for digital companies organised 	<ul style="list-style-type: none"> > Low collaboration amongst digital and non-digital stakeholders > Low networking between digital and non-digital companies
 Finance	<ul style="list-style-type: none"> > Strong business angels community providing equity capital to IT companies > Larger VC funds started operation 	<ul style="list-style-type: none"> > Limited funding is available by banks in all areas of finance > Limited bank loans to digital companies. > Non-existent VC funding by banks
 Support services	<ul style="list-style-type: none"> > No strengths in any domain of support services, apart incubators and accelerators 	<ul style="list-style-type: none"> > Low offer of intermediary tech support such as innovation labs, accelerators, fablabs, citylabs, for digital and non-digital companies
 Governance & leadership	<ul style="list-style-type: none"> > No particular strengths in any domain of gov and leadership 	<ul style="list-style-type: none"> > Stakeholders do not share a common vision on digital development > No single authority for planning and implementation of a digital development plan

	Opportunities	Threats
	Infrastructure > Nothing identified	> Nothing identified
	Access to data > Nothing identified	> The mindset towards the open data culture and participatory governance > Silos of data creation and management in the public administration
	Digital skillset > Training and professional expertise to be offered by the private sector and IT companies	> The public interference to digital education
	Companies' digital competencies > Nothing identified	> The public interference in digital competencies > Trends towards strong public regulation > Eventual barriers in public procurement of IT services
	Community > Platform-oriented growth > Creation of communities of practice in IT related domains	> Low connectivity between digital and non-digital sectors > Somehow isolated IT community from the other economic sectors of the city
	Finance > Funding from ESIF / structural funds > Interconnection between public and private funding > Use of funds available in the S3 strategy	> Most serious threat is bureaucracy > Funding for IT companies should not be managed by public authorities
	Support services > A virgin domain for the provision of support services and various types of city-based labs	> City-labs and intermediary support services to be offer in the sphere of the public domain
	Governance & leadership > There are many opportunities for e-government and e-services based on sound business processes	> Provision of governance and leadership by business as usual procedures > Barriers created by silos in the public administration

Appendix I: Table of abbreviations and definitions

Digital Cities Challenge (DCC)

The Digital Cities Challenge initiative, was launched by the European Commission in November 2017 and scheduled to run until August 2018. It helps cities (The Digital Cities, referred as DC) develop and implement digital policies that can transform day to day life for residents, businesses, workers, and entrepreneurs.

Digital City Teams (DCT)

Each participating Digital City has a Digital City Team which will be in charge of managing and coordinating the involvement of the city in the Challenge. Digital City teams will include a) the core team which consists of one Lead Expert, one Local Expert, one Support Consultant as well as Thematic Experts; and the b) the Digital City leadership team which is made up of representatives of the city (i.e. local elected officials, local public servants, and the designated project management team).

Digital Transformation Trajectory (DTT)

The Digital Transformation Trajectory refers to the evolutionary path a city follows while taking part in the initiative, from the preliminary assessment of the digital potential of the City, to the definition of the City's digital transformation strategy and roadmap.

Field Advisory Services (FAS)

Field Advisory Services are services provided by the Digital Cities Challenge to Cities throughout the duration of the initiative. The Field Advisory Services include the organisation of one assessment visit and a number of local workshops, which will gather local stakeholders involved in defining the digital transformation strategy of the City.

Key Performance Indicators (KPIs)

The objective of the KPIs is to collect data that can diagnose the current status in terms of digital maturity and measure the progress made by cities during and at the end of the Digital Cities Challenge initiative. The KPIs will facilitate the activities of the policy makers and stakeholders of cities when identifying and addressing the bottlenecks and obstacles of the

processes of digital transformation and industrial modernisation. They will also enable the right identification of the key success factors of the different initiatives and actions undertaken.

Self-Assessment Tool (SAT)

The objective of the SAT is to identify the starting points for discussion on how to (further) develop, reshape and improve the digital transformation strategies of European cities. It is an online-tool developed by the project with a set of questions and corresponding response options to be filled in collectively by a set of stakeholders such as industry representation, utility companies, education and research and financial institutions. The SAT covers eight key dimensions: Infrastructure, Open data, Digital skillset, Digital competencies of companies, Community, Finance, Support services, Governance and leadership.

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