ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

FINAL REPORT //

DIGISER

Digital Innovation in Governance and Public Service Provision

Annex 1.4 Service Area Index Report // April 2022

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Abbreviations

API	Application Programming Interface
DESI	Digital Economy and Society Index
DIGISER	Digital Innovation in Governance and Public Service Provision
DIGISURVEY	The survey deployed during DIGISER with 255 respondent cities
DPSVI	Digital Public Value Service Index
EAB	European Advisory Board
EDCI	European Digital City Index
EIF	European Interoperability Framework
ESPON	European Spatial Planning Observation Network
EU	European Union
EU ODP	European Union Open Data Portal
FUA	Functional Urban Areas
GDC	Green Digital Charter
GDP	Gross Domestic Product
GDPpc	Gross Domestic Product per Capita
GDPR	General Data Protection Regulation
ICC	Intelligent City Challenge
ICT	Information and Communications Technology
KPI	Key Performance Indicator
LAU	Local Administrative Units
LEA	Learning Technology Accelerator
NUTS	Nomenclature of Territorial Units for Statistics
OASC	Open and Agile Smart Cities
OECD	Organisation for Economic Co-operation and Development
OGD	Open Government Data
PA	Public Administration
PCP	Pre-Commercial Procurement
Q_	Question (in Digiser Survey)
R&D	Research and Development
SAB	Scientific Advisory Board
SAG	Scientific Advisory Group
SDGs	Sustainable Development Goals
SEM	Structural Equation Modelling
SI	Service area Index
T-LL	Triple-Loop Learning
ToR	Terms of Reference
UNDP	United Nations Development Programme
Reference Sample	It refers to the representative sample of 156 cities used to establish the European average

1 Introduction

One of the main goals of DIGISER has been the development of indicators capable of capturing and synthetically describing the performance of cities in the digital transition and their ability to drive this transition towards the creation of public value. This work resulted in the development of the DPSVI, Digital Public Service Value Index (DPSVI), that is reported in detail in the *Annex 1.2 DPSVI Report*[1].

In summary, the DPSVI is conceived as a multi-level composite index, nourished by primary data collected through a questionnaire (DIGISURVEY) targeting European cities.

These data have been processed and combined to feed a system of composite indicators that provide a synthetic assessment of the performance of cities in relation to complex phenomena underlying digital transformation in European cities (cfr. *Annex 1.1 Extended Methodology*).

1.1 DPSVI and Service Areas analysis

In addition to the main DPSVI, the research team explored an alternative and complementary analytical approach that shifted the point of view from the single city to the public service areas: instead of observing the way in which cities are performing on public value creation through digital innovation, the Service Index presented in this document, focuses indeed on the performance of several service areas.

The underlying research question aims at exploring to what extent each service area contributes to the digital transformation of the city, and what are the most advanced service areas in terms of digitalization.

In detail, DIGISER considered the service areas described in the following Table , drawn upon pre-existing studies and classification[2] in the attempt to define a taxonomy applicable to different institutional systems where responsibilities and competences of local authorities can differ significantly.

General / Administration	
Included Service Sectors	***Example of a digital solution***
Certification/registration	*Certify/register personal information online*
Information	*Find information online*
Taxation & fees	*Declare taxes, pay fees online*
Interaction	*Provide feedback/information online*
	Follow council meetings (streaming)
	Participate in process (eVoting, streaming)
Business services	*Certify/register business information online*
Building & Spatial Planning	
Included Service Sectors	***Example of a digital solution***
Strategic/Land use planning	*Consult data and plans (GIS)*
	Apply for permits and trace progress
	Consult/participate (streaming, teleconference)
	Predictive modelling
	Car Share
	Fleet and Ride Share
	Person-to-Person Car Rental
	Real-Time Tracking of Journey inside and in stations (Cloud, Big Data, AI, IoT)
	Notifications on service interruptions

[1] The annexes to the Final Report of DIGISER will be made available at: https://www.espon.eu/DIGISER

[2] Main references for the definition of the Service Areas were two studies carried out by the Committee of the Regions:

- Committee of the Regions, ed. *Regional and Local Government in the European Union: Responsibilities and Resources*. CDR - Studies, E-1/2001. Luxembourg: Office for Official Publications of the European Communities, 2000.
- Committee of the Regions. and European University Institute. *Study on the Division of Powers between the European Union, the Member States, and Regional and Local Authorities.* LU: Publications Office, 2008.

Construction	*Apply for permits, register and certify*
	Legal: building codes for smart buildings
Transport & Mobility	
Included Service Sectors	***Example of a digital solution***
Parking	*Pre-Booking & Reservations*
	Dynamic Availability & Smart Payment
	EV Charging
	Towing and removal
Traffic Management	*Real-Time Traffic Information and Management (Cloud, Big Data, AI, IoT)*
	Road User Charging (IoT)
	Connected Vehicles
	Connected Traveller
	E-Call Road Assistance
	Digital Information Boards
Logistics	*Crowdsourced Logistics*
Delivery	*Apps*
	Robots & Drones
Public Transport	*Multimodal Transportation Information (Apps)*
	Route Management and Planning
	Autonomous Transport Systems [Robotics, Big Data, AI, IoT, 5G]
	Dynamic Availability & Smart Payment
	Bike/Scooter Share
Utilities	
Included Service Sectors	***Example of a digital solution***
Waste disposal	*Route Management and Planning*
	Smart Sensor Bins and RFID Tags (IoT)
	Volume/Frequency-Based Payment System
Water (clean & waste)	*Smart meters*
	Public Health Monitoring (Smart Sensors)
	Quality Monitoring (Smart Sensors)
	Leak & degrading infrastructure detection
	Maintenance planning (automated geolocation of failures)
	Infrastructure repairs (robotics)
Elecriticty	*Smart meters and consumption monitoring*
	Electronic billing
	Smart Energy Grid
Internet	*Public wifi (4G, 5G)*
	Package stations
Street lighting	*Smart lampposts*
Road maintenance	*Apps to communicate about road conditions*
	Snowplow, cleaning (route planning)
Heating	*Real time energy demand information and management*
	Smart Thermal Grid
	Smart energy systems
	Smart buildings
Social & Welfare Services	
Included Service Sectors	***Example of a digital solution***
Social Housing	*Registration, process management*
Building smart monitoring and management	
Social assistance	*Registration, process management*
Water (clean & waste)	*Smart meters*
Public Health Monitoring (Smart Sensors)	
Quality Monitoring (Smart Sensors)	
Healthcare	
Included Service Sectors	***Example of a digital solution***
Public health services	*Registration, ticketing, booking, access to records*
	Remote assistence, Digital/virtual rehabilitation, health-related data monitoring
Outpatient services	*Registration, ticketing, booking treatments, access to records*
	Health-related data monitoring
Education	
Included Service Sectors	***Example of a digital solution***

Pre-primary education Primary/secondary education	*Enrolment* *eLearning* *eBooks*
Culture & Leisure	
Included Service Sectors	***Example of a digital solution***
Cultural services	*Ticketing, booking access, digital guides (app), service evaluation*
Recreation and sporting activities	*Ticketing, booking access, service evaluation*
Tourism services	*Ticketing, booking access, digital guides (app), service evaluation*
Emergency response	*Real Time Call Centers* *Drones*
Order & Safety	
Included Service Sectors	***Example of a digital solution***
Emergency preparedness	*Emergency preparedness plans (Digital Twin, IoT, VR)*
Public safery	*Facial recognition (IoT, Drones, AI)*
Police	*Crime prediction modelling (AI)* *Recording (Bluetooth, Cloud Computing)* *GPS tracking*

Table 1 – DIGISER: Taxonomy of Service Areas

Even though service areas are the items observed in this alternative analytical approach, nonetheless the database used to analyse them consists of the same primary data used in the computation of DPSVI and based on the answers of cities to the DIGISER Survey. In particular, the SI relies on 16 matrix or multiple-choice questions that collected the data per service areas, as exemplified by the following figure.

2.4 Is your public authority part of a (local, regional, national, EU) network of cities sharing operational digital solutions or open source code?
Note: If yes, please answer for each service area that applies. If not, please select "Not Applicable"

	Local	Regional	National	International	Not Applicable
* General Services / Administration	☐	☐	☐	☐	☐
* Building & Spatial Planning	☐	☐	☐	☐	☐
* Culture & Leisure	☐	☐	☐	☐	☐
* Education	☐	☐	☐	☐	☐
* Healthcare	☐	☐	☐	☐	☐
* Order & Safety	☐	☐	☐	☐	☐
* Social & Welfare Services	☐	☐	☐	☐	☐
* Transport & Mobility	☐	☐	☐	☐	☐
* Utilities	☐	☐	☐	☐	☐

Figure 1 - Example of a service-based multiple-choice matrix from DIGISURVEY

The following table includes the text of all questions used to create the Service Area Indexes and information about the type of questions.

Question Number and text	Question Type
2.4 Is your public authority part of a (local, regional, national, EU) network of cities sharing operational digital solutions or open source code? Note: If yes, please answer for each service area that applies. If not, please select "Not Applicable"	Matrix - Single choice
2.5 Does your public authority benefit from sharing digital solutions, services or products with other public authorities? Note: If yes, please answer for each service area that applies. If not, please select "Not Applicable"	Matrix - Single choice
3.3 Which are the top 3 service areas particularly active in competitive funding calls (e.g. EU or national funding)?	Multiple choice

Question Number and text	Question Type
5.2.4 To what extent do different service areas collect and share data?	Matrix - Likert
5.2.5.2 Specify for each service area the purposes of the integrated data modelling function (Local Digital Twins or similar) is used: Note: Please select as many as apply per service area	Matrix - Multiple choice
5.12.1 If your public authority is producing/using its own Big Data, which service areas are covered? Note: Please select as many as apply per service area	Matrix - Multiple choice
5.12.2.1 If your public authority is using Big Data produced by third parties, which service areas are covered? Note: If yes, please answer for each service area that applies. If not, please select "Not Applicable"	Matrix - Multiple choice
7.2 Does your public authority use service-related data to improve your digital service offer in the following areas? Note: Please select all that apply, otherwise please select "Not applicable"	Matrix - Multiple choice
7.3 State for each service area if the adoption of Artificial Intelligence technology is planned, implemented, not planned or not applicable: Note: Please consider "Not Applicable" if the service area is not under the responsibility of your public authority, or the information is not available.	Matrix - Single choice
7.4 State for each service area if the adoption of Internet of Things (IoT) technology is planned, implemented, not planned or not applicable: Note: Please consider "Not Applicable" if the service area is not under the responsibility of your public authority, or the information is not available.	Matrix - Single choice
7.5 State for each service area if the adoption of the blockchain technology is planned, implemented, not planned or not applicable: Note: Please consider "Not Applicable" if the service area is not under the responsibility of your public authority, or the information is not available.	Matrix - Single choice
7.6 State for each service area if the adoption of wearable technology is planned, implemented, not planned or not applicable: Note: Please consider "Not Applicable" if the service area is not under the responsibility of your public authority, or the information is not available.	Matrix - Single choice
7.7 State for each service area if the adoption of robotics technology is planned, implemented, not planned or not applicable: Note: Please consider "Not Applicable" if the service area is not under the responsibility of your public authority, or the information is not available.	Matrix - Single choice
8.1 How would you describe the level of digitalisation of services provided by the public authority in the following service areas?	Matrix - Likert
8.2 When a public service is provided online as well as offline, how many users are choosing the digital option?	Matrix - Likert
8.3 Indicate the availability of comprehensive multilingual options in the service interfaces of the public authority used by the following service areas Note: Please select as many as apply.	Matrix - Multiple choice

Table 2 - Service Area Questions in DIGISURVEY

1.2 Service Index data model

Alike the DPSVI itself (cfr cfr. *Annex 1.1 Extended Methodology*), an analytical model has been designed to measure and interpret the state of the art of the digital transformation and organizational innovation in each service area.

The Service Index Data Model is structured as a hierarchical tree of indices fed directly by questions, where each sub-index aims to explore a specific phenomenon and is epistemically relevant for its interpretation.

Considering the relatively small base of data to be computed, the analytical model, represented in Figure 14, looks like simpler than the original DPSVI tree, and all the indices are positioned at the same (unique) level.

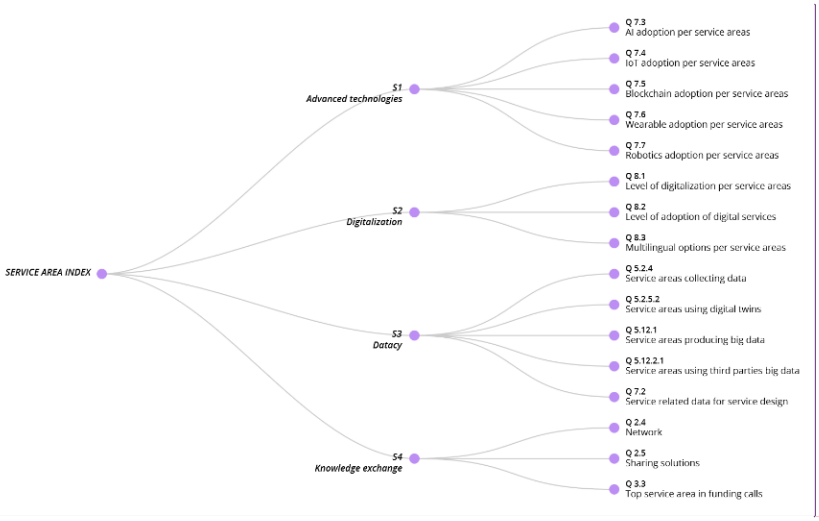


Figure 2 - Service Areas analytical framework

The 16 questions are combined to create composite 4 thematic indexes aimed at exploring a specific perspective on digital transformation in service areas. The four Indexes are then combined into an unique index (SI Index) that can be used to compare and assess the performance transversally to the four themes. The following table specifies the focus of each one of the sub-indexes.

Cod	Label	Description
S1	**Advanced technologies**	It reports the state of the art of the adoption and use of brand new and complex technologies as AI, IoT, Blockchain, Wearables, Robotics
S2	**Digitalization**	It assesses the level of digitalization of each service area in core and ancillary services and the level of actual usage of digital services by citizens and users
S3	**Datacy**	It focuses on the contribution of each service area to feed the open data ecosystem of their organization, as well as to their capacity to exploit the potential of open data and big data for service design and delivery
S4	**Knowledge Exchange**	It explores the role of each service area in disseminating, sharing, and exchanging knowledge regarding digital innovation both within the organization and with other public organizations

Table 3 – Definition of sub-indexes for Service Areas

1.3 Methodology for SI computation

Service Area Indices, calculated and computed on top of the data collected through the DIGISURVEY, consist of "scores" referred to each Service Area, that undergo, first, a process of standardization and then, of aggregation.

1.3.1 Standardization

This first phase aims at mapping the raw answers provided by the cities into numerical values via data coding and/or standardization techniques.

Commented [MS1]: @Francesco Fagiani da invertire S2 e S3

Commented [FF2R1]: Sistemato, ho chiesto a Ilaria la sistemazione grafica. Appena è pronto sostituisco

To render the information gathered via the questionnaire processable via computational methods, each answer, or group of answers, requires to be transformed into a given number. As a result, raw data are replaced by a set of numerical values x_p, where $p = 1, \dots, P$ and P is the total number of questions, or groups of them.

As stated just above, this operation is usually performed in an ad-hoc way, given the specificities of each item of the questionnaire, nevertheless some general guidelines were followed. The following table provides a synthesis of the methods for data standardization that have been adopted for each category of answers.

Type of question	Standardization methods
Binary	Converted into dummy (0-1)
Single Choice	Converted to cardinal value (e.g., answer A = 1, answer B = 3, Answer 3 =0)
Likert Scales	Converted to correspondent ordinal (e.g., Low = 1, Medium-Low = 2, Medium-High = 3, High = 4)
Multiple Choice / Matrix	Converted into dummies, then (weighted) sum, propaedeutic yes/no are dropped.

Table 4 - Standardization methods overview

Before aggregating the numeric answers, it is crucial to rescale them into a $0.00 - 1.00$ range, so to make them comparable. The mathematical operation that needs to be performed to move these different scales into a unique one, where 0 is the worst possible value and 1 is the best possible one, is the following:

$$x_p^{IT} = \frac{x_p - x_p^{min}}{x_p^{max} - x_p^{min}}$$

Where x_p^{IT} is the rescaled value, x_p is the original value mapped on a generic scale and x_p^{min}, x_p^{max} are, respectively, the minimum possible and the maximum possible value of datum x_p.

1.3.2 Aggregation

In this second phase the standardized values computed on top of the answers to DIGISURVEY questions, are aggregated via a mathematical procedure, with the goal of creating the indexes that have been defined in Figure 2 - Service Areas analytical framework.

After having refined the data to be taken as input, in accordance with the standard literature for this kind of dimensionality reduction task, the indices are introduced as linear combinations of data, that is:

$$I = \frac{\alpha_{n_1^I} x_{n_1^I}^{IT} + \alpha_{n_2^I} x_{n_2^I}^{IT} + \dots + \alpha_{n_{N_I}^I} x_{n_{N_I}^I}^{IT}}{\alpha_{n_1^I} + \alpha_{n_2^I} + \dots + \alpha_{n_{N_I}^I}}.$$

The following table illustrates the different relative weight attributed to each of the question composing an index.

Q_#	S1	S2	S3	S4
2_4	-	-	-	33%
2_5	-	-	-	33%
3_3	-	-	-	33%
5_2_4	-	-	29%	-
5_2_5_2	-	-	14%	-
5_12_1	-	-	14%	-
5_12_2_1	-	-	14%	-
7_2	-	-	29%	-

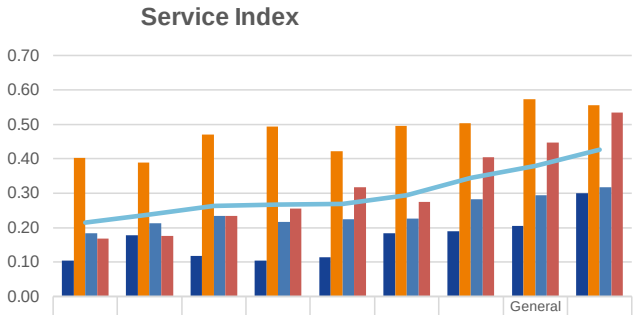
Q_#	S1	S2	S3	S4
7_3	20%	-	-	-
7_4	20%	-	-	-
7_5	20%	-	-	-
7_6	20%	-	-	-
7_7	20%	-	-	-
8_1	-	50%	-	-
8_2	-	25%	-	-
8_3	-	25%	-	-

Table 5 - Service Area Indexes - Relative weight of underlying questions

The final operation is the aggregation of the four Sx Indices into a higher level general Service Area Index, where all sub-indexes have equal weight, resulting in the simple average of its inputs $x_p^{IT}, p = n_1^I, \dots, n_{N_I}^I$.

2 SI - Service Index

2.1 SI – Definition and structure



	Healthcare	Order & Safety	Culture & Leisure	Education	Social & Welfare Services	Utilities	Building & Spatial Planning	General Services / Administration	Transport & Mobility
S1 - Advanced technologies	0.10	0.18	0.12	0.10	0.11	0.18	0.19	0.21	0.30
S2 - Digitalization	0.40	0.39	0.47	0.49	0.42	0.50	0.50	0.57	0.56
S3 - Datacy	0.18	0.21	0.23	0.22	0.22	0.23	0.28	0.29	0.32
S4 - Knowledge exchange	0.17	0.18	0.23	0.25	0.32	0.27	0.40	0.45	0.53
SI - Service Index	0.21	0.24	0.26	0.27	0.27	0.29	0.34	0.38	0.43

Figure 3 – Service Index – Overview per Sector Areas

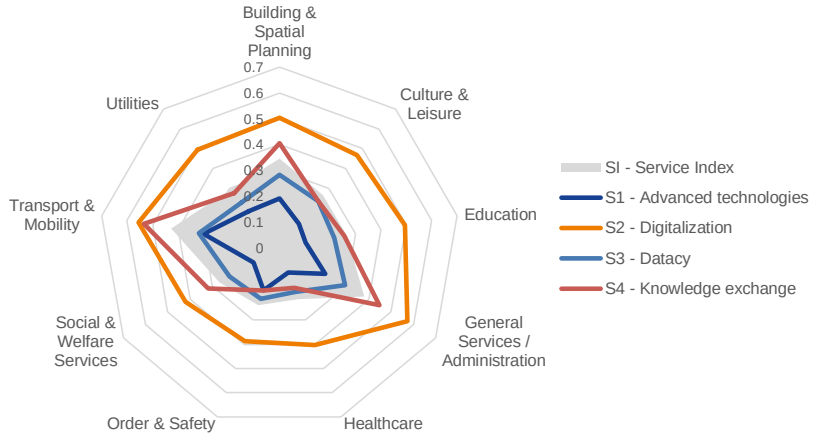


Figure 4 – Service Index – Radars

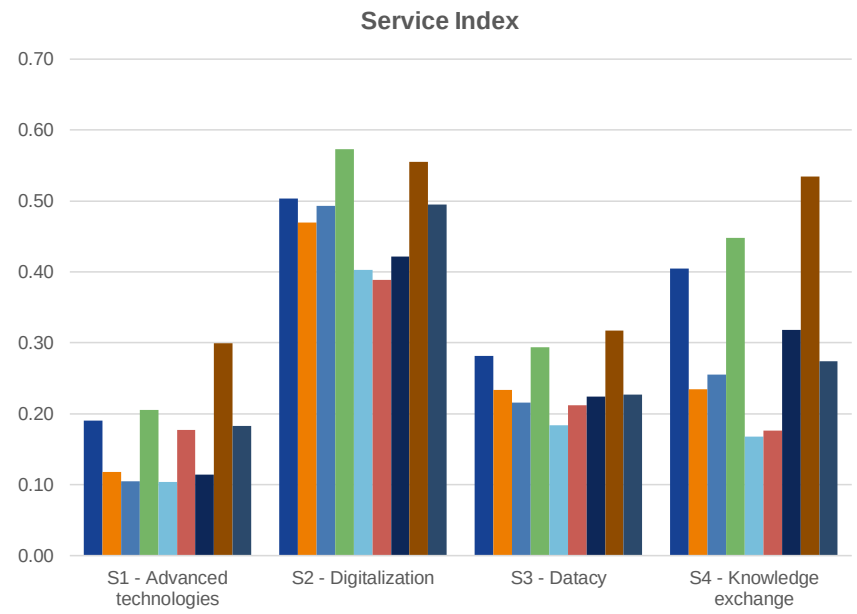


Figure 5 - Service Index – Overview per Sub-indices

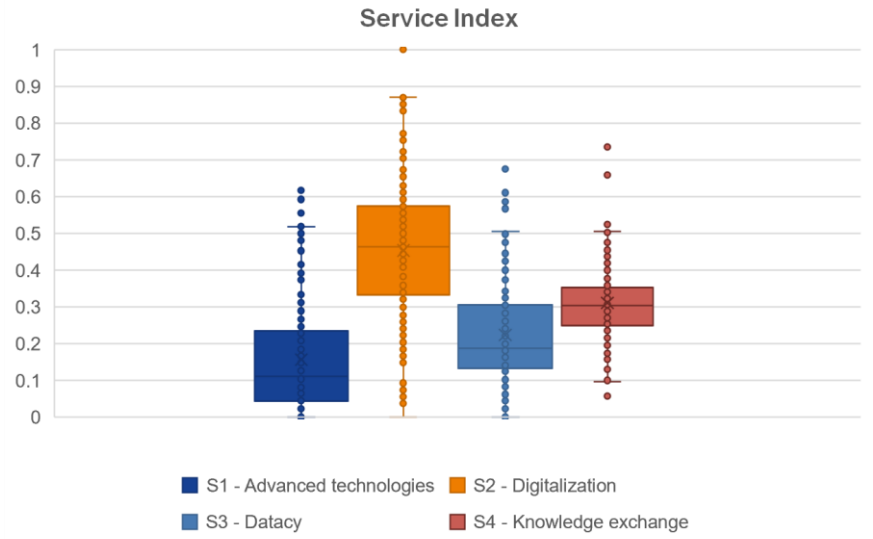
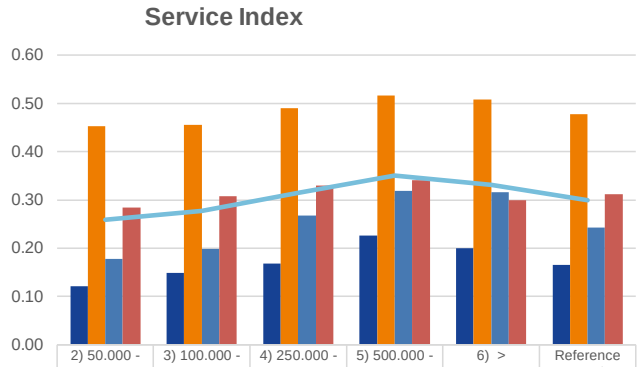


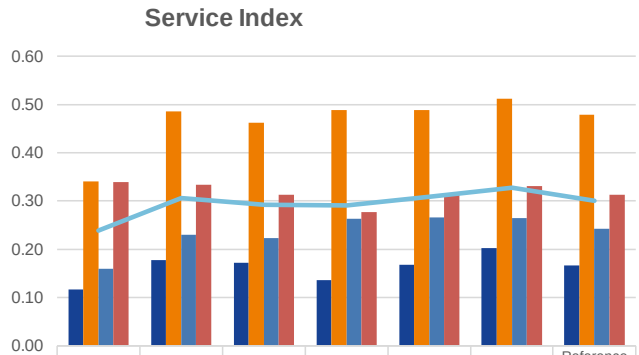
Figure 6 - Service Index – Box Plot

2.2 SI - Population and GDP per Capita



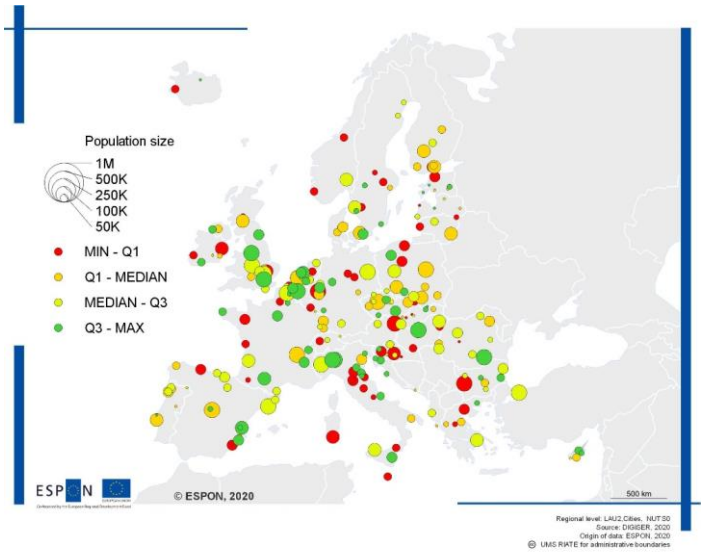
	2) 50.000 - 100.000	3) 100.000 - 250.000	4) 250.000 - 500.000	5) 500.000 - 1.000.000	6) > 1.000.000	Reference Sample
S1 - Advanced technologies	0.12	0.15	0.17	0.23	0.20	0.17
S2 - Digitalization	0.45	0.46	0.49	0.52	0.51	0.48
S3 - Datacy	0.18	0.20	0.27	0.32	0.32	0.24
S4 - Knowledge exchange	0.28	0.31	0.33	0.34	0.30	0.31
SI - Service Index	0.26	0.28	0.31	0.35	0.33	0.30

Figure 7 – Service Index per Population

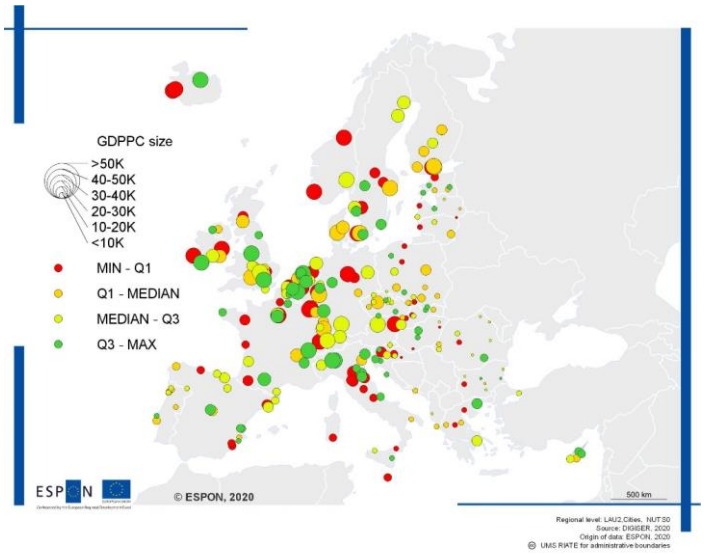


	< 10K	10K-20K	20K-30K	30K-40K	40K-50K	> 50K	Reference Sample
S1 - Advanced technologies	0.12	0.18	0.17	0.14	0.17	0.20	0.17
S2 - Digitalization	0.34	0.49	0.46	0.49	0.49	0.51	0.48
S3 - Datacy	0.16	0.23	0.22	0.26	0.27	0.26	0.24
S4 - Knowledge exchange	0.34	0.33	0.31	0.28	0.32	0.33	0.31
SI - Service Index	0.24	0.31	0.29	0.29	0.31	0.33	0.30

Figure 8 – Service Index per GDPpc



Map 1 – Service Index and population size



Map 2 – Service Index and GDPpc

2.3 Highlights

The SI summarizes the role that the different areas of public services are playing in the framework of the digital transformation processes of the public sector, indicating which service areas are frontrunners and which ones are followers.

The analysis of the SI allows both to make inferences regarding the performance of the different service areas at the higher level of the Service Area tree (Figure 2 - Service Areas analytical framework), and to compare how its different sub-indices contribute to its formation.

Figure 3 – Service Index – Overview per Sector Areas reports the average values of SI and allows you to define a ranking of the different Service Areas, which is also observable in the comparison between the different radars published in *Figure 4 – Service Index – Radars.*

Transport & Mobility area is the front runner both at SI level and in most of the sub-indicators, proving as the sector where technological transformation is most advanced and above all the only one in which the most advanced technologies in the management of public and private transport are experimented significantly. This area appears to be very active also in networking and scaling out of technical and organizational solutions, as demonstrated by the S4 indicator.

The second area in almost all sub-indicators is General Services, which is driven by the excellent performance in the S2 Indicator. It indicates that many basic administrative management processes are now advanced on the road to digitization. If it is not possible to read in the data a correlation between mere digitization and organizational transformation in these areas of service, it can still be hypothesized that the spread of open standards and the pressure of directives and regulations of a higher institutional scale may have played a role in mobilizing local authorities to adopt digital solutions for both the management of their internal procedures and for the management of interactions with the public.

The third area is Building & Spatial Planning, driven by the results of S3 Datacy, which would seem to indicate a high degree of both technical and organizational transformation related to the management of georeferenced data that underlie the provision of services to citizens and businesses.

An ad hoc reflection concerns the services provided by utility companies, which in the research hypotheses were expected as possible leaders of this ranking, being by their nature subjects endowed with greater agility and autonomy and potentially more easily innovable than the "in-house" management of services by administrations. The ambiguous results of Utilities indicators pictures a situation with several shadows and that would require a study specifically aimed at investigating this type of subjects. In the case of utilities, it seems that the population is a decisive factor: while those operating in cities above 250,000 inhabitants are a factor in the dynamization of innovation, those below are always at the bottom of the rankings, indicating a resistance to change.

The other sectors are in descending order in a fairly similar performance range, showing no significant differences.

Observing the index at the highest scale of SI (Figure 7 – Service Index per Population) could be observed a direct correlation with the population of the responding cities at least up to the 500,000-1,000,000 inhabitants (but the lowest result of the upper range of 1,000,000 is also explained by the fact that many capitals are in the lower range). This figure is already confirmed in the DPSVI indicators (see Annex 1.2.1) and seems to be driven by the S3 - Datacy indicator, which would indicate a better data management capacity in cities with a larger population.

On the other hand, there do not seem to be clear correlations between the indices and the GDPpc (Figure 8 – Service Index per GDPpc), although it seems to appear a clear barrier for the cities that are placed in the lower range.

Calculating the value of the SI Index at the city level you lose detailed view of the behavior in the single service areas, but it is possible to observe spatial trends (Map 1 – Service Index and population size and Map 2 – Service Index and GDPpc). These maps seems toy confirm what has already been observed in the indicators that make up the DPSVI: a block of frontrunner cities in Belgium, the Netherlands, and the Baltic countries, followed by the major centers of the most populous countries such as France, Italy and Spain, while the central European regions do not present a definite pattern and a more critical area is detected in the south-oriental regions of Europe.

3 S1 – Advanced Technology

It reports the state of the art of the adoption and use of brand new and complex technologies as AI, IoT, Blockchain, Wearables, Robotics.

3.1 S1 - Definition and structure

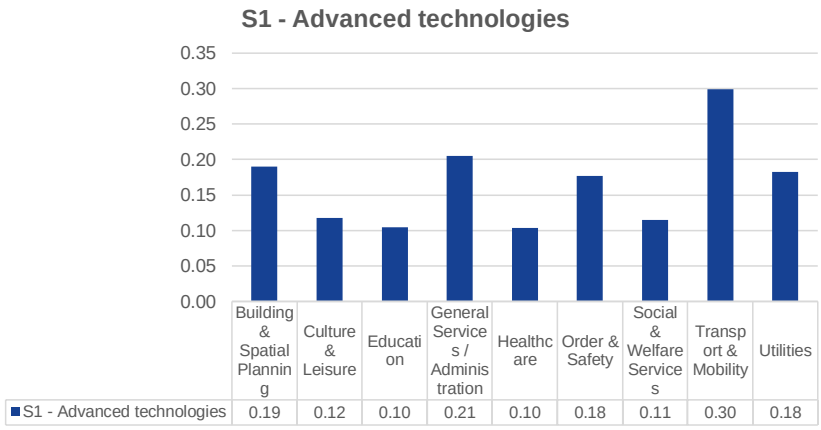


Figure 9 - S1 - Overview

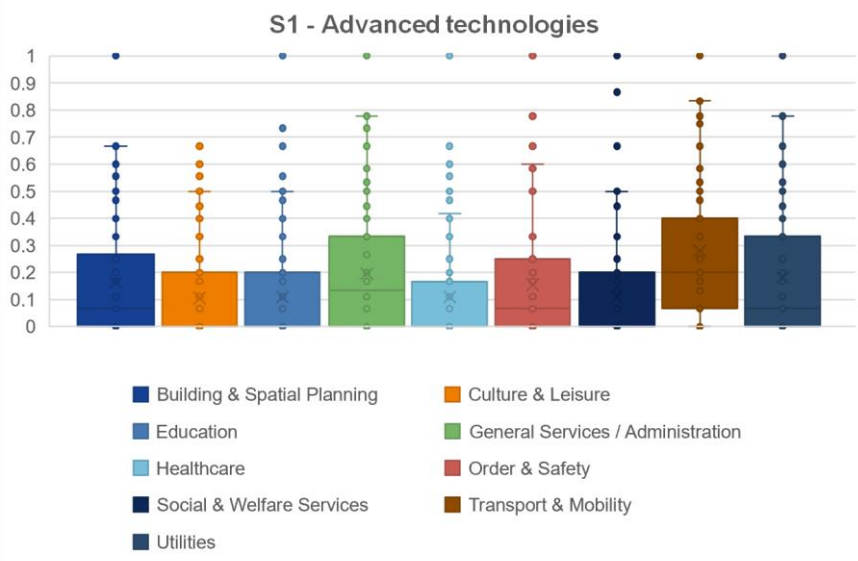


Figure 10 - S1 - Box Plot

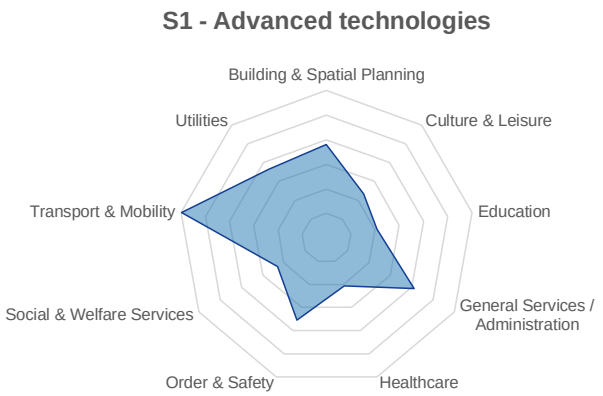
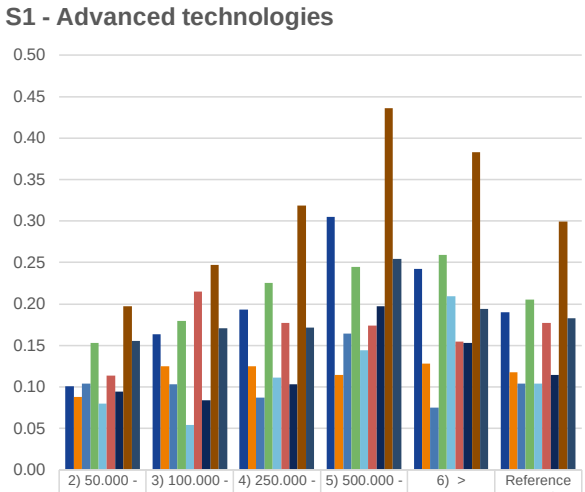


Figure 11 - S1 - Radar

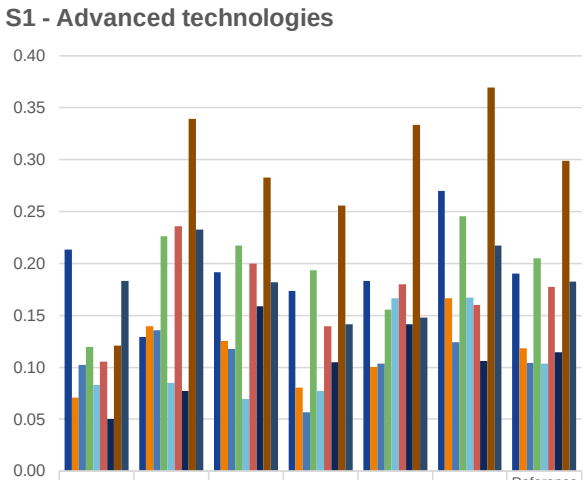
3.2 S1 - Population



	2) 50.000 - 100.000	3) 100.000 - 250.000	4) 250.000 - 500.000	5) 500.000 - 1.000.000	6) > 1.000.000	Reference Sample
S1_BS - Advanced technologies-Building & Spatial Planning	0.10	0.16	0.19	0.30	0.24	0.19
S1_CL - Advanced technologies-Culture & Leisure	0.09	0.12	0.12	0.11	0.13	0.12
S1_ED - Advanced technologies-Education	0.10	0.10	0.09	0.16	0.07	0.10
S1_GA - Advanced technologies-General Services / Administration	0.15	0.18	0.23	0.24	0.26	0.21
S1_HE - Advanced technologies-Healthcare	0.08	0.05	0.11	0.14	0.21	0.10
S1_OS - Advanced technologies-Order & Safety	0.11	0.22	0.18	0.17	0.15	0.18
S1_SW - Advanced technologies-Social & Welfare Services	0.09	0.08	0.10	0.20	0.15	0.11
S1_TM - Advanced technologies-Transport & Mobility	0.20	0.25	0.32	0.44	0.38	0.30
S1_UT - Advanced technologies-Utilities	0.16	0.17	0.17	0.25	0.19	0.18

Figure 12 - S1 – Population clusters

3.3 S1 - GDP per Capita



	< 10K	10K-20K	20K-30K	30K-40K	40K-50K	> 50K	Reference Sample
S1_BS - Advanced technologies-Building & Spatial Planning	0.21	0.13	0.19	0.17	0.18	0.27	0.19
S1_CL - Advanced technologies-Culture & Leisure	0.07	0.14	0.13	0.08	0.10	0.17	0.12
S1_ED - Advanced technologies-Education	0.10	0.14	0.12	0.06	0.10	0.12	0.10
S1_GA - Advanced technologies-General Services / Administration	0.12	0.23	0.22	0.19	0.16	0.25	0.21
S1_HE - Advanced technologies-Healthcare	0.08	0.08	0.07	0.08	0.17	0.17	0.10
S1_OS - Advanced technologies-Order & Safety	0.11	0.24	0.20	0.14	0.18	0.16	0.18
S1_SW - Advanced technologies-Social & Welfare Services	0.05	0.08	0.16	0.10	0.14	0.11	0.11
S1_TM - Advanced technologies-Transport & Mobility	0.12	0.34	0.28	0.26	0.33	0.37	0.30
S1_UT - Advanced technologies-Utilities	0.18	0.23	0.18	0.14	0.15	0.22	0.18

Figure 13 - S1 – GDPpc clusters

3.4 Highlights

This indicator is composed of a set of questions very similar to each other and all oriented to investigate the adoption of cutting-edge and relatively recent technologies. Consequently, the significantly low average score (Figure 9 - S1 - Overview) as well as the concentration of the vast majority of responses in the lower part of the spectrum (Figure 10 - S1 - Box Plot) should be interpreted as a signal that the actual level of embedment of these technologies remains relatively limited and carried out experimentally in a limited number of the cities surveyed in DIGISER.

There are significant differences between the different service areas that and Transport & Mobility area clearly looks more advanced than the other sectors. General Administration and Planning follows as in most indexes, but in this case at a larger distance.

Cluster analysis (Figure 12 - S1 – Population clusters and Figure 13 - S1 – GDPpc clusters) suggests that there is a correlation between the population of the responding cities and this index, while such a correlation is not observable if the responses are aggregated by GDP per capita.

4 S2 – Digitalization

It assesses the level of digitalization of each service area in core and ancillary services and the level of actual usage of digital services by citizens and users

4.1 S2 - Definition and structure

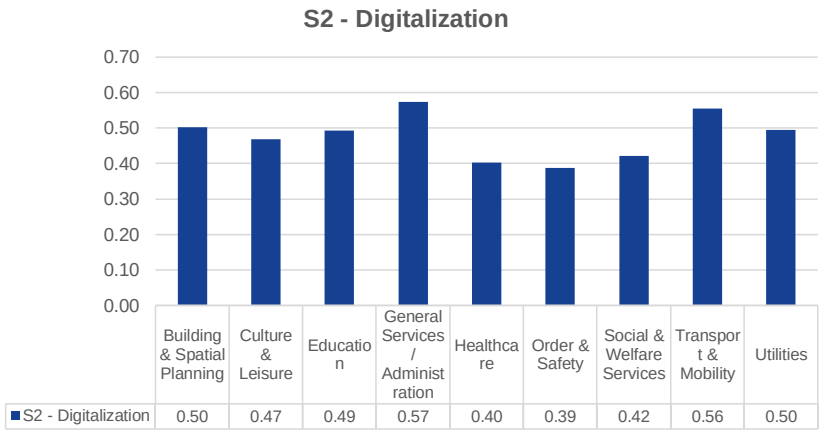


Figure 14 – S2 - Overview

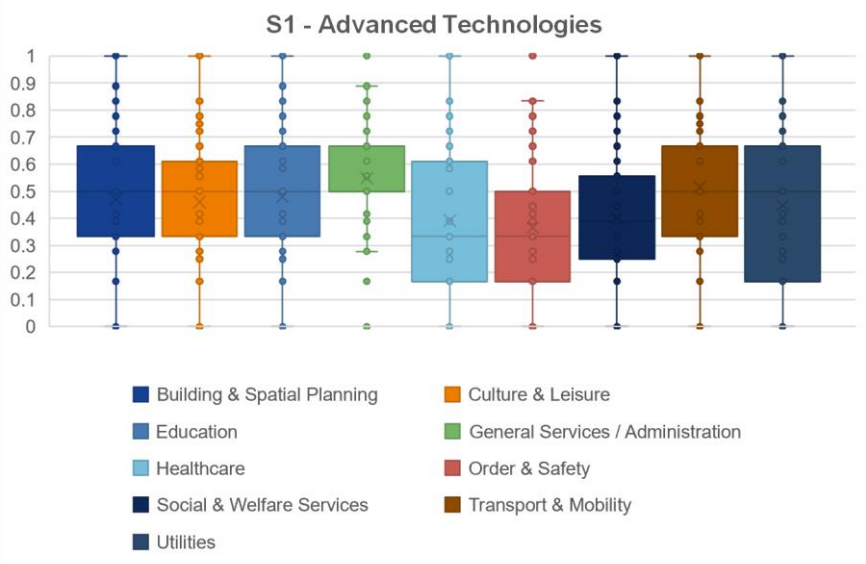


Figure 15 – S2 - Box Plot

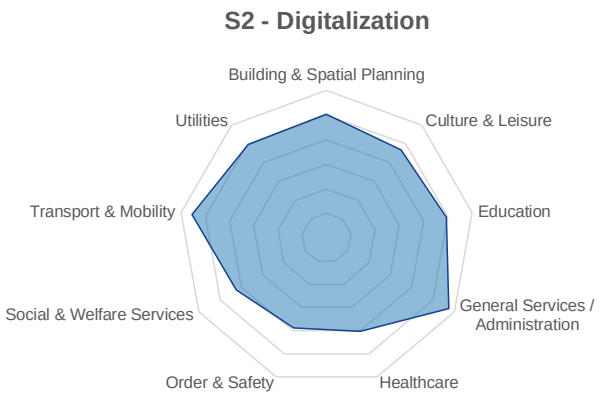
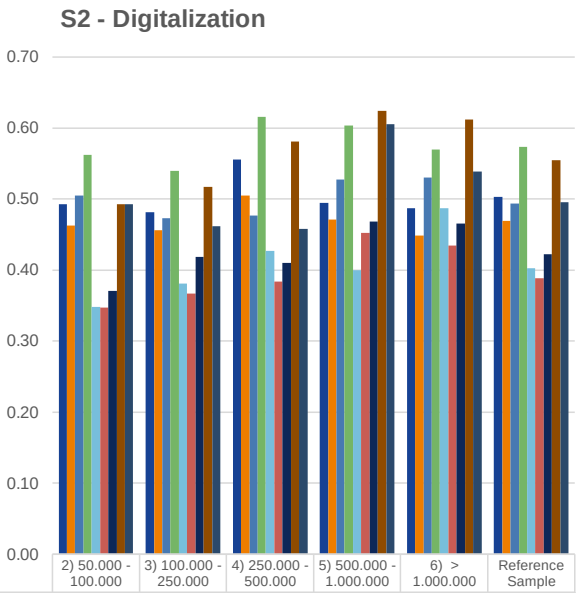


Figure 16 – S2 - Radar

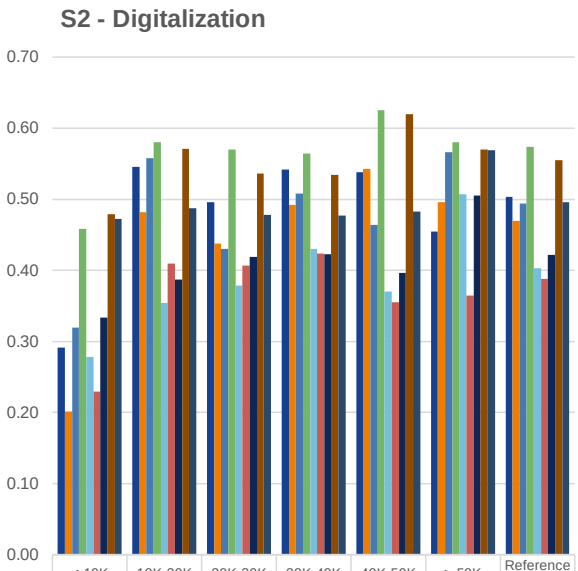
4.2 S2 - Population



	2) 50.000 - 100.000	3) 100.000 - 250.000	4) 250.000 - 500.000	5) 500.000 - 1.000.000	6) > 1.000.000	Reference Sample
S2_BS - Digitalization-Building & Spatial Planning	0.49	0.48	0.56	0.49	0.49	0.50
S2_CL - Digitalization-Culture & Leisure	0.46	0.46	0.50	0.47	0.45	0.47
S2_ED - Digitalization-Education	0.50	0.47	0.48	0.53	0.53	0.49
S2_GA - Digitalization-General Services / Administration	0.56	0.54	0.62	0.60	0.57	0.57
S2_HE - Digitalization-Healthcare	0.35	0.38	0.43	0.40	0.49	0.40
S2_OS - Digitalization-Order & Safety	0.35	0.37	0.38	0.45	0.43	0.39
S2_SW - Digitalization-Social & Welfare Services	0.37	0.42	0.41	0.47	0.47	0.42
S2_TM - Digitalization-Transport & Mobility	0.49	0.52	0.58	0.62	0.61	0.56
S2_UT - Digitalization-Utilities	0.49	0.46	0.46	0.61	0.54	0.50

Figure 17 - S2 – Population clusters

4.3 S2 - GDP per Capita



	< 10K	10K-20K	20K-30K	30K-40K	40K-50K	> 50K	Reference Sample
S2_BS - Digitalization-Building & Spatial Planning	0.29	0.55	0.50	0.54	0.54	0.45	0.50
S2_CL - Digitalization-Culture & Leisure	0.20	0.48	0.44	0.49	0.54	0.50	0.47
S2_ED - Digitalization-Education	0.32	0.56	0.43	0.51	0.46	0.57	0.49
S2_GA - Digitalization-General Services / Administration	0.46	0.58	0.57	0.56	0.63	0.58	0.57
S2_HE - Digitalization-Healthcare	0.28	0.35	0.38	0.43	0.37	0.51	0.40
S2_OS - Digitalization-Order & Safety	0.23	0.41	0.41	0.42	0.36	0.36	0.39
S2_SW - Digitalization-Social & Welfare Services	0.33	0.39	0.42	0.42	0.40	0.51	0.42
S2_TM - Digitalization-Transport & Mobility	0.48	0.57	0.54	0.53	0.62	0.57	0.56
S2_UT - Digitalization-Utilities	0.47	0.49	0.48	0.48	0.48	0.57	0.50

Figure 18 - S2 – GDPpc clusters

4.4 Highlights

This indicator focuses on the level of digitization of the different service areas and the real level of use of digital services by the reference population.

The first consideration is that the average level of digitization is quite high in almost all areas explored, (Figure 14 – S2 - Overview) with a frequency distribution (Figure 15 – S2 - Box Plot) concentrated around the center of the spectrum.

Considering the high scores recorded, it is particularly surprising the homogeneity between the different service areas that have fairly limited variations, as evidenced by the regularity of the shape drawn in the radar chart (Figure 16 – S2 - Radar).

While the ranking among service areas looks like similar to that observable in the other indexes, in this case the area with the highest performance is the General Services, demonstrating that the digitalization process has penetrated deeply even in the less specialized sectors of administration as well as in local societies, progressively removing the barriers that have characterized the dawn of the digitization of public services.

The analysis for clusters (Figure 17 - S2 – Population clusters and Figure 18 - S2 – GDPpc clusters) does not seem to highlight strong correlations and presents different behaviors for each service area. In any case, it seems that it is possible to identify in the clusterization by GDP per capita a threshold (10.000,00 € GDP per capita) below which the cities seem to be struggling in digitalization process.

5 S3 – Datacy

It focuses on the contribution of each service area to feed the open data ecosystem of their organization, as well as to their capacity to exploit the potential of open data and big data for service design and delivery

5.1 S3 - Definition and structure

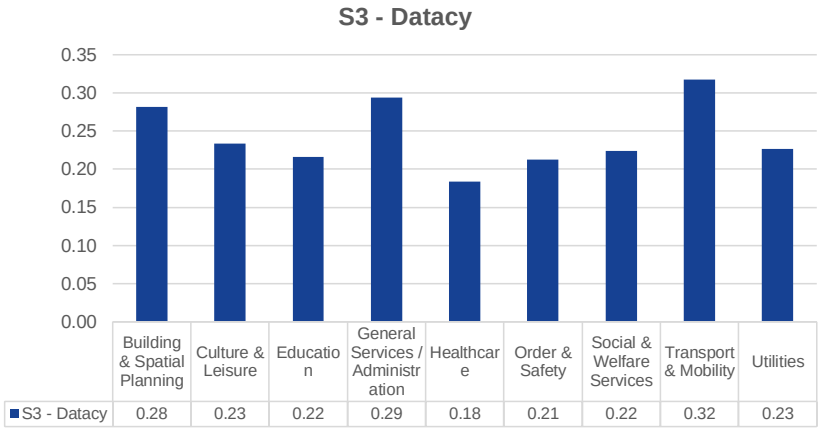


Figure 19 - S3 - Overview

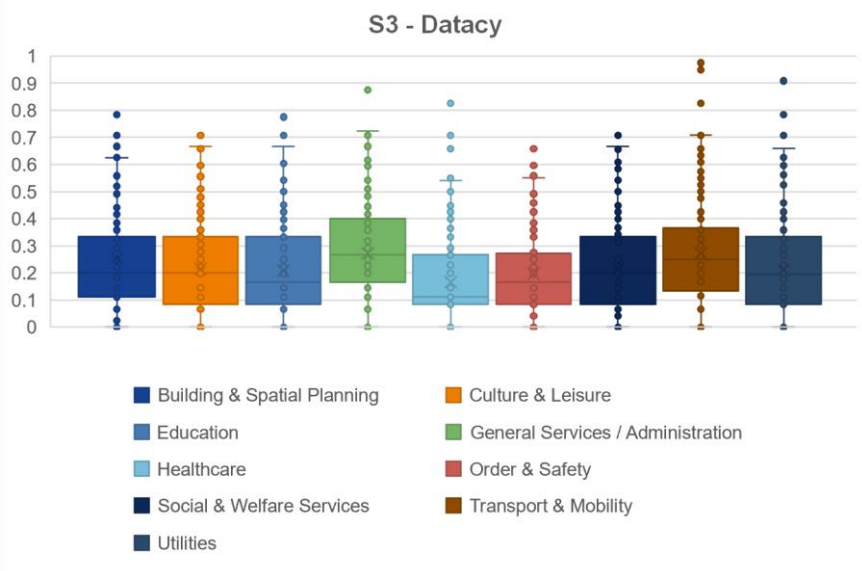


Figure 20 - S3 - Box Plot

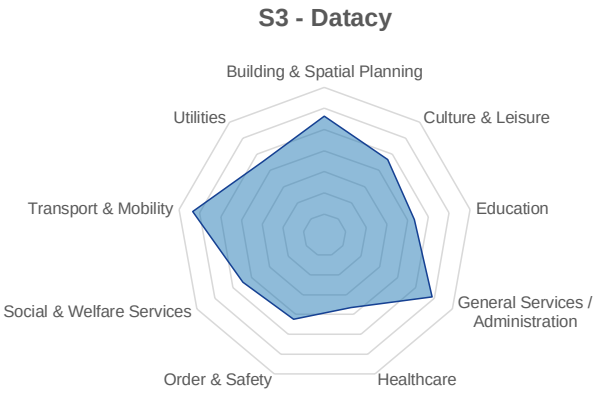
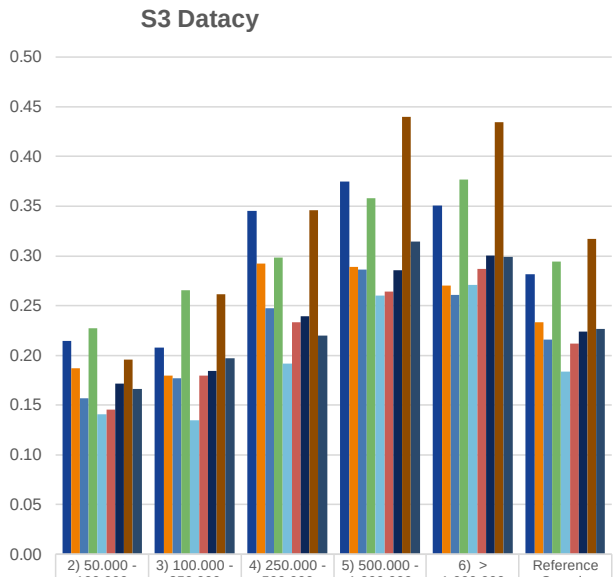


Figure 21 - S3 - Radar

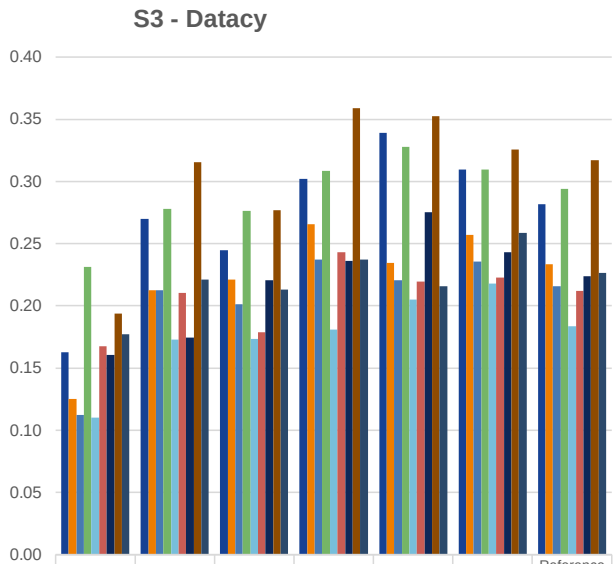
5.2 S3 - Population



	2) 50.000 - 100.000	3) 100.000 - 250.000	4) 250.000 - 500.000	5) 500.000 - 1.000.000	6) > 1.000.000	Reference Sample
S3_BS - Datacy-Building & Spatial Planning	0.21	0.21	0.35	0.37	0.35	0.28
S3_CL - Datacy-Culture & Leisure	0.19	0.18	0.29	0.29	0.27	0.23
S3_ED - Datacy-Education	0.16	0.18	0.25	0.29	0.26	0.22
S3_GA - Datacy-General Services / Administration	0.23	0.27	0.30	0.36	0.38	0.29
S3_HE - Datacy-Healthcare	0.14	0.13	0.19	0.26	0.27	0.18
S3_OS - Datacy-Order & Safety	0.15	0.18	0.23	0.26	0.29	0.21
S3_SW - Datacy-Social & Welfare Services	0.17	0.18	0.24	0.29	0.30	0.22
S3_TM - Datacy-Transport & Mobility	0.20	0.26	0.35	0.44	0.43	0.32
S3_UT - Datacy-Utilities	0.17	0.20	0.22	0.31	0.30	0.23

Figure 22 - S3 – Population clusters

5.3 S3 - GDP per Capita



	< 10K	10K-20K	20K-30K	30K-40K	40K-50K	> 50K	Reference Sample
S3_BS - Datacy-Building & Spatial Planning	0.16	0.27	0.24	0.30	0.34	0.31	0.28
S3_CL - Datacy-Culture & Leisure	0.13	0.21	0.22	0.27	0.23	0.26	0.23
S3_ED - Datacy-Education	0.11	0.21	0.20	0.24	0.22	0.24	0.22
S3_GA - Datacy-General Services / Administration	0.23	0.28	0.28	0.31	0.33	0.31	0.29
S3_HE - Datacy-Healthcare	0.11	0.17	0.17	0.18	0.20	0.22	0.18
S3_OS - Datacy-Order & Safety	0.17	0.21	0.18	0.24	0.22	0.22	0.21
S3_SW - Datacy-Social & Welfare Services	0.16	0.17	0.22	0.24	0.28	0.24	0.22
S3_TM - Datacy-Transport & Mobility	0.19	0.32	0.28	0.36	0.35	0.33	0.32
S3_UT - Datacy-Utilities	0.18	0.22	0.21	0.24	0.22	0.26	0.23

Figure 23 - S3 – GDPpc clusters

5.4 Highlights

This indicator is built upon questions that explore in detail the level of command of public authorities over data management processes in different areas of public services, analyzing in detail how data is collected, generated, shared and used.

Figure 19 - S3 - Overview shows how this indicator presents averagely low results (even if above those of S1) with the service areas that are placed in two distinct bands: on the one hand Transport & Mobility, General Services and Building & Spatial Planning stand - in this order- around a score of 0.3, while all the others oscillate around 0.2. (Figure 21 - S3 - Radar).

In this case is visible a correlation with the population that appears very linear for the service areas of the highest end (precisely Transport & Mobility, General Services and Building & Spatial Planning) while for the others a threshold seems to appear between the cities above and below 250,000 inhabitants (Figure 22 - S3 – Population clusters).

The relationship between this index and the GDP per capita (Figure 23 - S3 – GDPpc clusters) seems more contradictory, even if a discriminating threshold around 10.000 € already observed in other indicators is observable.

6 S4 – Knowledge exchange

It explores the role of each service area in disseminating, sharing, and exchanging knowledge regarding digital innovation both within the organization and with other public organizations

6.1 S4 - Definition and structure

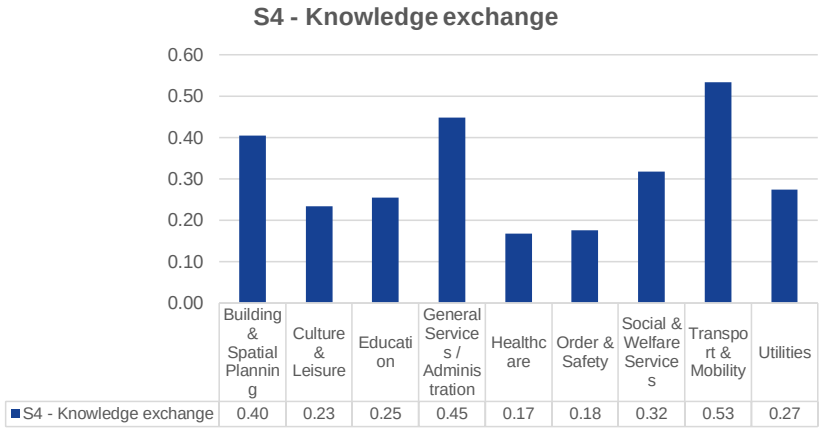


Figure 24 - S4 - Overview

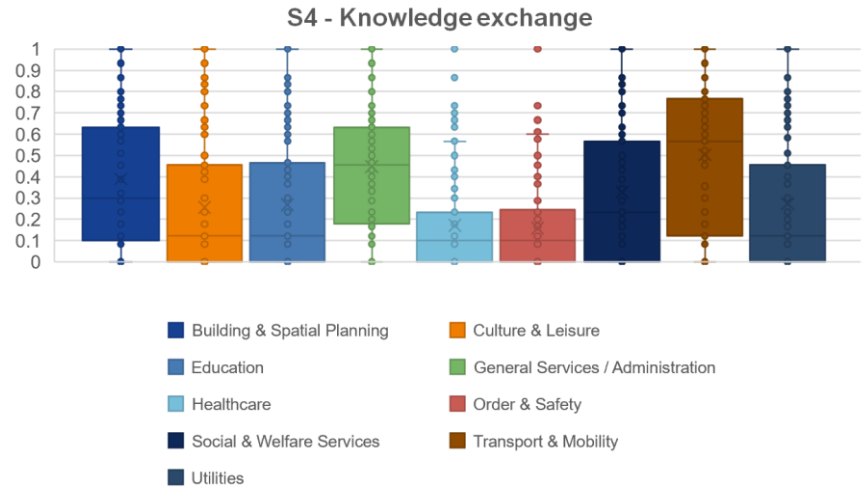


Figure 25 - S4 - Box Plot

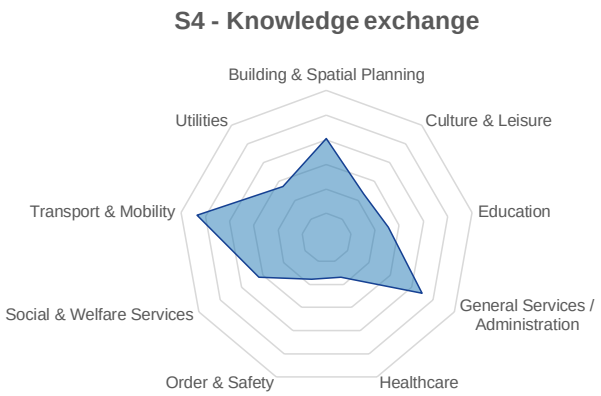
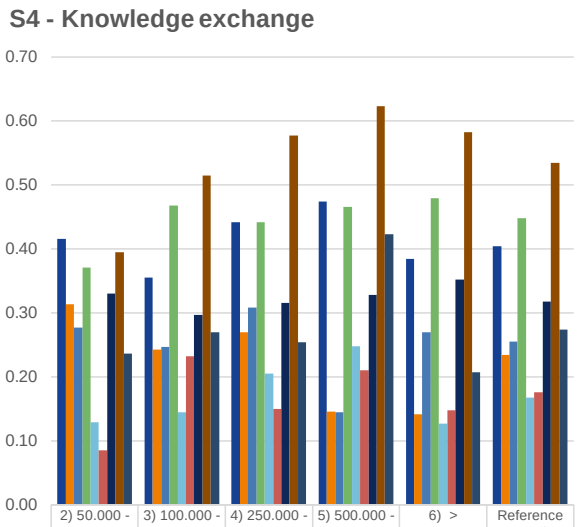


Figure 26 - S4 - Radar

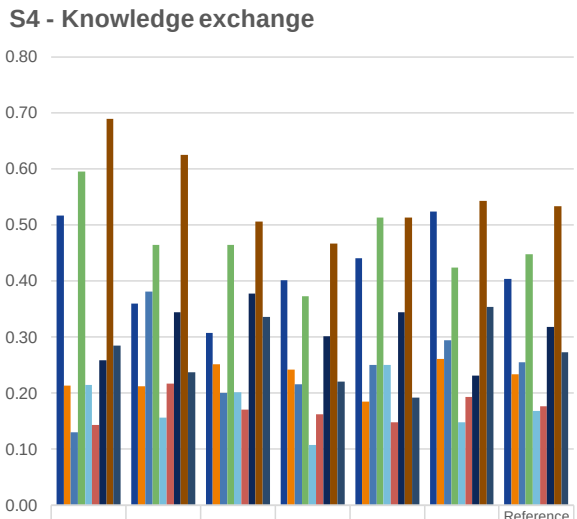
6.2 S4 - Population



	2) 50.000 - 100.000	3) 100.000 - 250.000	4) 250.000 - 500.000	5) 500.000 - 1.000.000	6) > 1.000.000	Reference Sample
S4_BS - Knowledge exchange-Building & Spatial Planning	0.42	0.36	0.44	0.47	0.38	0.40
S4_CL - Knowledge exchange-Culture & Leisure	0.31	0.24	0.27	0.15	0.14	0.23
S4_ED - Knowledge exchange-Education	0.28	0.25	0.31	0.14	0.27	0.25
S4_GA - Knowledge exchange-General Services / Administration	0.37	0.47	0.44	0.47	0.48	0.45
S4_HE - Knowledge exchange-Healthcare	0.13	0.14	0.21	0.25	0.13	0.17
S4_OS - Knowledge exchange-Order & Safety	0.09	0.23	0.15	0.21	0.15	0.18
S4_SW - Knowledge exchange-Social & Welfare Services	0.33	0.30	0.32	0.33	0.35	0.32
S4_TM - Knowledge exchange-Transport & Mobility	0.40	0.51	0.58	0.62	0.58	0.53
S4_UT - Knowledge exchange-Utilities	0.24	0.27	0.25	0.42	0.21	0.27

Figure 27 - S4 – Population clusters

6.3 S4 - GDP per Capita



	< 10K	10K-20K	20K-30K	30K-40K	40K-50K	> 50K	Reference Sample
S4_BS - Knowledge exchange-Building & Spatial Planning	0.52	0.36	0.31	0.40	0.44	0.52	0.40
S4_CL - Knowledge exchange-Culture & Leisure	0.21	0.21	0.25	0.24	0.18	0.26	0.23
S4_ED - Knowledge exchange-Education	0.13	0.38	0.20	0.22	0.25	0.29	0.25
S4_GA - Knowledge exchange-General Services / Administration	0.60	0.46	0.46	0.37	0.51	0.42	0.45
S4_HE - Knowledge exchange-Healthcare	0.22	0.16	0.20	0.11	0.25	0.15	0.17
S4_OS - Knowledge exchange-Order & Safety	0.14	0.22	0.17	0.16	0.15	0.19	0.18
S4_SW - Knowledge exchange-Social & Welfare Services	0.26	0.34	0.38	0.30	0.34	0.23	0.32
S4_TM - Knowledge exchange-Transport & Mobility	0.69	0.63	0.51	0.47	0.51	0.54	0.53
S4_UT - Knowledge exchange-Utilities	0.28	0.24	0.34	0.22	0.19	0.35	0.27

Figure 28 - S4 – GDPpc clusters

6.4 Highlights

This indicator uses three very different questions to explore the extent to which the different service areas are protagonists within local, national and international networks aimed at the exchange of digital solutions and at the replication of technological and organizational innovations that have been successful in homogeneous contexts.

Figure 24 - S4 - Overview and *Figure 26 - S4 - Radar* show substantial differences between the different service areas to a greater extent than in the other cases. Also in this case the three areas of Transport & Mobility, General Services and Building & Spatial Planning are ranked at the upper end (although with considerable differences between them). At the opposite the performance of education services and especially of utility companies appear particularly negative, considering that the latter – at least theoretically – are subjects that should push towards the construction of intermunicipal synergies and integration strategies aimed at increase efficiency.

The distribution of the underlying responses to this indicator also has a remarkable differentiation, which photographs a very varied behavior of the responding cities, with very different exchange and networking capacities (Figure 25 - S4 - Box Plot).

The index appears to be in fairly linear correlation with the population, at least as far as the leading service areas are concerned (Figure 27 - S4 – Population clusters).

The data relating to the breakdown of the sample by GDPpc bands is instead quite surprising, with the three service areas Transport & Mobility, General Services and Building & Spatial Planning that perform very well in cities with a lower GDPpc and in particular in the lower range, which in all other indicators is always very penalized (Figure 28 - S4 – GDPpc clusters).

Observing that this phenomenon concerns in particular the three leading service areas, it can be hypothesized that smaller cities are prone to the transposition and local replication of technological and organizational innovations successfully tested elsewhere, and that these three service areas are those in which the level of standardization and consolidation of technical and methodological solutions has reached the greatest maturity and adaptability.

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