A theoretical framework for the DSI index

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DIGITAL SOCIAL INNOVATION

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BACKGROUND

DSISCALE (branded externally as DSI4EU) aims to support policy makers, funders and, most importantly, practitioners to grow and scale digital social innovation (DSI) in Europe and to harness the power of people and technology to tackle some of Europe's biggest social challenges.

A key part of DSISCALE is to better understand the systemic and macro-level conditions which support the creation, growth and sustainability of DSI initiatives, and to analyse geographically how different parts of the European Union are positioned to support DSI initiatives. Much of this builds upon research carried out by the preceding DSI4EU project, which explored the challenges to growth for DSI at both the macro (system) and micro (project) levels.[1] DSISCALE aims to use this analysis and understanding to influence and help policymakers (and other stakeholders) to proactively build ecosystems which are conducive to the growth of DSI.

The central activity within this area of work is the development of the experimental DSI Index, which aims to measure and compare the capacity of local or national ecosystems to support DSI. The aims of the index aims are five-fold:

• To identify success factors for the creation, growth and sustainability of DSI initiatives;

• To help policymakers understand how they can better support DSI, drawing upon successful examples from other places;

• To incentivise the development and implementation of supportive policies;

• To inform practitioners about where has the best conditions to support DSI, which may influence where practitioners decide to set up or grow their initiatives;

• To raise awareness about, and interest in, DSI among people, communities and organisations not currently involved in the field.

Ultimately, our aim is to situate the Index within the wider framework of DSISCALE's activities, including direct policy engagement with cities, the European Commission and national governments, practical support and peer learning for DSI practitioners and other stakeholders, creation of accessible research on the current DSI landscape and the future of DSI, and building a stronger network of DSI in Europe.

After beginning work on the Index in January 2018, this report summarises our progress and findings in the first six months of work. It is organised as follows: **Section 1** explains why indexes are useful and sets out the rationale behind, and aims for the DSI Index; **Section 2** lays out the theoretical framework of the Index developed in the first half of this year; and **Section 3** explains the planned methodology for constructing the Index over the coming months.

1. INTRODUCING THE DSI INDEX

1.1 Why an index for Digital Social Innovation?

Previous studies and coordination and support activities on DSI, including those carried out by the DSI and DSI4EU projects before DSISCALE, have tended to focus on measuring activity - the volume, geographical spread and characteristics of the DSI initiatives taking place around Europe. This has provided valuable insight and helped researchers, policymakers and other stakeholders to better understand and engage with the field. Nevertheless, there has been less research looking at the enabling and hindering factors behind this activity, exploring what helps or holds back DSI initiatives' creation, growth and scale.

There are currently no comprehensive assessments, tools or methods for assessing the capacity of local, regional and national innovation ecosystems to support DSI and CAPS initiatives. The digital social innovation composite index (hereafter, the DSI Index) seeks to address this gap.

A note on terminology

DSI is not the only term used to refer to the use of digital technology to address social challenges. 'Civic technology', 'tech for good' and 'social tech' are also used widely across Europe, and among many communities are much more widely recognised. For this reason, we have used these terms somewhat interchangeably in the development of the index and when speaking to people in the field. However, in the context of this report, we only use the term DSI.

1.2 Aims of the Index

The purpose of the DSI Index is to provide an open-source tool to measure and compare the capacity of local or national ecosystems to support DSI. This will support DSI projects and other stakeholders in the field in five ways:

1. **Identify success factors for the creation, growth and sustainability of DSI**. The Index will be produced by combining indicators for several key factors that are important to starting, sustaining and growing DSI projects. By identifying what these key factors are and disseminating our insights through the Index, we will enable a better understanding of the success factors for developing DSI ecosystems and raise awareness on how to spread and promote these conditions between funders,

2. **Help policymakers understand how they can better support DSI, drawing upon successful examples from other places.** The DSI Index will produce an overall score ranking ecosystems in Europe based on their capacity to support DSI, either at the local or national level (see Section 1.4). Alongside the overall score, a second output of the index will be scores for how well ecosystems perform on different dimensions of the index. These dimensions, or themes, group several indicators, which together measure a particular aspect of an ecosystem's capacity to support DSI, for example, funding or skills. Using these themes, policy makers will be able to use the index as a diagnostic tool to understand where their city, region or country is falling behind and thus what areas future policies should be targeted for improvement. The Index will be accompanied by a set of case studies and examples of supportive strategies, policies and initiatives from across Europe to enable sharing of best practice and replication/adaptation of successful experiences.

3. **Incentivise the development and implementation of supportive policies.** The scores allotted to ecosystems will act as a competitive incentive for policymakers to implement supportive policies which aim to better support DSI within politicians and policy makers cities, regions or countries.

4. **Inform practitioners about where in Europe has the best conditions for supporting DSI, which may be influence where practitioners decide to set up or grow their initiatives.** DSI initiatives are often set up in reaction to a particular local need. However, where there is some flexibility on where a DSI initiative could be located, or, more likely, where an existing initiative is looking to expand, the Index will provide practitioners with useful insight into where might be amenable for projects to locate or grow with maximum chances of success. Furthermore, the scores on individual themes and indicators will support practitioners to make informed decisions based on what is most relevant to their project's characteristics and needs.

5. **Raise awareness about, and interest in, DSI among people, communities and organisations not currently involved in the field.** By providing an accessible benchmark for how cities or countries rank in their ability to support DSI, we hope the Index will spark wider conversations and interest - for example within the startup sector, governments and funding institutions.

1.3 What are composite indexes and why are they useful?

Composite indexes attempt to measure complex social or economic phenomena by combining several individual indicators which, individually, would not adequately describe the phenomenon in question. The individual indicators that make up the composite index are selected, combined and weighted based on an underlying model of the structure of the phenomenon that is being measured.

The DSI index will add to a growing list of composite indexes which aim to explore how different geographic regions compare against a wide range of complex issues with more or less relevance to the field of DSI, including:

- Entrepreneurship and the digital economy - such as the European Digital City Index[2], CITIE[3], the Global Entrepreneurship Index[4], the Digital Transformation Monitor[5] and the Global Innovation Index[6];

- Digital skills and infrastructure - such as the Digital Economy and Society Index[7];

- (Open) data - such as the Open Data Barometer[8], the Global Open Data Index[9] and the European Data Portal[10];

- Open licensing - such as Creative Commons' State of the Commons[11];

- Sustainability - such as the Environmental Performance Index[12] and the Sustainable Cities Index[13];

- Wellbeing - such as the OECD Better Life Index[14] and the Fab City Dashboard[15];

- Social innovation and entrepreneurship - such as the Social Entrepreneurship Index[16] and the Social Innovation Index[17].

None yet exists which is looking at DSI specifically, and our Index aims to fill this gap.

1.3.1 The strengths of composite indexes

Composite indexes are useful in two particular cases: either when a single indicator could not conceivably measure the phenomenon due to its complexity and abstract nature; or when a single indicator is conceivable but would be too difficult or costly to measure.

While in theory we could scrutinise each indicator within a composite index individually (and indeed this is sometimes useful), combining them makes it much easier to interpret information without losing sight of, or access to, the underlying information.

Indexes are particularly powerful tools for policymaking when they are captured over multiple years, allowing trends to be

identified. These trends can help draw policymakers' attention to particular issues or help them evaluate the impact of specific interventions. Country or city rankings based on index scores are especially good at attracting media attention, facilitating public discussion, promoting accountability and harnessing competitive spirits to motivate policymakers into action.[18,19]

1.3.2 The weaknesses of composite indexes

Composite indexes, like all models, are by necessary simplified versions of reality. And while it is this simplification that makes them useful, it means that in some sense they will always have their errors and misrepresentations. In the words of George Box, one of the greatest statistical minds of the 20th century, "all models are wrong, but some are useful".

Like all models, composite indexes are created through a combination of science and art, and their construction necessarily entails numerous decisions (such as the choice and weighting of indicators) which are more or less subjective. Such decisions are not always clear cut and are almost always subject to debate. Getting these decisions wrong, or having to ignore indicators that are too difficult to measure, can can result in simplistic or inappropriate policy messages.

Even if constructed as well as possible, problems may arise if policy conclusions drawn from composite indexes are (consciously or unconsciously) erroneous. The complexity of composite indexes means misrepresentation is an ever-present risk. For this reason, it is important that those producing indexes are transparent about the processes, methodologies, decisions and experts used in constructing them, and about what their limitations are. Composite indexes should not become "black boxes" whose users are blind to the decisions and processes behind the final numbers. And policymakers should not make any policy-decisions based on a single index (or model more generally).

1.4 Geographical coverage

In an ideal world, the DSI Index would focus on ranking cities for several reasons:

- This would be in keeping with the principle of subsidiarity in policymaking, "the principle that social and political issues should be dealt with at the most immediate (or local) level that is consistent with their resolution";[20]

- DSI is particularly active at city level, due both to the challenges faced by cities (ranging from transport and air pollution to provision of healthcare, housing and education), and the density of people, assets, infrastructure, knowledge and skills which allows for collaborative technologies to thrive;

- Cities are more and more becoming a hotbed for innovative policymaking and strategies (both in digital and non-digital policy);

- In many countries, although not all, cities have significant power over the policy decisions which affect people's day-to-day lives the most and effective ways of engaging with citizens.

However, creating a city-based composite index comes with its own challenges:

- While there are 28 EU member states, there are hundreds of cities, and we could not conceivably develop a comprehensive Index within the resources and timeframe of this project;

- Better data exists at the national and regional level (for example, that collected by national statistics bodies).

For this reason, we have not made a decision about the geographical level of the DSI Index in the first six months of the project, during which time we have focused on developing the theoretical framework. The decision will be made in coming months as we begin to select and source data.

If, due to the lack of city-level data and resource constraints, we are unable to create a city-level index, we will instead focus on the 28 EU members states. If we do focus on the city level, our aim would be to cover

the capital cities of all member states plus 12 further cities (i.e. a total of 40) chosen based on: our existing knowledge of where DSI activity is taking place; our existing networks and contacts; and broad representation.

1.5 Methodology for building an index

The methodology we plan to follow when building the DSI Index is based on that used for the European Digital City Index, which itself is adapted from the "ideal sequence" of steps detailed in the JRC/OECD Handbook on constructing composite indicators (Figure 1)[21]. In following this methodology and carefully documenting each stage of the process we will ensure the index is as robust and transparent as possible. We have now completed the first stage of the index methodology which involved developing the theoretical framework for the index. The process by which this achieved and insights from this stage are discussed in more detail in Section 2; the remaining stages of the index development are described in Section 3.

Figure 1. Flow diagram illustrating the ideal sequence steps for the construction of composite indicators as suggested by the JRC/OECD Handbook.

Adapted from https://digitalcityindex.eu/methodology
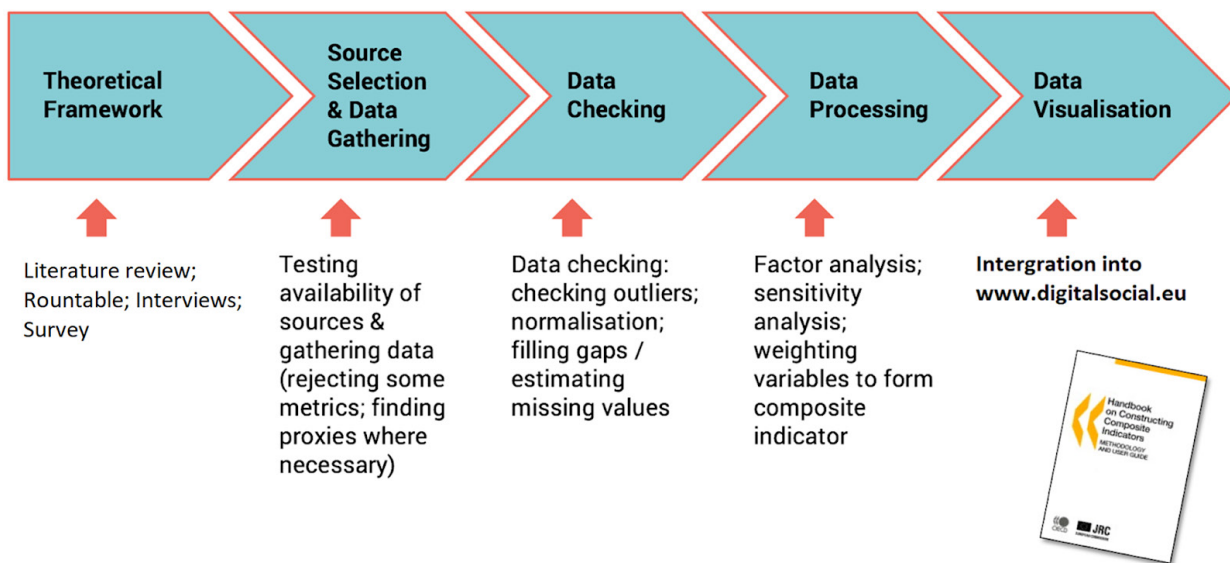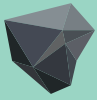
2. FRAMEWORK

2.1 Introduction

The first stage of creating a composite index involves building the theoretical framework which then provides the basis for the selection and combination of indicators. It is at this stage that involvement of experts and a broad range of stakeholders is most important.

The objectives of this stage are to:

- Clearly define and understand the phenomenon that the index will measure;

- Understand what factors are important to measuring that phenomenon (i.e. which indicators should be included in the index);

- Structure the chosen indicators into 'themes', if necessary.[22] These are groupings of indicators which are linked to each other; ideally, the themes should have similar numbers of indicators within them;

- Understand the relative importance of the chosen themes and individual indicators to the phenomenon in question, in order to properly weight them in the construction of the index;

- Understand how much a deficit in one of the chosen indicators can be offset by a surplus in another.

Throughout the development of the framework, we have aimed to be as inclusive, transparent and open as possible, in keeping with the values of DSI and to create an Index which is not just useful but also accepted and welcomed as legitimate by different stakeholders in the DSI community.

2.2 Framework development activities

The development of the framework has now been completed. Below we outline the activities which comprised this stage.

2.2.1 Defining the concept

As discussed above, the index will compare the capacity of cities or countries to support DSI initiatives. Although DSI continues to evolve as a field, for this index we will continue to use the definition first outlined in our first study on digital social innovation, published in 2015:

"A type of social and collaborative innovation in which innovators, users and communities collaborate using digital technologies to co-create knowledge and solutions for a wide range of social needs and at a scale and speed that was unimaginable before the rise of the Internet."[23]

When we refer to the 'capacity to support', we are looking beyond top-down government level policy levers,[24] considering policy in the broadest sense of the word. For this, we will analyse the DSI ecosystem as a whole including political, economic, social, cultural and technological factors affecting a city or country.

2.2.2 Interviews and roundtable

We conducted 11 interviews with DSI experts from across Europe between March and May 2018[25], and organised a a roundtable discussion at Nesta's offices in London on 14th March 2018. The interviews were semi-structured and explored broadly which factors were important for the creation, growth and sustainability of DSI initiatives (an interview guide is included in Appendix A). Interviewees were chosen from a range of backgrounds and geographies and were picked for their broad expertise and knowledge. The roundtable covered similar topics; as well as general discussion facilitated by Nesta, participants worked in small groups to discuss factors before grouping these together into themes and voting to determine which were considered the most important.[26] As Nesta has a strong network of DSI-related organisations in London, one of Europe's hotbeds of activity,

we felt it was beneficial to bring these people into a room together rather than to conduct individual interviews. The agenda for the roundtable is included in Appendix B.

2.2.3 Literature review

While there is limited literature specifically on DSI, we looked at literature on related topics such as digital entrepreneurship, social innovation and impact measurement (see Appendix C for a selected literature review). This was primarily based on non-academic literature such as think tank research, reports from practical programmes and grey literature. We also reviewed our own literature from previous projects, such as *What next for digital social innovation?* Although not everything that is highlighted as being important to supporting these broader fields will be of particular relevance to DSI, we used our own knowledge of DSI and insights from interview and the roundtable to draw out what believe to be relevant from this literature.

We also explored literature related to composite indexes[27] and examples of indexes from other fields, including their methodologies. We focused particularly on those measuring phenomena related to DSI, such as those listed above in section 1.3. Nevertheless, other methodologies of indexes not related to DSI[28] also provided us with useful examples of index production methodologies.

2.2.4 Selecting indicators

Through the interviews, roundtable and literature review we identified 69 potential indicators for the DSI index. We then narrowed these down, in an internal workshop at Nesta, to 32 indicators to be included in the Index. Longlisted indicators were excluded from the shortlist for one of two reasons:

- Duplication (they were a subcategory of another indicator or were closely related to another indicator)

- Irrelevance (there was no strong link to DSI)

These 32 indicators were then grouped by the research team into seven themes, grouped alongside other related indicators. The seven themes are: Skills, Support Systems, Infrastructure, Funding, Diversity

and Inclusion, Collaboration, and Civil Society.

We then made the decision for the Index to take a "nested" structure. Within this structure, each indicator will have a score; these scores will be combined (weighted) to give a score for the theme as a whole; these scores will be combined (weighted) to give a score for the Index as a whole.

In Section 2.3 we discuss each of these themes and why the indicators that belong to them were chosen.

2.2.5 Survey to understand relative importance of indicators

From the interviews, roundtable and literature review it was clear that some of the chosen themes and indicators are more important to supporting DSI than others. In order to get a better understanding of their relative importance from a wide number of stakeholders, we conducted a survey[29]

of over 100 individuals involved with DSI[30], asking them to rank our chosen themes and indicators in order of importance to supporting DSI. The survey was open to anyone with knowledge of DSI, and widely promoted through social media, and via email. A €50 voucher was offered to one respondent (chosen through a random prize draw) in order to incentivise responses. More information on the survey can be found in Appendix D. Insights from the survey are reported below.

We chose this participatory method of allocating weights to indicators over statistical methods[31] to better reflect the reality of DSI, and to ensure the index is seen to be legitimate by all segments of the DSI community.

2.3 Themes and Indicators

Below we describe and discuss the justification for the inclusion of the 32 indicators we have chosen. We discuss the

The Digital Social Innovation Index
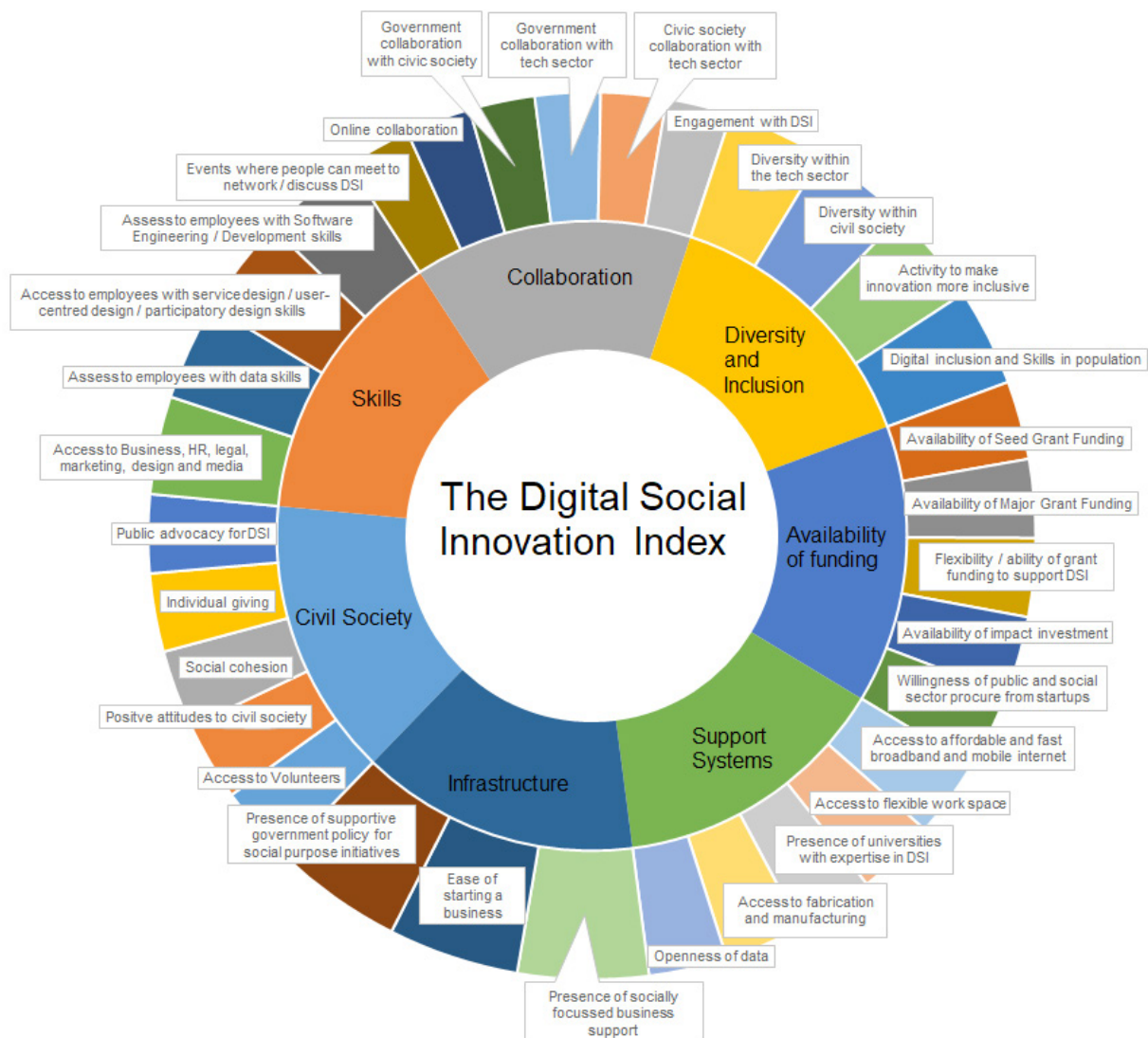
indicators under the subheadings of the seven themes.

2.3.1 Skills

Anecdotal evidence suggests a wide range of technical and non-technical skills are needed for DSI initiatives to thrive, although there is limited comprehensive research on this. Drawing upon our knowledge and insight from literature exploring related fields like entrepreneurship, social impact and social innovation ecosystems, we can distinguish a number of soft skills (e.g. communications, administration) and hard skills (e.g. programming) which are commonly used as a measurement of human capital, powering ecosystems and helping them to grow.[32] Other literature highlights the importance of knowledge and skills as a requirement for grassroots innovation as well as a measurement of successful outcomes.[33]

Our interviewees highlighted the importance of having access to people with the service design thinking and skills needed to generate and design innovative solutions to social problems. The need for people with advanced data and software engineering skills was also highlighted, in keeping with the findings of our 2017 report *What next for digital social innovation?*[34]: access to skills is a necessity for DSI to succeed, but there are shortages in two key areas: technical/ digital skills and business skills (e.g. marketing, business planning).

Skills

Access to business, HR, legal, marketing, design and media support	Growing DSI initiatives needs access to people with a wide range of skill sets including HR, Legal, Marketing, Design, media and other business support professionals.
Access to employees with data skills	Data is often at the core of DSI initiatives products and services. Therefore, having access to people with skills in collecting, manipulating, analysing and interpreting data is crucial.
Access to employees with service design/ user-centred design/participatory design skills	DSI initiatives are able to meet their full potential when the product or service they offer is designed around the specific needs of their users and beneficiaries, which in turn requires people with service design skills.
Access to employees with software engineering/ development skills	DSI initiatives are typically based around a mobile or web app which require software development skills to create.

2.3.2 Civil society

Most DSI originates within civil society in its broadest sense, ranging from large charities to informal community groups. Through our review of literature and interviews, we found that an active, trusted and developed civil society is important in encouraging the creation of DSI and in encouraging citizen engagement in DSI. Literature around social innovation, and social impact in particular, emphasises the importance of a strong civil society in enabling the conditions needed for any kind of social innovation culture to prosper.

Furthermore, a developed civil society is both a result of and a contributing factor to social cohesion. The UN defines social cohesion as the belief shared by members of a community that they share common moral values that enable them to trust each other[35]. A cohesive society allows communities to come together to discuss and solve common problems, which in turn is important for DSI initiatives to grow and

deliver impact. Further to this, TEPSIE's 'Blueprint of Social Innovation Metrics'[36] lists social cohesion as an important indicator of social capital and networks. Whilst social cohesion was not directly mentioned in any of our interviews, positive attitudes towards civil society was listed as an important prerequisite for DSI.

Literature on social innovation also highlights the importance of indicators related to the density of volunteers in reflecting an active civil society.[37] This was supported by our interviewees, who cited that a culture of volunteering is important to supporting DSI initiatives.

Roundtable participants also suggested that a culture of volunteering is indicative of public engagement in social causes more generally.

The UK Civil Society Almanac 2017[38] emphasises elements such as charitable giving and government spending on grants and governance. Donations from individuals can help fund DSI initiatives but also indicate an active engagement in civil society by the public. Our interviewees confirmed this, emphasising the importance of private donations in ensuring the financial sustainability of DSI initiatives.

Civil Society

Access to volunteers	DSI initiatives often rely on the support of volunteers. Alongside this, a culture of volunteering indicates an active civil society and public engagement in social causes.
Positive attitudes to civil society	As DSI tends to be bottom-up and citizen-driven, positive attitudes towards civil society would be expected to in turn generate trust in, enthusiasm for and active involvement in DSI initiatives from citizens.
Social cohesion	A cohesive society is essential for communities to come together to discuss and solve common problems, which in turn is important for DSI initiatives to grow and deliver impact.
Individual giving	Donations from individuals can help fund DSI initiatives but perhaps more importantly they indicate an active engagement in civil society by the public.
Public advocacy for DSI	Public advocacy from politicians and other public figures can raise awareness about DSI, encourage people to innovate and get involved in DSI, drive funding towards DSI, promote the adoption of other supportive policies and attract other stakeholders such as funders and researchers.

2.3.3 Diversity and inclusion

Diverse and inclusive communities, environments and sectors (of different genders, sexes, ethnicities, sexual orientations, abilities, ages etc.) lead to better, more sustainable DSI initiatives.

A myriad of studies have shown that more diverse and inclusive companies and sectors are more innovative.[39] This is likely because more diverse groups encompass and bring with them a wider range of interests, experiences, backgrounds and ideas. Diversity is particularly important in

the field of DSI where minority groups are more likely to have lived experience of the social challenges which DSI tries to tackle. This has been a common theme throughout our research and interviews. As DSI sits both within the tech sector and civil society, we included indicators addressing diversity in both fields.

We have also included an indicator to reflect what activity is being undertaken to make innovation more inclusive. Digital innovation has the potential to improve the welfare of disadvantaged groups and minorities, but can also lead to winner-takes-all markets

which might increase inequality. At the same time, as DSI is bottom-up and works to address social challenges – which are often experienced most acutely by disadvantaged groups and minorities – it is more likely to grow in an environment where all segments of society are able and encouraged to innovate. Policymakers and other actors can help underrepresented groups to become more involved in innovation through policies and initiatives such as targeted grants, entrepreneurship education and extra-curricular outreach for young people.

Furthermore, digital inclusion and digital skills among the population are important for DSI to grow. Firstly, target groups of DSI are often disadvantaged groups, who are also most likely to be digitally excluded. Secondly, for DSI to deliver impact equitably it must be open and accessible to everyone, regardless of age, ethnicity, ability, gender, income or location. Indeed, emerging research from the civic technology community suggests that without digital inclusion, digital technologies can replicate or even exacerbate existing patterns of inequality and discrimination.[40] Thirdly, a more digitally-skilled population is likely to be more innovative.

Diversity and Inclusion

Diversity within the tech sector	Greater diversity within these sectors suggests more progressive practices and a more inclusive culture. This has been shown to promote innovation but is also important because minority groups are more likely to have lived experience of the social challenges which DSI tries to tackle.
Diversity within civil society	
Activity to make innovation more inclusive	DSI is more likely to grow in an environment where all segments of society are able and encouraged to innovate. Places can promote inclusive innovation through policies and initiatives e.g. targeted grants, entrepreneurship education and extra-curricular outreach for young people.
Digital inclusion and skills in population	Societies must be be skilled in and have access to digital technology everyone is to benefit from DSI initiatives, particularly vulnerable groups who often have most to gain from DSI. A digitally-skilled population is also likely to be more innovative.

2.3.4 Collaboration

Given the open and multidisciplinary nature of DSI, collaboration (both online and offline) is a key success factor. DSI works best when a diverse group of people with different expertise (such as technology, social challenges and provision of public services) work together.

We know that explicitly outwards-looking technologies which are powered by, and drive, collaboration are at the heart of DSI[41]. As the DSI ecosystem remains relatively fragmented, it can be difficult for practitioners to identify, learn from and collaborate with similar projects. Collaboration and sharing of knowledge and best practice between policymakers, practitioners, investors and other stakeholders is key to enabling peer learning and supporting the sustainable growth of DSI (and something which we aim to facilitate through DSISCALE).

Interviewees and roundtable participants highlighted the importance of physical spaces and events where people interested in DSI (and related fields) can come together to share knowledge, network and collaborate. As well as bringing together those already working in DSI, events provide

a way for people in different sectors (tech, civil society, government), who may not otherwise meet, to come together.

The necessity for people with tech expertise to be able to talk to and collaborate with expertise in social issues (e.g. in government and civil society) was probably the most emphasised point during the interviews we held. Alongside this, as pointed out in previous DSI4EU research[42], local and national governments are a fundamental stakeholder in the DSI ecosystem, carrying out three main roles: enabler (through policy, funding and support), customer

(through contracts and procurement) and partner (through strategic deployment of DSI tools, products and services). Thus, we have decided to include indicators to reflect the importance of collaboration between these three stakeholders.

As DSI is technology-based and open, online collaboration is common, including for software development on platforms such as GitHub. While online collaboration is not necessarily place-based, the use of collaborative platforms in a location may indicate a culture of collaboration.

Collaboration

Events where people can meet to network and discuss DSI	Events relevant to DSI are important for those interested and involved in the field (and related fields) to share knowledge, network and collaborate.
Online collaboration	As DSI is technology-based and open, online collaboration is common, including for software development on platforms such as GitHub.
Engagement with DSI	An active community of people talking about DSI can help foster informal sharing of knowledge, collaboration, and uptake by potential users.
Government collaboration with civil society	These three sectors are at the heart of DSI, and collaboration between all three – both bilaterally and as a group – is imperative for DSI to grow and scale its impact.
Government collaboration with tech sector	
Civil society collaboration with tech sector	

2.3.5 Availability of Funding

Unsurprisingly, experts consistently said that the availability of funding is important for DSI initiatives at all stages of development. Grant funding in particular was highlighted as being crucial to starting and sustaining initiatives. Experts also repeatedly stated the importance not just of amounts of funding but of its flexibility, to allow for agile technology development and user-centred design, and the need to change direction which comes with that, and to be

able to accommodate changes to the wider political, economic and social landscape. Good funding also needs to be open and accessible to everyone, rather than reliant on knowing the right people or knowing how to write applications. With regards to grant funding, it was also stressed that while it can be relatively straightforward to access small grants to get new projects off the ground, it was much more challenging to find larger longer term grants, which is key to supporting initiatives to grow and become sustainable.

Beyond grant funding, DSI initiatives which have potential to create financial as well as social returns may also look to raise larger amounts of money by selling equity in their business. The importance of equity investment is almost invariably highlighted in literature and indexes related to entrepreneurship and digital innovation but typically this has focus on venture capital (VC) investment[43,44]. While we considered including an indicator related to the amount VCs are investing into businesses in a given city or country, we decided against this because in reality, traditional VCs rarely invest in DSI initiatives. However, several interviewees did suggest the importance of an active impact investment scene. While impact investment can come from multiple potential sources, including VC funds, it was decided that an indicator focussed on the activity of impact investors would be a more relevant indicator because these investors, whether business angels, VCs, Pension funds or other financial institutions, would be more likely to back DSI initiatives.

Alongside the funding offered, impact investors will often also provide mentoring and guidance to digital social entrepreneurs.

Entrepreneurship literature has highlighted the huge benefits associated with procurement from large organisations to growth, helping startups scale up their operations and conveying validation to potential future customers[45]. In addition, every year public authorities in the EU spend around 14% of GDP on public procurement, making it potentially one of the most powerful tools they have to support startups.[46] A large number of DSI initiatives work in fields where the public and social sector holds a monopoly, such as in healthcare, education and employment support. It is for this reason why we have included a indicator on the 'Willingness of public and social sector procure from startups'. In particular, commitment to procuring open technologies will enable DSI initiatives to grow their impact.

Funding

Availability of seed grant funding	Access to relatively small amount of grant funding is needed get early stage initiatives off the ground. Here we are talking about grants of less than €200,000.
Availability of major grant funding	Access to larger grants is needed to fund established DSI initiatives to scale their project and impact. Here we are talking about grants of more than €200,000.
Flexibility / ability of grant funding to support DSI	Flexible funding allows agile product and service development and enables smaller organisations, citizen groups and collaborative projects to access funding.
Availability of impact investment	Impact investors can, in return for equity or debt, provide the investment needed to enable DSI initiatives to grow, but also often provide mentoring and guidance helping DSI initiatives to build a sustainable business model.
Willingness of public and social sector to procure from startups	Accessing procurement and commissioning is often the only way in which DSI initiatives are able to deliver at scale. In turn, DSI has the potential to enable public services to be delivered more efficiently and to involve citizens as co-creators rather than just users of services.

2.3.6 Infrastructure

DSI initiatives' creation, growth and sustainability is enabled by good infrastructure, both digital (such as broadband and mobile internet and provision of open data) and physical (such as workspaces, universities, makerspaces, fablabs).

By definition, DSI relies heavily on the internet, both on the supply side (for example if the initiative relies on data gathering or cloud-based processing) and on the demand side (for example an app which requires good wireless connection). It is therefore important that DSI initiatives and their users have access to fast and affordable broadband and mobile internet. Indicators relating to the speed and affordability of internet have been featured in other indexes on digital entrepreneurship.[47]

Interviewees consistently highlighted the importance of flexible office spaces, such as coworking spaces, as a place to work. Alongside this, flexible workspaces facilitate the exchange of ideas and collaboration between people with different skills and from different sectors.

A significant proportion of DSI initiatives are based on open hardware and digital fabrication, so it is also important that spaces are available where users and producers can access fabrication equipment such as 3D printers, laser cutters and milling stations allowing them to prototype,

manufacture and co-create innovations. Examples of such spaces include makerspaces, Fab Labs, hackerspaces and DIY Biolabs[48]. Universities often host such flexible office and manufacturing spaces, but some also collaborate with DSI initiatives and do valuable research, hold events and teach courses related to DSI.

Interviewees also regularly talked about the importance of access to and quality of open data (i.e. data which anyone is free to access, use, modify, and share) to the DSI community. This is both because it can be used to help develop new products and services, but also because the opening up of government data increases transparency, which is the field of activity for much DSI. While data is not often treated as infrastructure, as the Open Data Institute points out, 'Data is as important as our road, railway and energy networks and should be treated as such'. And in order to make maximise data use and value, we need not only data assets but also the organisations that operate and maintain them, and guides describing how to use and manage the data.[49]

Infrastructure

Access to affordable and fast broadband and mobile internet	DSI initiatives are typically based around a mobile or web app and therefore access to affordable and fast broadband and mobile internet is essential to potential developers and users.
Access to flexible work space	DSI initiatives often rely on shared and flexible office space as a place to work, hold meetings and network, especially in early days. Alongside this, flexible workspaces facilitate the exchange of ideas and collaboration between people with different skills and from different sectors.
Presence of universities with expertise in DSI	Alongside doing research and teaching courses related to DSI, universities often hold events, provide equipment and workspace and collaborate with DSI initiatives.
Access to fabrication and manufacturing facilities	DSI includes hardware as well as software-based initiatives (particularly open hardware). For this reason, it is important that spaces are available where users and producers can access fabrication equipment such as 3D printers, laser cutters and milling stations allowing them to prototype, manufacture and co-create innovations. Examples of such spaces include makerspaces, Fab Labs, hackerspaces and DIY Biolabs.
Openness of data	The accessibility and quality of open data (i.e. data which anyone is free to access, use, modify, and share) is important to the DSI community both because it can be used to help develop new products and services but also because the opening up of government data increases transparency which is generally seen to be a positive thing.

2.3.7 Support systems

DSI initiatives are helped by the presence of intermediaries and system-level support, allowing them to access skills, knowledge, advice, legal frameworks and more in a structured way. Therefore, within this theme, we include indicators about the presence of supportive government policy for social purpose initiatives, socially-focussed business support and other support intermediaries.

Governments can help DSI to thrive through supportive policies and initiatives. Supportive policies aimed at the civil sector as a whole, rather than just DSI, are still likely to benefit DSI. Such policies include: defining legal forms which make it easier to set up, raise funding for and run social initiatives; providing tax relief for social initiatives and investors; and offering grants, loans and investment to social initiatives.

Governments and other stakeholders can also assist DSI by funding and running support programmes such as accelerators, incubators, mentoring and training programmes. The exact support offered by these programmes varies, but may include workspace, training, networking opportunities, business model development, mentoring, funding and access to technical equipment. A growing number of programmes have a focus on supporting socially driven ventures, and their importance was highlighted by several interviewees[50].

While the most grassroots DSI initiatives may not have legal structures, it is almost always essential if initiatives want to scale their impact and access funding. DSI will be more able to grow if it is easy, trusted and cheap to set up a business. The process of registering a new company can alone be a bureaucratic process; and after formation, new businesses have a multitude of administrative hoops to jump through such as tax, employment law, social security, business rates etc. For this reason we will include a indicator aimed at reflecting the ease (or difficulty) of this process in different locations.

Support Systems

Presence of socially focussed business support	Support includes that offered by accelerators, incubators and other initiatives such as mentoring and training programmes.
Ease of starting a business	While the most grassroots DSI initiatives may not have legal structures, it is almost always important if initiatives want to scale their impact and access fundingt. DSI will be more able to grow if it is easy, trusted and cheap to set up a business.
Presence of supportive government policy for social purpose initiatives	Governments can help DSI initiatives to thrive through supportive policies such as defining legal forms which make it easier to set up and run social initiatives, providing tax relief for social initiatives and investors, and offering grants, loans and investment to social initiatives.

2.4 Relative importance of themes and indicators

2.4.1 Findings from the survey

A total of 114 practitioners, public sector employees, researchers, intermediaries, funders and policymakers responded to our survey in which they ranked the themes and indicators described above in order of their importance to starting, sustaining and growing DSI. Respondents first ranked the importance of the seven chosen themes. Average rankings were normalised to be between 0 and 100 (i.e. a percentage).

The graph below shows the distribution of rankings given to each theme (Figure 2).

Based on median rankings (solid bars), we can divide the themes into three groups: (1) Civil Society, Collaboration and Skills, (2) Diversity and Inclusion and Availability of funding, and (3) Infrastructure and Support Systems. These groupings broadly correlated with the importance of different factors indicated by interviewees and roundtable participants. These median values will be used as the weightings for the index (see Table 1). While there was some variation in mean rankings within these groupings, we decided that as there were only 7 levels (or rankings) to choose from the rankings should not be treated as continuous and

therefore median is a better measure of centrality.

It is important to note that the differences in average rankings were actually relatively small and there was a lot of variation between how people ranked the themes. In fact, each theme was ranked as being the most important and least important by at least one person. This suggests that there is not much consensus within the DSI community about what is most important to starting, sustaining and growing DSI. Given the the breadth and diversity of the DSI field, this is perhaps not surprising.

Table 1. Median rankings of themes. Shades of green group themes with same median rankings

Theme	Median ranking (%) / weighting
Skills	17.86
Civil Society	17.86
Collaboration	17.86
Diversity and Inclusion	14.29
Availability of Funding	14.29
Infrastructure	10.71
Support Systems	10.71

Figure 2. Boxplots of distribution of rankings for themes. The box shows the interquartile range (IQR). The whiskers show 1.5 * IQR and outliers are shown as circles outside the whiskers (none in this case). The bar shows the median ranking and the circle in the box shows the mean ranking.
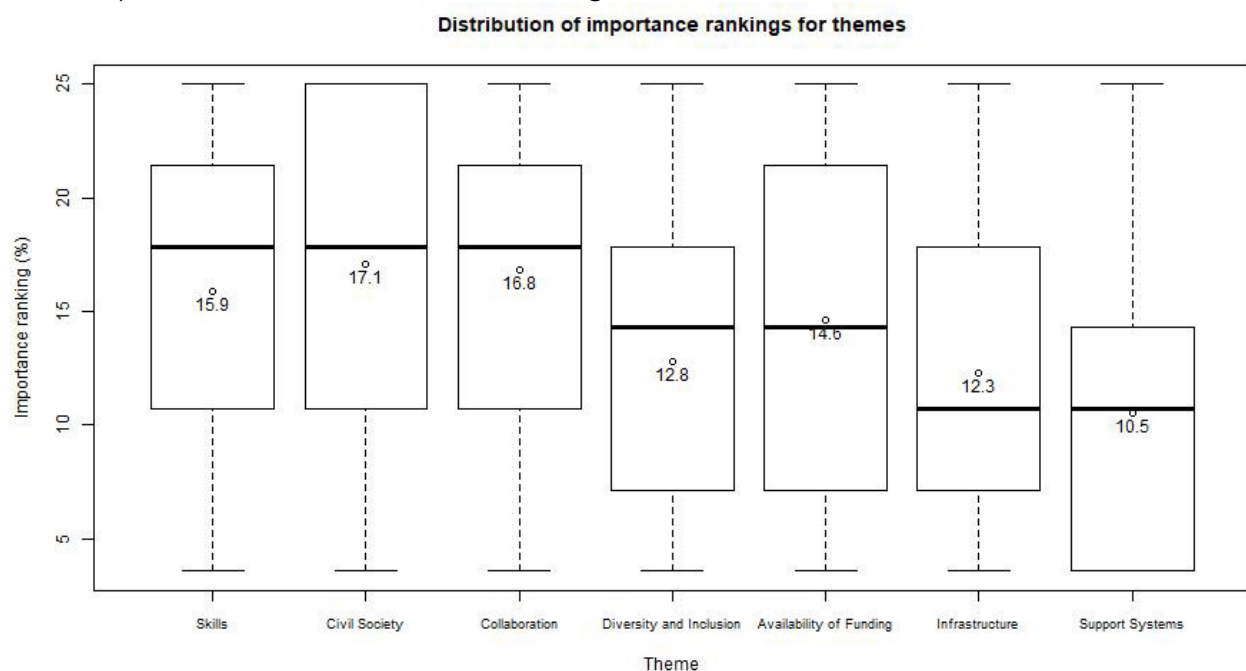
Respondents were then asked to rank the importance of the indicators within each theme according to there importance relative to the other indicators in the same theme. Within each theme, indicators could be grouped into 2-4 groups according to their median ranking within that theme (see Table 2). As with the themes, there was lots of variation in how indicators were ranked with each theme, being ranked as being the most important and least important by at least one person (see Appendix E for indicator ranking boxplots). Out of all the indicators, 'Collaboration between civil

Table 2. Median rankings of indicators within each theme. Shades of green group indicators with same median rankings

	Indicators	Median ranking (%) / weighting
Civil Society	Positive attitudes to civil society	26.67
	Social cohesion	26.67
	Public advocacy for DSI (e.g from political / leading figures)	26.67
	Access to volunteers	13.33
	Individual giving	6.67
Collaboration	Collaboration between civil society and tech sector	23.81
	Collaboration between government and civil society	19.05
	Engagement with DSI	19.05
	Collaboration between government and tech sector	19.05
	Online collaboration	11.9
	DSI-related public events	9.52
Diversity and Inclusion	Activity to make innovation more inclusive	30
	Digital inclusion and skills in population	30
	Diversity within the tech sector	20
	Diversity within civil society	20
Availability of Funding	Flexibility and ability of grant funding to support DSI effectively	26.67
	Availability of seed grant funding	20
	Availability of impact investment	20
	Willingness of public and social sector procure from startups	20
	Availability of major grant funding	13.33
Infrastructure	Access to affordable and fast broadband and mobile internet	26.67
	Openness of data	26.67
	Access to flexible work space	20
	Presence of universities with expertise in DSI	13.33
	Access to fabrication and manufacturing facilities	13.33
Skills	Access to employees with service design / user-centred design / participatory design skills	40
	Access to employees with software engineering / development skills	30
	Access to employees with data skills	20
	Access to business / HR / legal / marketing / design and media support	10
Support Systems	Presence of supportive government policy for social purpose initiatives	50
	Presence of socially focused business support	33.33
	Ease of starting a business	16.67

society and tech sector' received the highest ranking relative to others in the same theme. This is in line with the interviews, in which this indicator was repetedly referred to as being the most important factors to supporting DSI.

2.4.2 Compensability between indicators

At this stage we also discussed whether compensability between indicators should be allowed. Compensability refers to the extent to which a deficit in one indicator or theme can be offset (compensated) by a surplus in another. This decision effects how weighted indicators are combined during the aggregation stage.

Our research has suggested that all the indicators that are to be included in this index are important to starting, sustaining and growing DSI. We therefore do not believe that having a higher score in one completely negates the absence of another and believe that the method used to aggregate indicators in the index should reflect this.

2.5 Challenges in developing the framework

A number of challenges arose when discussing the index and potential indicators with interviewees and roundtable participants. While we had anticipated some of these, as we continued to develop the framework we continued to come up against tricky questions. While this made it all the more important for our index methodology to be as inclusive as possible, we are aware that it is by no means definitive, and far from perfect. Largely, these challenges have resulted from the huge breadth of the field of DSI, and we outline a few specific challenges below.

- **Stages of development.** Several experts pointed out that the specific needs of DSI initiatives differ considerably depending on their stage of development.[51] For example, availability of advice and mentoring on running a

social purpose initiative is likely to be much more important to early stage DSI initiatives than scaling DSI initiatives, while public procurement might be very important to an established initiative but of little interest to new initiatives.

- **Breadth of organisational types.** For-profit organisations will have different requirements to not-for-profit organisations, an example being that they will be more likely to be interested in selling equity and less reliant on grants.

- **Breadth of social challenges.** DSI is active in a vast range of social challenges - healthcare, education, transport, housing, justice, environment, democracy and migration to name only a few. Of course, each of these challenges is itself vast. The enabling and hindering factors for DSI initiatives varies enormously and it would be impossible to cater to all of these within a composite index.

- **Breadth of technologies.** DSI encompasses a huge range of technologies, so we have faced challenges with some infrastructural indicators. Open data and digital fabrication tools, for example, are central to the success of some DSI initiatives, but completely irrelevant for others. However, we have decided to include them as indicators and allow the survey findings to suggest how indicators like these should be weighted. One possible way of addressing the four challenges above would be to effectively produce multiple indexes, one for each different type of DSI initiative (i.e. based on their stage of development, organisational type, social challenge they are addressing and technology they are using), by using the same indicators for each index but weighting them differently depending on characteristics of the DSI initiative. This would be presented using an online user interface

allowing policymakers to pick and choose the different characteristics (e.g. sector, organisation type or development stage) they were interested in seeing an index and ranking for. While this approach would be impossible within the scope of DSISCALE, it should be considered if another iteration of the index is created in the future. Furthermore, as the Index will be open-source, specific sectors or fields could tailor it to their needs if they desired.

- **Political and socio-economic contexts.** DSI responds to social challenges, and so it may be posited that more DSI would take place organically in places with more social challenges. Taking this hypothesis to its logical end, places with more (or more serious) social challenges would be better "ecosystems" for DSI to grow. But, of course, we would not want to include this in a composite Index. Furthermore, country-specific contexts affect the nature of DSI in different places. For example, DSI initiatives tackling corruption and improving transparency and accountability are thriving in countries with weaker state institutions - but we would not argue that policymakers should weaken institutions to promote DSI. While this may at first seem facetious, these geographical and contextual differences have posed a real challenge in developing the framework, and one which we have not managed to completely solve thus far.

3. NEXT STEPS AND METHODOLOGY FOR CONSTRUCTING THE INDEX

3.1 Source selection & data gathering

Having developed the theoretical framework for the index, the next stage is to decide how to measure the indicators that have been chosen. The choice of what data sources will be used to measure the chosen indicators will be based on their relevance to the indicator, analytical soundness, geographical coverage and their relationship to other indicators being considered. We have already begun this work over the course of the theoretical framework development, for example, logging indicators and data sources suggested in literature or by experts.

Where no direct measures of indicators are available we will consider using proxies. For example, if we are unavailable to find data for the indicator 'Access to Employees with Data Skills', we would consider instead using data on the proportion of the population with STEM degree under the assumption that data skills are a part of most (if not all) STEM degree programmes. It is possible that for some indicators we will not be able to find a direct measure or an acceptable proxy measure. If this is a case we may have to omit these indicators from the index.

A wide variety of data sources will be considered during this stage including publicly available data (e.g. from national governments, the EU and other public organisations) and commercial data, as well as primary data collected through web scraping and API queries. Data sources may also include other indexes identified through the literature review. At the end of this stage we will have a summary table of the characteristics of the data to be collected (such as geographical coverage, year, source and description).

3.1.1 Denomination of indicators

At this stage, careful thought will be given to which of the collected data is dependent on, or affected by, size-related factors such as the population, land area or GDP of the city or country. When necessary, indicators will be scaled to account for differences in these factors.

3.2 Data checking

The data collected in the previous stage will come from a variety of sources and will vary in terms of quality and geographical coverage. There are three main things to consider in the data checking stage: firstly, how to deal with missing data; secondly, how to deal with outliers (i.e. data points that differ greatly from other values in a data set); and thirdly, how to normalise data, transforming it such that all indicators are on the same scale.

3.2.1 Missing values

In order for our index to fairly compare geographical regions on a like for like basis, we require a complete data set with the same data points for every region. However, the geographical coverage of economic and demographic datasets is often incomplete. Therefore, we must have a strategy for dealing with missing values.

Where possible our first approach will be to try and find another data source which is more complete. If this is not possible we will use regression to assign (or 'impute') estimates to missing values. While it is possible to make a single estimate for each missing value, this would not allow us to capture the effect that the variance associated with missing value estimates has on the final ranking. Instead we will use multiple imputation[52], whereby missing values are estimated multiple times, to create several "complete" datasets. Average estimates will be computed by taking a mean of the datasets created and between- and within-imputation variance is calculated.

These mean estimates will be used for the final index, however, in order to test the sensitivity of the index to the estimates made we will recreate the index using each estimate set and compare how the dataset used effects the final rankings.

3.2.2 Outliers

Index building is based on a benchmarking principle where baseline values considerably influence a city or countries index score as well as its rank. The presence of outliers may result in inappropriate benchmarks and must therefore be dealt with before the index can be constructed.

Problematic indicators will be identified as those that have a distribution with a kurtosis greater than 3.5 and absolute skewness greater than 2.[53] For indicators with upper-end outliers, the largest value will be transformed to have the same value as the second largest value and for those with lower-end outliers, the smallest value will be transformed to have the same value as the second smallest value. This process will then be iterated until the indicator's skewness and kurtosis fall within the acceptable limits.

3.2.3 Normalisation

Indicators will have different measurement units and scales of magnitude. Data must therefore be normalised so that different indicators are on the same scale before they can be aggregated into the composite index. We will use the relatively simple min-max normalisation method with which we will transform indicators to within an identical [0.1, 0.9] range using the equation below.

Equation 1. Min-max normalisation [0.1, 0.9]

$$Z_{i,j} = \left(\left(\frac{x_{i,j} - \min(x_j)}{\max(x_j) - \min(x_j)} \right) \times 0.8 \right) + 0.1$$

where $z_{i,j}$ is the normalized value for city or country i and indicator j

$x_{i,j}$ is the original value for city or country i and indicator j

$max(x_j)$ is the maximum value for indicator j

$min(x_j)$ is the minimum value for indicator j

While minmax normalisation is perhaps more commonly performed by transforming data to within a [0, 1] range. We have chosen a [0.1, 0.9] range in this instance because the geometric aggregation that we plan to use in the aggregation stage does not accept zero values.

3.2.4 Direction of Indicators

At this stage we will also make sure all indicators are expressed in the same direction i.e. higher values are better for supporting, starting and sustaining DSI initiatives. For indicators currently expressed in a form where lower values are better, we will reverse the scale using the equation below.[54]

Equation 2. Inversing scales

$$V_{i,j} = \max(x_j) - (x_{i,j} - \min(x_j))$$

where $V_{i,j}$ is the reverse scale value for city or country i and indicator j

$x_{i,j}$ is the original value for city or country i and indicator j

$max(x_j)$ is the maximum value for indicator j

$min(x_j)$ is the minimum value for indicator j

3.3 Data Processing

This stage will involve exploring the structure of the dataset through multivariate analysis, weighting and aggregating the data in a way that reflects the theoretical framework and analysing the sensitivity of the index to decisions made during it production.

3.3.1 Multivariate Analysis

We will assess the overall structure of the data collected and processed using Principal Components Analysis (PCA)[55]. PCA helps reveal how different indicators change in relation to each other and how they are associated, which can help us decide whether the way we have grouped into 'Themes' makes sense from a statistical point of view. Based on this we may decide to refine the way indicators are grouped. This

analysis may also inform us of whether there are any indicators which, due to their high correlation to others, do not help explain much variation and thus could possibly be removed from the index.

3.3.2 Aggregation and weighting

Once the final set of indicators and their structure has been decided, the next step is to aggregate the indicators into theme scores and then aggregate these theme scores into the overall index scores for each city or country.

The aggregation method used depends on the theoretical framework of the index. In this case, we decided to weight indicators and themes differently depending on their importance to starting, sustaining and growing DSI, according to DSI stakeholders. The relative weightings for each theme and indicator can be found in Table 1. We also decided that themes and indicators should be aggregated in a non-compensatable fashion meaning that a low score for one indicator or theme cannot be completely offset (compensated) by a high score in another.

In order to have non-compensability between themes and indicators, we will aggregate themes and indicators using a geometric mean rather than an arithmetic mean (commonly referred to as just a 'mean'). Whereas with an arithmetic mean, the compensability is constant, with geometric aggregations compensability is lower for the composite indicators with low values. This means that when using a geometric aggregation, a city or country with a low score for one indicator or theme will need a much higher score on the others to improve its score.

The theme and indicator weightings decided on in the theoretical framework development stage will be implemented alongside the geometric mean aggregation using the equations below. The output of this stage will be the theme scores and overall index score for each city or country.

Equation 3. Geometric Aggregation for Theme Scores

$$TS_{i,k} = \left(\prod_{j=1}^{J} z_{i,j}{}^{w_j} \right)^{1/\sum_{j=1}^{J} w_j}$$

where $TS_{i,k}$ is the aggregated theme score for city or country i and theme k

w_j is the weight given to indicator j=1,…,J

$z_{i,j}$ is the normalised value for city or country i and indicator j=1,…,J

Equation 4. Geometric Aggregation for Index Scores

$$IS_i = \left(\prod_{k=1}^{K} TS_{i,k}{}^{w_k} \right)^{1/\sum_{k=1}^{K} w_k}$$

where IS_i is the aggregated Index score for city or country i

w_k is the weight given to theme k=1,…,K

$TS_{i,k}$ is the aggregated theme score for city or country i and theme k =1,…,K

3.3.3 Further analysis of index

Once we have created our first iteration of the index we will perform further analysis to understand how individual indicators correlate to the themes as a whole and how themes are correlated with one another. The results of this may lead to further refinement of the Index's structure. We will also use a cluster analysis to explore which cities are most similar with regards to the indicators on which they score high or low, that is, their strengths and weaknesses in supporting DSI.

3.3.4 Sensitivity analysis

As mentioned earlier, composite indexes often appear to be completely objective when in fact, their construction involves many subjective decisions from the indicators chosen to the method used to normalise the data. In order to test the sensitivity of the final index rankings to the various decisions made throughout the construction process we are planning to create multiple versions of the index, using a

number of different methodology options.

1. Indicator Selection – We will test the effect of sequentially and randomly excluding indicators/themes from the Index (using a Monte Carlo simulation as described in EDCI construction methodology)[56]

2. Normalisation method – We will recreate the index using Z-score normalisation[57] rather than Min-Max normalisation

3. Imputation of missing values – We will test the effect of regression imputation by recreating the index with each of the datasets created through multiple imputation

4. Aggregation selection – We will recreate the index using using a weighted arithmetic mean rather than a weighted geometric mean to aggregate themes and indicators

5. Weight Selection – We will test the effect of randomly varying the weights of the indicators (as described in EDCI construction methodology).[58]

3.4 Data Visualisation

Having created the final index we will create visualisations to show how cities and countries score for each indicator, theme and for the overall index. Alongside scores we will show how cities or countries rank in comparison to one another. These visualisations will be published on digitalsocial.eu. For each theme we will also suggest some examples of supportive policies related to that theme which other cities or countries have implemented.

4. CONCLUSION AND NEXT STEPS

In this report we have summarised the findings from the first stage of the process of constructing the DSI index, the development of the theoretical framework. We have also explained the methodology which we plan on following in order to complete the production of the index. Though the planned methodology for the construction of the index has been described as being a linear process, from our experience in producing indexes, it will in reality be highly iterative as we repeat steps in order to fine tune the index. Having identified 32 indicators across seven broad themes, we will now concentrate on identifying sources of data to measure these indicators.

If you would like to know more about the Index, contribute knowledge or share your opinions, please contact us via email (**contact@digitalsocial.eu**), Twitter (**@DSI4EU**) or via the Feedback form on our website (**digitalsocial.eu/feedback**).

APPENDICES

Appendix A. Interview Guide

Introduction to interview

- **Introduce self and Nesta**

- **Introduce index** - The index which will compare the capacity of local and national ecosystems to support tech for good, or digital social innovation, initiatives across Europe.

- **Purpose of index** - The purpose of the index, which is part of the EU-funded DSI4EU (Digital Social Innovation for Europe) project, is three-fold: 1) To help understand the factors which help DSI to thrive in different countries and cities; 2) To help policymakers understand how they can better support DSI, and to put pressure on them to implement supportive policies ; and 3) To help DSI practitioners understand where they may want to locate work and resources.

- **What we want from interview** - The index will be created by combining several indicators for key factors to which are needed to start, sustain and grow DSI initiatives. The first stage of this work is to fully understand exactly what these key factors are and how important they are relative to one another. So we contacted you as an expert in the area primarily to understand what you see these key factors as being and how we might be able to measure them.

- **Time** - The interview should take around 30 minutes.

Section One - Background

- Can you tell me a bit about your organisation and your interest in DSI?

- Confirm where they are based and where they work

Section Two - Key factors

- Why did you decide to set up in {{location}}

- What were the main challenges you faced in setting up a project in {{location}}?

- What are particular enabling factors, things you were able to use in London?

- More generally, what do you think are the most important factors to being able to set up and sustain a DSI project?

- When producing the index we need to make sure we take into account the relative importance of different factors by applying weights to the importance indicators. If you had to choose one of the above, which would you say was the most important?

- If you could ask for more of one thing in {{location}} what would it be?

- Moving into the future do you think anything is going to become more or less important?

Section Three - Measurement

- In order to produce the index we need to find good measures of the different key factors you mentioned. What do you think a good measure of XX would be?

- Do you know any good sources of data for things we might want to include in the index?

Debrief:

Thank you for taking the time and sharing with us. After we have spoken to other experts in the field we may want to get back in touch to ask you to compare how important you think other factors are that people suggest is this ok?

Before we finish, do you have any questions for me about the index or wider programme?

Appendix B. Information sent to DSI index roundtable participants

Workshop: Developing the DSI4EU Index

Nesta, 58 Victoria Embankment, London, EC4Y 0DS (Library)
14th March 2018, 0900-1100
Notes: bit.ly/IndexWorkshop

Background

Nesta has recently kicked off the latest phase of its work on digital social innovation (DSI) with funding from the European Commission. Building on past work, this project aims to support the growth and scale of DSI in Europe through a range of activities including research, policy engagement, on-the-ground support, events and communications, blogging and mapping.

One key activity within the project is the development of an experimental DSI Index, on which the workshop's discussion will be centred.

Indexes are commonly-used tools which compare the performance of different countries, cities, organisations and governments at the macro level in everything from democratic accountability to economic growth. A number of indexes exist which are relevant to the field of DSI, like the European Digital City Index, CITIE, the Open Data Barometer, the Global Open Data Index, the Fab City Dashboard, Creative Commons' State of the Commons report, the European Data Portal, the Global Entrepreneurship Index (GEDI), the Digital Entrepreneurship Monitor (DEM), the Digital Economy and Society Index (DESI), the Global Innovation Index (GII), the Social Entrepreneurship Index and the Social Innovation Index.

However, as far as we know, none exist to explore the capacity of local and national ecosystems to support DSI. This project is a first attempt at developing such an index.

Its purpose is threefold:

- To help understand the factors which help DSI to thrive in different countries and cities;

- To help policymakers understand how they can better support DSI, and to put pressure on them to implement supportive policies;

- To help DSI practitioners understand where they may want to locate work and resources.

Methodology

Between now and the end of June we will be building the theoretical framework for the Index through semi-structured interviews, desk research, roundtables and analysis of methodologies and indicators used in other relevant indexes. This will lead to a set of weighted indicators. From July 2018 until March 2019 we will select sources and then gather, check and visualise data. We will be using hard data (e.g. statistical sets), open data and soft data (e.g. data scraped from platforms through APIs).

As experts in the fields of DSI and tech for good, representing a range of stakeholders including funders, practitioners and researchers, we are confident the workshop will provide valuable input for the theoretical framework.

Should you have a few minutes in advance, we'd really appreciate people having a quick think beforehand about what challenges they see/face for DSI projects and organisations, and what measures might be relevant as indicators of a city, region or country's capacity to support DSI.

Attendees

- Alina Kadyrova, University of Manchester

- Basma Al-Nabulsi, Nesta

- Billy Dann, Comic Relief

- Daniel Robinson, Nominet Trust

- Jonathan Bone, Nesta

- Mark Cridge, mySociety
- Martha Young, Comic Relief
- Matt Stokes, Nesta
- Mor Rubinstein, 360Giving
- Nissa Ramsay, Think Social Tech
- Peter Baeck, Nesta
- Stav Bar-Shany, DotEveryone

Agenda

0900-0930 Networking and light refreshments

0930-0935 Introduction to Nesta and DSI4EU (Matt Stokes)

0935-0945 Introductions around the table

0945-0950 The DSI Index (Jonathan Bone)

0950-1005 Group discussion: Challenges for DSI

1005-1050 Identifying indicators (small groups) and feedback to group

1050-1100 Voting on indicators and wrap-up

Appendix C. Selected literature review

	Title	Authors	Year	Key Factors Discussed
1	Fab City Whitepaper: Locally productive, globally connected self-sufficient cities	Tomas Diez	2016	• Government collaboration with civic society;
2	ARUP: City Resilience Index	The Rockefeller Foundation ARUP	2015	• Collective identity and community support; • Effective mechanisms for community to engage with government; • Cohesive communities; • Actively engaged citizens; • Inclusive and conducive collaboration between all actors involved in decision-making;
3	Innovation, Sustainability and Democracy: an analysis of grassroots contributions	Adrian Smith Andrew Stirling	2017	• Cultures of expertise; • Technical knowledge; • Access to material deliberation spaces;
4	Assessing your innovation district: A how-to guide	Jennifer S. Vey Jason Hachadorian Julie Wagner Scott Andes Nathan Storring	2018	• Infrastructure indicators; • Diversity and inclusion;
5	A Methodological Framework for Measuring Social Innovation	Michael Hoelscher Georg Mildenberger Eva Bund	2015	• Knowledge; • Information/Communication technology (i.e. broadband prices); • Social climate; • Collaboration and networks; • Financial resources; • Political anchoring/support; • Social capital and networks;
6	Measuring What Matters—Indicators of Social Innovativeness on the National Level	Gorgi Krlev Eva Bund Georg Mildenberge	2014	• Equal opportunities; • Subject specific competencies;
7	Policy for social innovation: Five ways policy can support social innovation	Madeleine Gabriel	2016	• Access to social impact funds and grants; • Supportive regulation and legal framework;

	Title	Authors	Year	Key Factors Discussed
8	Blueprint of Social Innovation Metrics: Contributions to an Understanding of the Opportunities and Challenges of Social Innovation Measurement	Eva Bund David-Karl Hubrich Björn Schmitz Georg Mildenberger Gorgi Krlev	2013	• Equal opportunities; • Skill acquisition; • Social capital and networks (social cohesion);
9	Bridging the Digital Innovation Divide: A toolkit for strengthening ICT centric ecosystems	International	2017	• Infrastructure (i.e. tech hubs); • Capital and funding; • Skills; • Culture and communities; • Policy and regulation;
10	The Logic of Innovation Locations: Understanding the drivers that enable cities to host innovation economies	Tim Moonen Greg Clark	2017	• Investors; • Pool of qualified workers; • Policy incentives to secure solutions to pressing problems; • Support of nation agencies and institutions for interdisciplinary research;
11	The Global Creativity Index	Richard Florida Charlotta Mellander Karen King	2015	• Tolerance;
12	'Everything is gentrification now': but Richard Florida isn't sorry	Oliver Wainwright	2017	• Inclusion (in tech sector);

Appendix D. Indicator ranking survey

Respondents were first asked to rank the importance of each of the 7 chosen themes to the creation, sustainability and growth of DSI initiatives (see below for screen shot). Themes were ranked by dragging items from the left-hand list to the right-hand list to order them, putting themes they considered to be the most important at the top of the list and those that they considered to be least important at the bottom. By hovering their mouse over the name of each theme, respondents could see definition or an explanation of why it has been included in the index.

Having ranked the themes, we then asked respondents to rank the importance of the individual indicators that make up each theme relative to the other indicators in the same theme (see below for screenshot). Respondents could see a definition / explanation of why each indicator was included by hovering their mouse over the indicator name.

Finally we asked respondents some questions about themselves. We asked them which of these categories best describes you?: Practitioner (you are involved in a DSI project or organisation), Researcher (on DSI or a related field); Policymaker, civil servant or government official; Funder or investor; Intermediary or support organisation (e.g. coworking space, accelerator, network, alliance); Public sector (service delivery or frontline); None of the above - I'm just interested in DSI; Other - Please specify. We also asked them for their name, organisation name and email address and whether they would like to be entered into a prize draw, join the DSI4EU mailing list, receive a copy of the DSI index when published and / or be contacted for further into the index.

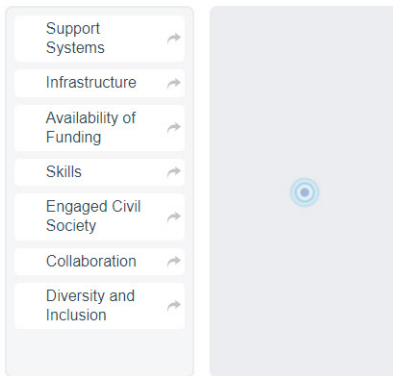# Digital Social Innovation Index Survey

As we mentioned on the previous page, we have identified 32 factors that are considered important for starting, sustaining and growing DSI initiatives. These factors have been grouped into 7 overarching themes.

1. Please rank how important you consider each of the following themes to the creation, sustainability and growth of DSI initiatives.

Hover over each theme to read a description of the theme.
Skills, Engaged Civil Society, Collaboration, Diversity and Inclusion, Availability of Funding, Infrastructure and Support Systems

Drag all items from the left-hand list into the right-hand list to order them. Put the item you consider most important at the TOP of the list and the item you consider least important at the BOTTOM of the list.

- Support Systems
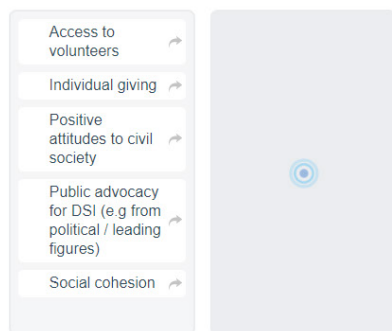- Infrastructure
- Availability of Funding
- Skills
- Engaged Civil Society
- Collaboration
- Diversity and Inclusion

[Back] [Next]

20%

2. Within the theme **'Engaged Civil Society'**, please rank how important you consider each of the following indicators to the creation, sustainability and growth of DSI initiatives.

Hover over each indicator to read a description of the indicator and the rationale for including it:
Access to volunteers, Positive attitudes to civil society, Social cohesion, Individual giving and Public advocacy for DSI (e.g from political / leading figures)

Drag all items from the left-hand list into the right-hand list to order them. Put the item you consider most important at the TOP of the list and the item you consider least important at the BOTTOM of the list.

- Access to volunteers
- Individual giving
- Positive attitudes to civil society
- Public advocacy for DSI (e.g from political / leading figures)
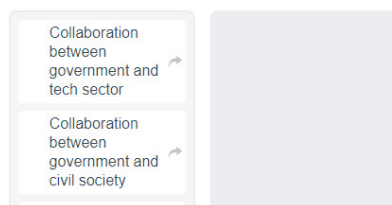- Social cohesion

3. Within the theme **'Collaboration'**, please rank how important you consider each of the following indicators to the creation, sustainability and growth of DSI initiatives.

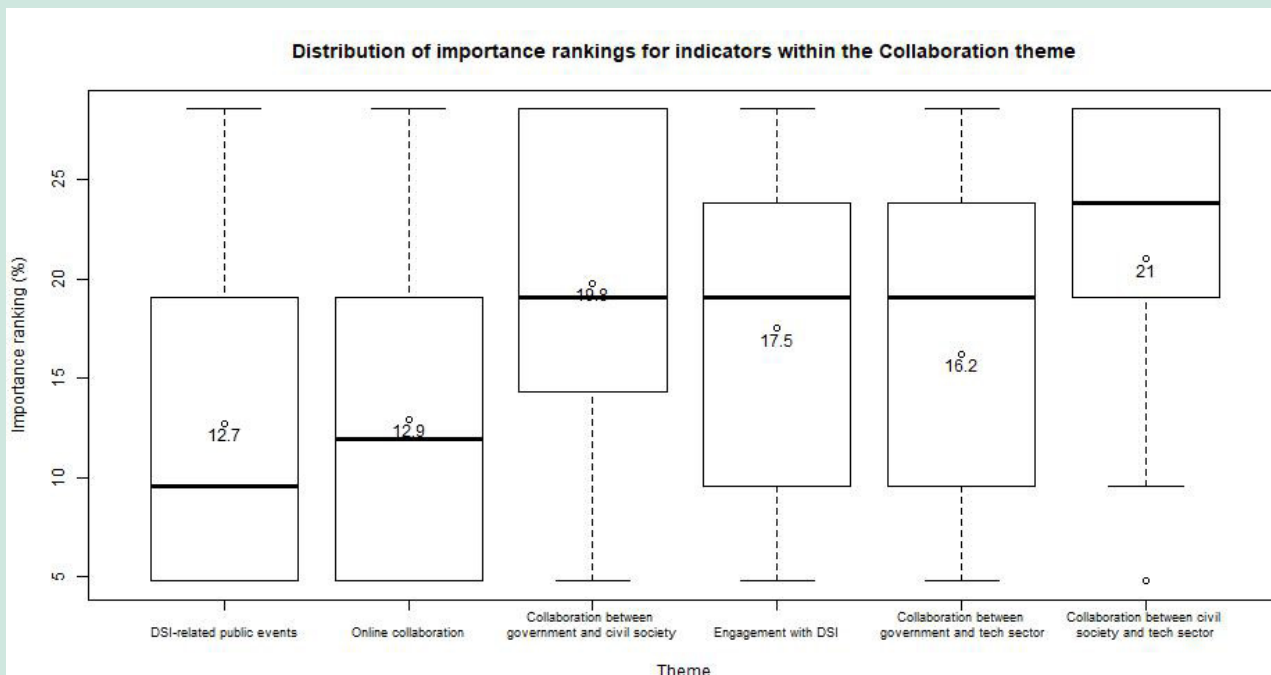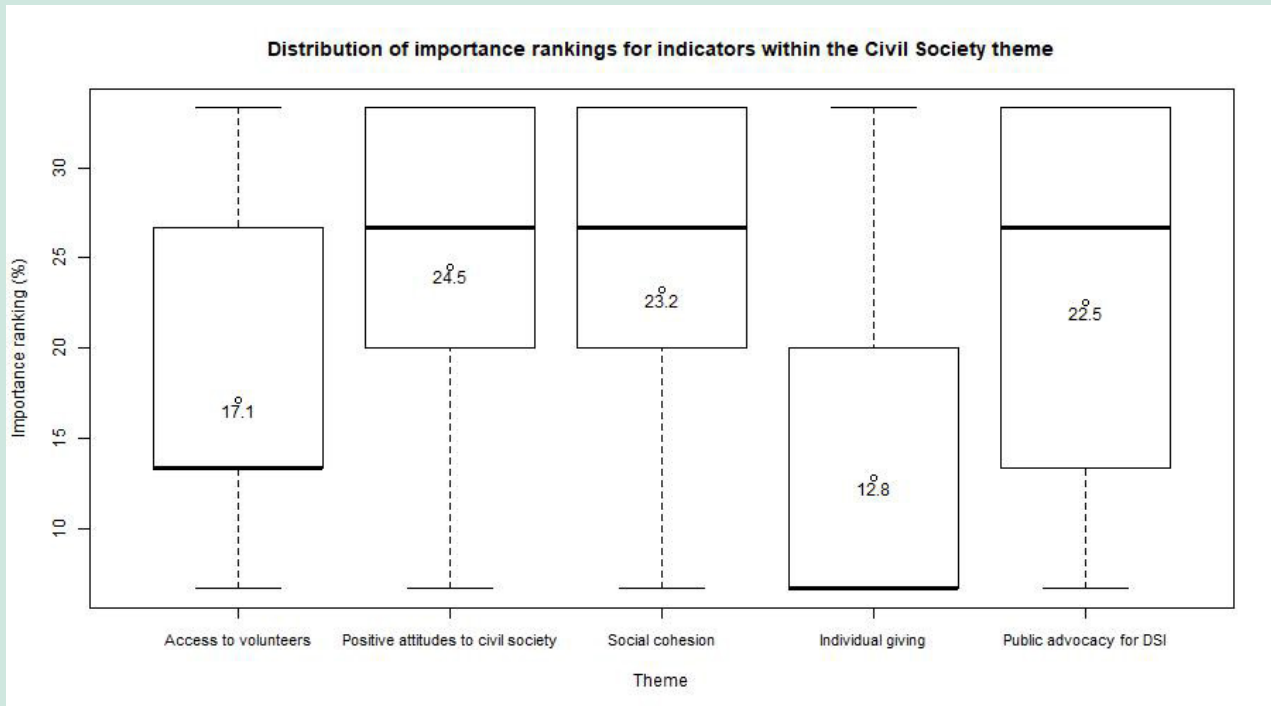Hover over each indicator to read a description of the indicator and the rationale for including it:
DSI-related public events, Online collaboration, Collaboration between civil society and government, Engagement with DSI, Collaboration between government and tech sector and Collaboration between civil society and tech sector

Drag all items from the left-hand list into the right-hand list to order them. Put the item you consider most important at the TOP of the list and the item you consider least important at the BOTTOM of the list.
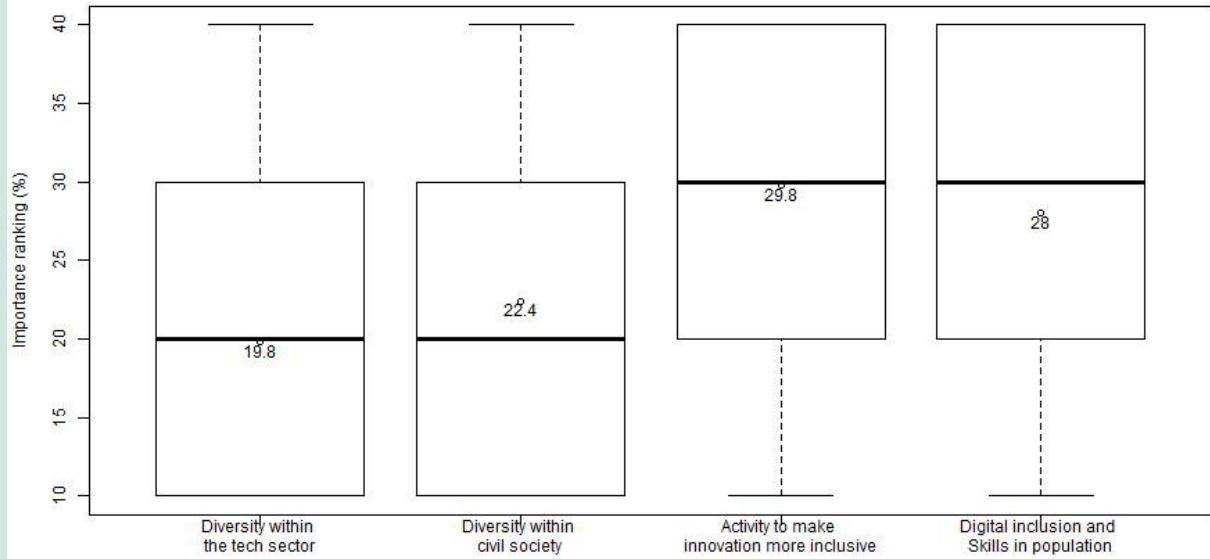
- Collaboration between government and tech sector
- Collaboration between government and civil society

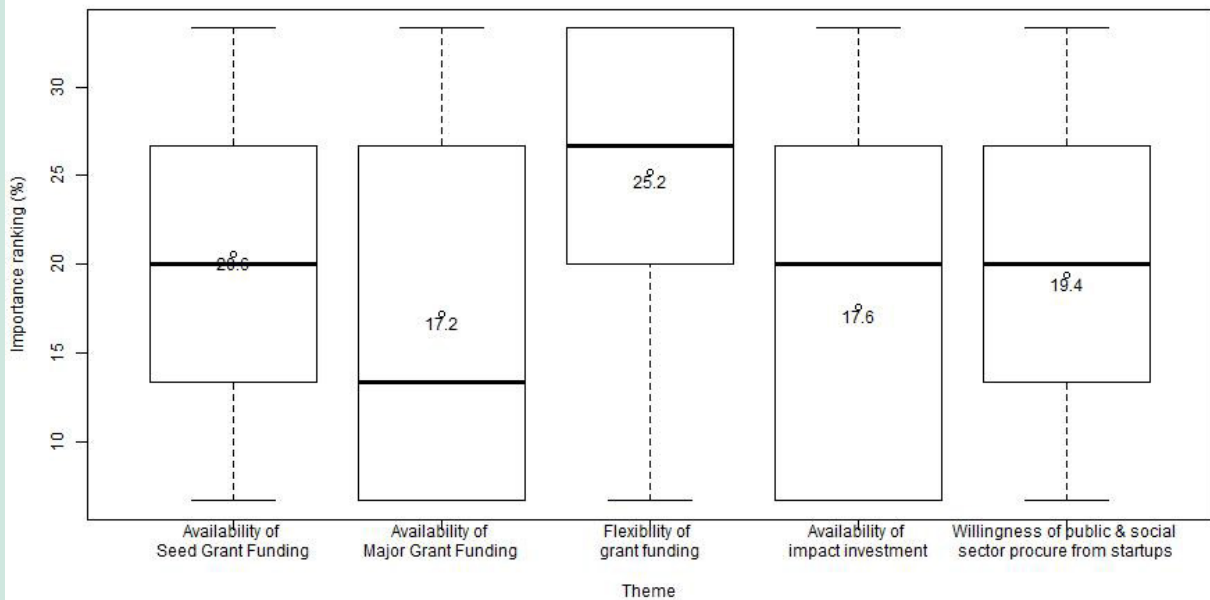## Appendix E. Boxplots of distribution of rankings for indicators in each theme.

The box shows the interquartile range (IQR). The whiskers show 1.5 * IQR and outliers are shown as circles outside the whiskers. The bar shows the median ranking and the circle in the box shows the mean ranking.
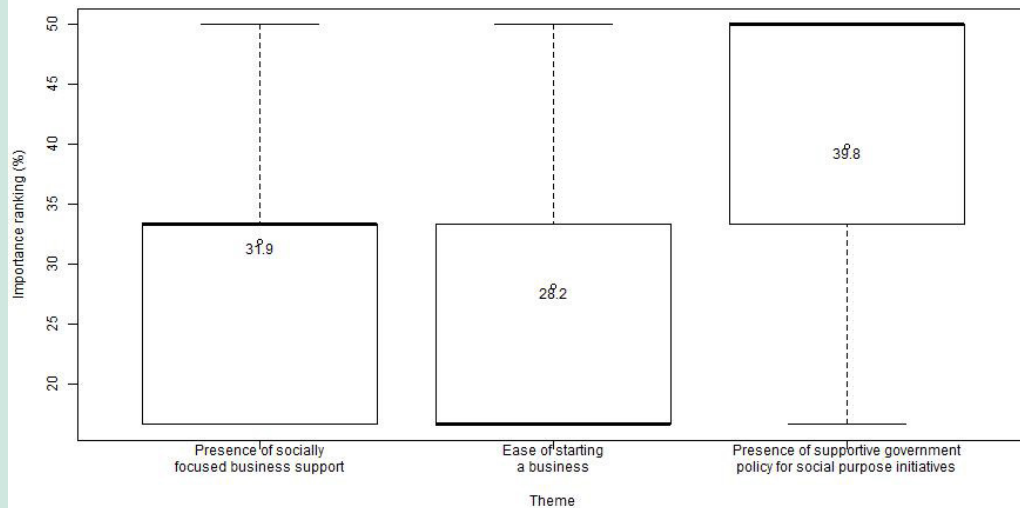

Distribution of importance rankings for indicators within the Civil Society theme

Distribution of importance rankings for indicators within the Collaboration theme

Distribution of importance rankings for indicators within the Diversity and Inclusion theme

Importance ranking (%)

| Diversity within the tech sector | Diversity within civil society | Activity to make innovation more inclusive | Digital inclusion and Skills in population |

19.8 — 22.4 — 29.8 — 28

Distribution of importance rankings for indicators within the Availability of Funding theme

Importance ranking (%)

| Availability of Seed Grant Funding | Availability of Major Grant Funding | Flexibility of grant funding | Availability of impact investment | Willingness of public & social sector procure from startups |

Theme

20.6 — 17.2 — 25.2 — 17.6 — 19.4

Distribution of importance rankings for indicators within the Support Systems theme

Importance ranking (%)

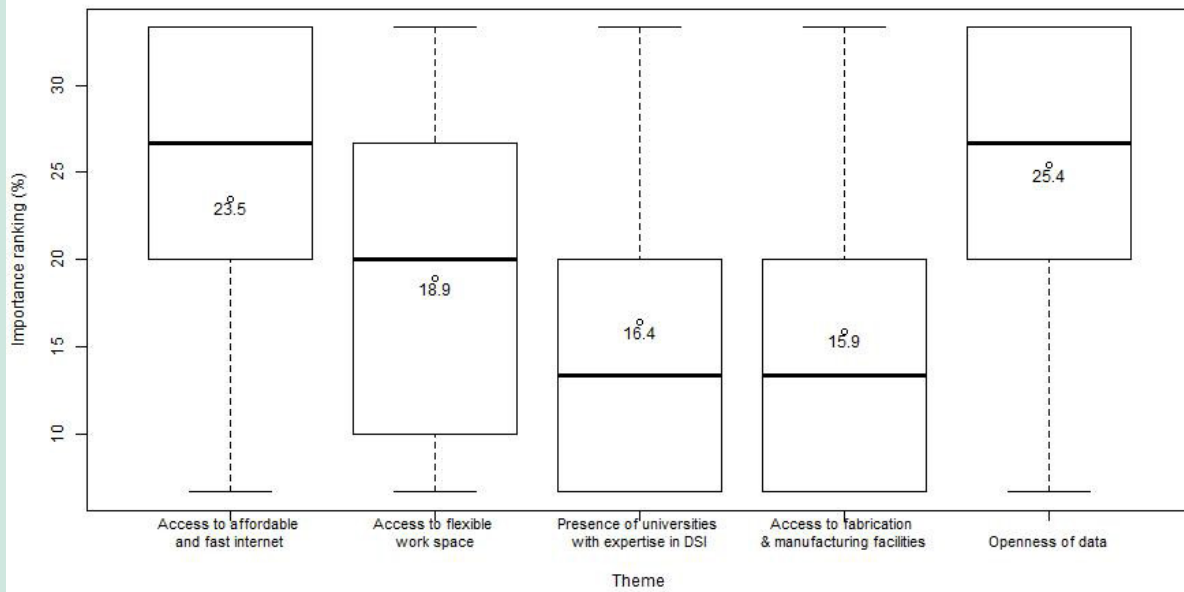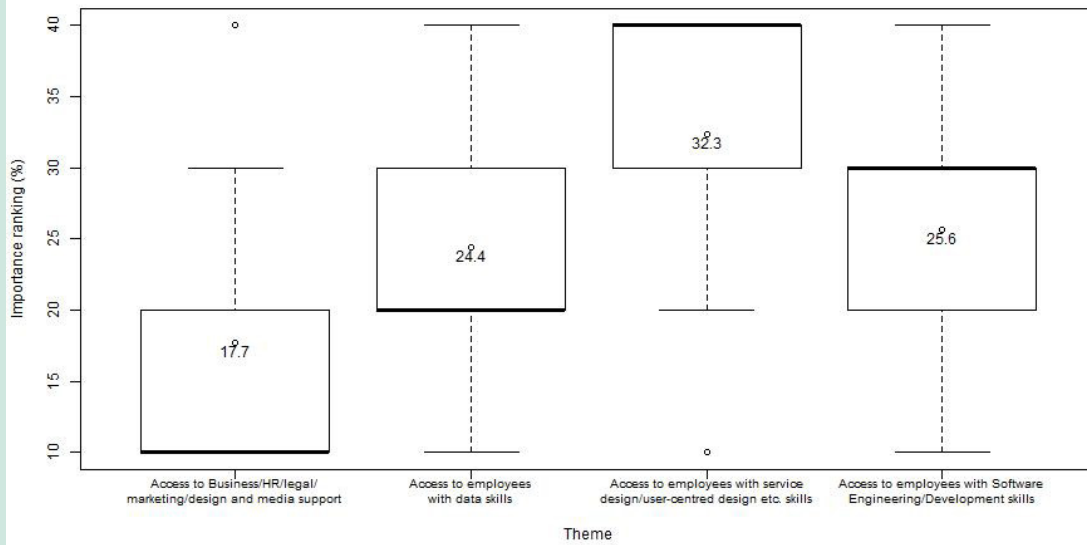| Presence of socially focused business support | Ease of starting a business | Presence of supportive government policy for social purpose initiatives |

Theme

31.9 — 28.2 — 39.8

Distribution of importance rankings for indicators within the Infrastructure theme

Distribution of importance rankings for indicators within the Skills theme

ENDNOTES

1. Stokes, M., Baeck, P., Baker, T. (2017) 'What Next for Digital Social Innovation.' London: Nesta. https://www.nesta.org.uk/report/what-next-for-digital-social-innovation-realising-the-potential-of-people-and-technology-to-tackle-social-challenges/

2. https://digitalcityindex.eu/

3. https://www.nesta.org.uk/report/citie-a-resource-for-city-leadership/

4. https://thegedi.org/global-entrepreneurship-and-development-index/

5. https://ec.europa.eu/growth/tools-databases/dem/monitor/

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8. http://opendatabarometer.org

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10. https://www.europeandataportal.eu/

11. https://www.arcadis.com/en/global/our-perspectives/sustainable-cities-index-2016/

12. http://archive.epi.yale.edu/cgi-sys/suspendedpage.cgi

13. https://www.arcadis.com/en/global/our-perspectives/sustainable-cities-index-2016/

14. http://www.oecdbetterlifeindex.org/#/11111111111

15. http://dashboard.fab.city/

16. http://poll2016.trust.org/methodology/

17. https://eiuperspectives.com/technology-innovation/old-problems-new-solutions-measuring-capacity-social-innovation-across-world-0

18. Saisana, M., Saltelli, A., Tarantola, S. (2005) 'Uncertainty and sensitivity analysis techniques as tools for the quality assessment of composite indicators.' Journal of the Royal Statistical Society A. https://rss.onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-985X.2005.00350.x

19. Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Saltelli, A., Hoffman, A. (2008) 'Handbook on constructing composite indicators: Methodology and user guide.' Ispra: Joint Research Centre-European Commission. http://www.oecd.org/sdd/42495745.pdf

20. https://en.wikipedia.org/wiki/Subsidiarity

21.   Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Saltelli, A., Hoffman, A. 'Handbook on constructing composite indicators: Methodology and user guide.'

22. For example, the European Digital City Index is composed of the following 10 themes: Access to Capital, Business Environment, Digital Infrastructure, Entrepreneurial Culture, Knowledge Spillovers, Lifestyle, Market, Mentoring and Managerial Assistance, Non-digital infrastructure and Skills.

23. Bria, F., Sestini, F., Gasco, M., Baeck, P., Halpin, H., Almirall, E., Kresin, F. (2015) 'Growing a digital social innovation ecosystem for Europe: DSI Final Report.' Brussels: European Commission.

24. As was the focus of the city initiatives for technology, innovation and entrepreneurship (CITIE) index, https://www.nesta.org.uk/report/citie-a-resource-for-city-leadership/

25. Interviewees: Tom Walker (Engine Room), Paul Miller (Bethnal Green Ventures), Matt Jackson (Comic Relief; Anthropotech), Clémence Pène (C40 Cities), Rebecca Portail (Eurocities), Wietse Van Ransbeeck (Citizenlab), Krzysztof Izdebski (EPF), Regina Sipos (Social-Digital Innovation), Julia Kloiber (Open Knowledge Foundation Germany), Sandor Lederer (K-Monitor Association), Joe Gaylord (Social-Digital Innovation).

26. Roundtable participants: Nissa Ramsay (Think Social Tech), Billy Dan (Comic Relief), Stav Bar-Shany (Dot everyone), Mor Rubinstein (360Giving), Daniel Robinson (Nominet Trust), Martha Young (Comic Relief), Mark Cridge (mySociety), Alina Kadyrova (The University of Manchester).

27. e.g. Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Saltelli, A., Hoffman, A. 'Handbook

on constructing composite indicators: Methodology and user guide.'; Bandura, R. (2006) 'A Survey of Composite indexes Measuring Country Performance.' New York: United Nations Development Programme. http://old.usc.ac.ir/IPPWebV1C035/TemplateFileFolder/10-8-2013/OriginalFolder/0a6e29c4-1fa6-4496-a362-000f0851d4fc_indices_2008_bandura.pdf; Freudenberg, M. (2003) 'Composite indicators of country performance: a critical assessment.' Paris: OECD. https://www.oecd-ilibrary.org/docserver/405566708255.pdf?expires=1530009643&id=id&accname=guest&checksum=A96E7D3F3C8796F773058082B5935207

28. e.g. Yale's Environmental Performance Index (http://archive.epi.yale.edu/cgi-sys/suspendedpage.cgi), Transparency International's Corruption Perceptions Index (https://www.transparency.org/research/cpi/overview) and UNDP's Human Development Index (http://hdr.undp.org/en/composite/HDI)

29. Survey conducted using SurveyGizmo (https://www.surveygizmo.com/)

30. This included practitioner, public sector employees, researchers, intermediaries, funders and policymakers.

31. Other weighting methods are derived from statistical models, such as factor analysis, data envelopment analysis and unobserved components models (UCM). The aim of these statistically driven weighting methods is to minimise an element of double counting that may be introduced if two collinear indicators are included in the composite index. Weights may also be chosen to reflect the statistical quality of the data with higher weights being assigned to statistically reliable data with broad coverage. However, Nardo et al. (2008) suggests that this method could be biased towards the readily available indicators, penalising the information that is statistically more problematic to identify and measure.

32. ITU. (2017) 'Bridging the digital innovation divide: A toolkit for strengthening ICT centric ecosystems.' Geneva: ITU. https://www.itu.int/en/ITU-D/Innovation/Documents/Publications/Policy_Toolkit-Innovation_D012A0000D13301PDFE.pdf

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34. Stokes, M., Baeck, P., Baker, T. 'What Next for Digital Social Innovation.'

35. Larsen, CA. (2014) 'Social cohesion: Definition, measurement and developments.' Aalborg: Institut for Statskundskab, Aalborg Universitet. http://www.un.org/esa/socdev/egms/docs/2014/LarsenDevelopmentinsocialcohesion.pdf

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37. Bund, E., Gerhard, U., Hoelsche, M., Mildenberger, G. (2015) 'A Methodological Framework for Measuring Social Innovation.' Historical Social Research. http://www.transitsocialinnovation.eu/content/original/Book%20covers/Local%20PDFs/172%20Bund_Gerhard_Hoelscher_Mildenberger_2015_Methodological_Framework_to_Measure_Social_Innovation.pdf

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39. Saxenian, A. (2002) 'Silicon Valley's New Immigrant High-Growth Entrepreneurs.'

Economic Development Quarterly. http://journals.sagepub.com/doi/10.1177/0891242402016001003;

40. Stokes, M., Baeck, P., Baker, T. 'What Next for Digital Social Innovation.'

41. ibid.

42. ibid.

43. e.g. ITU. (2017) 'Bridging the digital innovation divide; European Digital City Index

44. One interviewee did also mention that access to Venture Capital may be important to DSI.

45. ITU. (2017) 'Bridging the digital innovation divide; Mocker, V., Bielli, S., Haley, C. 'Winning Together - a guide to successful corporate-startup collaborations.' London: Nesta. https://www.nesta.org.uk/blog/winning-together-a-guide-to-successful-corporate-startup-collaboration/

46. European Commision (2017) 'European Semester Thematic Factsheet Public Procurement.' Brussels: European Commission. https://ec.europa.eu/info/sites/info/files/file_import/european-semester_thematic-factsheet_public-procurement_en_0.pdf

47. Digital City Index (https://digitalcityindex.eu/theme/3); The Digital Transformation Monitor (https://ec.europa.eu/growth/tools-databases/dem/monitor/)

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50. Vey, J., Hachadorian, J., Wagner, J., Andes, S., Storring, N. (2018) 'Assessing your innovation district: A how-to guide.' Brookings. https://www.brookings.edu/research/assessing-your-innovation-district-a-how-to-guide/

51. Nevertheless the vast majority of DSI initiatives are still in their early stages.

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53. This threshold is based on Groeneveld and Meeden (1984), which sets the criteria for a normal distribution as having an absolute skewness less than 1 and kurtosis less than 3.5. We will relax Groeneveld and Meeden's (1984) skewness criterion to greater than absolute 2 to account for the relatively small sample of cities or countries that will be part of the analysis.

54. The reversing of indicators scales can be done either before or after normalisation.

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57. Z-score normalisation converts indicators to a common scale with a mean of zero and standard deviation of one. This was not the primary choice of normalisation because it exaggerates the influence of extreme values which therefore have a bigger net effect on the overall composite index composite indicator, which we decided would be an undesirable feature in our index.

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