ESPON

EUROPEAN UNION

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Inspire Policy Making with Territorial Evidence

DIGISER

Digital Innovation in Governance and Public Service Provision

Annex 1.2.7 Institutional Capacity Report // April 2022

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FINAL REPORT //

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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 156 cities intended to be the best approximation attainable that could be considered as representative of the variety of European cities.

1 Introduction

This document present one part of the results of the analysis of the DPSVI, the Digital Public Service Value Index.

One of the main goals of DIGISER has been indeed 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 1.1 Extended Methodology.*

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.

1.1 DPSVI Definition and structure

The DPSVI and its other sub-indices are meant to be a concise **measurement of the performance of each city** with respect to several phenomena, that are explored through the combination and cross-checking of the answers to several single questions.

The core data model for the computation of the DPSVI, developed on top of the conceptual framework described in the *Annex 1.1 Extended Methodology,* is represented in the following picture:

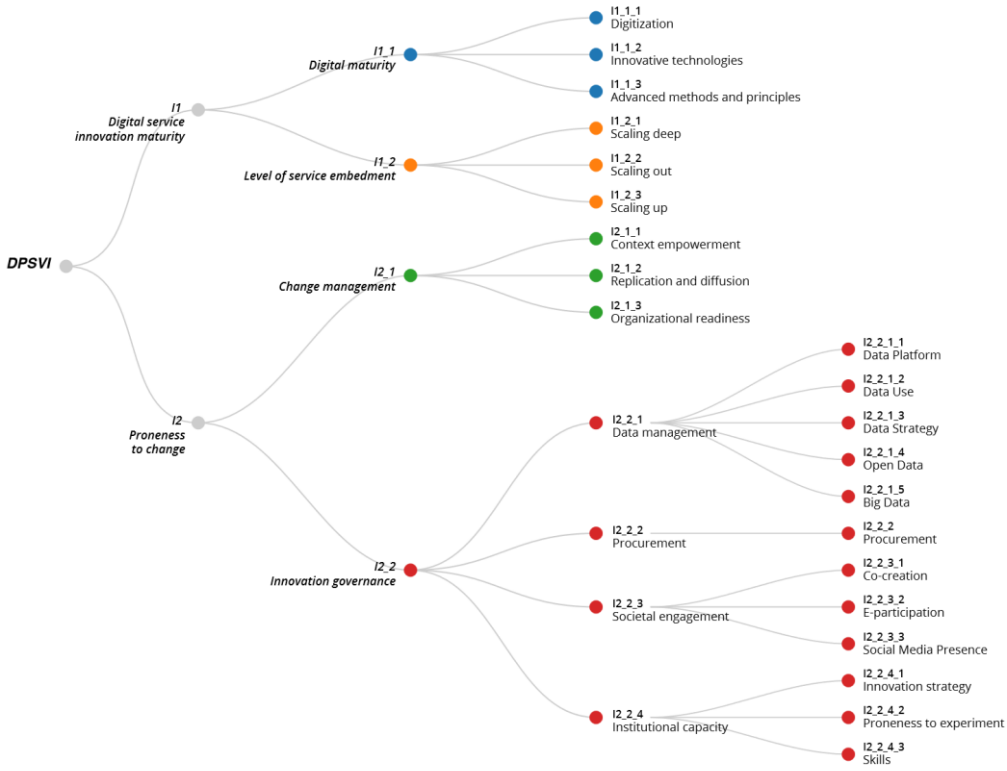


Figure 1 - DPSVI Structure

Overall, the DPSVI is composed of 31 Composite indexes that are organized in three groups (cfr. Table 1 - Composite indexes of DPSVI:

- 3 Top Indexes: are the apical indexes including the DPSVI itself and the two pillars (I1 DIGITAL SERVICE INNOVATION MATURITY and I2 PRONENESS TO CHANGE)
- 21 Bottom Indexes: the indexes directly generated on top of DIGISURVEY data
- 7 Intermediate Indexes: the other indexes in intermediate positions

Code	Label	Level	Description
I1	**DIGITAL SERVICE INNOVATION MATURITY**	**Top**	**It explores the degree of penetration and maturity of technical and organizational innovation in public service delivery**
I1_1	Digital maturity	Intermediate	It assesses the level of digitalization of the public authority, intended not only as shift toward digital technologies, but also encompassing the related organizational change, namely the delivery of innovative public services
I1_1_1	Digitization	Bottom	It focuses on the degree of digitization of pre-existing internal procedures either ancillary or directly related to public service delivery
I1_1_2	Innovative technologies	Bottom	It explores the degree of adoption of innovative technologies (AI, blockchain, wearables, etc.)
I1_1_3	Advanced methods and principles	Bottom	It analyses the level of consistency of methods and principles used to increase the digitalization level of the public authority
I1_2	**Level of service embedment**	Intermediate	It indicates the extent to which the innovation of services is pervasive and has already generated changes
I1_2_1	Scaling deep	Bottom	It indicates the extent to which the innovation of services is pervasive and has already generated changes in the local context, at societal level
I1_2_2	Scaling out	Bottom	It indicates the extent to which the innovation of services has already generated changes either by replicating successful innovations from other contexts or exported elsewhere the innovations experimented locally
I1_2_3	Scaling up	Bottom	It indicates the extent to which the innovation of services is pervasive and has already generated changes within the organization of the public authority
I2	**PRONENESS TO CHANGE**	**Top**	**It assesses the inclination or readiness of the public authority to change and alter its behaviour, vision, procedures, and its preparedness to integrate and amplify innovations**
I2_1	Change management	Intermediate	The capacity of public administrations to put in play a set of actions, norms, policies, and tools either to proactively support innovation in digital service development and provision, or to increase its capacity to detect and adopt innovation dynamics developed in different contexts (within the context, or towards or from other contexts).
I2_1_1	Context empowerment	Bottom	It measures the effectiveness of the strategies, developed by the public authority, to ensure impacts of innovation within in the local context, at societal level, e.g. instillation of cultural values oriented to innovation and change; encouragement for the development of sustainable relationships
I2_1_2	Replication and diffusion	Bottom	It measures the effectiveness of the strategies developed to ensure replicability in other contexts to the innovations experimented locally, so to impact a larger number of citizens or communities
I2_1_3	Organizational readiness	Bottom	It measures the effectiveness of the strategies developed to ensure impacts of innovation within the organization of the public authority
I2_2	Innovation governance	Intermediate	It refers to the way in which the public authority uses transversal administrative processes (data management, societal engagement, public procurement, capacity building) as a leverage to promote cross-sectoral digital innovation
I2_2_1	Data management	Intermediate	It assesses the innovation capacity of data management strategies used by the public organization
I2_2_1_1	*Data Platform*	Bottom	It assesses the features of the data platform and the consistency between data management strategy and its underlying technical infrastructure
I2_2_1_2	*Data Use*	Bottom	It explores, from an operational perspective, how data are used by the public administration for the purposes of evaluation and monitoring, delivery, and anticipation and planning.

Code	Label	Level	Description
I2_2_1_3	*Data Strategy*	Bottom	It investigates whether the definition and the embrace of governance models effectively set appropriate and favorable conditions for data-driven, data-informed, or data-aware decisions and services for creating public value.
I2_2_1_4	*Open Data*	Bottom	It provides an overview of the degree of application of open data principles, practices, and framework, that are meant to improve performance and efficiency of government services in general
I2_2_1_5	*Big Data*	Bottom	It refers to the capacity of the city to generate, manage and use big data
I2_2_2	Procurement	Bottom	It assesses the level of digitalization of the public procurement processes within the public authority and their orientation to digital innovation
I2_2_3	Societal engagement	Intermediate	It provides an overview of the intensity and level of digitalization of societal engagement policies, and their impact on public service design and innovation
I2_2_3_1	*Co-creation*	Bottom	It gives the level of involvement of the citizens in service design and innovation
I2_2_3_2	*E-participation*	Bottom	It refers to the level reached by the municipality in involving citizens and/or communities through digital platforms
I2_2_3_3	*Social Media Presence*	Bottom	It provides information about how pervasive is the communication via social media by the municipality
I2_2_4	Institutional capacity	Intermediate	It refers to the institutional capacity of the public authority in relation to the experimentation and consolidation of digital innovation
I2_2_4_1	*Innovation strategy*	Bottom	It provides information about the agenda setting and pursuing capacity in relation to digital innovation strategies
I2_2_4_2	*Proneness to experiment*	Bottom	It analyses the readiness to experiment new organizational settings and methods within the public authority
I2_2_4_3	*Skills*	Bottom	It assesses the availability, within the public authority, of skills as key to the management of digital innovation

Table 1 - Composite indexes of DPSVI

1.2 DPSVI Methodology

The computation of indexes followed three steps.

- **Mapping** In this first step the DIGSURVEY's questions and answers are mapped to the indexes
- **Standardization**: this second step aims at transforming each question mapped to an index in a standardized value on the scale 0,00-1,00, converting the raw answers provided by the cities into numerical values via data coding and/or standardization techniques.
- **Aggregation**: in this final step the standardized numerical values obtained from the questions are aggregated and combined into indexes according to the hierarchy established in the Data Model. The value of indexes corresponds to a weighted average of the values of the questions aggregated.

1.2.1 Mapping questions and answers

The first step of data processing has been the detailed mapping of questions to the 21 Bottom Indexes, that are the ones directly generated on top of the raw data collected with the Digisurvey, while the other indexes are resulting from a successive aggregation between composite indexes.

Figure 2 maps the detailed relation between the questions of the DIGISURVEY and the DPSVI structure and represents the logical basis for the statistical aggregation of data. Chapter 2 includes a detailed description of the branch analysed in this document.

It is important to clarify that in several cases only a limited number of answers (of a given questions) have been mapped to indexes. In this manner the same question could have been used more than once but considering each time only a limited set of possible answers to which has been attributed a different meaning (and consequently a different numeric value). In summary the same question could have been standardized in different manners according to the indexes to which it is associated.

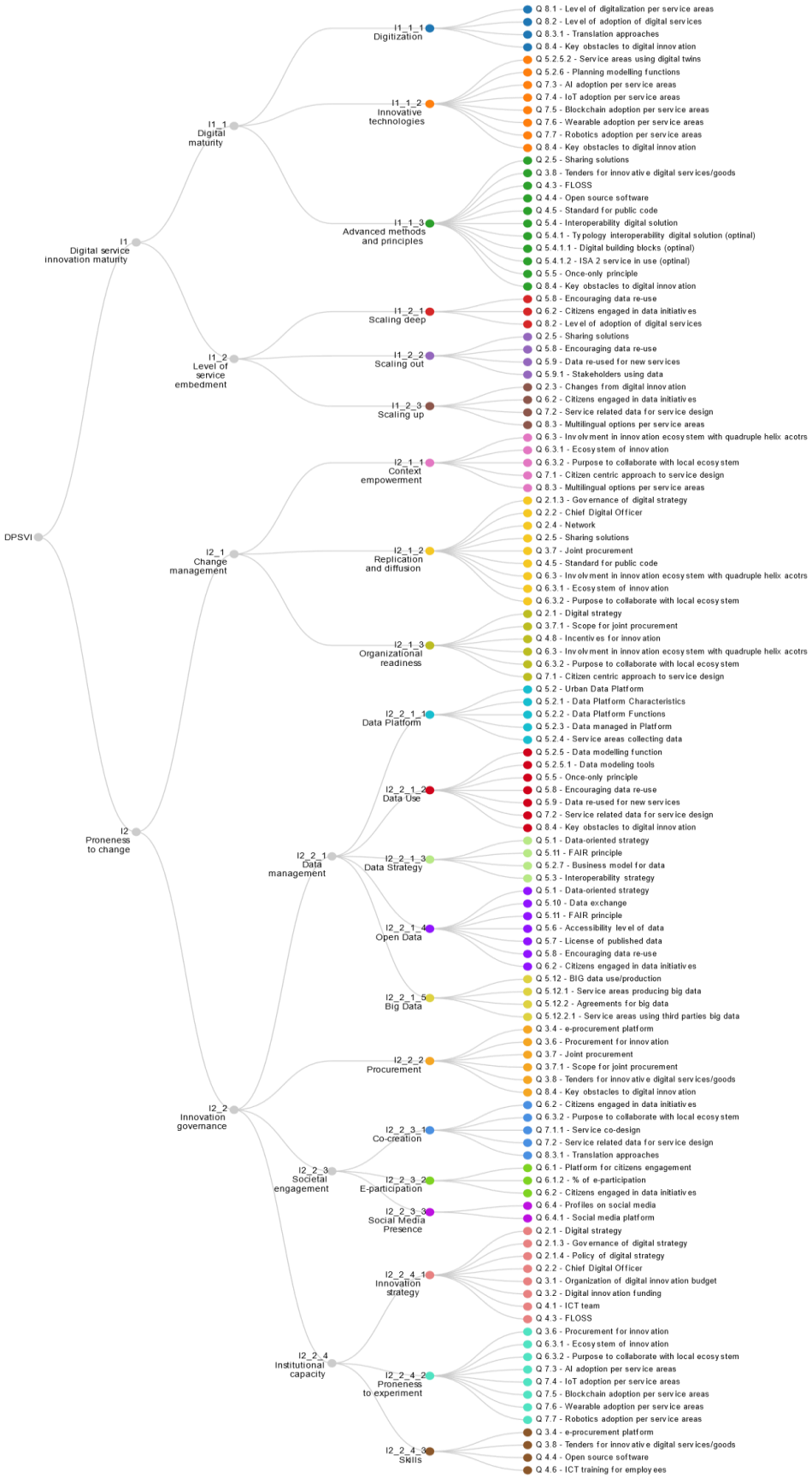


Figure 2 - DPSVI detailed structure – Questions

1.2.2 Standardization

To render the information gathered via the questionnaire processable via computational methods, each question, or group of answers, has been transformed into a number.

In practice, raw data have been 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.

This operation is usually performed in an ad-hoc way, given the specificities of each item of the questionnaire. Nevertheless, the following table provides a synthesis of the methods for data standardization adopted for each category of question.

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.
Scalars	Normalised using external values (population, size of municipality) if representative of relative phenomena
Matrix – Service Level	Converted into dummies, then summed by column (i.e., process level), finally normalised over number of digitalised services

Table 2 - Standardization methods overview

The *Annex 1.1 Extended Methodology* **i**ncludes all the information related to the standardization process underlying the DPSVI, including the detailed map of answers to indices and the weight attributed to each answer for standardization purposes.

Before aggregating the numeric answers, these have been rescaled 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.

1.2.3 Aggregation

In this final phase the standardized values computed on top of the answers to DIGISURVEY questions, are aggregated via a mathematical procedure, with the goal of finally creating the indexes.

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 table published in chapter 2 illustrates the different relative weight attributed to each of the question composing the indexes presented in this document.

1.3 Technical note: how to read charts

This report includes a large number of charts and maps that are generated on top of the indexes that make up the DPSVI and in some cases referred to the same underlying questions. This chapter explains how to interpret the legend that accompanies the publication of charts and maps.

1.3.1 Key info for DPSVI charts and Maps

The charts used to represent DPSVI indexes are relatively simple, being limited to radars, columns, box plots. All charts include a legend reporting the following key information:

Index observed	Index type	Index level	Data Sample	Cluster
Indicates the code and the label of the index observed	*Indicates the type of index as either:* • DPSVI • SI	*Indicates the Index position in its Data model:* • Top • Intermediate • Bottom	*Indicates the sample that the data refers to* • All respondents • Reference sample	*Indicates the series showed in the charts and listed in the legend* • Capital cities • Reference sample • Population • GDPPC • Country

Table 3 – Index charts legend

1.3.1.1 Index type

This information identifies the family of index, being either part of the DPSVI tree (Digital Public Value Service Index) or of the SI tree (Service Areas Index)

1.3.1.2 Index type

This information identifies the position of the index in its data model (cfr. Figure 1 - DPSVI Structure)

- **Top**: refers to the three apical indexes, built on top of all the other indexes:
    - DPSVI
    - Digital Service Innovation Maturity
    - Proneness to Change
- **Bottom**: refers to all the indexes generate directly from questions (cfr Figure 2 - DPSVI detailed structure – Questions)
- **Intermediate**: all the other indexes composed by indexes

1.3.1.3 Data sample

This information identifies the sample on top of which data are computed:

- The "**All respondents" sample** is composed by **all the 255 respondent cities** with the exclusion of duplicate questionnaire coming from the same authority (same city at the same administrative level).
- The "**Reference" sample** is composed by a **selection of 155 respondents**. The reference sample is intended to be the best approximation attainable that could be considered as representative of the variety of European cities.

1.3.1.4 Cluster

Data can be grouped in clusters showed as series in the charts and listed in the legend. The cluster considered in the report could be the followings:

- **None**: no cluster, the data refers to the entire sample
- **Capital cities**: comparing the results of capital cities with all the other respondents.
- **Reference sample**: compared results of reference sample and all other respondents.

- **Population**: compared results among cities by population size
- **GDPPC**: compared results among cities by GDP per capita size
- **Country**: compared results among countries
- **Authority Type**: compared results among different types of local government
- **Case Studies**: 10 selected cities also surveyed through qualitative methods

In few cases cluster and possible answers can be switched, in this case the chart visualizes cluster class on the y-axis and the possible answers as chart series.

1.3.2 Key info for Q charts

In few cases the report presents charts referring to some of the questions that make up the indices. The charts used to present questions are relatively simple, being limited to bars and columns, represented in simple, stacked and 100% stacked formats.

All charts include a summary table reporting the following key information:

Question observed	Question type	Data Sample	Clusters	Value
Indicates the code and the label of the question observed	*Indicates the question typology and whether it is a matrix* • Single choice • Single choice - Binary • Single choice - Likert • Multiple choice • Matrix - Single choice • Matrix - Likert • Matrix - Multiple choice	*Indicates the sample that the data refers to* • All respondents • Reference sample	*Indicates the series showed in the charts and listed in the legend* • Capital cities • Reference sample • Population • GDPPC • Country	*Indicates the units in which the data are represented* • Count • Percentage

Table 4 – Question charts legend

1.3.2.1 Question type

Within the two macro-categories of simple and matrix questions it is possible to further distinguish between the following kind of questions, each one collecting data in a different manner:

Simple questions typologies:

- *Single choice – Binary*: One single choice between “Yes” or “No”
- *Single choice – Likert*: One choice among items in a Likert scale
- *Single choice*: One choice among all the possible answers
- *Multiple choice*: Possibility to select multiple answers

Matrix question typologies:

- *Matrix - Single choice*: Possibility to select just one answer (column) per row
- *Matrix – Likert*: Possibility to select just one answer per row. The columns are organized as a Likert scale
- *Matrix - Multiple choice*: Possibility to select multiple answers per row.

1.3.2.2 Data sample

This information identifies the sample on top of which data are computed. The samples used for the question charts are the same used for the Indexes (cfr. 1.3.1.3)

1.3.2.3 Cluster

Data can be grouped in clusters showed as series in the charts and listed in the legend. The cluster explored by the report are the same used for the Indexes (cfr. 1.3.1.4).

1.3.2.4 Value

The value indicates the units in which the data are represented along the x-axis.

The data could be represented as:

- *Count*: DPSVI number that select a particular answer
- *Percentage*: relative number of respondents that select that answer.

In the case of clustered bar charts, the percentage is based on the number of respondents to that specific question. In the case of 100% stacked bar, the percentage is based on the total number of selections received by that answer (row ‘s percentage). The percentage could also be based on the total number of selections received by the question.

2 Institutional Capacity of European Cities

2.1 Definition of the indices and exploration of its structure

Institutional capacity is strongly related to transformation drivers, organisational ones included, capable of influencing the adoption and management of digital technologies. It entails both training and educational activities put in play to enhance the digital skills of civil servants. Moreover, it affects the proneness of public administrations to enhance and mobilise their organisational and technological resources through the adoption of ICT technologies or the modification of internal rules and procedures. Institutional capacity considers therefore dimensions as Innovation strategies, Proneness to experiment, Skills and competences related to both digital management and information, and communication technology.

This is an *Intermediate Level* Index, composed by three *Bottom Level* Indexes:

- **I2.2.4.1 - Innovation strategy**: It provides information about the agenda setting and pursuing capacity in relation to digital innovation strategies
- **I2.2.4.2 - Proneness to experiment**: It analyses the readiness to experiment new organizational settings and methods within the public authority
- **I2.2.4.3 – Skills**: It assesses the availability within the public authority of skills key to the management of digital innovation

2.1.1 Mapping Details

The following figure and table include the detailed list of the questions that have been mapped to this index and its sub-indexes, according to the methodology explained in Chapter 1.2.1

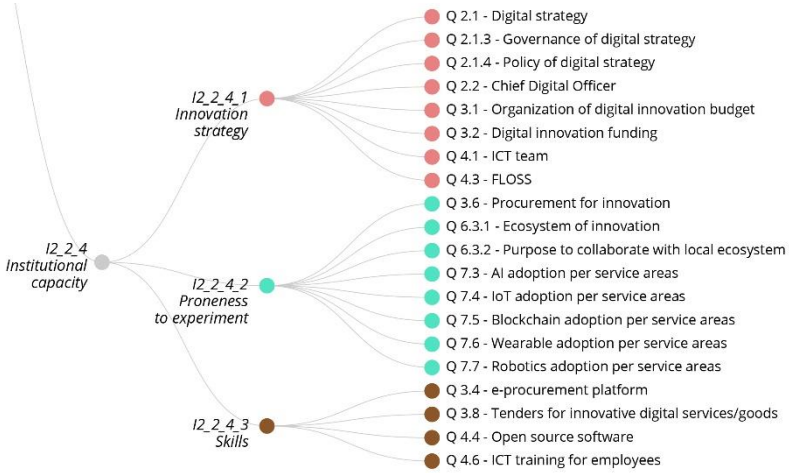


Figure 3 – Institutional Capacity index composition (questions tree)

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

Question number and text	Question Type
2.1 Has your public authority formally approved and published a digital innovation strategy (also digital transformation strategy, smart city strategy or similar)?	Single choice
2.1.3 What is the governance of the digital innovation strategy?	Multiple choice
2.1.4 Was the development of the strategy linked to regional, national or European regulatory frameworks, strategies, directives (such as, for example on EU level: the INSPIRE directive, EU Data Directive, Tallinn declaration, living.in.eu declaration, smart specialisation strategies, etc)?	Single choice

Question number and text	Question Type
2.2 Does your public authority have a Chief Digital Officer (or similar position such as Chief Information Officer / Chief Innovation Officer, etc) coordinating the implementation of the digital innovation strategy?	Single choice
3.1 How is the budget for digital innovation organised in your public authority?	Single choice
3.2 What are the key funding sources for digital innovation in your public authority? :	Matrix - Likert
3.4 Does your public authority have or use an e-procurement platform?	Single choice
3.6 If any, which of the following public procurement procedures did your public authority run - in addition to standard procurement procedures?	Matrix - Single choice
3.8 Are the tenders for procuring innovative digital services/goods including the following requirements?	Multiple choice
4.1 Does your public authority have:	Single choice
4.3 Does your public authority encourage the use of Free/Libre and Open Source Software (FLOSS)?	Single choice - Binary
4.4 Does the authority's IT set-up offer the possibility to implement open source alternatives?	Single choice - Binary
4.6 Does your public authority provide ICT training to its employees?:	Matrix - Single choice
6.3.1 If yes, please select as many organisations as apply from the list below	Multiple choice
6.3.2 What is the purpose for your public authority to collaborate with the local ecosystem?	Multiple choice
7.3 State for each service area if the adoption of Artificial Intelligence technology is planned, implemented, not planned or not applicable:	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:	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:	Matrix - Single choice
7.6 State for each service area if the adoption of wearable technology is planned, implemented, not planned or not applicable:	Matrix - Single choice
7.7 State for each service area if the adoption of robotics technology is planned, implemented, not planned or not applicable:	Matrix - Single choice

Table 5 – Institutional Capacity related Questions in DIGISURVEY

The *Annex 1.1 Extended Methodology* to the DIGISER Final Report hosts a dedicated Appendix (Appendix I) with all the information related to the standardization process underlying the DPSVI, including the detailed map of answers to indices and the weight attributed to each answer for standardization purposes.

2.1.2 Aggregation details

The following table provides information regarding the weights attributed to each question in computing the value of the indexes presented in this report, according to the methodology presented in Chapter 1.2.3.

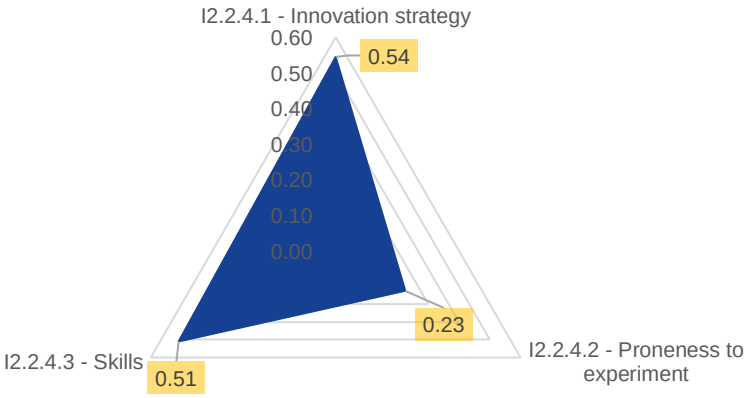
Q_#	I2_2_4_1	I2_2_4_2	I2_2_4_3
Q_2.1	100%	-	-
Q_2.1.3	100%	-	-
Q_2.1.4	100%	-	-
Q_2.2	100%	-	-
Q_3.1	100%	-	-
Q_3.2	100%	-	-
Q_3.4	-	-	10%
Q_3.6	-	25%	-
Q_3.8	-	-	30%

Q_#	I2_2_4_1	I2_2_4_2	I2_2_4_3
Q_4.1	100%	-	-
Q_4.3	100%	-	-
Q_4.4	-	-	30%
Q_4.6	-	-	30%
Q_6.3.1	-	13%	-
Q_6.3.2	-	13%	-
Q_7.3	-	10%	-
Q_7.4	-	10%	-
Q_7.5	-	10%	-
Q_7.6	-	10%	-
Q_7.7	-	10%	-

Table 6 – Institutional Capacity - Relative weight of underlying questions

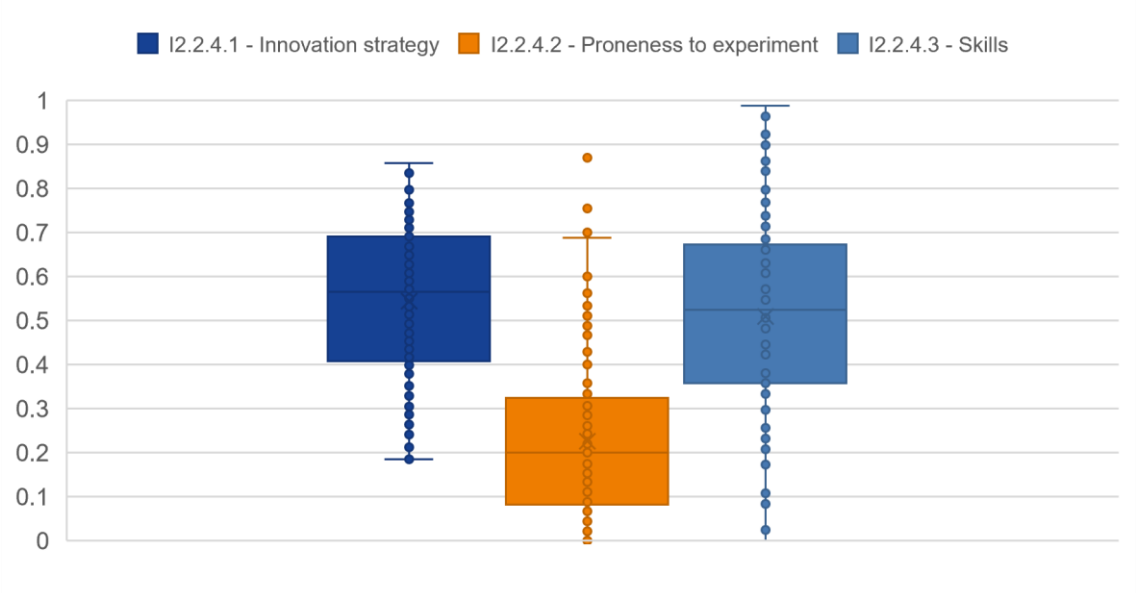
An extensive overview of the weights used to calculate the DPSVI is available in *Annex 1.1 Extended Methodology.*

2.2 Index overview



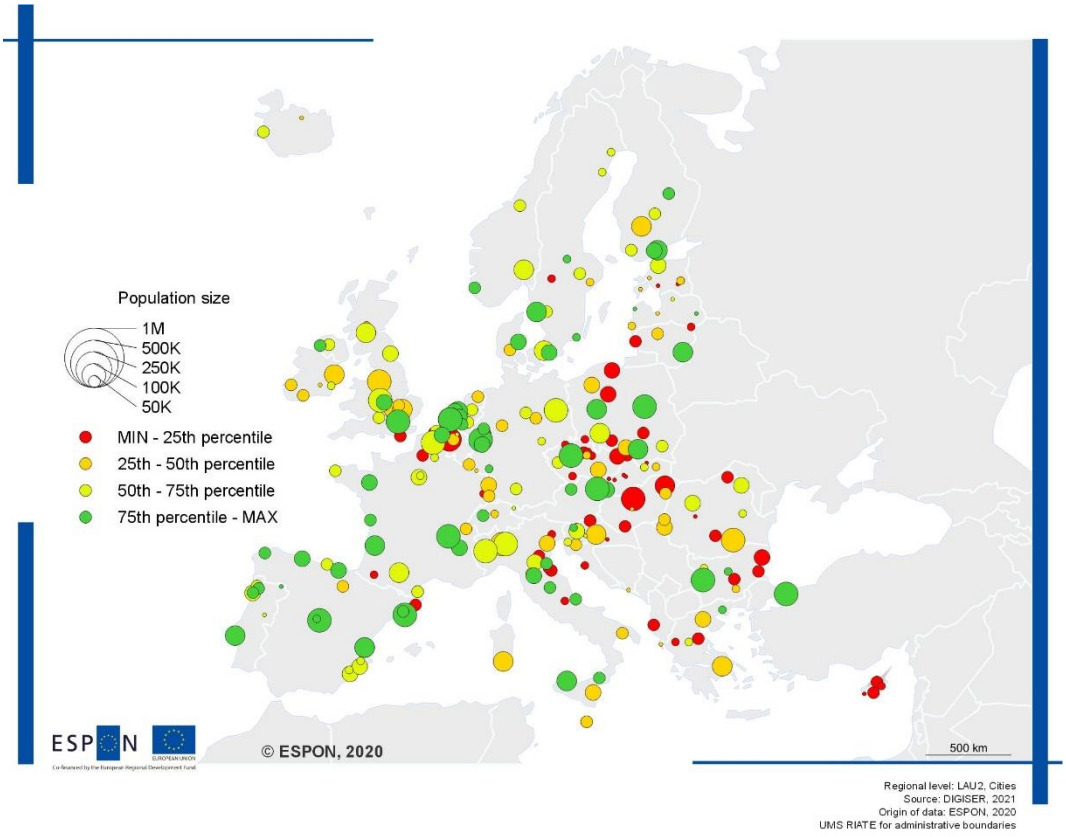
Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4 – Institutional Capacity	DPSVI	Intermediate	Reference Sample	na

Figure 4 – Institutional Capacity overview

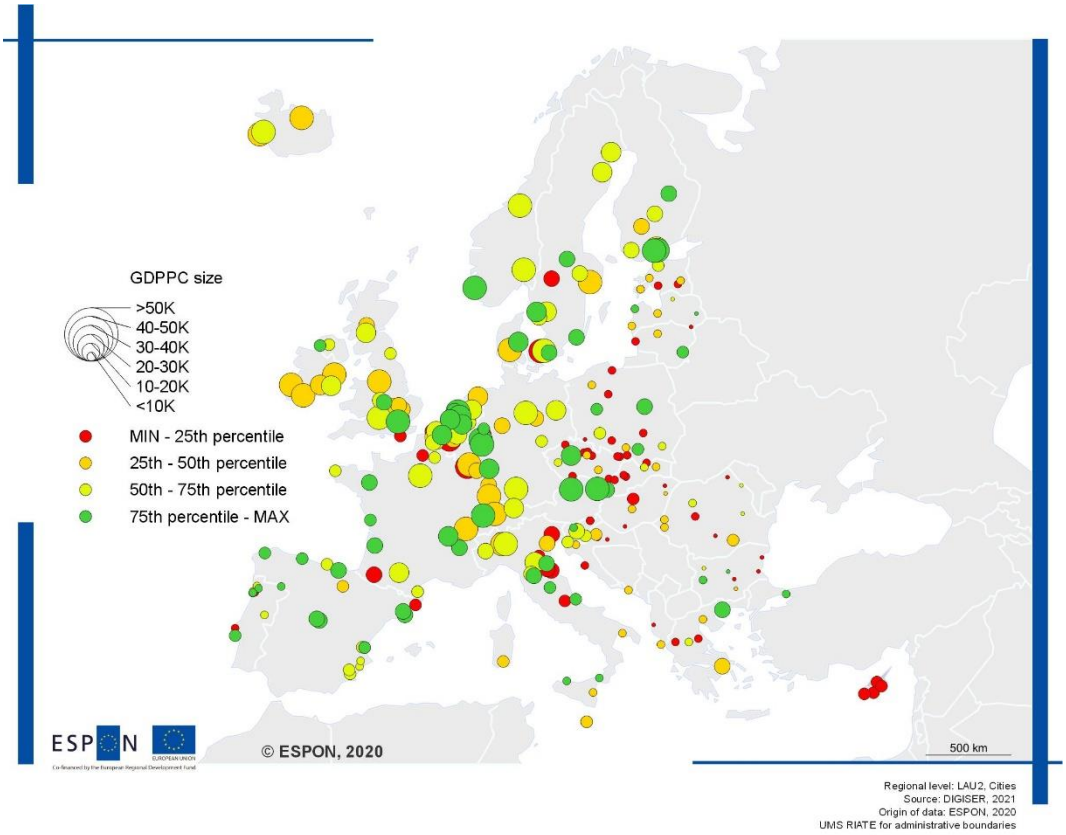


Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4 – Institutional Capacity	DPSVI	Intermediate	Reference Sample	na

Figure 5 - Institutional Capacity composition

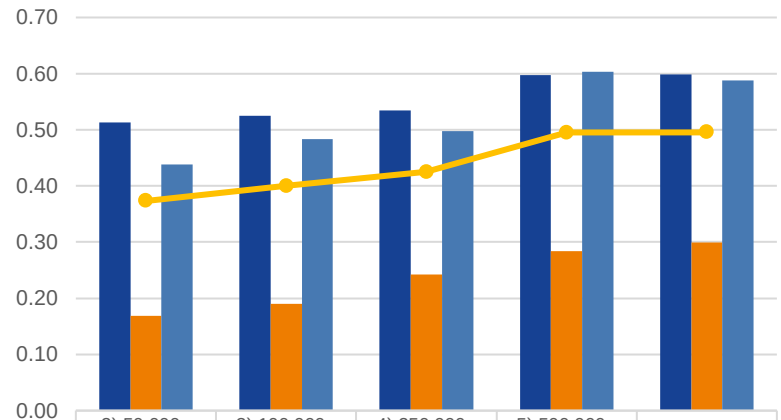


Map 1 – Institutional Capacity and population size



Map 2 – Institutional Capacity and GDPPC size

2.3 Population

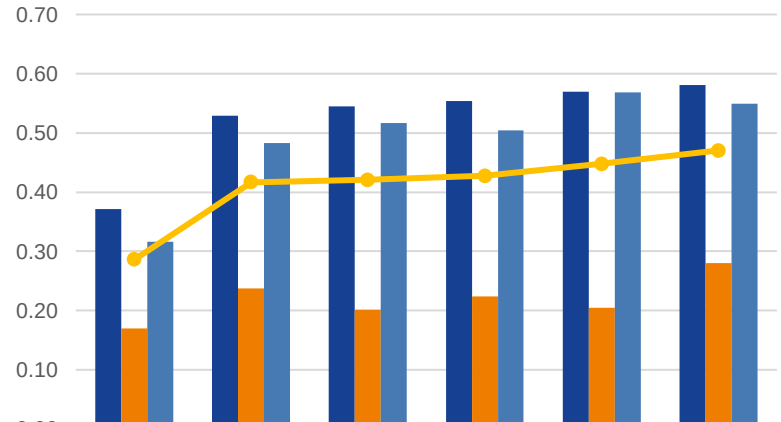


	2) 50.000 - 100.000	3) 100.000 - 250.000	4) 250.000 - 500.000	5) 500.000 - 1.000.000	6) > 1.000.000
I2.2.4.1 - Innovation strategy	0.51	0.53	0.53	0.60	0.60
I2.2.4.2 - Proneness to experiment	0.17	0.19	0.24	0.28	0.30
I2.2.4.3 - Skills	0.44	0.48	0.50	0.60	0.59
I2.2.4 - Institutional capacity	0.37	0.40	0.42	0.50	0.50

Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4 – Institutional Capacity	DPSVI	Intermediate	Reference Sample	Population

Figure 6 - Institutional Capacity by population

2.4 GDP per Capita

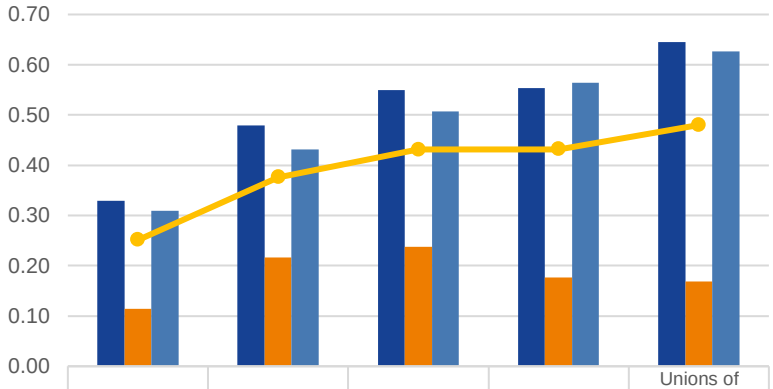


	< 10K	10K-20K	20K-30K	30K-40K	40K-50K	> 50K
I2.2.4.1 - Innovation strategy	0.37	0.53	0.54	0.55	0.57	0.58
I2.2.4.2 - Proneness to experiment	0.17	0.24	0.20	0.22	0.20	0.28
I2.2.4.3 - Skills	0.32	0.48	0.52	0.50	0.57	0.55
I2.2.4 - Institutional capacity	0.29	0.42	0.42	0.43	0.45	0.47

Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4 – Institutional Capacity	DPSVI	Intermediate	Reference Sample	GDPPC

Figure 7 - Institutional Capacity by GDPC

2.5 Authority Type

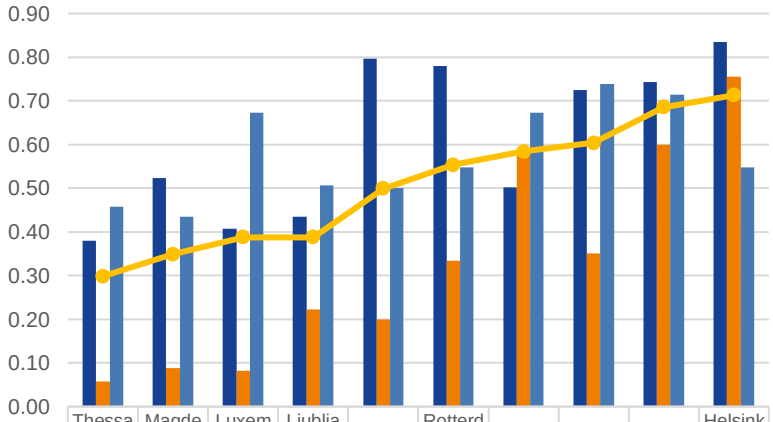


	District/Parish/ Ward	County/Province	Municipality (city/town)	Metropolitan Area	Unions of municipalities/ Mountain communities
I2.2.4.1 - Innovation strategy	0.33	0.48	0.55	0.55	0.65
I2.2.4.2 - Proneness to experiment	0.11	0.22	0.24	0.18	0.17
I2.2.4.3 - Skills	0.31	0.43	0.51	0.56	0.63
I2.2.4 - Institutional capacity	0.25	0.38	0.43	0.43	0.48

Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4 – Institutional Capacity	DPSVI	Intermediate	Reference Sample	Authority type

Figure 8 - Institutional Capacity by authority type

2.6 Case Studies



	Thessaloniki	Magdeburg	Luxembourg	Ljubljana	Milano	Rotterdam	Aarhus	Poznan	Porto	Helsinki
I2.2.4.1 - Innovation strategy	0.38	0.52	0.41	0.44	0.80	0.78	0.50	0.72	0.74	0.84
I2.2.4.2 - Proneness to experiment	0.06	0.09	0.08	0.22	0.20	0.33	0.58	0.35	0.60	0.76
I2.2.4.3 - Skills	0.46	0.43	0.67	0.51	0.50	0.55	0.67	0.74	0.71	0.55
I2.2.4 - Institutional capacity	0.30	0.35	0.39	0.39	0.50	0.55	0.58	0.60	0.69	0.71

Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4 – Institutional Capacity	DPSVI	Intermediate	Case studies	na

Figure 9 - Institutional Capacity, case studies

2.7 Highlights

- The institutional capacity index has a considerable variability, oscillating between 0.83 in Barcelona (Spain) and 0.02 in Larnaka (Cyprus). A small group of cities overperform in this index, pushing most of the cities below the average score of 0.398
- In general, it seems that the performance of the cities of the DIGISER reference sample tends to see higher results in the sub-indexes "I2_2_4_1 Innovation Strategy" and in "I2_2_4_3 Skills" than the values recorded in the category "I2_2_4_2 Proneness to experiment", which is fed by a series of questions that investigate the current level of use of experimental technologies.
- Clustering by countries, which is influenced in smaller countries by the limited number of respondents, seems to identify some spatial trends:
    - The Iberian Peninsula and the Baltic countries (excluding Norway) are in the top quartile
    - The most populous countries (excluding Italy) such as France, Germany, England and Poland all rank in the second quartile
    - There is a block of negative results in the eastern and Mediterranean countries, where the institutional capacity of local authorities is more limited
- There are direct correlations between population size and performance on both the main I2_2_4 index and its sub-indices.
- There are direct correlations between the GDPPC of the population and the performance both on the main index I2_2_4 and on the related sub-indices

3 Innovation Strategy of European Cities

3.1 Definition of the indices and exploration of its structure

Digital innovation or digital transformation strategies are intended to encourage faster and better ways to perform, better exploiting technology for processing and computing, increasing accessibility to information, speeding up procedures, making them automated and reducing errors.

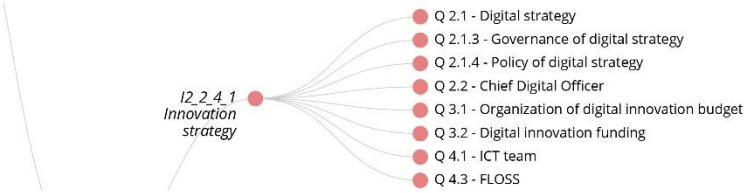
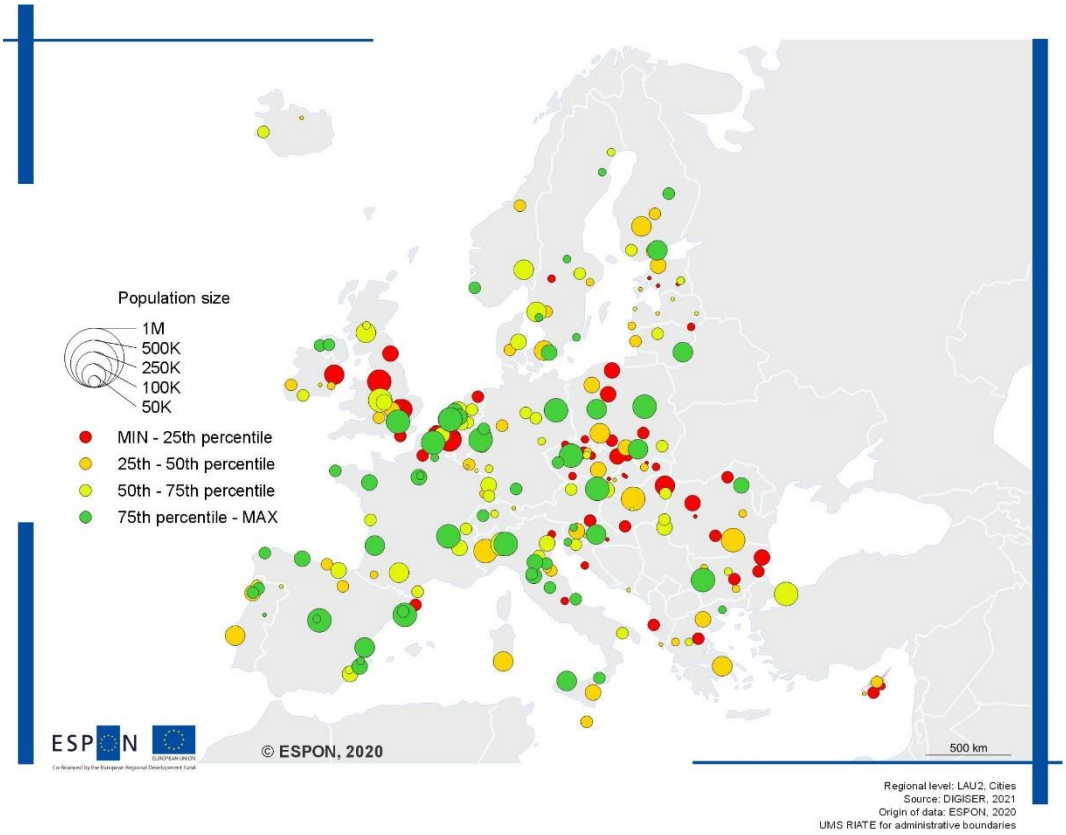


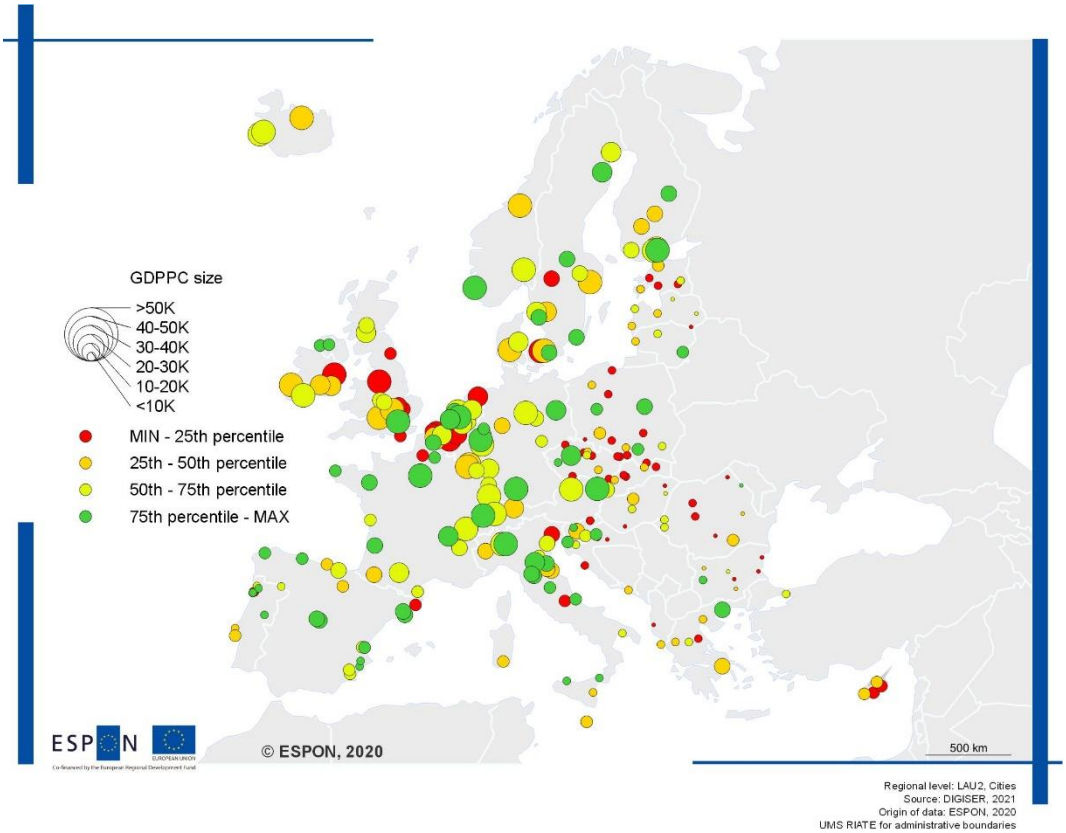
Figure 10 – Innovation Strategy index composition (questions tree)

This is a *Bottom Level* index, composed by nine questions, each one computed for a limited number of possible answers:

- **Q_2.1** Has your public authority formally approved and published a digital innovation strategy (also digital transformation strategy, smart city strategy or similar)?
- **Q_2.1.3** What is the governance of the digital innovation strategy?
- **Q_2.1.4** Was the development of the strategy linked to regional, national or European regulatory frameworks, strategies, directives (such as, for example on EU level: the INSPIRE directive, EU Data Directive, Tallinn declaration, living.in.eu declaration, smart specialisation strategies, etc)?
- **Q_2.2** Does your public authority have a Chief Digital Officer (or similar position such as Chief Information Officer / Chief Innovation Officer, etc) coordinating the implementation of the digital innovation strategy?
- **Q_3.1** How is the budget for digital innovation organised in your public authority?
- **Q_3.2** What are the key funding sources for digital innovation in your public authority? : Structural and cohesion funds (e.g. ERDF)
- **Q_4.1** Does your public authority have (ICT support):
- **Q_4.3** Does your public authority encourage the use of Free/Libre and Open Source Software (FLOSS)?

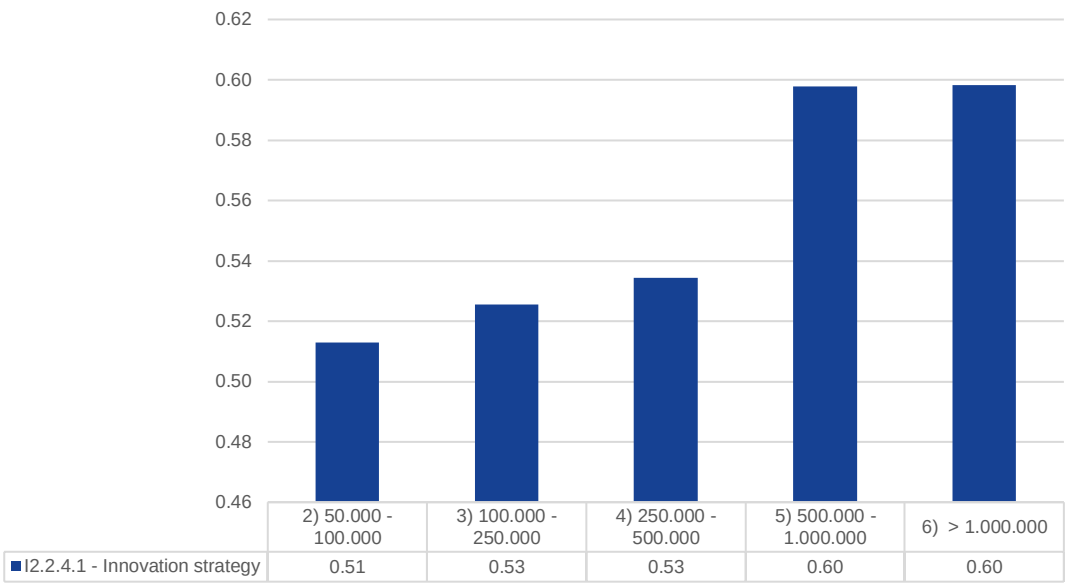


Map 3 – Innovation Strategy and population size



Map 4 – Innovation Strategy and GDPPC size

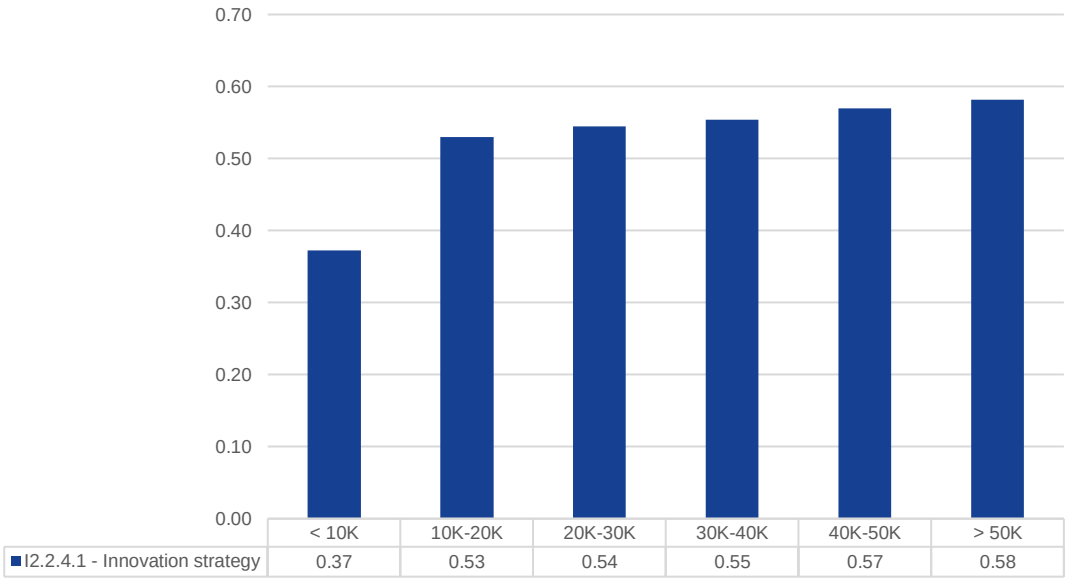
3.2 Population



Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.1 – Innovation Strategy	DPSVI	Bottom	Reference Sample	Population

Figure 11 - Innovation Strategy by population

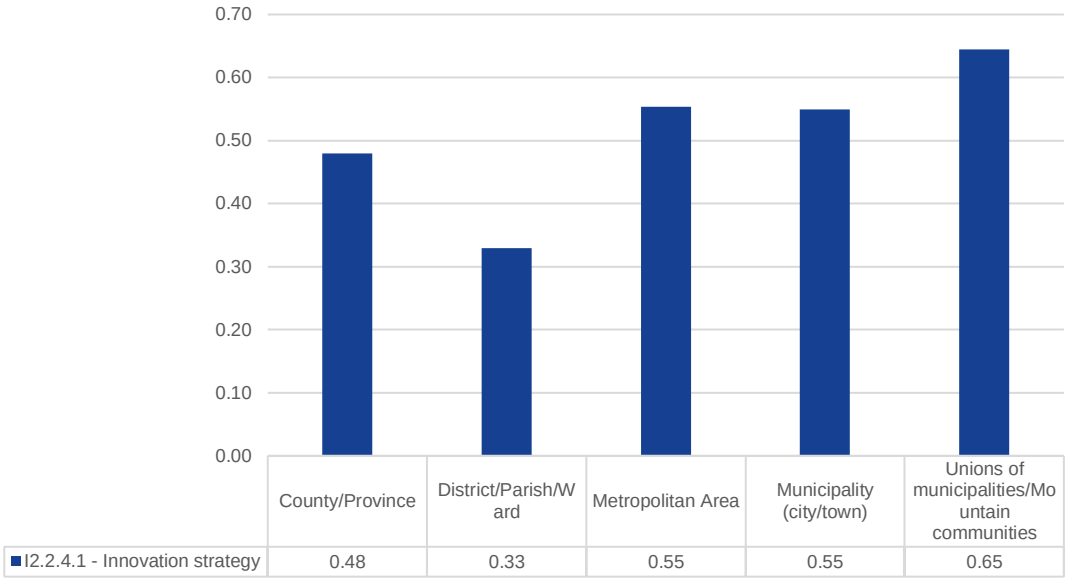
3.3 GDP per Capita



Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.1 – Innovation Strategy	DPSVI	Bottom	Reference Sample	GDPPC

Figure 12 - Innovation Strategy by GDPC

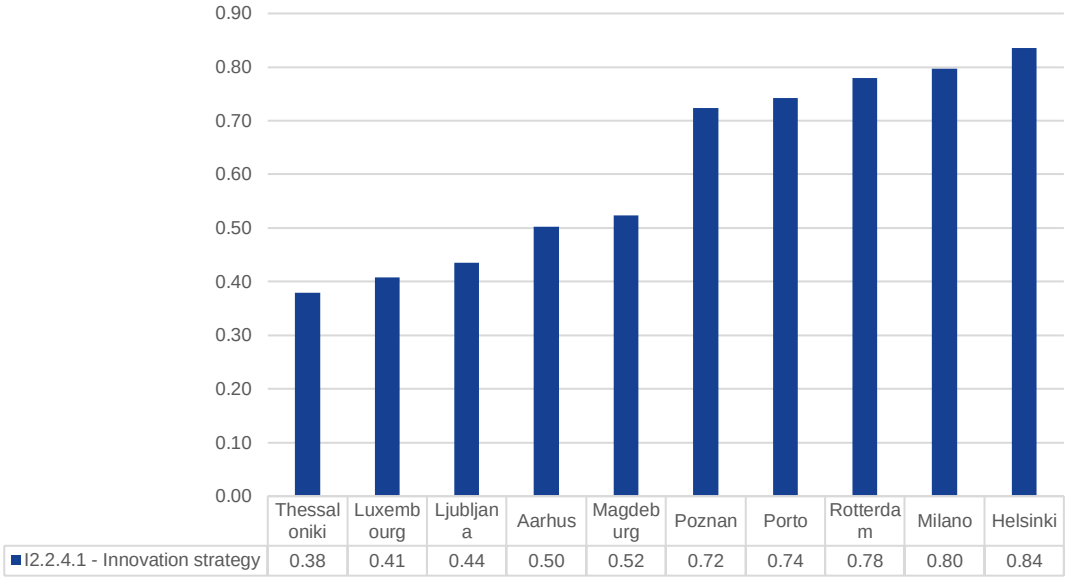
3.4 Authority Type



Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.1 – Innovation Strategy	DPSVI	Bottom	Reference Sample	Authority type

Figure 13 - Innovation Strategy by authority type

3.5 Case studies

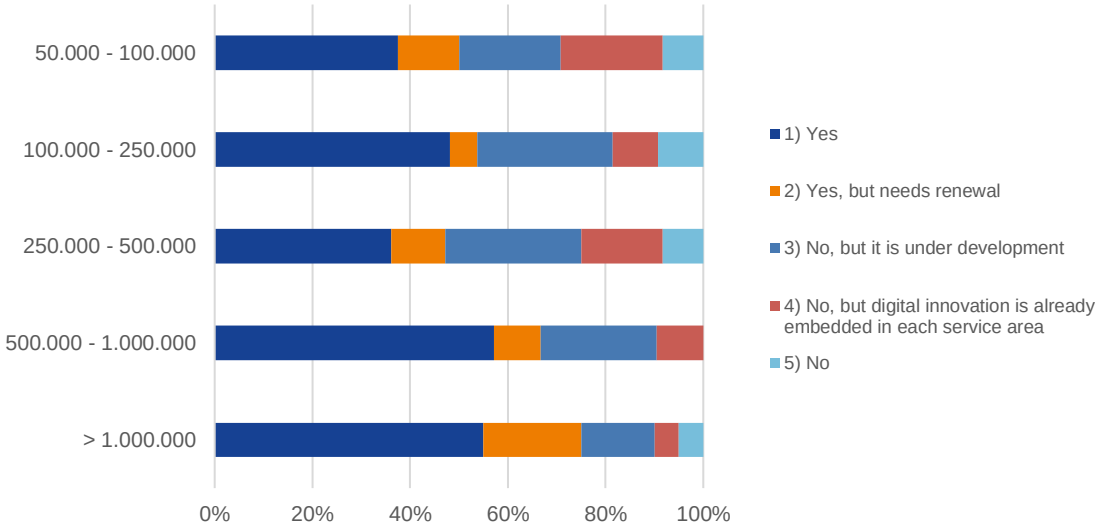


Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.1 – Innovation Strategy	DPSVI	Bottom	Case studies	na

Figure 14 - Innovation Strategy, case studies

3.6 Relevant question results

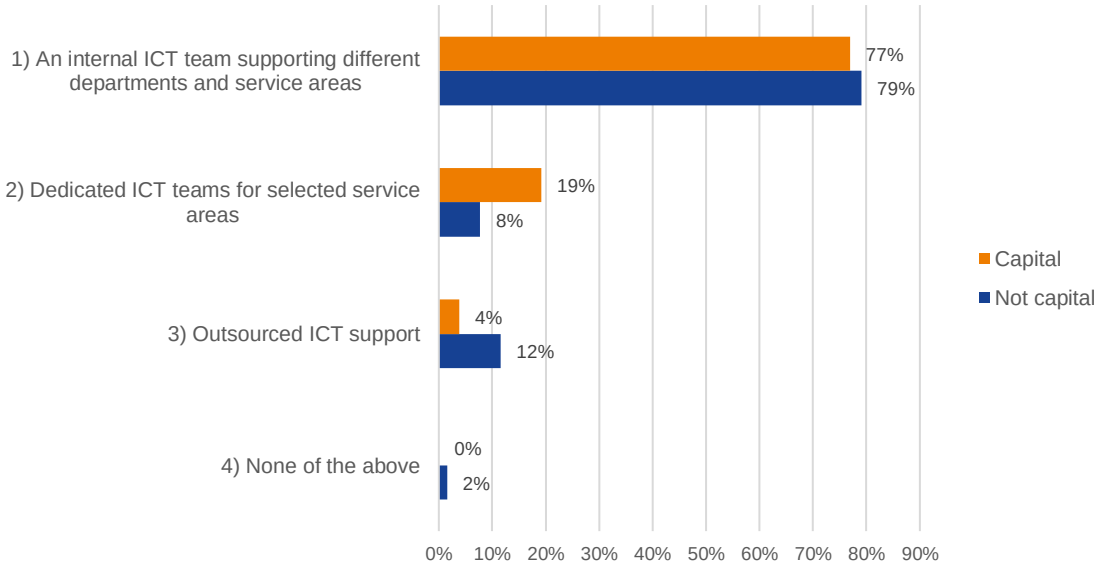
3.6.1 Has your public authority formally approved and published a digital innovation strategy (also digital transformation strategy, smart city strategy or similar)?



Question observed	Question type	Data Sample	Clusters	Value
Q_2.1	Single choice	Reference Sample	Population	Percentage

Figure 15 – Strategic Documents

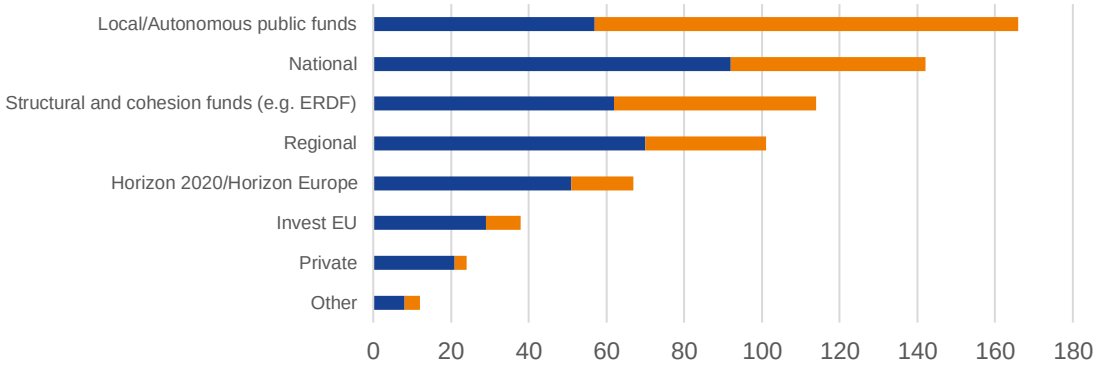
3.6.2 Does your public authority have?



Question observed	Question type	Data Sample	Clusters	Value
Q_4.1	Single choice	Reference Sample	Capital cities	Percentage

Figure 16 – ICT support team

3.6.3 Does your public authority have?



	Other	Private	Invest EU	Horizon 2020/Horizon Europe	Regional	Structural and cohesion funds (e.g. ERDF)	National	Local/Autonomous public funds
3) High Relevance	8	21	29	51	70	62	92	57
4) Most Relevant	4	3	9	16	31	52	50	109

Question observed	Question type	Data Sample	Clusters	Value
Q_4.8	Matrix - Single choice	Reference Sample	Capital cities	Percentage

Figure 17 – Digital Innovation Funding

3.7 Highlights

- It is the highest of the indices that make up *I_2_2_4 institutional capacity*, averaging 0.54. This data can be linked to the fact that the strategic planning of the innovation has reached discrete levels of proceduralization and some key requirements (e.g. appointment of the DPO, formal approval of a digital agenda, etc.) are mandatory by law in many countries. The analysis of the Q_2_1 question seems to support this interpretation.
- Looking at the correlation with the population size, there is a significant gap between cities under 500,000 inhabitants and those above that figure (Group that also includes many capitals). On the other hand, performance is much more homogeneous if we look at the breakdown by GDPpc cluster. Here, only the cities belonging to the poorest territories seem to suffer a gap, while all the other groups score similar performances.
- Demand Q_4_1 allows us to observe the relative advantage of the Capitals. This group of cities has the capacity to organize a decentralized ICT support service with resources allocated in each sector, while the other cities manage technical support in a centralized form (and the smaller cities outsource this service).
- The question Q_3_2 shows how the implementation of innovation strategies remains highly dependent first on its own funds managed independently by local authorities, and secondly on access to extraordinary resources made available by public bodies of superior scale, with a central role of ERDF and Horizon. Particularly surprising is the very low figure related to the ability to activate private resources, which in only 3 cases are considered as "most relevant"

4 Proneness to experiment of European Cities

4.1 Definition of the indices and exploration of its structure

Being prone to innovate and experiment is a key factor of value creation for the public sector, contributing to increasing public administrations' competitiveness and welfare. The predisposition and openness to experiment, to conduct public research and development expenditure, and to invest in technological innovation impact on the level of innovativeness of an organisation, determining its ability to reach more desirable outputs and outcomes.

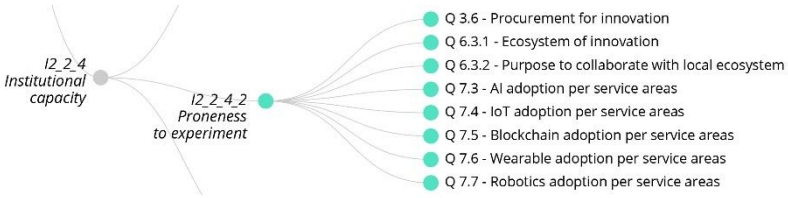
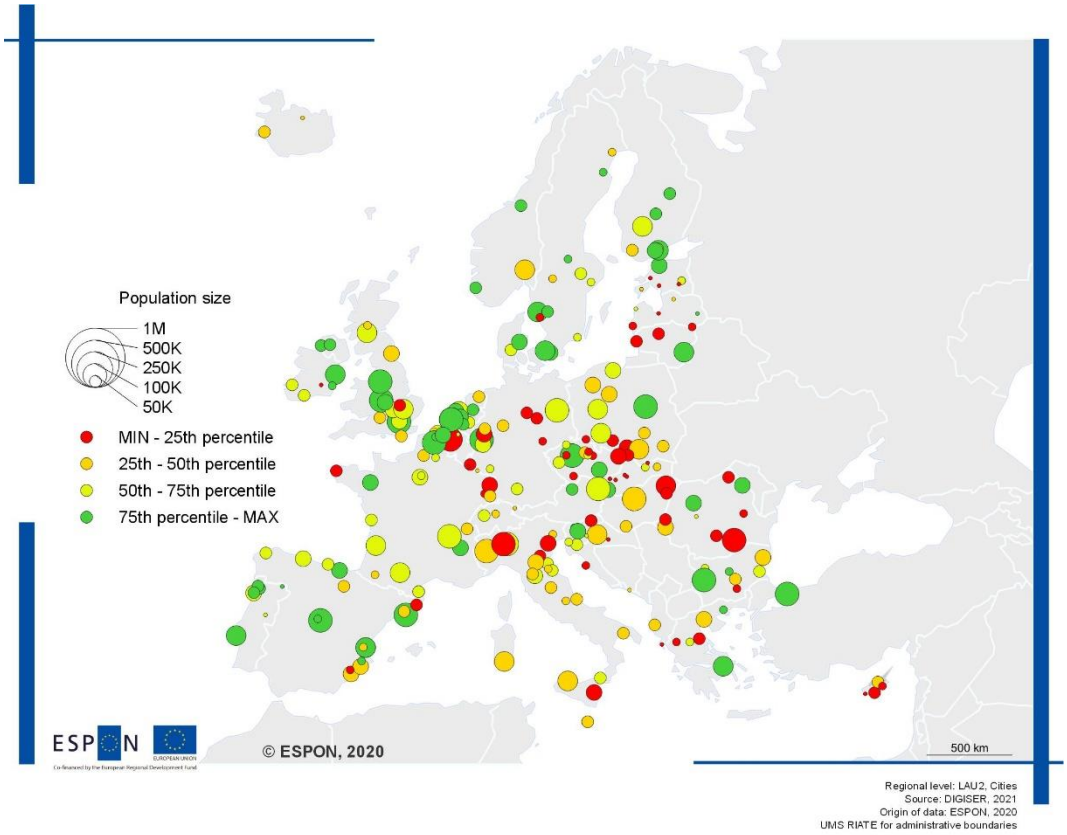


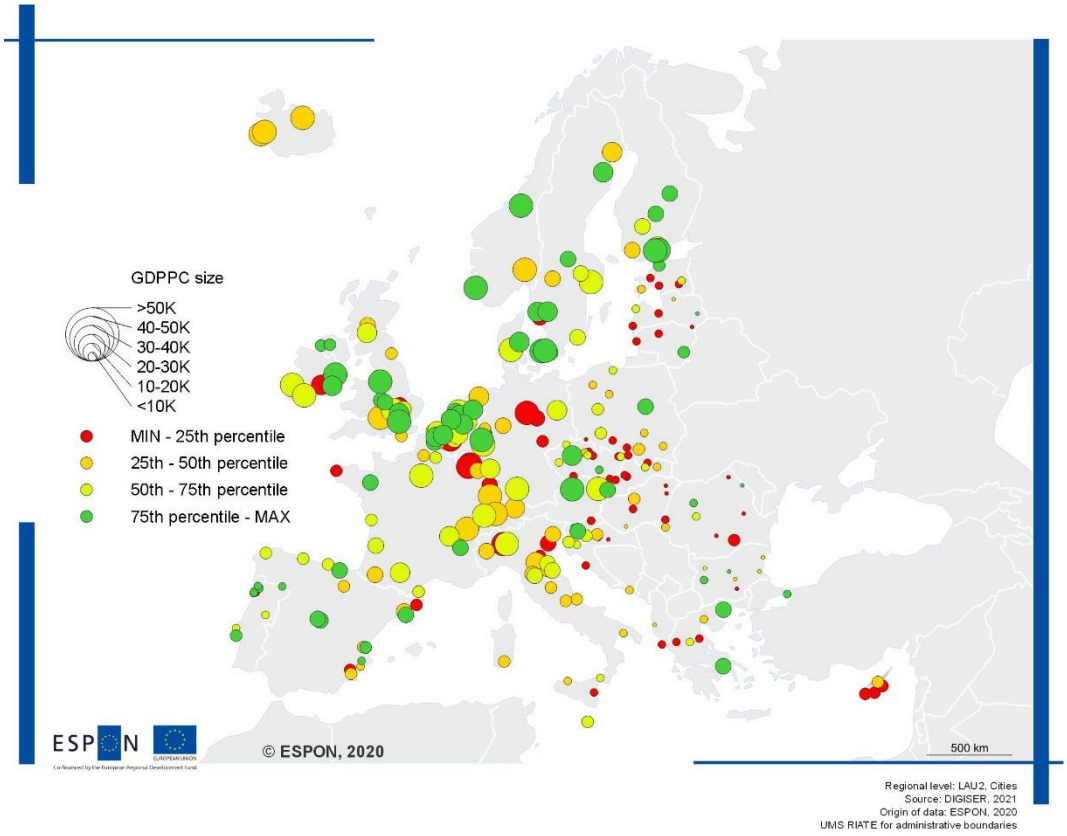
Figure 18 – Proneness to experiment index composition (questions tree)

This is a *Bottom Level* index, composed by seven questions, each one computed for a limited number of possible answers:

- **Q_3.6** If any, which of the following public procurement procedures did your public authority run – in addition to standard procurement procedures (PCP/PPIs)
- **Q_6.3.1** Is your public authority directly involved in ecosystems for innovation together with other actors of the quadruple helix ? Please select as many organizations.
- **Q_6.3.2** What is the purpose for your public authority to collaborate with the local ecosystem?
- **Q_7.3** State for each service area if the adoption Artificial Intelligence technology is planned, implemented, not planned or not applicable
- **Q_7.4** State for each service area if the adoption of Internet of Things (IoT) technology is planned, implemented, not planned or not applicable
- **Q_7.5** State for each service area if the adoption of Blockchain technology is planned, implemented, not planned or not applicable
- **Q_7.6** State for each service area if the adoption of wearable technology is planned, implemented, not planned or not applicable
- **Q_7.7** State for each service area if the adoption of robotics technology is planned, implemented, not planned or not applicable

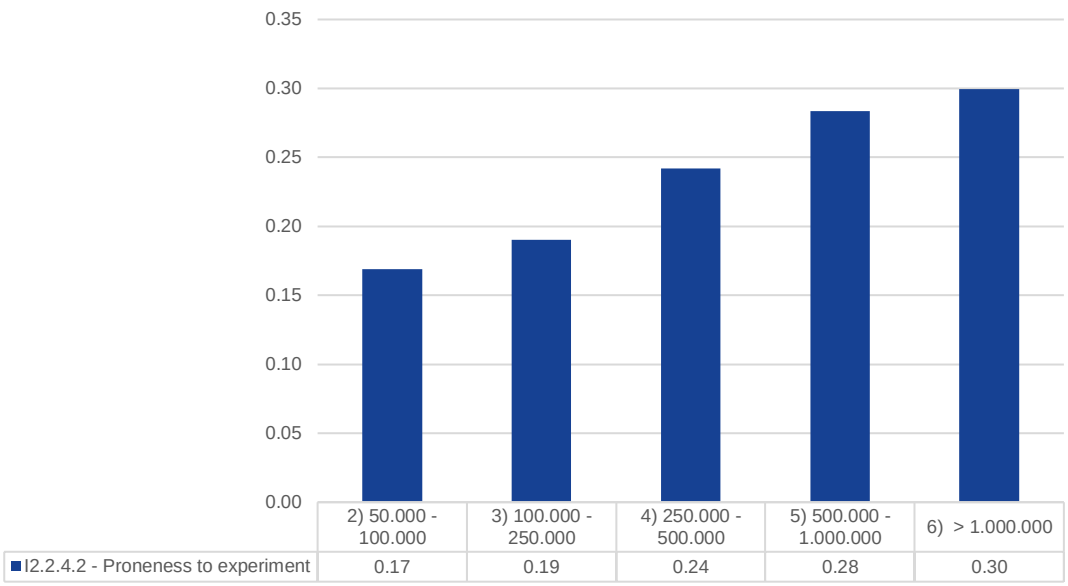


Map 5 – Proneness to experiment and population size



Map 6 – Proneness to experiment and GDPPC size

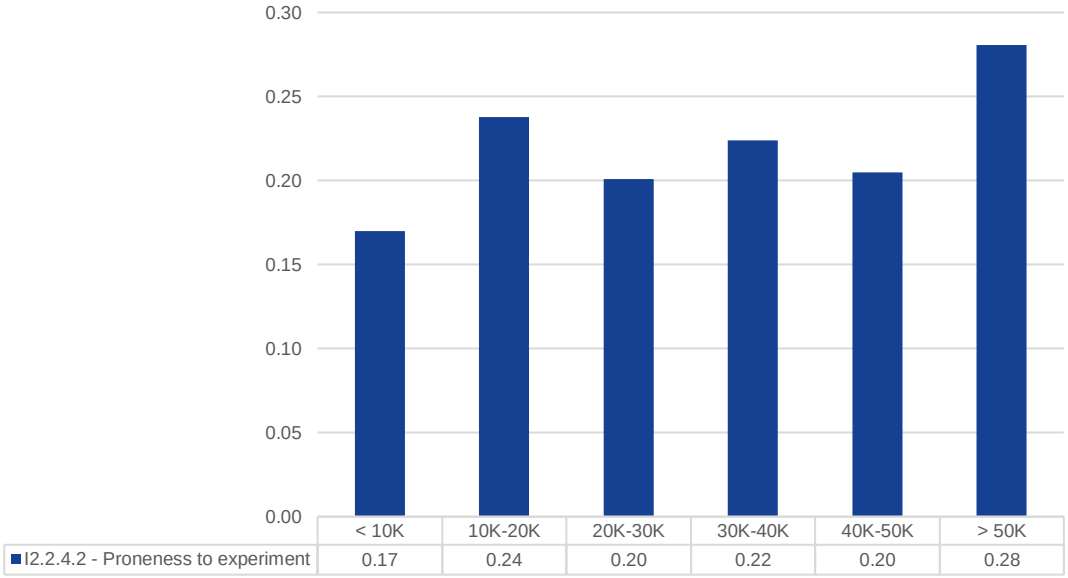
4.2 Population



Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.2 - Proneness to experiment	DPSVI	Bottom	Reference Sample	Population

Figure 19 - Proneness to experiment by population

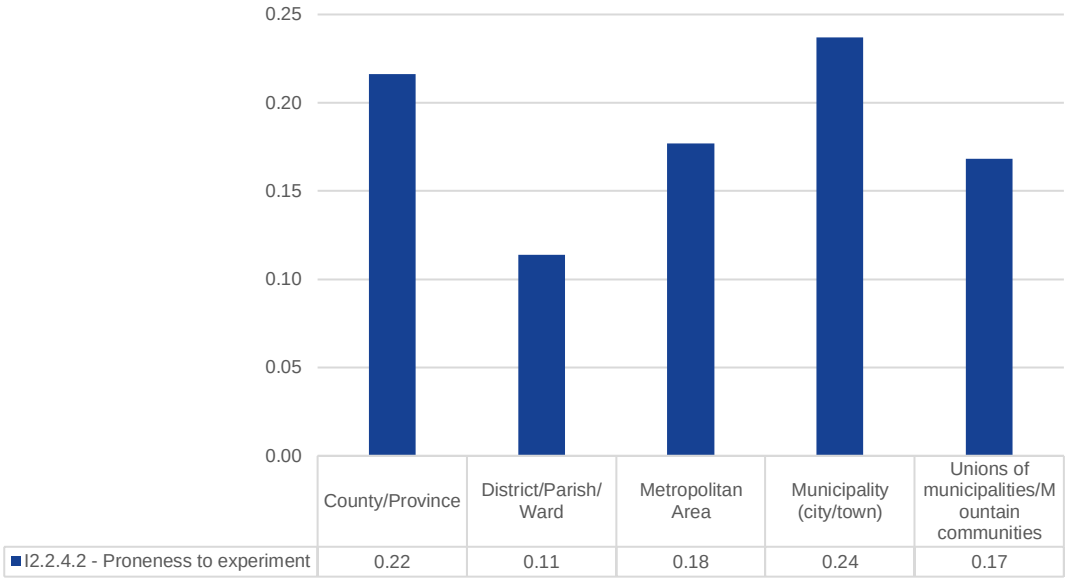
4.3 GDP per Capita



Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.2 - Proneness to experiment	DPSVI	Bottom	Reference Sample	GDPPC

Figure 20 - Proneness to experiment by GDPC

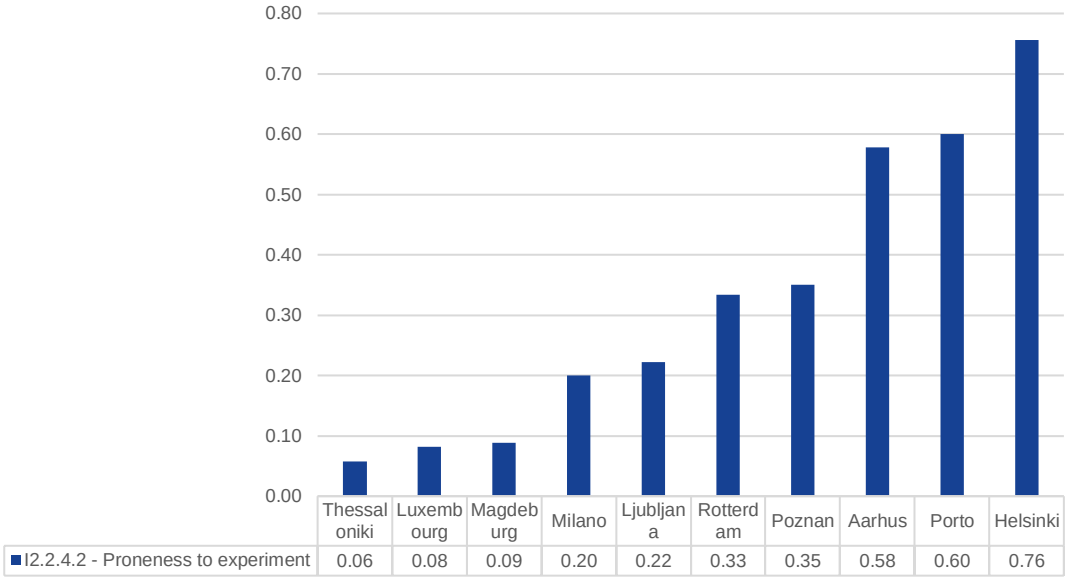
4.4 Authority Type



Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.2 - Proneness to experiment	DPSVI	Bottom	Reference Sample	Authority type

Figure 21 - Proneness to experiment by authority type

4.5 Case studies

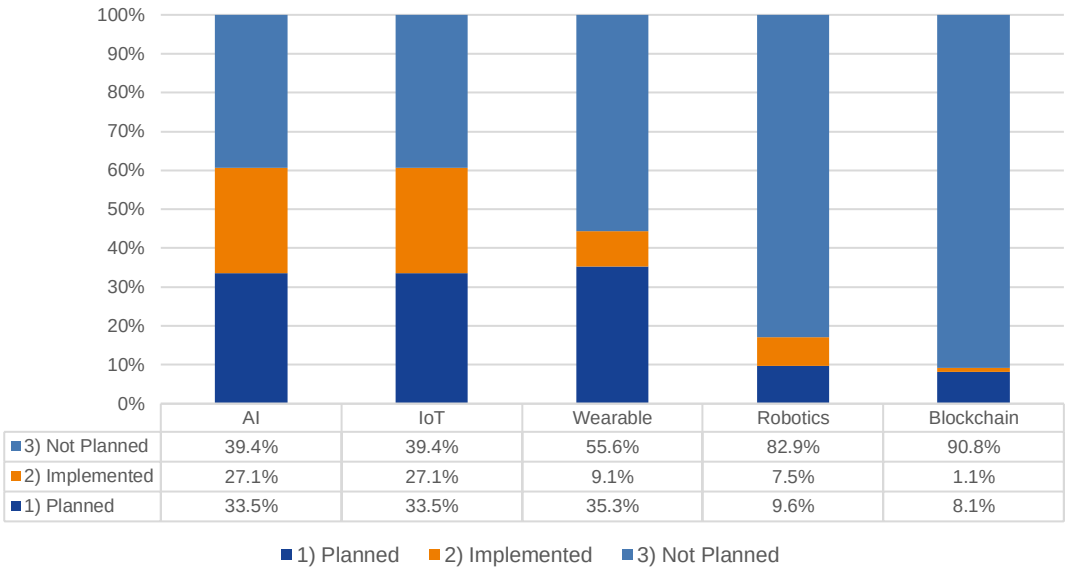


Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.2 - Proneness to experiment	DPSVI	Bottom	Case studies	na

Figure 22 - Proneness to experiment, case studies

4.6 Relevant question results

4.6.1 State if the adoption of this technology is planned, implemented, not planned or not applicable



Question observed	Question type	Data Sample	Clusters	Value
Q_7.3 – 7.7	Simple choice	Reference Sample	Technologies	Percentage

Figure 23 – Experimenting advanced technologies

4.7 Highlights

- It is the lowest of the indexes that make up *I_2_2_4 institutional capacity*, averaging 0.23. This low performance in most of cities can be referred to the fact that this index is built on top of the analysis of the planning and implementation of the integration of advanced and experimental technologies such as AI, IoT, Blockchain, Robotics, and wearable.
- The in-depth analysis of the underlying questions Q_7_3 to Q_7_7 seems to confirm this hypothesis, with some of the technologies considered that have been actually planned by a limited number of cities and implemented by an even smaller number. In particular only for AI and IoT around 30% of cities have already experimented some kind of integration, and another 30% is planning it, while the other categories either are only planned or, as in the case of blockchain, not even considered in future planes of digital transition.
- Linear correlation with population size, no direct correlation with the GDPPC

5 Skills of European Cities

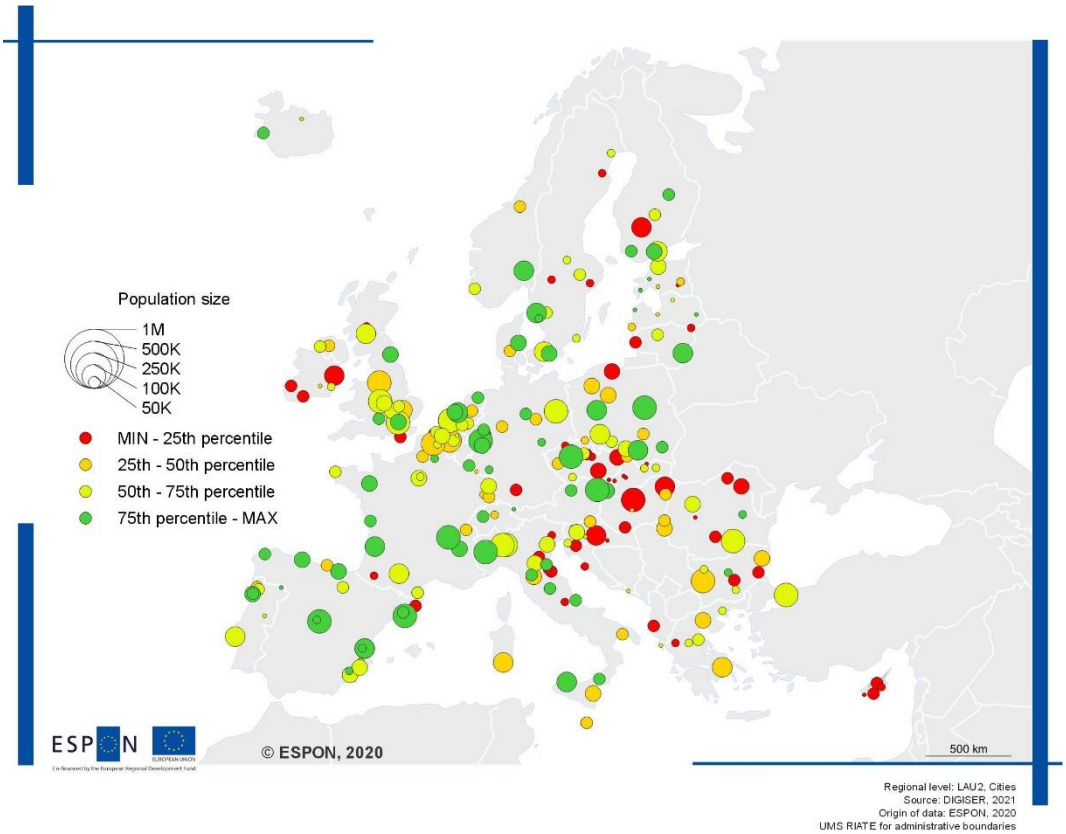
5.1 Definition of the indices and exploration of its structure

Digital skills are central in the digital transformation of the public sector, playing a fundamental role in the management of digital innovation within the public authority.

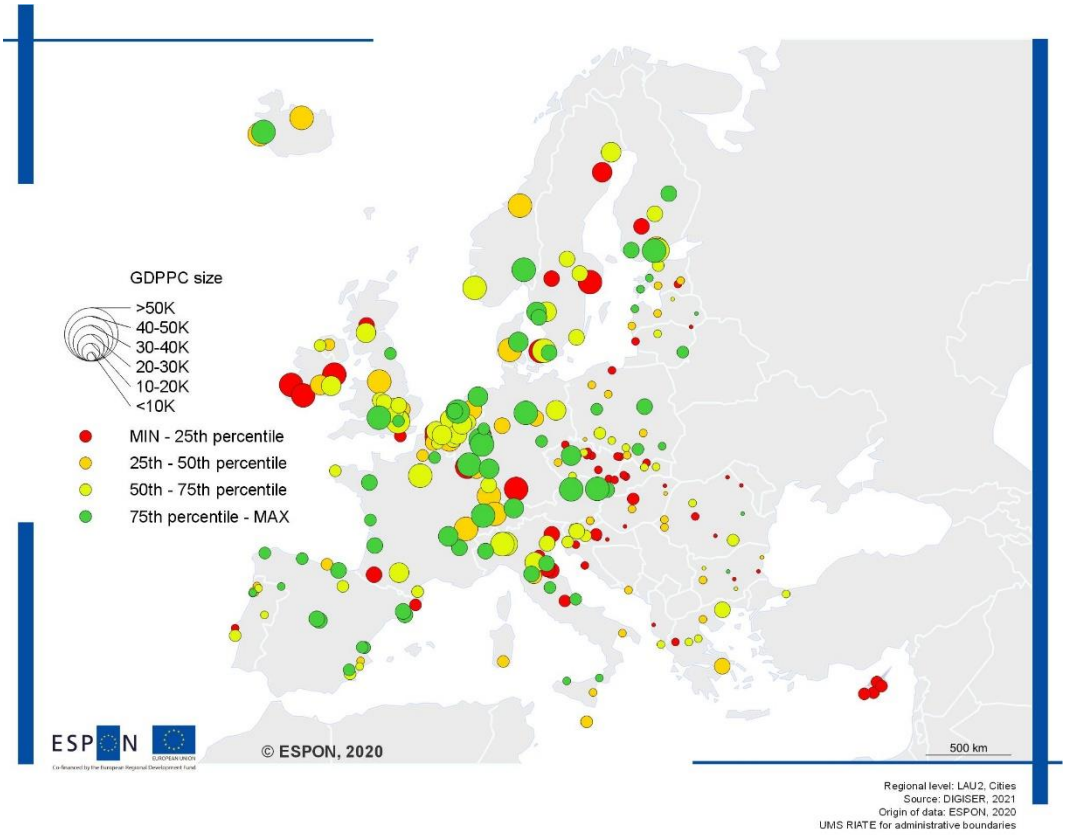
Figure 24 – Skills index composition (questions tree)

This is a *Bottom Level* index, composed by eight questions, each one computed for a limited number of possible answers:

- **Q_3.4** Does your public authority have or use an e-procurement platform?
- **Q_3.8** Are the tenders for procuring innovative digital services/goods including the following requirements?
- **Q_4.4** Does the authority's IT set-up offer the possibility to implement open source alternatives?
- **Q_4.6** Does your public authority provide ICT training to its employees?

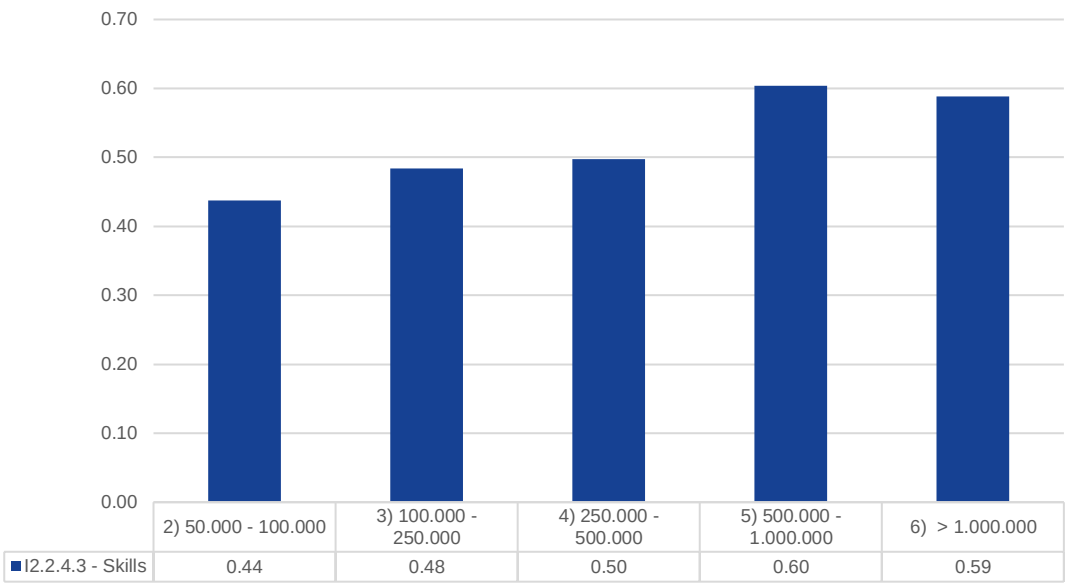


Map 7 – Skills and population size



Map 8 – Skills and GDPPC size

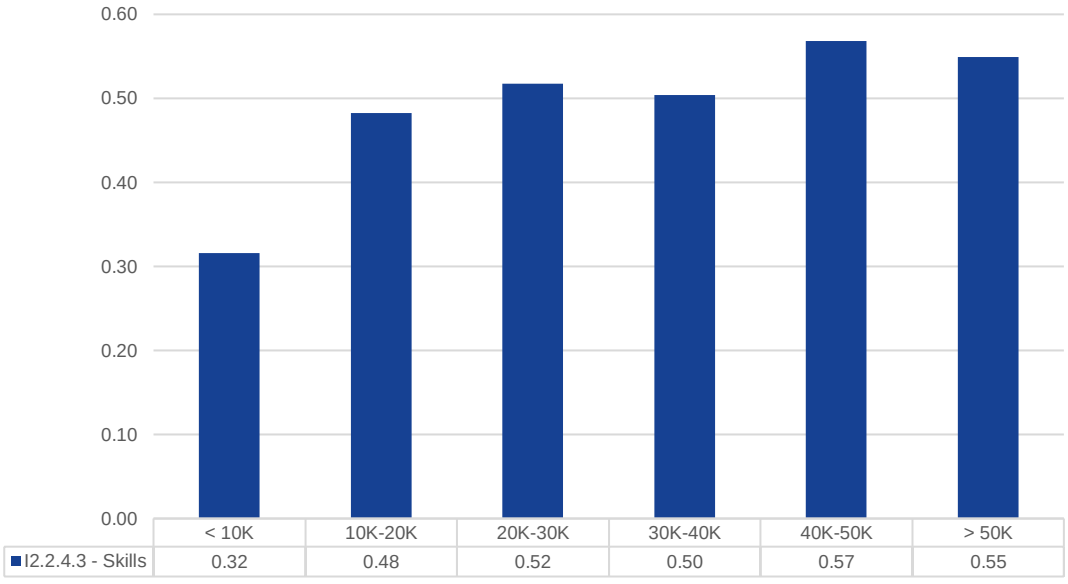
5.2 Population



Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.3 - Skills	DPSVI	Intermediate	Reference Sample	Population

Figure 25 - Skills by population

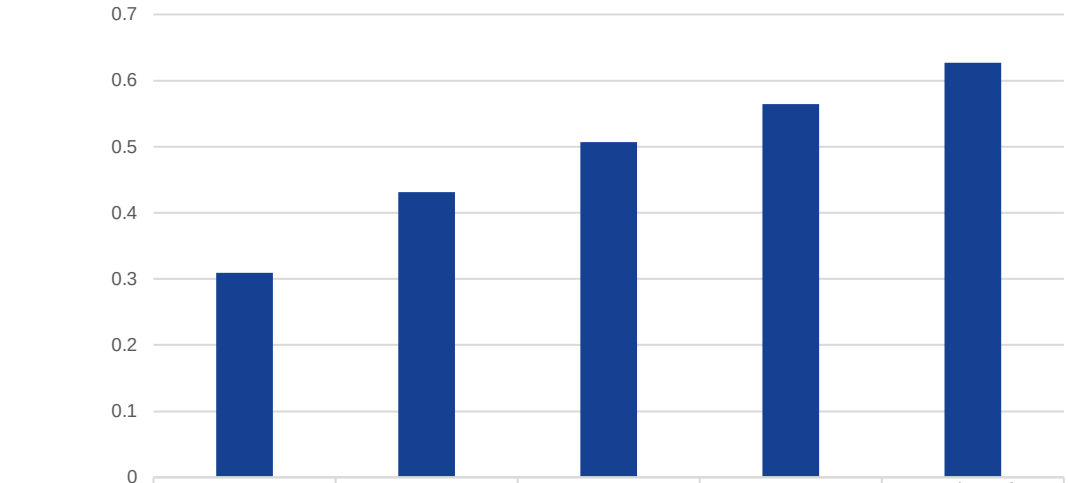
5.3 GDP per Capita



Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.3 - Skills	DPSVI	Intermediate	Reference Sample	GDPPC

Figure 26 - Skills by GDPC

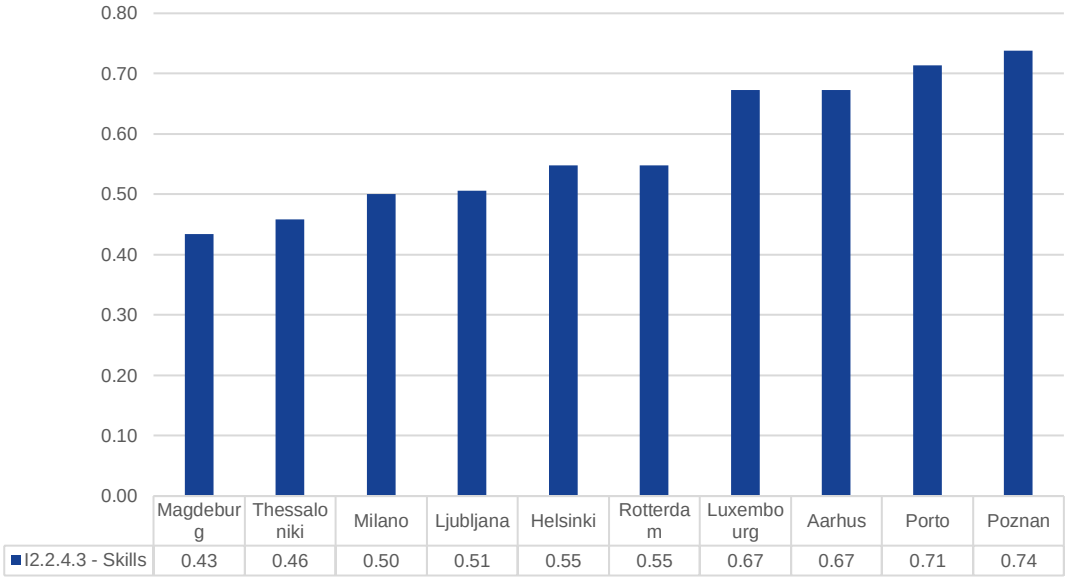
5.4 Authority Type



Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.3 - Skills	DPSVI	Intermediate	Reference Sample	Authority type

Figure 27 - Skills by authority type

5.5 Case studies

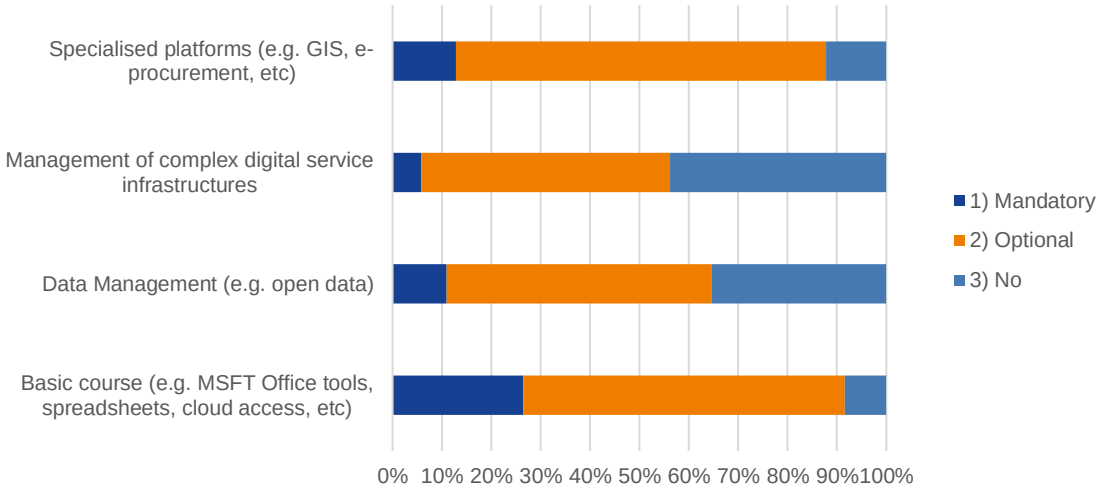


Index observed	Index type	Index level	Data Sample	Clusters
I2.2.4.3 - Skills	DPSVI	Intermediate	Case studies	na

Figure 28 - Skills, case studies

5.6 Relevant question results

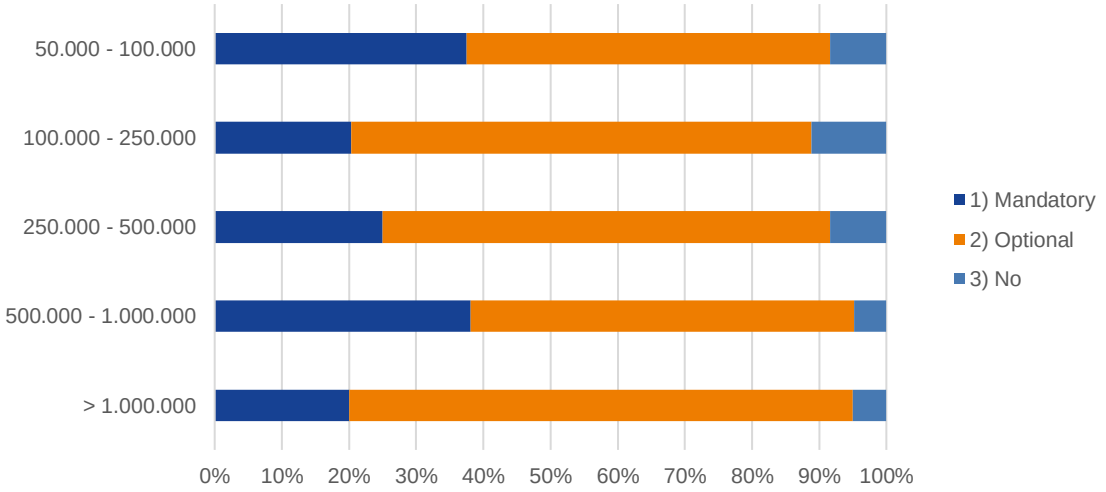
5.6.1 Does your public authority provide ICT training to its employees?



Question observed	Question type	Data Sample	Clusters	Value
Q_4.6	Matrix -Single choice	Reference Sample	Matrix options	Percentage

Figure 29 – ICT Training approaches

5.6.2 Does your public authority provide ICT training to its employees?



Question observed	Question type	Data Sample	Clusters	Value
Q_4.6	Single choice	Reference Sample	Population	Percentage

Figure 30 – Basic ICT training provision

5.7 Highlights

- The correlation of this indicator with the population and with the GDPPC is weak and non-linear.
- Looking at the breakdown by GDPPC, only the group of cities with GDPPC below 10K euros per inhabitant reaches lower average scores, while above this threshold there are no substantial differences between the different cohorts considered
- There are clear differences in the average performance of different authority types, with metropolitan authorities and unions of municipalities appearing to invest more in the development of skills necessary to govern digital transition processes.
- Looking in detail at the answers to question 4.6 it is possible to develop some extra hypotheses:
    - There is a high degree of investment in basic training, very high in smaller cities, that seems to indicate the persistence of a demand for basic digital skills still unmet
    - Cities, especially the larger ones, invest considerably and offer compulsory training courses also related to the use of specialized tools and platforms (e.g. GIS management platforms)
    - There is little investment in training related to infrastructure management tools and information processes. This data may possibly refer to the limited availability of pre-packaged training curricula for these domains, and the challenge of developing curricula and training courses that are not standard but shall be tailored to the needs of the organization that promotes them

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