

# Actionable open data connecting city data to local actions

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*Open Data are recognised as invaluable resources at the city level for improving local services, community engagement and businesses initiatives, but their use still struggles to have the desired impact. This work addresses the underuse of Open Data by exploring the connection between data and actions in everyday urban activities implemented by local governments, public agencies, businesses, non-profit organisations and research institutions operating in the city. The empirical results of this exploratory study outline a structural misalignment between a) roles of local actors in city activities and their data-related activities, b) provision of Open Data and information needs of local*

*actors, c) expected uses of data in local actions and forms of support to the users provided by current city Open Data portals. The envisioned alternative approach to foster the use of Open Data at the city level rely on identifying the appropriate data to be produced for supporting local actions, instead than focusing on publishing data disconnected from real information needs of organisations working for local communities.*

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## Introduction

City data, intended as the corpus of data produced in the city by urban sensors, organisations and communities, are metaphorically considered as the new gold of our times. Indeed, city data are often perceived as resources able to provide value on their own, promising to reveal the solutions to local problems and opening new unforeseen economic opportunities and development. In a data landscape dominated by private data, Open Data represent the public part of these new urban resources, constituted by all those data publicly released that can be “*freely used, shared and built-on by anyone, anywhere, for any purpose*” (James, 2013). Open Data are not necessarily produced at the city level, but it is at that scale that there are the major expectations in terms of enabling public authorities, communities, and business sector to make effective use of data for local projects and services.

While Open Data represent a small segment of city data, their importance is sustained by the idea that they can contribute to improving transparency, accountability, efficiency and productivity of local governments and public agencies, promoting active citizenship and democratic participation of local communities, supporting businesses in developing new services and commercial activities (Kitchin, 2014). The shared point in these arguments is that Open Data could be used to make better decisions at individual and collective levels, informed by the use of data, and that these decisions could generate broad benefits for society.

Despite these high expectations of Open Data, their use remains marginal and still struggles to have the desired impact. Open Data are a yet-to-be fulfilled promise to generate significant changes for the activities of city groups at local level (Goldstein & Dyson, 2013; Regan, & Sweeney, 2014; Sieber & Johnson, 2015) both under the perspective of enabling them to act (*power-to*) and rebalancing the role and capacity they have to influence institutional and informal decision making processes (*power-over*) (Schneider, Eiband, Ullrich, & Butz, 2018).

The underuse of Open Data is nowadays becoming an urgent problem, considering the institutional efforts and investments in producing and publishing Open Data, but also the growing requests of civil society organisations and local businesses to access public and free data on topics of public interest or relevant for their activities. For these reasons, the problem of the underuse of Open Data has been investigated (Barry & Bannister, 2014; Beno, Figl, Umbrich, & Polleres, 2017; Janssen, Charalabidis, & Zuiderwijk, 2012; Zuiderwijk, & Janssen, 2014), identifying that the most challenging barrier to overcome is the lack of understanding of the needs of potential users of open data and data portals (Sieber & Johnson, 2015).

The link between users’ needs and open data is still unclear, in particular in reference to what could make the use of city data appropriate and suitable in the everyday activities, such as providing educational services, monitoring social issues, organising citizens initiatives, and running commercial businesses.

To study the users’ needs connecting data and actions in an urban context, we introduce the concept of **Actionable Open Data**. Its working definition is: **Open Data produced for enabling individual and collective actions that are generated, supported, or mediated through the access, manipulation and use of data by local governments, public agencies, businesses, non-profit organisations and research institutions.**

Building on this concept, this paper explores the modalities in which city data, whether currently released as Open Data or not, are or could be connected to local actions by addressing the following research questions:

- How do local actors operating in the city connect their activities to the production and use of city data?
- What types of data are or can be considered as actionable by local actors engaged in city activities?
- What are the expected uses of these actionable data in local actions?

The contribution of the paper to research on information technologies supporting local communities is two-fold. Firstly, the empirical results of this exploratory study outline that there is a structural misalignment between a) the perceived roles of local actors and their activities in the production and use of data, b) the provision of data and the actual information needs of local actors, c) the expected uses of city data in local actions and the forms of support provided by current Open Data portals. Secondly, relying on the frame of Open Data portals as civic technologies, the results of the study envision a possible shift in approaching the problem of the underuse of Open Data, moving the focus from fostering the use of available data to the identification of the appropriate data to be produced for supporting local actions.

The remainder of the paper is structured as follows. Section 2 examines the problem of the underuse of Open Data and the key aspects to be explored. Section 3 indicates the methods for data collection and analysis used for conducting the exploratory study. Section 4 reports the results of the study addressing the three research questions about the connection between data and actions, and Section 5 contains a discussion on the implications of these findings to reframe the problem of the underuse of Open Data in local actions.

## **Background and related work**

This section is organised into two parts. To start, we explain how the problem of the underuse of Open Data is connected to the implementation of the Open Government paradigm and the focus of Open Data technologies on the needs of data producers. Then, we review the related work providing the basis for an alternative framing of Open Data and Open Data technologies as civic technologies, highlighting the aspects that require to be explored for addressing the underuse of Open Data in local actions by connecting data to actions.

### **The underuse of Open Data**

The underuse of Open Data had been extensively studied, identifying the key barriers preventing their broad use (Barry & Bannister, 2014; Beno et al. 2017; Janssen et al. 2012; Zuiderwijk, & Janssen, 2014). Among the identified barriers, the most important are: the lack of self-evident uses and value of the available data, the inaccuracy and obsolescence of information, the lack of standardised metadata or significant information complementing the datasets, as well as the format of files often requiring specific software to be explored. Looking at the Open Data portals as the key technologies for accessing to

Open Data, the fundamental barrier to the use of data is the lack of support (offline and online) for understanding the content of the available datasets and the restrictions to their reuse.

The barriers identified in previous studies take into account primarily the perspective of governmental authorities and the use of open data across different public organisations (Attard, Orlandi, Scerri & Auer, 2015; Chan, 2013; Ubaldi, 2013; Veljković, Bogdanović-Dinić, & Stoimenov, 2014). These studies also expose that the overall barrier in the use of Open Data beyond public bodies is that “*there is no insight into the user’s perspective and the users’ needs are not known*” (Janssen et al. 2012, p.23). As a consequence, the design of Open Data portals is centred on the needs of data producers (mostly local government and public agencies) that are known, instead than configuring a digital environment to support users coming from private and civil society organisations in adopting Open Data in their activities.

The production of Open Data is indeed entangled with the paradigm of Open Government and led to frame the publication and release of data as an “act of transparency” of local governments and public agencies toward the general public (Goldstein & Dyson, 2013; Lnenicka, 2015). Indeed, the produced data are mainly traces of the actions of these public bodies, in the form of census data, spatial data, administrative records and budgets, public reports, local plans and policies, public services delivery records. On this background, the scope of Open Data portals is to facilitate the publishing of documents and data related to the administrative activities by the competent public officers (Lnenicka, 2015; Sáez Martín, Rosario & Pérez, 2016; Umbrich, Neumaier & Polleres, 2015), and secondarily enabling users (often intended generically as “citizens”) to scrutinise data for controlling and monitoring the work of public institutions.

The result is that the actual users of Open Data portals are in general the institutions publishing or exchanging data with other public bodies, or a small niche of occasional users such as journalists, activists, researchers, or professionals working in ICT companies (Attard et al. 2015; Lee, Almirall & Wareham, 2015). While the efforts of this small niche provided a few showcases and examples about the potential applications of Open Government Data for the benefit of local communities, they had a limited impact (Lee et al. 2015; Worthy, 2015). In some ways, these examples also involuntarily sustained the myth of the intrinsic value of Open Data, waiting just to be unveiled for realising their empowering aims, even though the reality of Open Data remains to trace transparency acts of local government and public agencies and not intentionally enable local communities to use data in their activities, projects, services.

### **Reframing Open Data as digital civics in the city Open Data ecosystem**

The dominant vision of Open Data as expression of Open Government processes started to be challenged in the last years by the new vision of Open Data as *commons* (Hess & Ostrom, 2005) intended to enable citizens, communities and local actors to build their own insights from publicly available data to use, reuse and integrate these data.

This new vision calls for reframing the intended users of Open Data from being recipients of public information to become active subjects having the right to use these shared resources to generate value for their own activities. In this sense, the vision of Open Data as *digital commons* (Bollier, 2011) has two main outcomes. It brings back attention to people and their actions regarding the use of Open Data, instead of to data itself. Then, it

enlightens the importance of the interrelations between data and actions at the local level that are defined by the communities accessing to shared informational resources.

The vision of Open Data as digital commons has not yet found a concrete translation in new approaches to the production and use of Open Data. However, recent literature on Open Data Ecosystems and Digital Civics provides some essential building blocks for starting to develop these alternative approaches.

The framework of Open Data as an Ecosystem is centred on the dynamic relationships between actors, context and technology. The actors play the roles of data producers, infomediaries, and data consumers. The context is defined by cultural, institutional, financial, and technological resources. Technology is seen as the operative medium between the actors in the ecosystem (Davies, 2011; Harrison, Pardo & Cook, 2012; Heimstädt, Saunderson & Heath, 2014; Zuiderwijk, Janssen & Davis, 2014).

In regards to the actors, the framework of the Open Data Ecosystem identifies the unit of action not at the level of the individual users of data, but at the level of structured organisations (Davies, 2011; Harrison et al. 2012) having resources, capacity, and motivations to set up collective actions on/with/through data. In addition, within the Open Data Ecosystem it is explicit that each actor “play” a role in connecting data to actions, and that this role can change, and it is not necessarily attached to the identity of a specific organisation as a public institution, or business.

By adopting an ecosystem view of Open Data, we recognise that the dichotomy of government/citizens is not representative of the dynamics connecting data and actions because these dynamics are developed mainly at an organisational level, with organisations that can cover multiple roles in the process of data production and use. What still needs to be explored is how these roles are managed and how they impact on the connection between data and actions in the city context.

Regarding the role of technology, the framework of the Open Data ecosystem does not specify how the relationships among data producers and data users can be mediated by technology. However, research on Digital Civics (Boehner & DiSalvo, 2016; Vlachokyriakos, Crivellaro, Le Dantec, Gordon, Wright & Olivier, 2016) frames technology as an enabler of new models of organisation, service provision and citizen empowerment (Vlachokyriakos et al. 2016), and outlines three possible forms of support provided by technology to this community-development oriented process.

These forms of supports are synthesised in the categories of computed civics, mediated civics, and proxied civics. Technology can provide access to informational resources and the means to process data for civic purposes (*computed civics*). Technology can also provide a new frame to activities and processes that not necessarily have a civic meaning or are of public interest as civic activities and processes (*mediated civics*). More radically, technology can facilitate different modes and forms of actions by and in between different organisations working together or independently on an issue (*proxied civics*) (DiSalvo, Jenkins & Lodato, 2016).

Open Data technologies cover so far only the role of computed civics, but without overcoming the threshold of niche users and triggering significant changes in the production and use of Open Data. The alternative roles of technology as mediated and proxied civics remain to be explored in relation to Open Data technologies, especially in

the city context. Indeed, most of the everyday urban activities (commercial, recreational, cultural, social activities) not only have a profound impact on the way we live in cities, but shape the characteristics of the public sphere in which we act in cities (see Madanipour 2003). These activities, while not usually framed as civics, generate outputs (and also data of public interest) having a civic value that could be enhanced by technology. Moreover, the diversity of local actors operating in the urban context, but in a shared space and frequently dealing with common issues, requires building technologies that can facilitate their different forms of actions by using shared informational resources such as city Open Data.

As regarding the context in the framework of the Open Data Ecosystem, the understanding of the key dimensions and dynamics in the city context is still an open challenge. Indeed, while the literature connecting technology and *civic design* (DiSalvo, & Dantec, 2017) focus the attention on the relation between data and action (Forlizzi, 2018; Hanna & Ashby, 2016) for the empowerment of local communities, the information needs of communities and how data could be used to address local issues are still unclear (Goldstein & Dyson, 2013; Harding, Knowles, Davies & Rouncefield, 2015; Sieber & Johnson, 2015; Taylor, Lindley, Regan & Sweeney, 2014; Taylor, Lindley, Regan, Sweeney, Vlachokyriakos, Grainger & Lingel, 2015).

A significant example is the work with local communities of Taylor et al. which explored the implications of “*data-in-place*” and indicates the crucial importance of discovering the actual needs and the potential use of data taking into account the interconnection between data, people, and things constituting the social geography of local practices (Taylor et al. 2015).

The exploration of the information needs of local communities to rethink the production and use of Open Data, but also the design of Open Data portals as civic technologies, requires the adoption of participatory processes with local actors and the shift of the design focus from *transactional* (producer-consumer exchanges) to *relational interactions* (Asad, Le Dantec, Nielsen & Diedrick, 2017). Opening the design process of a city data portal to the inputs and involvement of multiple local stakeholders is functional to study the appropriate support for a variety of goals, unpredictable practices, inter-organisational issues and unheard voices currently unaddressed (Taylor et al. 2015; Harrison et al. 2012; Vlachokyriakos et al. 2016; Taylor et al. 2014). Moreover, the involvement of local actors is crucial to building communities of potential end-users around Open Data portals considered as civic technologies in order to provide infrastructure (Bødker, 2015; Ehn, 2008) for the community reframing of Open Data as commons and create the conditions for organising offline and online support to data-driven actions (Asad, Fox & Le Dantec, 2014; Bäck, Friedrich, Ropponen, Harju & Hintikka, 2013; Taylor, Clarke, Skelly & Nevay, 2018).

## Methodology

Driven by the purpose of studying the underuse of Open Data from the perspective of different city stakeholders, and relying on the key points highlighted in the previous section, we designed our study to explore: a) the roles of local actors in the city Open Data Ecosystem, b) the information needs associated with their actions and c) the expected uses of city data that should be supported by Open Data technologies, coherently with the research questions listed in the introduction.

The exploratory study presented in this paper had been carried out in the city of Milton Keynes (UK) by organising a 5 hour-long workshop attended by the representatives of the major local organisations involved in the production and use of city data and facilitated by two authors of this paper. The 18 participants in the workshop gave voice to the different types of structured local stakeholders interested in city data:

- the local administration of the Milton Keynes area
- public agencies involved in the delivery of public services
- non-profits organisations working on community projects
- local businesses
- and the university located in the city.

The participants had been divided in five groups composed by representatives of different types of stakeholders and each group worked on one of the following five themes:

- community well-being: social, health and education services
- urban development: planning, housing and energy
- mobility: infrastructures, transportations and environment
- economic growth: employment, industry and business
- sustainability and smart living.

The workshop activities were organised to guide the participants in constructing stories reflecting their organisational challenges and practices in the production and use of data, but most important how access to data was linked to the specific actions at a local level, as reported in Table 1.

Table 1: Themes, participants' groups and topic of the stories developed in the workshop.

theme	User ID	Stakeholder	Story ID	Story Topic: Actionable Open Data for
COMMUNITY WELL-BEING	P1 - JR	PUBLIC AGENCY	N.1	Tracking the progresses of health care programmes
	P2 - LS	NON-PROFIT	N.2	Setting up a community agency to implement waste reduction projects
	P3 - JK	LOCAL GOV	N.3	Improving the management and impact of the social services delivery
	P4 - RB	NON-PROFIT	N.4	Developing individual and community resilience initiatives
URBAN DEVELOPMENT	P5 - VK	PUBLIC AGENCY	N.5	Elaborating guidelines to improve the safety of housing and public spaces
	P6 - PL	NON-PROFIT	N.6	Developing and promoting a new local plan as Housing Association
	P7 - SW	BUSINESS	N.7	Developing new data services for building groups, professional and residents
MOBILITY	P8 - MK	BUSINESS	N.8	Providing monitoring services on use and status of urban infrastructures

	P9 - MT	ACADEMIA	N.9	Studying and prototyping solutions to promote alternative mobility options
	P10 - LN	LOCAL GOV	N.10	Supporting mobility services for elders through public/private partnerships
	P11 - JQ	LOCAL GOV	N.11	Promoting and organising collective transportations for daily commuting
ECONOMIC GROWTH	P12 - IN	BUSINESS	N.12	Organising a large-scale innovation testing programme in the city
	P13 - DD	BUSINESS	N.13	Providing services to support emergency response units, police and residents
	P14 - MR	LOCAL GOV	N.14	Attracting and retaining highly skilled workforce in the city
	P15 - QL	NON-PROFIT	N.15	Improving the management of water infrastructures and water supply
SUSTAINABILITY	P16 - NN	ACADEMIA	N.16	Developing projects for social inclusion with local community and technology providers
	P17 - NR	ACADEMIA	N.17	Bringing university educational and training initiatives to local needs
	P18 - SR	LOCAL GOV	N.18	Encouraging home-working and low-impact individual behaviours

We asked participants to build their stories by assuming the perspective of representatives of their organisations and completing five consecutive tasks:

1. Selecting a challenge to overcome in their activities related to the use of city data and the role to play in the story covering one of the following six characters: promoter, implementer, influencer, beneficiaries, decision maker and resource holder.
2. Identifying and mapping the other actors involved in the story, their activities contributing (or hindering) to meeting the selected challenge
3. Identifying the information needed by each actor to implement their actions in the story
4. Annotating how every piece information would be used in the story
5. Highlighting positive and negative factors associated with the information need or their use in the activities represented in the story.

The story building was supported with basic paper tools such as a set of cards, for indicating the actors in the story and their roles, other cards for tracing their activities, and a gameboard on which to place these card and sketch the connections among the actors and actions in the story (see Fig. 1).



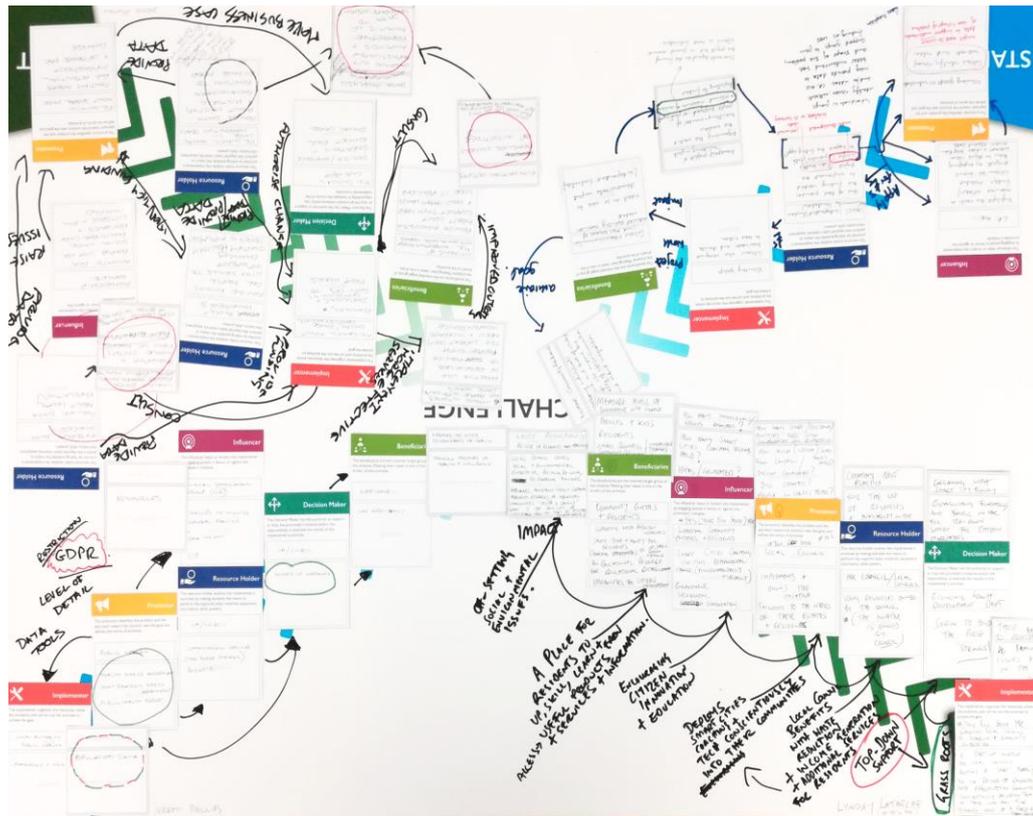
**Fig. 1. Tools provided to each group**

After the construction of the stories, the participants were involved in discussing all together the critical and positive factors highlighted about the link between data and actions in their stories.

### **Data collection**

The data used to elaborate the analysis came from:

- five visual artefacts representing 18 stories through a composition of role cards, activity cards, and other descriptions and signs sketched by the participants directly on the game boards (see Fig 2).
- notes taken by the facilitators interviewing all participants during the workshop activities to clarify and integrate the texts written on boards
- notes and transcripts of the group discussion with the participants carried out after the story building session
- transcripts of the post-workshop interviews with facilitators and external observers to document their observations, remarks, impressions.



**Fig. 2 Example of the visual artefact produced during the workshop**

## Data analysis

We have executed an in-depth qualitative and interpretative analysis (Schwartz-Shea & Yanow, 2013; Walsham, 2006;) of the stories traced in the visual artefacts. The analysis has been organised in two steps. Firstly, we have focused on understanding the dynamics in the city information ecosystem represented in the stories built by the participants. Then, we have analysed the information needs associated to the actions included in their stories.

The first part of the analysis covered: goals and roles set by the participants to build their stories, roles and activities of the other actors involved in the stories, and lastly the relationships connecting actors, actions, and data. All the information traced on the visual artefacts or included in the additional sources (interviews, notes, transcripts) had been iteratively conceptualised in dimensions characterising the production and use of data by local actors in the city information ecosystem, and then coded and interpreted to highlight the significant and recurrent patterns.

The second part of the analysis involved the 87 information needs associated with the stories. Firstly, a factual analysis of the required information has outlined the characteristics of potential data sources covering the identified information needs. Then, we have analysed the expected uses of the desired or required data sources in relation to the actors indicated in the stories and at higher level by considering the specificities of each theme developed by the five groups.

## Findings

In this section, we present the results of the analysis of the city open data ecosystem represented in the participants' stories, their information needs and the expected uses of city data in local actions to address the three research questions listed in the introduction.

### Challenges and roles of city stakeholders in the city Open Data ecosystem

As mentioned in the methodology section, we explored the dynamics in the city open data ecosystem by focusing on the perspective of each actor in the story as representative of one of the five classes of city stakeholders defined for the study: local government, public agencies, business, non-profit organisations, and academia. We examine firstly the challenges for the use of data in local actions set by the participants in the study, and then the identities and roles of other stakeholders mapped in the stories and operating in the city data ecosystem.

The challenges reported in the stories ranged from very abstract goals, such as *“improving health and well-being of population though safe and secure housing for all”*, to operative objectives such as *“to understand and predict the supply and demand status of the water [infrastructures] to devise solutions for water-stress issues”*. It was evident that the representatives of local government and public agencies preferred an abstract definition of their goals, differently from all other stakeholders. Moreover, the stakeholders with a recognised public mission, such as local government, public agency or no-profit organisations, define their goals under the light of their social mission and projecting the outcome of their data-related actions toward the collectivity and the common good. However, also in those cases, the implicit or operational goal referred to the specific interests of their organisations. For instance, *“retaining high qualified workers in the city”* was linked to the goal of *“sustaining local growth”*, but also more specifically to the fact that highly qualified workers residing in the city contribute to the municipal budget more than low skilled workers because of their preferences for bigger houses generated more tax. On the contrary, the representatives of the business sector preferred to define their challenges in operational terms, highlighting the importance of making explicit and publicly known that the interests of their organisations were the priority.

The mapping of other city stakeholders represented in the participants' stories brought out three recurrent elements in the narratives:

- a) The holders of data considered as essential to carry out local actions are not known, or their identity is unclear or underspecified.
- b) The structure, capacity and competencies of the organisations involved as external actors in the participants' stories are oversimplified, exaggerating or underplaying their real capabilities to produce, manage, process and use data.
- c) The relationships among different organisations built on the exchange of data are critical due to uncertainty in the roles of actors, the communication protocols, and the conditions and contents of the required datasets.

A significant example of the omission of key data holders can be found in story N.2. In this case, the entire flow of activities to start-up a community agency is based on the access to data about city waste reduction initiatives, such as *“how many*

*staff/residents/entities are in collaboration with enterprises [implementing the waste reduction measures]. How much (weight) saved from landfill? How much money is saved? Income generated? Jobs created? People in crisis helped? ”. While knowing this information is central to the story and the participant’s actions, the real or potential data providers are missing. In the story N.3, the data holders are instead underspecified and indicated generically as “external data sources [...] providing data to the Milton Keynes Council”.*

As regarding the second point, story N.4 provides an example of a participant overlooking the scope and competences of other two actors in his story. Strong expectations had been oriented toward the public health authority and the technical team managing the city data portal to “*help them [the participant’s organisation] access to relevant data [...] to engage citizens in defining issues, interests and ideas at local level*”. Data that could be relevant for having these results are not specified, while it is assumed that it will be up to the two other actors to make such evaluation. In the same story, the participant expressed confidence in the capacity of his non-profit organisation to “*monitor the impact of community resilience measures at local level*” as one of the key skills gained from their experience working with communities. It is worth noticing that in 13 out of 18 stories the ability to assess the impact of actions at the local level relying on complex information is considered a highly valuable skill, but it is never associated to the competencies available within community organisations.

In reference to the third point, story N.6 outline a process in which city data are elaborated and exchanged in synergy among different units of a housing association, building up the value of data step by step and enabling the activities for implementing a new urban development project. However, this positive constructive flow is threatened by the uncertainty about how their “*data product*” will be received and used by the local council (as an external actor) to support or stop their project. Similarly, the story N.13 presents a very positive data workflow involving different organisations to set up a service of city-safety monitoring. The critical elements in the process are due to the uncertainties about contents, conditions and protocols for access to an essential data source: “*what data do the gov[ernment] collect, where is stored, how accessible is it? For whom?*”.

Indeed, as emerging from the stories, the access to city data is regulated by established protocols and specific agreements only in rare cases in which there is a stable partnership between the actors involved in a specific action, whether they have different purposes or they need to progress a joint flow of activities. In almost all other situations, the relationships between data producers and organisations interested in using data are not formalised, therefore generating uncertainties.

Mapping the roles attributed by the participants to the various actors represented in their stories (*beneficiaries, decision maker, resource holder, promoter, implementer, influencer*) with the roles that these actors have in the process of producing or using data within the city data ecosystem (*data subjects, data collection promoter, data provider, data processor, data consumer, data communicator*) highlighted the difference between ideal and real roles covered by city stakeholders in connecting data to actions. For instance, while citizens are considered as *beneficiaries* of data-related actions in 17 out of 18 stories, they are framed prevalently as *data subjects* and in a few cases as *data consumers*. Local government, conventionally considered the *data provider*, covered instead mostly the role of *data consumer* and *data collection promoter*, because of the need to make its own informed decisions and build plans and services based on evidence.

Interestingly, the local government is indicated in the stories as *resource holder* and *decision maker*, especially with respect to providing financial resources for supporting data-related initiatives, rather than as an actor able to produce or release data useful for local actions.

Beyond the dichotomy local-government/citizens, the business sector plays a relevant role in all the stories, as *implementer* and *resource holder*, because businesses are assumed to possess the financial and technological capacity, as well as skilled human resources to collect and process data and then enabling the use of data for local actions. On the contrary, public agencies and non-profit organisations play a marginal role in the stories, being mentioned only in 5 and 7 cases out of 18. Academia is consistently seen as *implementer* and *promoter* of local networks connecting technical, financial, administrative and community partners to implement data-related projects, but not as a subject able to produce data for supporting local actions.

### **Information needs in local actions**

The analysis of the participants' stories allowed us to identify a set of 87 desired or required datasets indicated as potential sources connecting data to local actions. We used this sample to study the **characteristics of the information needs** in local actions and address the second research question.

We stated by considering the licencing categories of data proposed by the Open Data Institute (2015) and dividing the data spectrum in open, public, restricted access to groups or specific persons and organisations, private closed data. The analysis of the data sources associated with the collected information needs and this categorisation show that only a marginal part of their needs are covered by open data (6 out of 87). Many of the information needs are linked to public data (23/87), accessible but not freely reusable, or to data available under restricted access (28/87). What is relevant is that around a third of information needs could be met by data produced for internal use by local stakeholders (35/87) and a quarter of them is not produced (21/87) due primarily to the uncertainty about the organisation that should take in charge their collection and elaboration. The remaining information needs are linked to data produced by privates for commercial purposes (15/87).

The most prominent type of data required to take actions in the stories is represented by structured profiles of the local context, people and organisations (30 out of 87). For instance, this type of information needs includes the "*skills of the residents and community members*", "*data about producers of recyclable wastes in the city*", and the "*land profiles including amenities and public services*". Complementary to the profiles, the participants often required lists of local actors (6/87), factual data about environment monitoring (6/87) and behavioural patterns in the use of mobility infrastructures (5/87).

The second core of information needs includes data documenting ongoing processes, initiatives and services (5/87) such as the "*level of civic engagement in community projects*", "*data about trends/process/status of waste collection and treatment*", "*data about historical/existing provision of social care services*". We also highlighted an interest in projects and plans (6/87) envisaging the future transformation of the city, as well as data supporting the impact assessment (5/87) of past and future actions.

Lastly, the request of statistical data (16/87) is often associated to the need of tailoring broader datasets for a specific audience or extracting only subsets, such as *“population data for urban planners”*, as well as *“data about the users of city walkways break down by age”* to plan mobility services for elderly people. Surveys (11/87) depicting perceptions and opinions about specific topics were also indicated as a desirable complement to statistic data, especially in the scenarios of planning, mobility and business development. For instance, surveys about *“who is not traveling and why”*, *“experiences related to the use of infrastructures and services”*, *“the perception of well-being of residents”*.

By focusing on the nature and volume of the “actionable data”, a significant majority of information needs pointed toward “qualitative data” (69/87), if necessary associated with “quantitative data” to make sense out of the recorded indicators (36/69). Less than a fourth are centred on quantitative data (18/87) when the needs are, for instance, costs, performances and size of user basin for a specific service. Story N.3, developed by a data expert of the city council, highlighted as a critical factor that the local government *“got a lot of data”*, but *“more resources and skills [are required] to do the analysis of the qualitative data”*.

Consistently, only a marginal part of the information needs requires *big data*, such as requests associated with monitoring traffic levels, energy consumptions and environmental parameters. Almost the totality of the information needs (79/87) could be fulfilled by *small data* providing a contextualised and comprehensive representation of the topic of the request. For instance, some requests concerns *“data about the impact of social services at local level”*, as well as *“data about the economic growth of the city”*.

Looking at the temporal features of the actionable data, the information needs highlighted strong demand for timely information about the ongoing activities and status of the city services and city resources (31/87), as well as indications for future actions based on the analysis of historical trends and current initiatives (25/87). Data about the past are relevant instead when connected to the assessment of the current state of affair to measure the impact of initiatives or as historical context for planning (31/87).

The spatial aspects linking data to their actionability highlighted that the same data could have often different uses at different scales, such as the *“list of local stakeholders and asset holders”* as well as the *“household consumption”* or the governmental data about *“safety and risky area”*. This interscalarity of a part of information needs is reflected in the level of detail of the required datasets ranging from the individual units to their aggregations, such as the *“cost of housing”* the could be measured at the city scale, neighbourhood scale or in reference to a specific building.

The last aspect to be considered in studying the information needs is that of data ownership, which can be concentrated in a single organisation, fragmented among different organisations or potentially distributed among individuals and organisations able to provide just a small portion of the overall dataset. Data sources owned by a single organisation could address less than a fourth of information needs (18/87). Most of the required datasets, in our sample, are under fragmented ownership (43/87) or could be produced by collecting distributed data within local communities (26/87).

### **Expected uses of the data sources associated to the information needs**

We focus the last part of our study on analysing the expected uses of the desired data sources in local actions represented by the collected information needs to address the third research question.

The intended uses of these data sources depend strongly on the level of expertise of users in data processing and the level of knowledge on the topic covered by the information need. Their analysis outlined four stable patterns.

Information needs related to a narrow selection of themes and types of data, such as data on mobility and traffic, economic data to assess investments and performances of business initiatives, and statistical elaboration of population parameters, are associated to users with high level of expertise both on data operations and on the topic. They expect to have direct access to raw data for performing specific data analysis required to implement or manage routine services provided by their organisations.

Information needs related to the factors influencing or potentially impacting the operational environment of local organisations, such as the overall economic growth of the city, the positive/negative perception of local services and the participation in community initiatives, are associated with users who are not necessarily experts on data processing. They expect to occasionally explore the requested data sources to find pieces of evidence, trends, specific factors affecting their own activities.

Information needs covered by lists of local resources, context profiles, projects files, reports of past initiatives are associated with user experts on the topic of data sources, but not necessarily with strong technical expertise. In these cases, they expect to build over time a comprehensive map of all the available information for one-time decisions about, for instance, future housing projects, local partnerships to set up, and the feasibility of new entrepreneurial initiatives.

The fourth pattern is defined by the information needs associated with the evaluation of the performances and results of local services and projects, or the assessment of changes over time, such as the impact of social care services, the security and safety risks in the city and trends in water consumption. In this case, users with a mixed level of expertise about data manipulation and on the topic expect to use the data for performing ad-hoc analysis, making sense of local phenomena, but also simple explorations and evidence seeking.

By looking at the set of stories build on each of the five themes, the collected information needs outline specific constraints in the production and use of city data inherent to each theme.

In the Community Well-Being scenarios, data are required to facilitate the understanding of the context by complementing statistics with local insights based on direct lived experiences. The major challenge here is the lack of the appropriate data to set up new community initiatives, to improve local services or to address issues and problems of residents because official data do not reflect significant aspects of the community life.

In the Urban Development scenarios, data are instruments for coordinating service provision, planning and housing projects, interests and complementary business needs.

The challenge, in this case, is harmonising heterogeneous data collected by different actors for different purposes to enable the coordination of these different local actions.

In the Mobility scenarios, data are mainly used for discovery by monitoring local infrastructures, optimising the use of facilities and resources, and setting new data-supported business initiatives on transportation. The challenge, in this case, is that the data collection on mobility phenomena requires a structured and systemic effort of multiple organisations to produce the required data, while their link to systemic actions remains weak.

In the Economic Growth scenarios, data are needed to support analyses of the business environment to identify new opportunities. The challenge, in this case, is the governance of the data sharing process because of the investments for data collection and the competitive advantages related to the exclusive access to data.

In the Sustainability scenarios, data are intended to foster behavioural, organisational and social change at the individual, institutional and community level. The challenge is triggering and keeping track of the on-going changes.

Interestingly, these use patterns for the data sources (both at the level of the single information needs or at the higher level of general themes for local actions) pointed out how the information needs and the challenges in the production and use of city data unite different type of organisations and stakeholders, despite divergent goals.

## Discussion

The findings of this study indicate that there is structural misalignment between the production of city open data and their potential use in local actions. This misalignment involves:

- **competencies and capacities** of the various local actors within the Open Data Ecosystem
- the mismatch between **information needs** associated with local activities and data currently released as city Open Data
- the **capabilities of Open Data technologies** to support different profiles of users, with different levels of expertise and operating in different domains.

In this section, we discuss the implications of these three aspects of the misalignment between city data and local actions, outlining alternative lenses to approach the problem of the underuse of Open Data by city stakeholders.

### Local stakeholders in the city data ecosystem

The stakeholders' profiles emerging from the analysis of the local actions represented by the workshop participants and their mapping of the other actors are significantly divergent from the conventional roles attributed to public and private institutions in the city Open Data Ecosystem as data producers and data consumers.

First of all, each organisation, and in general each class of stakeholders, cover **multiple roles in data-related local processes**: data collection promoter, data provider, data processor, data communicator, data consumer and data subject. From the perspective of the local actors in the city data ecosystem, it is crucial to make public the plurality of roles in the implementation of data-driven activities and in the process of data generation and use. Moreover, the results of the study point out the importance of letting the different stakeholders in control of defining and maintaining a consistent public representation of their organisational or social mission as strong motivation for being engaged in data use and production. Indeed, the perception of local organisations by other actors in the same city ecosystem is strictly related to their roles in local activities. Therefore, publicly **communicating the reasons why a specific organisation undertakes the effort of producing and releasing data of public interest** is important to benefit the secondary effects of that effort: authoritativeness on a topic, corporate ethics, and competitive advantage in building local partnerships.

On the other hand, the potential users of open data (and city data more in general) need **support in identifying the data providers** in the local open data ecosystem, and assessing if the organisational structure, capacities and competencies of the data providers are compatible with their needs and goals. It is worthy to highlight that the organisations holding the information required to implement local actions are often actors not considered central in the Open Data ecosystem, such as civil society organisations. In these cases, these organisations are aware of the value of their local knowledge, but the difficulty to cover all the roles in the data production process prevents them from being recognised as potential and valuable data providers.

In the complex relational context of the city data ecosystem, the challenge of the underuse of Open Data is a two-fold problem: assessing the compatibility of available data with the goals of local actions and accessing to the actors able to provide the integrative sources of information that could facilitate the use of data in the city context. Accordingly, the challenge of Open Data technologies is not providing access to data, but enabling the contact and engagement of people that can provide the context of data and supporting the navigation of the city data ecosystem.

However, it is worth considering that these issues cannot be overcome without addressing the misrepresentation of local actors in the data-related processes and the marginality of the organisations' ability to connect data to a specific context. Making valuable, transferable and usable the direct knowledge of the city context by transforming local organisations in new data providers can alter the current equilibrium of power among city stakeholders. Thus, alternative configurations of relationships mediated by data between consolidated data providers and new data providers can encounter a strong resistance specifically because of the risk associated to empower the latter in the city data ecosystem and over other stakeholders.

### **Features of actionable Open Data**

This study shows how Open Data that is currently available does not reflect the information needs of city stakeholders for their activities, not even of the local government and public agencies. The offer of city Open Data includes (in Milton Keynes and many other cities) datasets, reports and documents tracing the administrative activities and aggregating socio-demographic, environmental and geographic

information. The information needs presented in this study highlight how these types of data (licenced as open, conceived as static finished products documenting past activities, and published by one only data producer) cover only a marginal part of the needs of potential users.

The “status” of Open Data is a desideratum for most of the city data. On the basis of our analysis, Actionable Open Data includes most data sources that are now public data (not granting the right to reuse them), and also data produced for internal use by local stakeholders, whether public or private, that do not constitute monetizable resources in their core business. The licencing of these data and the difficult access to part of them are problems that can be addressed by local policies, but also providing technological support to aggregate these data sources. Lastly, other actionable data sources not currently produced because of the uncertain attribution of responsibility for their production could be considered as potential “data commons” requiring a coordinated effort to their collection.

The types of data considered as actionable are a structured elaboration of information. As a participant points out “we don’t have the right words to talk about data, a vocabulary for that. We all say just “data” but what we want is much more”. Indeed, Actionable Open Data are composite entities, possibly including statistical data and raw data in general, but mostly aggregating the available information in structured profiles at different spatial and temporal granularities (for instance, from the neighbourhood to the city, from weeks to decades) that have the “relational properties” of Open Data in terms of impartiality and reliability. In this sense, actionable data sources are mainly “qualitative data” making explicit the meaning and purpose of the measured indicators or the description of processes, and are small data illustrating a clear in-depth connection between factors of local phenomena. Lastly, actionable data sources provide information on the present and on the future to orient the decisions to be taken by local actors. The set of all these features represent actionable data sources as modular dynamic products, built over time. In other words, actionable data sources are those that can be progressively integrated with new information referred to additional spatial and temporal units respect to the original source, presenting potential aggregation tailored to the purposes and constraints of typical applicative scenarios.

The modular evolutive nature of actionable data sources requires the collection of the needed information from multiple organisations or even individuals having pieces of local knowledge built on their direct experience of the context. In this frame, the ownership of data become a complex relation among multiple actors to recompose fragmented or distributed information to generate an actionable data source.

These three highlights suggest that the problem of the underuse of Open Data should be approached as a problem of data collection for the collective and coordinated production at the local level of actionable data sources. Under this light, the technological challenge for Open Data technologies is not supporting users in using data, but providing support to the aggregation of the users' information needs to orient the data collection, and then facilitating the organisation of the data collection itself.

## Open Data technologies in local actions

The analysis and interpretation of the intended uses of data considered as actionable by the workshop participants indicate the **priority of the type of task to be performed over the type of data to be used in the expected forms of support provided by technology.**

Considering the different levels of expertise on the topic or data technologies, the users' profiles appear to be very diversified. Similarly, the data-related activities to be performed at the individual level and because of the organisational goals can significantly vary for each user over time and for each local action. However, regardless of the specificity of their profiles or activities, the users' priority remains **to identify a strategy (in terms of data sources, tools and techniques) to accomplish their data-related tasks** or, in other words, operationalise the fulfilment of their information needs.

Despite the wide range of data-related activities (e.g. planning, decision making, resource management), users tasks can be divided into four macro-clusters: a) exploration of data, b) identification of one specific piece of evidence in data, c) elaboration, mapping and aggregation of information, d) data analysis relying on raw data. Thus, forms of technology support centred on the common users' tasks could embrace the needs of a plurality of activities.

Besides tasks recurring across different data-related activities, each domain of city actions (e.g. services provision, urban development, mobility) also presents specific patterns of activities and consequently requires specific combinations of forms of support to the users' tasks. Therefore, the definition of the forms of support could be grounded in identifying the patterns of activities and tasks in common within each domain of city action.

Looking specifically at Open Data portals, the problem of the underuse of data is a problem of shifting the focus of the technology support from the acquisition of data sources to the identification of the correct operational path to manipulate data for the users' goals, accordingly to their expertise and to the domain in which they work.

## Conclusions

The results of the exploratory study presented in this paper suggest that the underuse of Open Data is connected to a structural misalignment between the representation of local actors and their activities in the production and use of city data, the offer and needs of data for local actions, and the focus of technology on data sources rather than data activities and users' tasks.

The implications of these results can be instantiated in three new lenses for reframing and analysing the problem of the underuse of Open Data considering the actors in the Open Data ecosystem, the context of the city and the role of technology. These three lenses shift the focus of the problem from:

- Accessing data to identifying organisations and people that can provide knowledge for making effective use of data
- Fostering the use of available data sources to organising the production of data reflecting shared information needs in city activities

- Supporting the acquisition of data to infrastructuring data-related activities by focusing on the common patterns of users' tasks in different domains.

On this basis, the directions to make Open Data actionable in local actions point toward Open Data technologies as systems actively aligning the production of data to the dynamic evolution of the information needs of the local stakeholders in the city data ecosystem, working at the same time as *mediated civics* and *proxied civics* (DiSalvo, Jenkins & Lodato, 2016). In this new frame, grounded on the vision of Open Data portals as civic technologies and Open Data as commons, a city data portal will act as community infrastructure, fostering synergies among the diverse actors operating in the city by translating local knowledge and capacities in new relationships oriented to data-supported local development aims.

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