

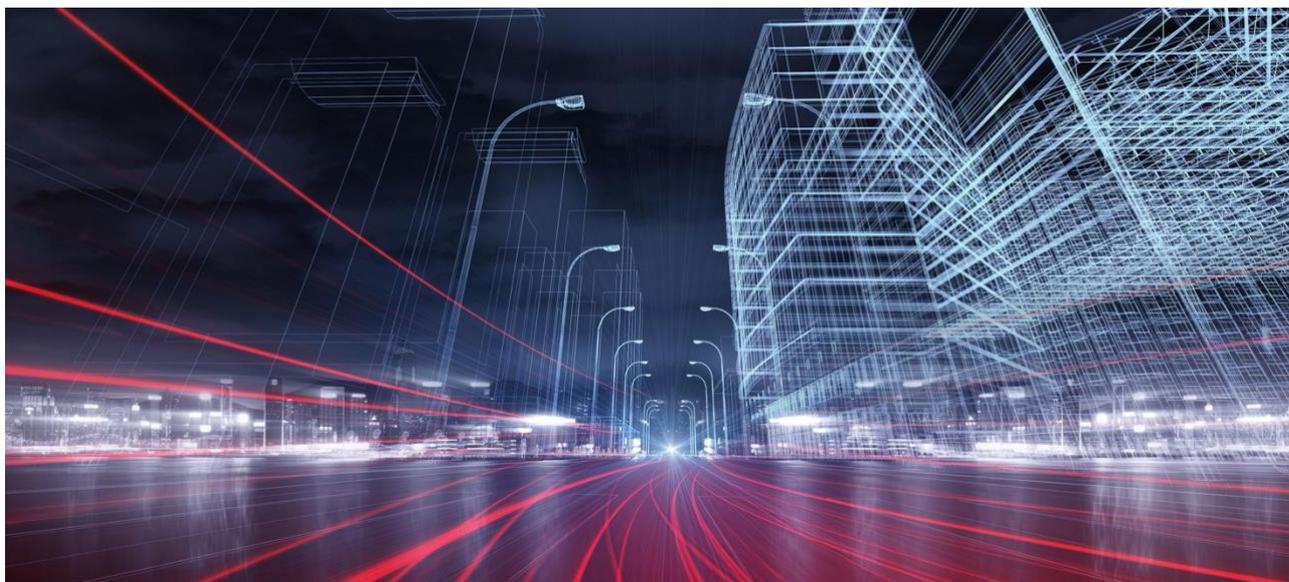


DIGITAL CITIES CHALLENGE

Assessment report for the city of Thessaloniki

A living lab for digitalisation

July 2019



Digital Cities Challenge

Assessment report for the city of Thessaloniki

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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 delivered in the Thessaloniki. 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 between February and March. A total of 41 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 21 to 23 April.
- A vision and ambition workshop which took place on 10 May.

This document represents the key input to the work performed during the subsequent phases of the digital transformation trajectory (i.e. definition of the city strategy and roadmap).

2. Key sectors of the local economy and DCC focus

The **main economic activities** in the 11 municipalities of the metropolitan area of Thessaloniki are trade, transport and tourism. In 2015 they represented 30% of the value added of the private sector, while real estate represented 21% and manufacturing 19%.¹ Manufacturing activities are located outside of the municipality of Thessaloniki and at the edge of the metropolitan area. The **main manufacturing sectors** of the Metropolitan area are agri-food, garment, which is continuously declining, and construction materials still in recession as a result of the recent crisis.

Within the boundaries of the municipality of Thessaloniki, the main activities are trade, transport and tourism with most of the manufacturing playing a marginal role.

The most relevant sectors are briefly discussed below, together with the key features of the ICT sector which has an important role to play in the digital transformation of the city.

Tourism

The value chain of tourism industry cross-cuts the boundaries of several sectors and economic activities including accommodation, travel agencies, catering and agri-food, entertainment, cultural activities, and transport. Tourism in the metropolitan area of Thessaloniki is experiencing a steady growth over the years fuelled by the increase of tourists from abroad. The number of overnight stays in 2017 increased by 2.7% compared to 2016 while the revenue per room increased by 9.2%, much higher than the rise in the average price of a room which was 5.8%.² Digital technologies are well spread among the hotels, although mainly in mature applications such as the promotion through websites and booking. At the same time applications focusing on the enhancement of tourist experience are already spreading. Currently, the Apple App store hosts 45 applications explicitly developed for Thessaloniki out of which 24 are related to tourism (mainly events, guides, visits routes, and booking). Despite

¹ Eurostat, database met_10r_3gva

² GBR Consulting, <http://www.reporter.gr/Eidhseis/Epicheirhseis/toyrismos/346185-Anebainei-o-toyrismos-sth-Thessalonikh-H-«aktinografia»-twn-episkeptwn>

the progress, a more comprehensive strategy covering all stages of the value chain is still missing.

Transport and Logistics

Thessaloniki hosts the second biggest port of Greece. It is expected that the modernisation of the port and the future investments, as a result of the recent change of the ownership, will increase its economic significance for the city. The ambition of the new management is the port of Thessaloniki to become smart and a major player for transport and logistics in the Mediterranean area and Southeast Europe.³ The strategic objectives are to significantly increase the transport of containers and conventional cargo, passengers and cruise activity⁴ with significant impact on tourism and trade activities in the city.

The tourism and trade activity in the city and the existence of the port give particular importance to transport and logistics while at the same time bring significant challenges. Most of the freight and tourist trips take place in the city centre and surrounding areas with buses and trucks. The system has been saturated, and the expected growth of the port will exacerbate the problem with adverse effects on the economy and quality of life. The electrification and exploitation of digital technologies from the port, logistics companies, commercial and tourism businesses and the Municipality, for the organisation of trafficking, can be a solution to the problem.

ICT

The ICT sector represented 4% of the value added of the private sector in the Metropolitan area of Thessaloniki in 2015.⁵ The sector proved to be resilient during the crisis period and now is attracting a growing number of start-ups and export-oriented enterprises. The metropolitan area of Thessaloniki has more than 260 ICT companies employing over 7,000 employees. As it was stressed during the interviews with entrepreneurs from the ICT sector, the local market is small, and it does not allow the specialisation of the local ICT companies and the production of competitive products that can be exported in other markets. Most ICT companies offer mature services (websites, social media management) and customisation of mature products, e.g. Customer Relationship Management, Enterprise Resource Planning, e-invoicing exploiting the advantage of local presence. A growing market is the applications for

³ Press release <http://bit.ly/2l51vld>

⁴ Press release about the master plan of the port
http://www.thpa.gr/index.php?option=com_content&view=article&id=1666&Itemid=1361&lang=el

⁵ Eurostat, database met_10r_3gva

the public administration (G2B and G2C). Other market segments served by local companies are applications for tourism, culture, transport and logistics, health and agrifood.⁶ Specialisation in selected globally emerging markets, where a local market can be developed, will allow local ICT companies to experiment before they enter the global markets.

Agri-food

Among the three main manufacturing activities, the agri-food sector seems to be the most relevant to the economy of the Municipality due to its strong links with tourism and trade and the existence of dynamic higher education faculties in the area.⁷ Recently the sector has attracted the attention of some local ICT companies which have been successful in developing applications for precision agriculture.

Due to their significance for the economic growth of the metropolitan area and the municipality of Thessaloniki in particular, the digitalisation efforts will focus **on tourism, transport/logistics, and ICT**. Agri-food activities that are part of the value chain of tourism and transport could be potentially included.

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

The city of Thessaloniki is on the path of digital transformation, achieving an overall maturity score of 2 out of 4 according to the assessment of 41 stakeholders who participated in the Self-Assessment exercise during the period February-March 2018.

⁶ Prefecture of Central Macedonia (2014), The strategy of Smart Specialisation (RIS3) of the Region of Central Macedonia.

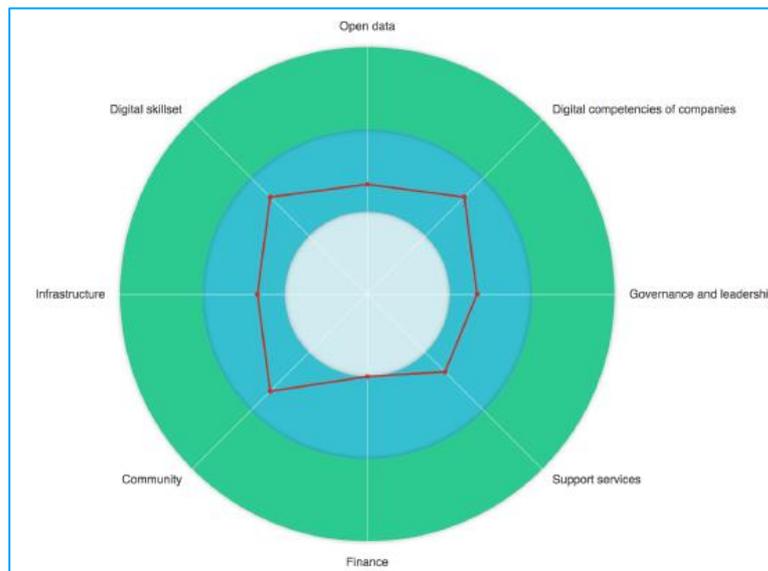
⁷ Department of Agriculture and Veterinary School of Aristotle University of Thessaloniki and the Americal Farm School.

Figure 1 Self Assessment Tool overall result



The current chapter provides a snapshot of the strength and weaknesses of the city of Thessaloniki while a more detailed account can be found in the chapter that follows.

Figure 2 City stakeholder average assessment by dimension

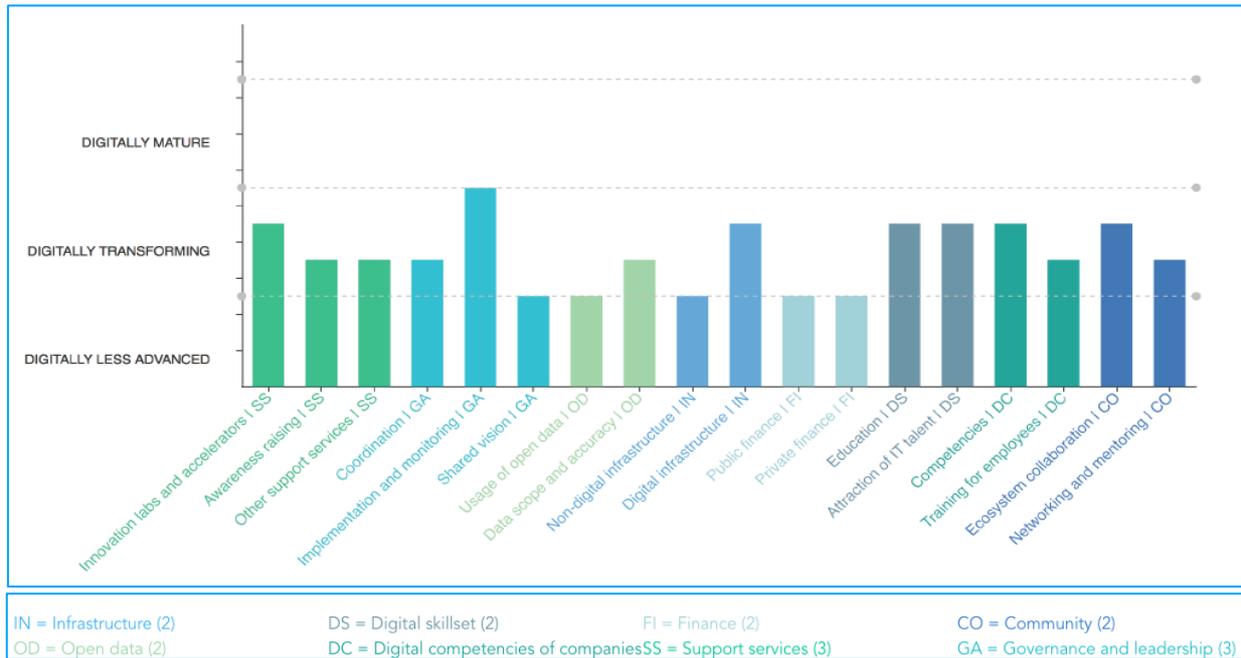


As shown in **Error! Reference source not found.**, the relative **strengths of the City** are the presence of a vibrant digital community, the existence of a skilled workforce and the digital competences of companies.

According to Figure 3 which provides a more detailed picture of each of the dimensions, the strengths of the **digital community** relies on the presence of the elements of a digital ecosystem in the city, although the connections among them and the networking are still less developed. Regarding the dimension of the **skilled workforce**, both its elements (see Figure 3) are among the highly rated. Although during the interviews the quality of the education was assessed as high, the score it received in SAT is medium reflecting the gaps in the availability of some skills and knowledge in some cutting-edge areas. The rating of the ability of local companies to attract talents refers mainly to the ICT companies. The medium score is due to the significant brain drain and the low attractiveness of the local companies compared to

international competitors, at it has been reported in the interviews. Finally, the score of the **digital competences** reflects more the existence of a dynamic ICT sector rather than the competences in the non-digital sector. The rather low level of digital skills in the non-digital sector is supported by statistics and was also confirmed by interviews. The main drawback in this dimension is the training on ICT provided by companies to their employees.

Figure 3 City stakeholder average assessment by sub-dimension



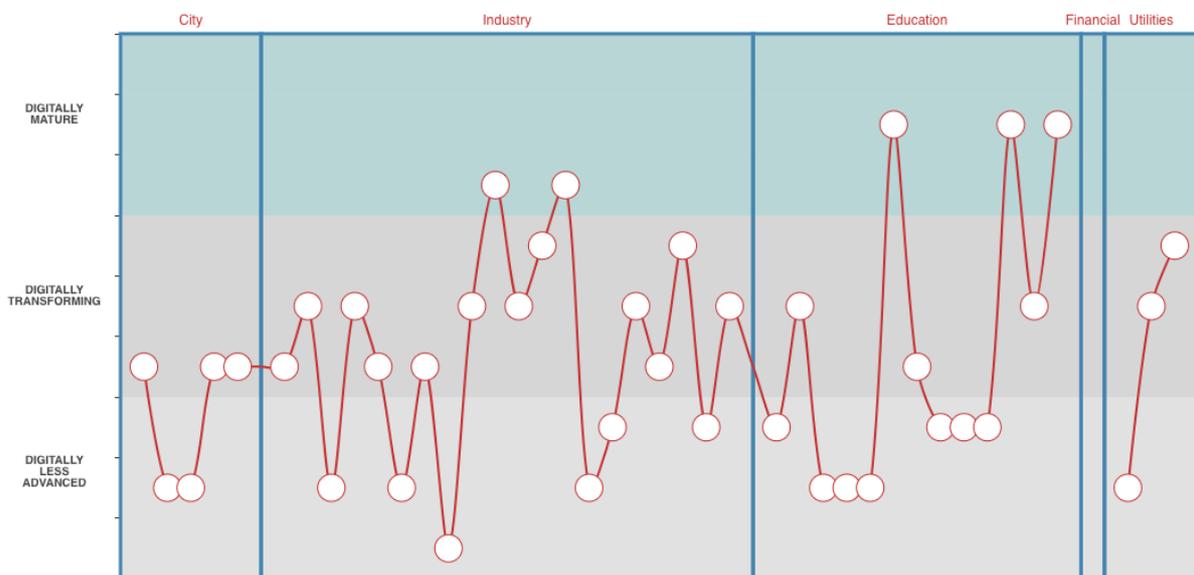
According to **Error! Reference source not found. 2Error! Reference source not found.**, the **major weakness** of the city is the **access to finance** which reflects the tight public budget and the unfavourable conditions for bank loans available to companies.

Governance, infrastructure, support services and open data are in the **middle**. For the **governance and leadership** dimension, the main strength is the existence of a plan for the implementation and monitoring of the digitalisation strategy which however is hindered by the low coordination and the lack of a shared vision among all stakeholders. For the **support services**, the main strength is the existence of innovation labs in the Aristotle’s University, three coworking spaces, four incubators and the OK!Thess, a very dynamic pre-incubator which provides most of the dealflow to the next phases of support. However, there are significant opportunities for improvements by increasing the portfolio and the depth of the support services. Despite the efforts of the city for the **opening of data**, the limited use of the data due to the use of nonstandard formats and the unsatisfactory quality, gave a relatively low score in this area. Finally, the quality of the **infrastructure** is continuously improved,

although the digital infrastructure is still lagging behind the digitally mature cities especially concerning the speed and cost, while the digitalisation of non-digital infrastructures is very low.

As it is illustrated in Figure 4, there is variability between the four types of stakeholders — city, industry, education and utilities — that replied to the SAT. The responses from industry are concentrated in the middle recognising the progress that has been made, while a smaller but still high portion adopts a rather pessimistic view. It is interesting to see that some of the companies assess the level of digitalisation as mature. However, this mainly reflects the opinion of ICT companies. Academics retain a more optimistic view. They have access to high-quality infrastructure and are at the centre of several of the initiatives that are taking place in the city and therefore they have a good understanding of the technical progress in the city. However, their view does not necessarily reflect the progress in the digitalisation of the local economy.

Figure 4 Individual city stakeholder replies by stakeholder type (city, industry, education, Financial, Utilities)



Notes: the points represent individual stakeholders by stakeholder type; the graph positions the replies of individual stakeholders by the level of digital maturity distinguishable by the three colour shades; Financial stakeholders have not replied to the SAT.

3.2. Key Performance Indicators

Data collection at the level of the city (at the municipality of Thessaloniki or the metropolitan area which is comprised of 11 municipalities) is challenging. Official statistics are not available at the level of the city, while statistics at the level of the region are scarce or outdated. The information that is necessary for several of the KPIs either is not collected and logged at the source, or the collection requires human resources that are not available in the administration and significant time.

The same is true for the KPIs at the level of the mission statements which will be used for the monitoring framework.

The KPIs for the **digital infrastructure** confirm the SAT rate of Thessaloniki as digitally transforming city. 87.6% of households (KP3) have internet at home, but only 67.2% of them have broadband access (KP1) with an average speed of 15.5 MBps (KP4) which is not sufficient for bandwidth demanding applications. The city coverage by 4G is 100% and the indoor coverage 82.8% (KP7). However, only 50% of people use mobile internet to go online (KPI6). Also, there are no intelligent sensors in the city (such as Low Power Wide Area Networks for the connectivity of devices) (KPI9).

The progress in **non-digital infrastructure** is slower than in digital infrastructure. Fibre network is available at the main business parks (KPI15). An integrated mobility platform to travel across transport modes (KP11) is available but with essential functionalities, and there is no real-time transport monitoring system (KPI12). Although there is progress in the digitalisation of the public transport system (buses), it is not yet possible to buy tickets online (KP13). Utilities do not provide a one-stop shop for water, gas, electricity for addressing changes in users profiles (KP14).

Open datasets are available (KPI18), however digital or non-digital companies use open data to develop new services or to support their business operation (KPI21 and KPI22).

In the area of **digital skillset and education**, the local educational system offers a steady flow of ICT graduates; the students in digital subjects represent the 6% of all students over the last five years (KPI24).

Development of mobile applications is among the **digital competencies of companies**. Currently, the existing mobile applications amount to 45 (KPI34).

Although no business angels are based in Thessaloniki, start-ups have access to business angels (KPI46).

Support services are well developed regarding quantity including eight innovation labs and incubators (four incubators, one pre-incubator, and three innovation labs) (KPI47).

There is significant room for improvement in the area of **governance and leadership**. The city has a digital strategy (KPI51). There is also a monitoring framework for the implementation of the digital city strategy (KPI54). However, no executive in the city administration is responsible for the implementation of the digital strategy (KPI52).

4. The local digital ecosystem: leadership and governance

The last few years the municipality of Thessaloniki has made efforts to develop a shared vision for the future of the city bringing together citizens, the academic community, businesses and communities across the municipalities of the metropolitan area of Thessaloniki.

In 2014 Thessaloniki joined the 100 Resilient Cities initiative pioneered by the Rockefeller Foundation. The initiative aims at developing a vision and a resilience strategy for Thessaloniki (Thessaloniki 2030) to co-create a more dynamic, inclusive and sustainable city on the horizon 2030. The design of the strategy was the result of a broad consultation between the public and the stakeholders of the metropolitan area of Thessaloniki.

Following the broader strategy of Thessaloniki 2030, the city continued with the design of the digital strategy of Thessaloniki in 2017. The development of the strategy was a participatory process tapping on existing alliances and partnerships of the city and main local stakeholders which contributed either at an ad-hoc base or in a structured manner as part of the working teams. Examples of partners at the national scale were the Greek chapter of the Open Knowledge Foundation, the city of Heraklion and the city of Athens, the Infostrag research team from the National Technical University of Athens, the Greek Free and Open Source Society and the Hellenic Association of Mobile Application Companies. At the city level the academic and business community represented mainly by the Aristotle University of Thessaloniki, the University of Macedonia and the Association of Information Technology companies in Northern Greece played an instrumental role on the formulation of the strategy. The primary objective of the strategy is the transformation of the city into an integrated, open and participatory platform by taking actions along five pillars:

- Development of the necessary digital infrastructures (e.g. broadband internet, wi-fi hot-spots, networks of sensors),
- Reduction of the digital divide by life-long learning and training,
- Opening of data,
- Increase the participation of citizens and
- Support entrepreneurship and innovation.

The strategy includes a roadmap with specific milestones and key performance indicators for the monitoring. The strategy will be updated every five years in 2020, 2025 and 2030. The primary measurable goals include the level of awareness and skills of the employees in the city administration and of the general public, the growth of use of the services by the citizens, the opening of data, the development of services supporting entrepreneurship, the reduction of the operating cost of the city administration and the increase of the ICT use in future projects.

Despite the clear goals and targets, the implementation of the strategy has been delayed as an organisational scheme to push forward the implementation is not yet in place, and the necessary budget has not been secured yet. Although the strategy was a collective work, the objectives, the expected changes and the envisaged impact have not been widely communicated, and therefore the awareness of the citizens is low.

5. The use of digital solutions by local companies

Despite the access of companies to ICT solutions and expertise which is similar to digitally mature cities (score 7.1 see **Error! Reference source not found.**), the level of sophistication of demand and the role of the management in the digitalisation of companies (scores between 3.9 and 5.3) reflect a less digitally advanced or digitally transforming city.⁸ Therefore, the level of digital competencies of the local companies is one of the significant challenges that should be addressed during the journey of the digital transformation of the city.

According to a survey⁹ implemented in 2012, the digitalisation of companies in the region of Central Macedonia and the characteristics of demand for ICT services and products are comparable to the national average. During the recent interviews with stakeholders, ICT companies and experts confirmed that this is still the case and the pattern of diffusion of digital technologies in Thessaloniki is comparable to the national average.

⁸ The use of cybersecurity and the embracing of manufacturing 4.0 by manufacturing companies are indications of sophistication of demand.

⁹ According to the survey of KTP SA <http://icteval.ktpae.gr/stats/delivery/#> the performance of the Central Macedonia Region is very close to the country average for all the indicators regarding the penetration and use of digital technologies and dservices.

Therefore, due to the lack of more recent statistics for the region or the city, national statistics which provide data for 2017 will be used instead.

Figure 5 SAT scores related to the digital competences of the companies in Thessaloniki



According to the Digital Economy and Society Index (DESI) for 2017, the digitalisation of Greek companies significantly lags behind the European average. Based on the measurement of several parameters such as broadband penetration, the frequency of internet usage, use of e-commerce and e-procurement, Greece is ranked 26th among the 28 EU Member States.

In terms of the digital intensity, the country is at the 24th position with the main drawbacks being the low use of e-invoices (6.5%), the low e-commerce turnover of SMEs which amounts to 3.4% of their total turnover compared to the EU average of 10.3%, the share of SMEs selling online cross-border which is 6.6% compared to EU average of 8.4%. Also, the share of companies using cloud services has been stagnated at a low level of 5.5%. On the positive side, 37% of the companies are sharing information online compared to the EU average of 34%, and they use social media as much as on average in the EU (21 %).

One of the obstacles to the adoption of digital technologies by local companies is the relatively low absorptive capacity of the companies. According to DESI for 2017, Greece is ranked 26th among the EU Member States on digital skills. The low performance could be the result, among other reasons, of the insufficient training within companies as it is suggested by the score in the SAT (score 4). During the interviews, it was also pointed out that the provided education and training in ICT in the primary and secondary education is insufficient and the education methods used outdated.

The investment and absorption of digital technologies vary across sectors. As it was mentioned in the interviews, the most common applications and services requested by companies are ERP, CRM, social media, web pages and electronic invoicing.

Digital strategies in the tourism sector are increasingly based on online presence, differentiation and reputation. Therefore, companies related to tourism invest relatively more than other sectors on websites, presence in multimedia and selling online. However, these somewhat standard and mature approaches do not harness all the potential offered by digitalisation. An increasing number of hotels and tourism companies around the globe are using mobile apps for creating new experiences for their customers and exploring new business models. Although the tourism-related mobile applications specific to Thessaloniki are increasing (mainly guides and events applications), the use of mobile applications by hotels is insufficient. Out of the 24 mobile apps in the Apple App store for tourism, only five are applications for hotels.

In the trade sector, the use of e-commerce is still limited while advanced e-marketing applications and services using geolocation for segmenting and targeting audience are still not used.¹⁰

In transport and logistics, there is an increasing number of applications for the tracking and management of cargo, vehicles as well as the whole supply chain. However, only a small fraction of the transport and trade companies use them.¹¹ The port of Thessaloniki has already digitised main operations related to the monitoring of cargo and ships, while new investments aiming at transforming it to a smart port are planned.

Digital technologies affect the whole value chain of the agrifood sector. Precision agriculture could increase the productivity of crops and the quality of produce. Recently, start-ups from Thessaloniki successfully entered this market developing both hardware and software solutions. IoT and smart packaging allow the monitoring of raw goods and processed products all the way through the value chain, increasing safety and quality. At the retail end of the value chain, e-business connect food producers directly with customers as the direct purchases from the producers became a consumer value in itself.

Although existing companies are embracing the digital technologies rather slowly, according to the interviews with local experts, most of the start-ups are either digital, or their products and business models rely on digital technologies. Several initiatives have been undertaken by local stakeholders including the city of Thessaloniki, the Region of Central Macedonia, the local universities and business associations to create infrastructure supporting

¹⁰ The conclusion is based on the information provided by experts during the interviews.

¹¹ Ibid

entrepreneurship and start-ups such as the pre-incubator OKThess, the incubators i4G and Thermi, the business park and incubator Technopolis Thessaloniki, which hosts digital companies, and the Technological Park of Thessaloniki.

Co-working spaces are available in Thessaloniki (e.g. in OKThess). However, infrastructures for experimentation and prototyping, e.g. fab labs are lacking.

Access to finance remains an issue for companies and the local authorities. There is a positive experience in attracting seed or Venture Capital funding by start-ups through the OKThess. However, the terms for bank lending are not attractive for business investments, including those for ICT.

Due to the absence of own source of funding the City of Thessaloniki relies on the funding from the European Structural Investment Funds (ESIF). The Regional Operational Programme of Central Macedonia has earmarked approximately €7 million for public investments on digitalisation, which however will be mainly directly to the digitalisation of the transport system in the region. Also, there are approximately €7 million available for co-funding the digitalisation of SMEs (see **Error! Reference source not found.**).

Besides, SMEs could use public funding for their digital transformation from the National Operational Programme EPANEK, which provides grants from €3,500 to €200,000 that could cover up to 50% of the total investment.¹²

Table 1 Potential ESIF funding sources for the digital transformation of Thessaloniki

Intervention fields	Regional Operational Programme (KEUR)	ROP Budget earmarked for Integrated Territorial Investments (KEUR) Metropolitan area of Thessaloniki
044 Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	6,600,000	
078 E-Government services and applications	1,000	350
079 Access to public sector information (e.g. open data, digitisation of cultural content, electronic libraries, etc.)	1,000	300

¹² SEPE.gr <http://www.sepe.gr/gr/information/news/article/11192407/duo-nees-draseis-upsous-100-ekat-gia-ton-psifiako-metashimatismo/>

Intervention fields	Regional Operational Programme (KEUR)	ROP Budget earmarked for Integrated Territorial Investments (KEUR) Metropolitan area of Thessaloniki
080 E-inclusion services, accessibility, e-learning	2,812	1,200
082 ICT Services and applications for SMEs (including e-Commerce, e-Business and networked business processes), living labs, web entrepreneurs and ICT start-ups)	5,952,000	

Sources: Regional Operational Programme of Central Macedonia 2014-2020; Call for Tender 088.2c 30/03/2018 for the submission of proposals to the Operational Programme Central Macedonia; Guide for the design and submission of an Urban Development Strategy: Thessaloniki,

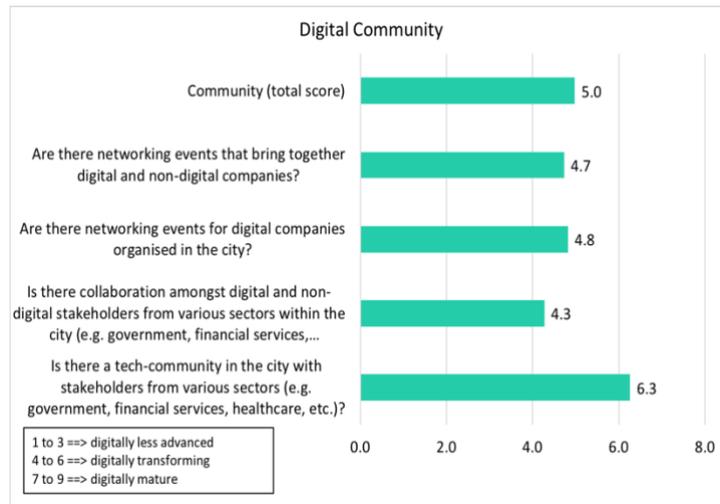
The funding of city's investments on digitalisation is also possible through loans. The municipality has negotiated with EIB a loan of 20 million with a competitive interest rate for covering a broad range of investment needs. Until now no request for payment has been made to the EIB by the municipality.

6. Community engaged in digital transformation

There is a vibrant digital community in Thessaloniki which however faces several of the challenges of a digitally transforming city. The community is not very well connected with non-digital companies and both top-down and bottom-up initiatives could stimulate the community:

- A significant number of initiatives around cutting-edge technologies, mainly supported by established technological communities, as well as by informal groups of developers.
- A smaller number of high-level initiatives supported by key players in the city.

Figure 6 SAT Scores related to the Digital Community



In the first case, the SKGTech initiative stands out. It is a non-profit organisation that embraces & brings together all the people who love technology with the ultimate goal to inspire, to create and to serve its members and the *society*.¹³ The SKGTech coordinates and promotes the actions of city’s technological communities mainly through physical events. Dozens of events are organised each year with the aim of empowering members’ technical background and promoting their work.

Other significant initiatives are:

- Open Coffee¹⁴ that aims to be the single point of reference for Greek start-ups;
- OpenThessaloniki,¹⁵ that aspires to be a platform for collecting data related to the town of Thessaloniki and develop applications and services aiming at open government;
- PyThess,¹⁶ a group for everyone interested in Python, Python-related technologies and programming in general;
- SHESHARP,¹⁷ a community of people dedicated to promoting women's engagement with technology & science; and

¹³ About SKGTech - <https://skgtech.io/about/>

¹⁴ OpenCoffee Greece - <http://opencoffee.gr>

¹⁵ OpenThessaloniki - <http://www.openthessaloniki.org/>

¹⁶ PyThess - <https://www.meetup.com/PyThess/>

¹⁷ SHESHARP - <http://www.shesharp.org/>

- TLAB,¹⁸ a community dedicated in research and development on state-of-the-art technologies in sectors of IoT, Networks, DevOps and embedded devices.

In the second case, the "Technology Forum" initiative¹⁹ stands out. Most of the city's stakeholders (industrial and business associations, universities and research centres, governance bodies and professional associations) have joined forces to organise a series of congresses. These events aim to facilitate the collaboration between industrial bodies (ICT & other industries) and research organisations (Universities & Research Centres). The ultimate goal is to empower participants to develop innovative products and services with international perspective by combining knowledge with the right technological tools. Moreover, the initiative aims to promote Thessaloniki as a pole of attraction for the whole of Southern Europe in the fields of technology, education and innovation. Although Technology Forum makes a lot of effort to establish the collaboration between digital and non-digital companies of the city, this collaboration is still a challenge. Towards this direction, it is critical to attracting non-digital companies to the events of the city's digital community.

The OK!Thess²⁰ initiative deserves a special mention for its contribution to the growth of Thessaloniki's digital community, as it offers the physical space for most of the events and acts as a promoter of cooperation between the technological communities.

¹⁸ TLAB - <https://www.tlab.gr/>

¹⁹ Technology Forum - <https://technology-forum.eu/>

²⁰ OK!Thess - <https://okthess.gr>

7. The state of local digital and physical infrastructure

Digital infrastructure

The local digital infrastructure includes fixed (such as ADSL, VDSL, FTTH) and wireless (such as 3G, 4G, Wi-Fi) broadband connections.

According to data from the largest telecommunication companies in Greece, the 4G network coverage in the city is 100% outdoors (Cosmote,²¹ Vodafone²²) and 82.8% indoors (Cosmote).

Although statistical data regarding fixed broadband connections at the city level are missing, the available information at country level shows that 70.6% of the country households, with at least one member aged 16-74 years old, use the broadband internet connection at home. According to recent statistics providing data for the average of Greece, the main reasons for not accessing the internet at home are: (a) lack of skills (70.2%), (b) the usefulness of internet information (23.1%) and (c) the high equipment cost (18.0%).²³ The responses regarding the cost of the equipment reflect the cost of the access to the internet, which is higher than the EU average. According to a study by the European Commission, the price for 12-30 Mbps and 30-100 Mbps stand-alone internet and the double play (Internet + fixed telephony) is almost double the EU average. Also, the double pay with TV and the triple play for the same basket of 12-30 Mbps and 30-100 Mbps cost more than the EU average for the >100Mbps basket.

Regarding the use of digital infrastructure from businesses, 86.6% of companies with 10 or more employees have an internet connection (country total, statistical office). 97.8% of them used DSL or any other type of fixed broadband connection (e.g. ADSL, SDSL, VDSL, FTTH, cable technology), while 54.6% used broadband connection using mobile telephony networks (3G or 4G). As regards the maximum contracted download speed used by the enterprises for

²¹ Cosmote - 4G Network coverage of Greece - <http://bit.ly/2sBm89g>

²² Vodafone - Κάλυψη Δικτύου - <https://www.vodafone.gr/coverage-checker/>

²³ Hellenic Statistical Authority, 2017, Press Release: Survey on the use of information and communication technologies from households and by individuals / 2017, available at <http://bit.ly/2sDBx8O>

their fixed broadband connection to the Internet, 71.7% has at least 2 but less than 30Mbps, 20% has at least 30 but less than 100Mbps, and 5.4% has more than 100Mbps.²⁴

The existing fixed broadband infrastructure is improved as the telecommunication providers upgrade their network offering 50Mbps VDSL connections in many districts of the city. Moreover, investments are made to expand a privately-owned fibre optic network to cover wider areas in the city. The aim is to bring to the premises of every home or business subscriber the capability offered by FIBER-to-the-Premises high-speed technology.²⁵

Free wireless access to the internet is limited at the university campuses, which however is accessible only by the academic community. Wi-fi access in all other public spaces is not available, as the Municipality has not yet implemented a municipal wireless network. The lack of free citywide wireless access to the Internet is the most significant deficit in the digital infrastructure of the city. The problem is relieved by the private initiative as most of the coffee shops and restaurants offer free Wi-Fi to their customers.

Physical infrastructure

The penetration of digital technologies in the physical infrastructure is very slow, with universities and research centres being the exception. Most of the universities and research centres offer 1Gbps fixed broadband Internet connectivity on their campuses to their staff and students together with free Wi-Fi both outdoors and indoors.²⁶ They also use intranets for providing access to content and personalised information to the students and the academic staff.

Among the main utilities, only the electricity suppliers offer online access to the customers for reviewing and paying their bills.

The organisation of Urban Transportation of Thessaloniki (OUTT) has recently introduced a system that provides real-time information about the routes, arrival schedules and bus stops which can be accessed by computer or mobile applications. Also, smart notification terminals have been installed at the bus stops that provide real-time information about the arrival of buses. However, a traffic monitoring and control system that could integrate the system of OUTT is not in place.

²⁴ Hellenic Statistical Authority, 2017, Press Release: Use of Information and Communication Technologies and Electronic Commerce in enterprises / 2017, available at <http://bit.ly/2sCAKFa>

²⁵ Hellenic Cable Networks (HCN) - <http://www.hcn.gr/en/poioi-eimaste/>

²⁶ GRNET S.A - <https://grnet.gr/en/>

The port of Thessaloniki, one of the biggest infrastructures in the city, is investing on digitalising the operations within the boundaries of the port, and as it is mentioned in chapter 4 one of the primary objectives is to become fully smart by digitalising also the interactions with the clients as well.

8. Digital solutions enabling the modernisation of business environment

Public investments on digitalisation mainly aim at improving the productivity and control of spending of public administration and the improvement of the service to the citizens. Less attention is given to improve the business environment.

The digitalisation of the city administration started almost a decade ago with the following main stages of development:

- Development of a Geographic Information Platform (GIS) in 2008.
- Development of an integrated web-based information system for the financial management of the municipality was developed in 2010.
- In 2016 an interactive application mapping the electricity distribution network was introduced. The application feeds with real-time information and alerts the relevant technical unit in the City administration which use them for maintenance and repairs.
- The “Improve My City” which is a platform for managing everyday problems of citizens and businesses, providing functions for submitting, managing and analysing their requests developed in 2017
- Finally, the Thessaloniki Urban Mobility Management, will gradually integrate existing systems that monitor parking, traffic and environmental conditions in the city.

Following its Digital Strategy, the City of Thessaloniki is planning to digitalise all services and the transactions with businesses in an effort to reduce the transaction cost for businesses and improve the quality of the offered services. Thus, businesses will be able to perform online

payments, see outstanding payments or apply for a permit. On its side, the city could keep track of rentals (e.g. kiosks) and payment orders and monitor projects and supplies.

The development of government-to-business (G2B) and government-to-citizen (G2C) applications provide an opportunity to the local ICT companies to develop the necessary capabilities for producing applications that can be sold in the much bigger European or even global market. Therefore, the city by pursuing the objectives of the Digital Strategy could be the driver for a boost to the local ICT industry. However, such a strategy presupposes that adequate procurement methods such as innovation procurement or pre-competitive procurement, which are not in favour of the lowest price bids but allow the learning and experimentation, are in place and used.

The opening of city's data, which is a work in progress (see chapter **Error! Reference source not found.**), will provide new opportunities to businesses for developing applications, use the available information for improving their decisions or increasing the added value of their products and services.

Implementation of digitalisation in the public sector is a slow process, which needs to overcome existing organisational silos, internal resistance to change, lack of incentives to the employees and very tight budgets.

A lesson learned from the digitalisation of services so far in the city of Thessaloniki is that even if a specific department initiates an application or service, the latter most probably cross-cuts the organisational structure of the administration, and therefore a strategy for engaging and empowering all possible administration units is necessary.

9. Data-driven innovation

The City of Thessaloniki was among the first cities in Greece that opened its data and make them available in an open data platform.²⁷ Currently, the city has opened 112 datasets which include:

- Urban planning (50 data sets)
- Environment (19 data sets)
- Public administration (15 data sets)
- Culture (14 datasets)
- Education (13 data sets)
- Tourism (13 data sets)
- Studies (6 datasets)
- Security (4 data sets)
- Geospatial data (1 dataset)
- Economy (1 dataset)
- Statistics (1 dataset)
- Health (1 dataset)

The city is in the process of further expanding the data sets available in the open data platform by opening financial data, demographics, waste management and the city's financial statistics.

Currently the development of applications relying on open data, especially those developed for commercial use, is limited.

In our interviews with ICT companies, it has been repetitively stressed that the full opening of data generated by the public sector and utilities companies will create significant business opportunities. In an IBM study for the City of Thessaloniki, which was delivered in 2017, similar

²⁷ <https://opendata.thessaloniki.gr/el>

conclusions were reported.²⁸ The study also offered examples of uses of data, such as the combination of data on traffic, tourism and events which could help businesses to plan promotions and improve customer service, or the access to energy usage data could help to build energy optimisation and saving services.

The city, in order to encourage the use and explore the potential of open data, organised competitions for the development of applications that use open data or crowdsourcing. During the competition Apps4Thessaloniki in 2014, 220 ideas were proposed by citizens and through open voting by 3.000 participants, 14 ideas were selected and developed by ICT developers. The competition site attracted more than 85.000 visitors indicating the interest of the public and the business community. The competition was repeated in 2015 for tourism applications. In the HackaThess, a hackathon organised in 2014, 11 teams of developers participated and developed applications. However, there is no information whether any of the developed applications reached the market.

Despite the real potential, most of the opened data offered by the city are not usable in their current state. As it is was pointed out in the IBM's study, the following drawbacks should be addressed before the data can be used in applications:

- Incomplete data.
- Data in different formats that cannot be distributed or used directly.
- Collection and storage performed manually and without specifications.
- The ownership of the data is not clear.
- There is a lack of organised and accessible governance processes of data

Apart from the city, there are several organisations such as the local HEIs and business associations that maintain databases for their own use.

²⁸ IBM (2017). Smarter ities Challenge report : Thessaloniki

10. Skills and entrepreneurial culture

There is a well-developed community of skilled ICT professionals in the city employed mainly in the local ICT sector and the local higher education institutes. At the same time, there is a steady flow of well-educated graduates from the local higher education institutions. The three of the four HEIs in the city train a total of 4,000 students in the field of digital technologies (57% of the human resources in the local sector of ICT), and each year 500 to 600 graduates enter the labour market. Approximately 40% of them holds a postgraduate title. The level of education provided is high and the quality of the workforce has attracted some foreign firms that have moved their activities in Thessaloniki.

The relatively low digitalisation of the local companies, discussed in previous chapters, should be attributed, among other factors to the low absorptive capacity of the local companies. Given the steady supply of well-educated personnel in the city, the relatively level of ICT skill in the local non-digital companies should be associated with other reasons. Due to their small size, most of the local companies outsource the ICT related activities to ICT service providers and therefore investing in acquiring by hiring or developing internally ICT skills are not a priority. This is also reflected in the low score of 3.9 on the relevant question about the level of digital training in companies, given by the industry on the SAT.

In contrast to the non-digital companies, the demand for well-educated professionals by the local ICT companies is high. Local ICT companies targeting consumers, or the public sector are under constant pressure by the competition of international companies and the big ICT companies from Athens. Despite the local demand by ICT companies not all of the graduates remain in the city. A significant brain drain is observed as the most talented people going abroad seeking work or a research position in universities abroad. It is estimated that the upper five per cent of the most talented students go abroad after graduation. As it was pointed out during the interviews with ICT companies and academics, the local companies cannot compete in the European market concerning prospects for career development, wages and working conditions. The brain drain is evident also in the postgraduate level as now fewer graduates stay at the university for a PhD.

Although the education provided is of high standards, the curriculum in the HEIs cannot always keep track of demand in new technology sectors, resulting in skills shortages. Nevertheless,

HEIs are well aware of the importance to keep their students up to date, and they organise extra curriculum training on hot subjects. Examples are the initiatives for Meet-ups (e.g. SKG Tech), and coding schools (ACM) organised by the Aristotelian University which are highly sought after and attended by graduates and students.

In response to the brain drain and the shortages in some technical skills the local ICT industry is trying to attract graduates either through the practice of internships/ training or by setting up ICT related industrial PhDs that are done in collaboration with businesses. The latter is the initiative iGrow Labs²⁹ of the Aristotelian University, the Technical Chamber of Greece, the Association of Information Technology Companies of Northern Greece and the incubator i4G. iGrow Labs provides co-working spaces for the students, organises workshops, events and meetups, offers scholarships for training trips abroad and prizes for the best thesis. It also offers support to graduates that would like to establish their own start-up.

Despite the efforts, it was recognised by all interviewed stakeholders that a more organised, long-lasting and systematic approach is necessary for keeping the graduates up to date and addressing the shortage of skills.

In addition to shortages in technical skills, there is a shortage of skills related to product design, and of soft skills including entrepreneurial skills.³⁰ However the soft skills shortage is more of a systemic problem of the education in Greece than a problem of the higher education alone, and thus it is more challenging to address.

The increasing number of start-ups in the last few years indicates the growth of an entrepreneurial culture in the city. Several initiatives including hackathons and other competitions, the organisation of seminars and the setting up of coworking and prototype development spaces contribute to the cultivation of an entrepreneurial culture. Among them the pre-incubator OK!Thess has a central role by helping young entrepreneurs to validate their ideas, set-up a company and attract seed funding

²⁹ <http://www.igrowlabs.gr/#offer>

³⁰ The issue was repeatedly pointed out during the interviews with local stakeholders

11. Digital transformation SWOT analysis

	Strengths	Weaknesses	Opportunities	Threats
Infrastructure	<ul style="list-style-type: none"> 100% 4G coverage in the city Ongoing investments for fiber-to-home Free Wi-Fi in universities campuses 	<ul style="list-style-type: none"> Average broadband access speed is inadequate for bandwidth demanding applications (e.g. IoT) 	<ul style="list-style-type: none"> The planned investments for the upgrade of the network by local providers will facilitates the implementation of the strategy 	<ul style="list-style-type: none"> The planned investments may delay the penetration of 5G (lock-in effect)
Access to Data	<ul style="list-style-type: none"> The municipality of Thessaloniki promotes open data ICT companies are interested in developing applications that use open data The municipality of Thessaloniki has created 112 open data sets and plans to open more 	<ul style="list-style-type: none"> Open data sets are not structured, controlled for quality, provided at real time, and APIs are not available Only the Municipality of Thessaloniki provides open data 	<ul style="list-style-type: none"> Use OD for developing commercial applications Use of OD for improving policy design Use OD by businesses to improve their services and decision-making 	<ul style="list-style-type: none"> Delays in ensuring quality and continues update of data could harm the credibility of OD and the feasibility of using them
Digital skillset	<ul style="list-style-type: none"> The HEI education is sufficient The HEIs organise coding schools and extracurricular training and activities for 	<ul style="list-style-type: none"> There are shortages in some specialities Businesses cannot attract talents who preferer to go abroad 	<ul style="list-style-type: none"> Coordination of the training initiatives by the municipality Development of training services especially on 	<ul style="list-style-type: none"> The inflexibility of the current legislative framework for the training services supported by public funding (KEK)

	Strengths	Weaknesses	Opportunities	Threats
	students and non-students	<ul style="list-style-type: none"> Shortage of soft and product development skills 	subjects and skills not covered by HEIs	could hinder the public funding of training
Companies digital competencies	<ul style="list-style-type: none"> There are dynamic ICT companies that can provide the necessary services Port is in a digital transformation path Tourism already is experimenting with digital applications and services 	<ul style="list-style-type: none"> Private investments for business education are low The ICT literacy of employees is very low compared to the EU average The use of ICT for commercial activities and logistics is lower than the EU average 	<ul style="list-style-type: none"> Digitalise the processes in key economic sectors Exploit synergies among sectors across the value chain Develop know-how for Smart Cities technologies and services in local ICT companies and public administration Experiment with disrupting technologies 	<ul style="list-style-type: none"> Non identified
Community	<ul style="list-style-type: none"> A digital community is formed including ICT companies, HEI, and research centres 	<ul style="list-style-type: none"> There is no critical mass within the main actors Fragmented efforts of the stakeholders Limited interaction between ICT and non-ICT entities 	<ul style="list-style-type: none"> Systematic development of the ecosystem Enlargement of the community by attracting non-ICT companies 	<ul style="list-style-type: none"> Non identified
Finance	<ul style="list-style-type: none"> City's strategy is in line with the national digital strategy and the Regional Operational Programme ROP potentially will co-finance public and private investments on ICT 	<ul style="list-style-type: none"> Bank lending terms are not attractive There is no experience in the municipality in innovation procurement procedures – It is a grey area regarding the legislation Tide public budgets 	<ul style="list-style-type: none"> Exploitation of existing ROP funds Use of innovation procurement and pre-competitive procurement methods by the municipality for the procurement of digital applications 	<ul style="list-style-type: none"> Strong competition in claiming funding from the ROP Resistant by the administration on applying new methods of procurement

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	Strengths	Weaknesses	Opportunities	Threats
	<ul style="list-style-type: none"> • Successful efforts for attracting VC and BA funding 			<ul style="list-style-type: none"> • Pressures to reduce debt could hinder the use of loans
Support services	<ul style="list-style-type: none"> • City supports entrepreneurship • There are successful support infrastructures for start-up 	<ul style="list-style-type: none"> • Absence of experimentation and prototype development infrastructures (e.g. fab-labs) 	<ul style="list-style-type: none"> • Development of service / infrastructure for experimentation and service planning • Strengthening existing innovation support infrastructures 	<ul style="list-style-type: none"> • Non identified
Governance and leadership	<ul style="list-style-type: none"> • The city is making efforts for coordination and consensus building • The City has developed a digital strategy 	<ul style="list-style-type: none"> • Delays in the implementation of City's digital strategy • Despite the consensus at the top, there has been little effort to raise awareness among businesses and the public 	<ul style="list-style-type: none"> • Strengthening the coordination role of the City 	<ul style="list-style-type: none"> • Non identified

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.

Higher Education Institutions (HEIs)

In Greece HEIs include both the universities and the Higher Technical Education Institutions (former TEIs).

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.

Appendix II: Bibliography

1. Call for Tender 088.2c 30/30/2018 for the submission of proposals to the Operational Programme Central Macedonia, in Greek
2. City of Thessaloniki (2014). Resilient Thessaloniki : A strategy for 2030
3. City of Thessaloniki (2016). Assessment of Urban Resilience :Thessaloniki, in Greek
4. City of Thessaloniki (2017). Digital Strategy 2017-2030, in Greek
5. City of Thessaloniki (n.a) Portal of Open Data of the City of Thessaloniki <https://opendata.thessaloniki.gr/el>
6. DESI (2018). Country Report Greece
7. Hellenic Statistical Authority (2017). Press Release: Survey on the use of information and communication technologies from households and by individuals, available at <http://bit.ly/2sDBx8O>
8. Hellenic Statistical Authority (2017) Press Release: Use of Information and Communication Technologies and Electronic Commerce in enterprises, available at <http://bit.ly/2sCAKFa>
9. Hellenic Federation of Enterprises (2015). Enterprises and digital economy – Supply Chain: New jobs better services, in Greek.
10. IBM (2017). Smarter Cities Challenge report : Thessaloniki
11. National Bank (2016). SMEs: ICT Sector, in Greek
12. Organisation of Thessaloniki Port (2018). Annual Financial Report for the Financial Year 2017, in Greek
13. Prefecture of Central Macedonia (2014a). The strategy of Smart Specialisation (RIS3) of the Region of Central Macedonia, in Greek.
14. Prefecture of Central Macedonia (2014b). Guide for the design and submission of an Urban Development Strategy: Thessaloniki, in Greek
15. Prefecture of Central Macedonia (2014c). Regional Operational Programmes of Central Macedonia and Region of Central Macedonia, in Greek
16. Prefecture of Central Macedonia (2017). Strategy for an Integrated Sustainable Urban Development.

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Cities Challenge