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The innovation of local public-sector companies: Processing big data for transparency and accountability

Paolo Pietro Biancone, Silvana Secinaro and Valerio Brescia*

Department of Management, Faculty of Economics and management, University of Turin, C.so Unione Sovietica 218 bis, Turin, Italy.

New Public Governance (Klijn, 2008) is the basis for our analysis of the group of public-sector and public service companies. It has furthered the involvement of citizens and of political governance in the management of resources (Boston and Pallot, 1997; Northcott et al., 2012). In order to manage the group while remaining accountable and guiding production choices, it is essential to have an overview and a guarantee of transparency (Hood and Peters, 2004; Willem and Buelens, 2007). This study aims to analyse whether the processing of big data is positively related to accountability and transparency. A qualitative analysis was made of a case study (City of Turin) with the aim of identifying advantages, critical issues and potential problems in the process of re-engineering the information system, and in transparency and active participation through big data and new citizen-friendly instruments. The processing of big data plays a decisive role in the creation of a panel of easy-to-interpret benchmarks that provide an immediate overview of reality. As we have seen in the case study, incoming data on the big data platform is often of low quality, which prevents a proper assessment of expenditure and gives no guidance as to which services are most needed by the final users. Public bodies must invest to reduce the costs generated by poor quality data and to improve Data Management processes. A single integrated system is the only instrument that can guarantee accountability and transparency through complete system outputs for stakeholders.

Key words: Accountability, new public governance, big data, transparency.

INTRODUCTION

Governance and change in local public-sector companies

Reforms involving the managerialization of public administrations (Farnham et al., 2016) work on the assumption that improving the mechanisms of governance and responsibility also improve performance in the public sector (Pollitt and Bouckaert, 2004, 2011). An analysis of the literature shows that public sector governance concerns the responsibilities related to

Corresponding author. Email: valerio.brescia@unito.it. Tel: 0039 011 6706139. Fax 0039 011 6706012.

the specific objectives of this sector, which are not only limited to the provision of services (for example, the cost and quality of a service) (Cristofoli and Valotti; 2005) , but also include the impact of policies on the community and on society at large (for example, political or taxation-related outcomes (Jacobs and Goddard, 2007). Specifically, governance involves several mechanisms and structures that clarify the responsibilities of the various parties involved in terms of organisation, approaches employed and the ability to meet the transparency requirements that are linked to accountability, through instruments such as internal control systems and external accountability (Goddard, 2005). The current view is to consider public-service companies as public-sector companies (Biancone et al., 2016). In essence, there has been a progressive shift from New Public Management (Hood, 1991), which adopted a managerial and business-like in order to improve efficiency and economy (Boston et al., 1996), to New Public Governance (Osborne and Gaebler, 1992). New public management is the collection of management and leadership practices gradually introduced to the public sector from the 1980s. New Public Management is a broad term for a variety of management ideas, often borrowed from the private sector, introducing ideas and tools like competition, privatization, management by objectives, decentralization etc. to the public sector (Hood, 1991, 1995).

The New Public Management movement has its origins in a critique of the traditional way of exerting control and management of public organizations and as a requisite for increased efficiency in the public sector. This goal can be achieved through the implementation of a communication path addressed to all stakeholders and, in particular, to citizens. Comparing the various experiences of reforms, we note that modernisation is implemented through a series of "drivers" of action. Specifically, we can differentiate between "old" drivers and "new" drivers, depending on whether we are talking about the very early stages of NPM or a later more mature stage in which, in addition to the initial critical points, the Public Governance approach gradually emerged (Klijn, 2008). There is a clear shift in the approaches used by public-sector companies towards stakeholders. The "old" drivers are based on decentralisation, resizing, consolidation, reconstruction of public systems, new organisational models and management formulae; competition in the public sector and guided competition between public organisations; "market-like mechanisms", internal markets, partnerships, contracting out/in, vouchers, property rights: privatisation of property, privatisation of public enterprises; assessment of outcomes and performance, accountability and assessment of programmes; cash limits, cost-benefit assessments, budget planning, multi-year financial statements, zero-based budgeting, etc.; devolution of responsibilities and flexibility. The "new" drivers, on the other hand, are seen

in: greater focus on ethics, where the intrinsic ethics of efficiency is found; performance- and results-based contracts and agreements based on performance, territorial pacts, planning agreements; improving regulations (Van Dooren et al., 2015). At this stage, the role of public-sector companies is to manage the change whose purpose is to implement the reform, new information technologies and from efficiency to effectiveness and the transition from "information" technologies to "information and communication" technologies with a closer relationship between public administrations and citizens, in which improving accessibility and participation, setting quality standards and avoiding political patronage are key features. Accountability emerges as an instrument of governance. One of the instruments of New Public Management is accountability of the public-sector company, which features five principles: responsibility is public and not only internal; it involves explaining and justifying, rather than propaganda; it is specifically directed at a target audience, it is not a random explanation; it involves an obligation for the players to come forward and take responsibility; as a consequence, it involves discussion and assessment which do not lead to a monologue without the commitment of policy implementers (Ferli et al., 2005).

The focus of governance has thus shifted to performance assessment, with a system of benchmarks that are internal to the same group (Bovens, 2007). In the public sector, accountability has three components: compliance, transparency and responsibility (Mulgan, 2002). Compliance in New Public Management is defined as the tendency of public-sector companies to bureaucratise business systems (Pollitt et al., 1999), even though bureaucratisation does not necessarily lead to assessments of the results (Hood and Peters, 2004). Transparency is the sharing of information about the decisions and activities of governance, proper document management and access to information for all sectors of society: investors, the research and development community, the media and the general public (Relly and Sabharwal, 2009). Accountability is one of the keystones of public administration and management, because it is the principle that informs the processes which take account of the people that hold and exercise public authority. Although the regimes of responsibility vary in important aspects between different political systems, they all contain processes whereby citizens hold their governors to account regarding their conduct and performance directly through elections.

Representatives of citizens in legislative bodies hold political managers and public servants accountable through mechanisms of public control and auditing. Political managers hold the civil servants that report to them to account through hierarchical structures of authority and responsibility. Moreover, courts and the administrative courts hold legislators, managers and

administrators accountable for the law (Aucoin and Heintzman, 2000; Stone, 1995; Mulgan, 1997). Transparency without accountability becomes meaningless and makes a mockery of sound public administration. Accountability depends on transparency or having the necessary information. And transparency and accountability without integrity may not end up serving the public interest (Armstrong, 2005).

The accountability system, therefore, is not based on individual the objectives of the public-sector company through financial reporting, but on a system of governance based on consolidated reporting (Levi-Faur, 2012; Stoker, 2016). This shift is due to the gradual inability of public-sector companies to respond autonomously to the needs of citizens and to the stakeholders to whom, according to the principle of subsidiarity, public-sector companies answer (Barnes et al., 2007). Governance and the capacity of local public bodies to manage the external aspects of public services is one of the most important aspects for guaranteeing the efficiency and effectiveness of services (Bouckaert et al., 2016; Hodge and Greve, 2017). In order to achieve this, useful information needs to be exchanged and a performance monitoring system needs to be in place, not only internally, but also with the external support of new IT systems (Kouzmin et al., 1999; Korac-Kakabadse and Kakabadse, 2001). The focus has shifted to the quality of the information made available and on good reporting practices using the governance instruments that are available to the private group and their implementation in the public group (Shaoul et al., 2012).

Performance, accountability and transparency, the role of information

The capacity to increase the decision-making processes of public bodies, citizens and stakeholders requires the application of instruments that can collate and summarise the various information flows, thereby ensuring a real process of accountability (Marturano, 1998). Performance assessment is one of the essential requisites for transparency and accountability in public service organisations (Reichard, 1998; Pollitt and Summa, 1997). However, transparency is a weak form of accountability. Often, when there is only access to information, an institution is transparent but not accountable. Accountability includes the ability to impose penalties or to compensate. The intermediate category refers to the ability to ask for explanations, which here is an area of overlap between transparency and accountability (Fox, 2007). As citizens are often the providers of services in public bodies, thus unconsciously defining the quality and quantity required (Brusca and Montesinos, 2006; Bovaird, 2006), providing transparent information to guarantee a choice is a non-negotiable element when defining public spending and, as a result, even the taxes and duties that

the public body will levy. The ability to ask for information and the type of data that can be consulted are therefore areas for analysis. Furthermore, the literature has always highlighted the fact that companies are part of a dynamic environment, which requires them to evolve, anticipating environmental changes and, to a certain extent, trying to influence them (Joskow, 1974; Roome, 1992; Oliver and Holzinger, 2008). From this perspective, the growing need for accountability towards stakeholders (Sternberg, 1997; Belal, 2002; Bäckstrand, 2006; Collier, 2008; Caperchione, 2003) is a particular feature of the environment of local bodies; as is the evolution of the concept of citizenship, from customer/user of services to active stakeholder (Doh and Guay, 2006; Chess and Purcell, 1999) with a say in how business is conducted.

The above has contributed to a new approach to decision-making and reporting, rooted in the active involvement of civil society and with a multi-stakeholder perspective (Moon, 2004; Chen and Delmas, 2011). In concrete terms, it is corroborated by the considerable spread of inclusive decision-making processes and social reporting (Adams, 2002; Deegan, 2002). This is because only a proper understanding of the information received can enable those receiving it to contextualise it, to relate it, at least potentially, to actual dynamics of participation and therefore to interpret it responsibly, uninfluenced by the prejudices of a culture of suspicion and mistrust in everything that is done in the exercise of public duty or, at least, using public resources. Several studies state that the revitalisation or the renewal of local democracy has four characteristics: improving participation in local elections; improving community leadership; reforming the internal management of local authorities, mostly following private sector guidelines and providing the public with opportunities to get involved in the decision-making processes of local authorities (Boston and Pallot, 1997; Burns et al., 1994). The relationship between choice and the response of the same players leads to new forms of market of democracy in local administrations.

New mechanisms have been introduced to improve the participation of the public and the local affairs that concern them, to make local authorities more aware of the concerns of citizens and to increase the choices available (Boston and Pallot, 1997, Wallis and Dollery, 2001; Northcott et al., 2012). The involvement of the public and of public employees in choices thus becomes one of the key elements that can lead to a renewal of democracy where decision-makers and the main stakeholders are involved in the assessment system, in terms of its efficiency and effectiveness (Kelly and Swindell, 2002) but also in terms of social welfare (Biancone et al., 2017; 2017a). In the mechanisms introduced to guarantee the new forms of democracy, it is essential to look at the issue of transparency and the use of information. Transparency is the ability to provide credible policies free from conflicts of interest, open information and the sharing of financial reports,

freedom of information and the participation of citizens in the formulation and implementation of public policies, so that state-run enterprises become accountable (Turnpenny et al., 2009). Transparency, therefore, concerns facility of access and use of government and non-profit information. The easier and more open it is for the public to obtain information, the greater the level of transparency. Yet they recognise that the new technologies – the Internet, enormous databases and digitalisation – make it necessary to protect confidential personal information (Hood and Peters, 2004; Willem and Buelens, 2007).

Resources in local public bodies and the drive for innovation: big data as an instrument

The experience of the private sector shows that data exploitation can lead to concrete benefits for an organisation. This has been communicated to policy makers, highlighting the potential use of big data within the public sector (Information Commissioner's Office [ICO], 2016). According to some researchers (Almeida and Calistru, 2013; Kim et al., 2014; Yiu, 2012; Thatcher, 2014), big data can help local governments to allocate resources to where they will have a bigger impact and restructure services to prioritise prevention and avoid the need for more costly interventions (Malomo and Sena, 2017). Big data can support local governments in their transition towards a services delivery model where their choice in terms of the quantity and quality of the services commissioned is based on data and on (current and future) users and their requirements (Beresford, 2015; Desouza and Smith, 2014). If big data can increase efficiency and effectiveness in public-sector companies, it is also important to identify when a public-sector company uses this tool. The main public-sector reforms, such as New Public Management (NPM), have driven many countries to do more with less (Farazmand, 1999; Kettl, 2005; Pollitt, 2010) and doing so can increase not only efficiency but also innovation. Some researchers (Osborne and Gaebler, 1992; Osborne and Plastirk, 1997) maintain that public-sector companies may be more innovative if they are forced to provide the same activities on a smaller budget.

The performances of public sector organisations are better when they can be guaranteed by innovation-driven organisations and policies (Bernier and Hafsi, 2007). There are also contrasting theories that claim that reduced budgets do not always lead to improvements and positive repercussions on innovation (Fernandez and Wise, 2010; Lægreid et al., 2011). New public governance today requires a new drive that includes the internal public group. The collection of information is based on the size, constant flow, large dimensions and veracity of information and must be based on the four Vs (volume, velocity, variety and veracity) (Fromm and Bloehdorn, 2014). The lifecycle of big data is divided into five stages: data acquisition, data cleansing, data modelling and data delivery. Several data-flow aspects must be considered for each stage.

Data quality and data type

There is limited literature on data quality and its application in local public-sector companies. Nevertheless, over the last few years of the digital age, there has been an increase in information and the speed with which we can obtain data about companies or individuals. Speed and availability are not always synonymous with quality. One of the biggest issues of our times is how to manage the very large quantities of information, including sensitive data, handled by public-sector companies. However, when defining data quality, it is useful to consider several aspects: it is not only about considering the accuracy of the data, but also other aspects, such as its constant updating, its multidimensional nature and proper representation (Cappiello et al., 2004). The management of big data must take account of a number of aspects at each stage. These include: the accuracy of the data (the data are represented in the correct parameters and are valid); accessibility of the data (the data elements should be retrievable and legal to collect); thoroughness of the data (all necessary elements must be included, the entire set of data is collected and documented, also taking account of intentional limitations); coherence of the data (the value of the data should be reliable and submitted via different applications); dissemination of the data (the data should be up-to-date.

A data value is up-to-date if it is recovered at a specific moment in time; it is out-of-date if it was current at a previous time and still not correct at a later time); granularity of the data (the characteristics and the value of the data must be defined to the right level of detail); precision of the data (the values assigned to the data should be large enough to support the application or process); relevance of the data (the data are meaningful to the provision of the process or the application for which they are collected). If these characteristics are borne in mind throughout the management process, it is possible to achieve data quality that is representative and can be used for systems of governance, accountability and transparency (Brackstone, 1999; Puddu et al., 2017). In management, the quality of incoming data must be airtight. Moreover, implementation and monitoring systems must be in place that can check downstream for potential errors. The quality level of the information processed by companies should first of all focus on the capacity, the organisation and the methods for saving incoming data. In this regard, partnerships between the various entities are particularly important, and can be achieved by setting up internal data governance structures. Every company can adopt a different organisational model, but the mission and the culture

behind the issue of "data quality" remains the same, namely the proper running of the company. Companies should be able to manage increasingly complex strategies, policies, processes and information systems that can support the running of internal processes and turn these into advantages over the main competitors. The quality of information processed, say, by a bank or an insurance company will depend on the completeness of the information, accessibility for the customer, timeliness and consistency. All these features are important for the delivery of financial services, in order to ensure the smooth business activities, without risks and excessive exposure. In order to run smoothly, each process requires planning and the involvement of several areas. In Data Quality Management, it is possible to identify a number of steps that are required to establish an ecosystem that remains stable over time.

OBJECTIVE AND METHODOLOGY

This study aims to analyse whether the processing of big Data is positively related to accountability and transparency. A qualitative analysis was made of a case study (City of Turin) with the aim of identifying advantages, critical issues and potential problems in the process (Marlatt and George, 1984) of re-engineering the information system, and in transparency and active participation through big data and new citizen-friendly instruments. The City of Turin has been identified as the best-case study able to better represent the adoption of innovative and digital adoption systems linked to transparency and accountability. As the consolidated balance sheet achieved before the obligation already provide useful ideas for reflection and sufficient maturity for analysis of a public group. The analysis of all the elements is systematic and independent of the innovation and accessibility policies implemented. To this end, the elements are analyzed by parties external to the public structure through analysis of paper sources (resolutions, completed projects, institutional sites, reporting of European funding) and interviews with politicians and managers confirming what have been identified. In the discussion the different elements that make up the system are analyzed starting from the literature and providing information on each element of the case study. The analysis therefore starts from the reference context, provides detailed information on all the elements related to the case study in the second subchapter, in the third the theories and the possible applications of big data quality are highlighted and finally the location of the article in the literature is identified international and in the context of knowledge on the subject. The conclusions provide both future perspectives and research limitations taking into consideration the reference literature analyzed in the introductory part.

RESULTS AND DISCUSSION

Context

In 2016, an estimated 67.4% of households in Italy had access to land-based broadband Internet services (ADSL, fibre optic, etc.), up from 64.4% in 2015. A steady 98% of businesses with at least 10 employees used the Internet, with those connecting to a mobile broadband rising slightly from 63.3 to 63.8% (60.0% in 2014). 63.2% of people aged six and over connected to the Web during the year (60.2% in 2015), whereas around 45% connected every day. Age is still the main discriminating factor when it comes to using the Internet. Young people make up the largest group of users (91% of 15-24 year-olds), but there was also significant growth in the 60-64 group (from 45.9 to 52.2%). Most users said they had basic (35.1%) or low (33.3%) digital skills. Digital competence was also limited in businesses: only 12.4% of those with at least 10 employees chose to run in-house ICT functions, whereas 61.9% used external resources. In one year, the percentage of Internet users who shopped online rose from 48.7 to 50.5%. Of those who had not shopped online in the previous three months, 40.9% had in any case looked for information about goods or services and/or sold goods online. Smartphones and cloud services make it possible to connect to the Web and access files at anytime and anywhere. 42.1% of internet users connect via their smartphones while they are away from home or the workplace. 29% use cloud services to save documents or other files for private use. 9% of businesses with at least 10 employees said they had analysed big data during the previous year; 7.9% using resources within the company and 2.9% using external resources (ISTAT, 2016). Investments in the digital market by local public bodies amounted to €1,217.1 m in 2015, with heavy investments also planned for the years 2016, 2017 and 2018 (Table 1).

Turin is the regional capital of Piedmont, in Northern Italy. In 2015, the city had a population of 892,276, with the percentage of residents aged over 65 rising steadily from 23.5% in 2005 to 25.4% in 2015. These numbers may considerably affect access to digital services. According to national data, while the over 65s have more difficulty accessing the Internet and using digital instruments, the ability of young people (aged 15 to 24) to use these new instruments is on the increase. The average age of the population is 46. The spread and use of digital information tools is rising (ISTAT, City of Turin Statistics Office, 2015). The spread of online shopping in Piedmont is in line with the average figures for the European Union (47% of Internet users) (ISTAT, 2016). 24% of Internet users in Piedmont accessed e-government services over the previous three months, compared to the European average of 42%. Specifically, just over 13% had sent pre-filled forms to the public administration (ISTAT, 2016) compared to 21%. Lastly, the main reasons given by households for not using the Internet (ISTAT, 2016) were not knowing what the Internet is (27%), followed by a lack of interest (26%) and lack of skills (24%). Relatively few gave financial reasons as a barrier to access (3.9% of those interviewed gave the cost of connection as a reason and 4.6% said the cost of the instruments needed for connection). Thus, there is "cultural" digital divide, which is to be expected in a population that is aging. While the barriers to access

Table 1. Digital market by economic sector in Italy.

Figures / Total on percentage	2013	2014	2015	2016E	2017E	2018E
Industry	4,06	4,13	4,14	4,16	4,17	4,22
Bank	3,82	3,91	3,96	4,01	4,07	4,13
Insurance	1,00	1,02	1,04	1,06	1,09	1,10
Public central administration	1,17	1,16	1,15	1,15	1,15	1,16
Defence	0,61	0,61	0,59	0,59	0,59	0,59
Public bodies	0,76	0,75	0,73	0,71	0,68	0,66
Health	0,87	0,86	0,86	0,87	0,88	0,90
Utility	0,88	0,91	0,92	0,93	0,96	0,98
Telecommunications and media	4,71	4,81	4,89	4,88	4,84	4,78
Distribution and Services	2,38	2,33	2,32	2,30	2,29	2,30
Travel & Transportation	1,26	1,28	1,30	1,32	1,34	1,37
Consumer	17,71	17,35	17,16	17,03	16,89	16,71
Total digital market	39,24	39,12	39,05	39,01	38,96	38,90
Digital business market	21,53	21,77	21,89	21,98	22,07	22,19
Total digital market in €m	166078,9	164214,1	166203,9	168956,6	172047	175836,8

Source: produced on data of Confindustria, Asscom data.

to digital instruments for the aging population may be a problem for the digitisation of public administrations, on the other than hand, almost everyone in the younger generations is capable of using the new instruments.

Big data of the city of Turin, qualities and defects of a complex system

The city management was asked to run the public-sector company according to governance criteria (Bovaird and Löffler, 2009; Lægreid and Verhoest, 2010). In order to create value for its stakeholders, while maintaining economy-efficiency-effectiveness conditions, the local public-sector company has always relied on planning and internal control instruments, as well as the supporting information system, in other words, internal governance. Nevertheless, as a result of the rapid shift in the legislative and socio-economic landscape, whereby its role and competences have changed, and with the arrival of the "Public Governance" and "Network Management" models, the local public-sector company has to use instruments that integrate with earlier ones to be able to verify implementation of its guidelines and strategies. Moreover, this takes place in a context in which it has to deal with an increasing number of outside players to which the public services that benefit the community are entrusted. Specifically, the need to define a model for the overall control of participating organisations is met in the process of liberalisation and privatisation of public services, which are key to internal reorganisation on the basis of the new information needs and the new professional and instrumental skills required to ensure

that the conduct of the participating bodies is geared towards protecting the local bodies and, indirectly, the citizens-users-stakeholders. This process has uncovered a need for greater use of management tools, not only within the public-sector company but also in the wider context in which it operates (Grossi et al., 2010).

One of the instruments identified is the consolidated financial statements which provide a mosaic view of the local context, presenting the performances and results achieved at an aggregate level (Robinson, 1998; Buiter, 1983; Walker, 2011; Schick, 2007) and observing the two principles of utility and accountability (Grossi and Steccolini, 2008). Starting with the premise that there are both national and international accounting standards for the financial statements of public-sector companies, it is necessary to investigate which standards are best suited to represent transparently and accurately the consolidated financial statements of the local public group, in a way that can be read by the stakeholders. International

Accounting Standards (IAS/IFRS) for the private sector: IAS 27, IAS 28, IAS 31, replaced since 2011 by IFRS 10, 11 and 12 for Groups, International Public Sector Accounting Standards (IPSAS) and specifically international public sector accounting standards IPSAS 6, IPSAS 7, IPSAS 8, for Local Public Groups, Financial Reporting Advisory Board (FRAB) and Governmental Accounting Standards (GASB) and Italian accounting principles (OIS Principle 4 of the Osservatorio per la Finanza e la Contabilità degli Enti Locali), Annex 4/4 to Legislative Decree no. 118/2011) should be considered for consolidation purposes (Shaoul et al., 2012; Biancone et al., 2014, 2016). Therefore, it is necessary to consider

the need for uniform accounting systems within the different sectors of public administration. The use of different principles and competence criteria inevitably leads to a system that is heterogeneous and introduces strong limitations to a process of proper consolidation of the accounts (Quagli, 2017). Thus, pro forma and actual financial statements should be as uniform as possible, and with a standard, mandatory structure, which cannot be modified, at least in terms of aggregate items (Borgonovi et al., 2016).

The City of Turin has produced consolidated financial statements for years. Like other Italian municipalities, the city's financial flows are all collected in a single system known as SIOPE (Information system for the transactions of public bodies). SIOPE gathers information about payments made to and by the treasurers of all public administrations [1]in Italy with a focus on the requirements of the European Community. Compared to the previous cash flow system, SIOPE responds to the need to improve, to know about the performance of public accounts – in terms of both the quantity of information available and timeliness – and to overcome the differences between the accounting systems currently in use within the various sectors of public administration sectors, by means of a uniform coding system differentiated according to the type of organisation and without affecting the structure of the financial statements of those organisations. SIOPE is therefore a fundamental instrument for monitoring public accounts, through the real-time recording of the supply needs of public administrations and the acquisition of the information needed for a more accurate compilation of the quarterly statistics of Italy's national accounts, to check compliance with the rules set out in Community law.

Joining this are two platforms called *Openbilanci* (with the financial statements of all Italian municipalities from 2005 to 2015 and the mayors accountable for them), created with European Union Regional Operational Programme funding (Lazio Region ROP) by DEEP (Data, Engagement, Platforms, Politics) and *Open municipio*. Both projects are based on open-data platforms and enable governance of the city in a neutral context where citizens and their representatives exchange and collaborate on an equal footing, albeit with different roles and responsibilities. Both platforms provide a process whereby the political and administrative activity of public-sector companies can be documented in real time and contextualized. The absence of a specific information policy for the benefit of users and the community has been one of the biggest limitations in the welfare policies implemented in recent decades. The Local Authorities themselves, the dispensers of welfare policies as well as most social services, are only recently becoming aware of the importance of information services. More

specifically, besides being unfair, ineffective and, often a source of corruption, the welfare dispensed in recent decades seems to have redefined the idea of citizenship, which appears to have taken over the spotlight in today's community. The right to information must be seen as an extension of the right to citizenship and as an integral part of social citizenship and welfare. A renewed welfare policy needs an "active citizenship" and this is a direct consequence of the right to information, transparency in decisions and the decision-making processes of the public administration, participation in decisions, active involvement of citizens in the reporting activities of public bodies (Bonsón et al., 2012; Devas and Grant, 2003). The second instrument that is essential for our analysis is the big data system and its integration with other systems. The City of Turin is procuring a system called the Yucca Smart Data Platform.

This is an entirely open source system, which provides solutions based on the Internet of Things and Big Data (Davis, 2001); it interconnects applications, social networks, systems and objects distributed across the local territory; it collects data and information and processes them in real time. One of the essential aspects of the Yucca Smart Data Platform is that it was conceived, designed and is currently run as an open source solution. More specifically, the development approach was based on Agile, shared and public tools. The entire system was developed on the GitHub platform. The components are fully available with EUPL open source licence. The components used by Yucca, such as the framework, libraries and middleware, were selected for being best of breed within open source communities. Lifecycle instruments (e.g. compile, build, etc.) are in use in the main open source communities. Yucca Smart Data Platform is capable of running the ecosystems of organisations, companies and projects according to the different objectives and data handled. Different ecosystems can have different visibility and cataloguing rules.

The management, development and use functions of the platform are available online via User Portals and are supported by a wizard that facilitates completion of the main use cases. Registered and recognised users can work independently within their own Tenant. Yucca Smart Data Platform consists of a series of subsystems divided according to accountability and consistency. Subsystems are decoupled and integrated through the use of APIs. Yucca Smart Data Platform is based on LAMBDA ARCHITECTURE.

The platform's overall architecture is designed to enable quick access to recent data, as well as offline operations for querying and analysis of all data stored over time. All technologies on the application and event processing layer (SPEED LAYER) are currently in clustering deployment and configured to support balancing and fault tolerance. The data persistence layer (BATCH LAYER) is based on the world's most advanced and scalable platform for Big Data: Apache Hadoop. In

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[1] Built by the Ragioneria dello Stato italiano, Banca d'Italia and ISTAT (National Institute of Italian Statistics).

addition to ensuring fault tolerance and resilience, it dynamically manages the allocation of resources and the priority given to each tenant. This component enables Yucca Smart Data Platform to implement very sophisticated real-time processing logics, including data filtering and streaming, event correlation, time window analysis, application of advanced streaming algorithms. The event hub is integrated with a big data engine implemented on the Yucca Smart Data Platform for the Enterprise Data Hub, thus benefiting from the analytical potential of the data available in storage. The City intends to use the Yucca Platform to collect and process big data from various sectors.

The City of Turin currently has several ongoing projects: *Sensori Aria (Progetto Io Torino)*, an air pollution project to prevent chronic exposure of children at school opening and closing times (enables closure of surrounding roads in the affected hours and verification and comparison with continuous detection); the project "Surveys on mobility for all citizens through the company GTT SpA a subsidiary of the City of Turin" with definition of which routes should be checked to find out which might be the most interesting, based on urban-planning proposals, for an alternative route for the number 2 metro line. *Analisi SIM* project, involving the acquisition of the databases of telephone companies in order to map concentrations on the map of Turin during the daytime. In places with higher concentrations, amenities and transport can be increased; "5T: management of live sensors" on the main car traffic routes, to facilitate decongestion by the municipal police of certain areas; and the *Anagrafe* project which maps which services are most requested in order to establish how many desks should be open to the public and whether or not to increase or integrate online services for greater efficiency. Project mapping reports received by the municipal police and information collected about accidents within the City of Turin. While on the one hand, the various projects and IT structures are expected to renew services, increase efficiency and effectiveness with greater accountability tools for governance, on the other, several problems related to the use of big data are immediately apparent. Beginning with the project to map the reports received by the police, the data available (crime category, report, district, address, date of report, time of report, exact description of problem) can immediately identify the number of cases reported during the period January – July 2017 (Figure 1).

Several issues arise from the data described above, the first concerning classification. Too many records are in the "other" category. Furthermore, there are no "consumer protection" categories. Problems relating to approximate geolocation: the street name is not sufficient (the exact address or a specific LON/LAT point is required). By doing this, it is possible to achieve greater granularity by identifying a district, area, statistical zone or a census area. Also, more parks and green areas

need to be identified. Time: No time bands provided for the issue (e.g. 4 time bands). Currently only the time of the report is entered, which is not relevant to categorisation. Furthermore, it may be useful to include fields indicating whether other institutions are involved in handling the report (e.g. local health authority,...). The number of applicants is not stated in each category: entering who the person reporting the issue is (citizen – several people – associations) would improve representation. The type of data and a quality management system is therefore essential for proper management of the information which may initially seem simple and easy to understand. Furthermore, several topics of discussion arise from this project, the first being the need for and the dissemination of knowledge in a collection of data which, in our case, is based on public reports, for example. For this it is important to know and differentiate between citizens who are "technological unconscious" (Beer and Burrow, 2013) and those that are "conscious users" regarding the sharing and use of data. Another issue to consider is the use of data from social media and the Internet, which provide a fluid association between the public, the state, groups and politicians and between individual citizens (Chadwick, 2006). As Segerberg and Bennett (2011) point out, the new media and new technologies enable a higher degree of personalisation than participation in politics. Citizens can receive information flows, make complaints directly on the City's page, get involved in a political cause on Twitter or discuss and exchange opinions on political issues and decisions. Yet it is also true that the Internet and social media have changed the face of politics, breathing new life and vigour into it through discussions in which citizens actively talk about political activities (Gil de Zuniga et al., 2014; 2015).

For example, a study conducted using social networks shows that these media increase the mobilisation effect (case study of 61 million Facebook users) (Bond et al. 2012), thus confirming their utility in the of accountability process. The study was based on interactions between individuals. These changes in the instruments of communication technology naturally have an impact on how citizens interact with each other and with their governments. They also introduce a new public domain and increase and cause further shifts in the customs and norms associated with the active citizen participation (Gil de Zuniga et al., 2015; Mourao, 2015). However, Twitter, for example, only represents a section of the population. We cannot demonstrate that the relationship between the results analysed from Twitter metadata and users is relatable to the entire population. Furthermore, only active users can be considered; in other words, there should be a mechanism to discard the comments automatically reposted by users to other social networks, which, hence, do not provide a real picture of Twitter-related activity (Boyd and Crawford, 2012). There is a real distinction between "user", "participation" and "activity"
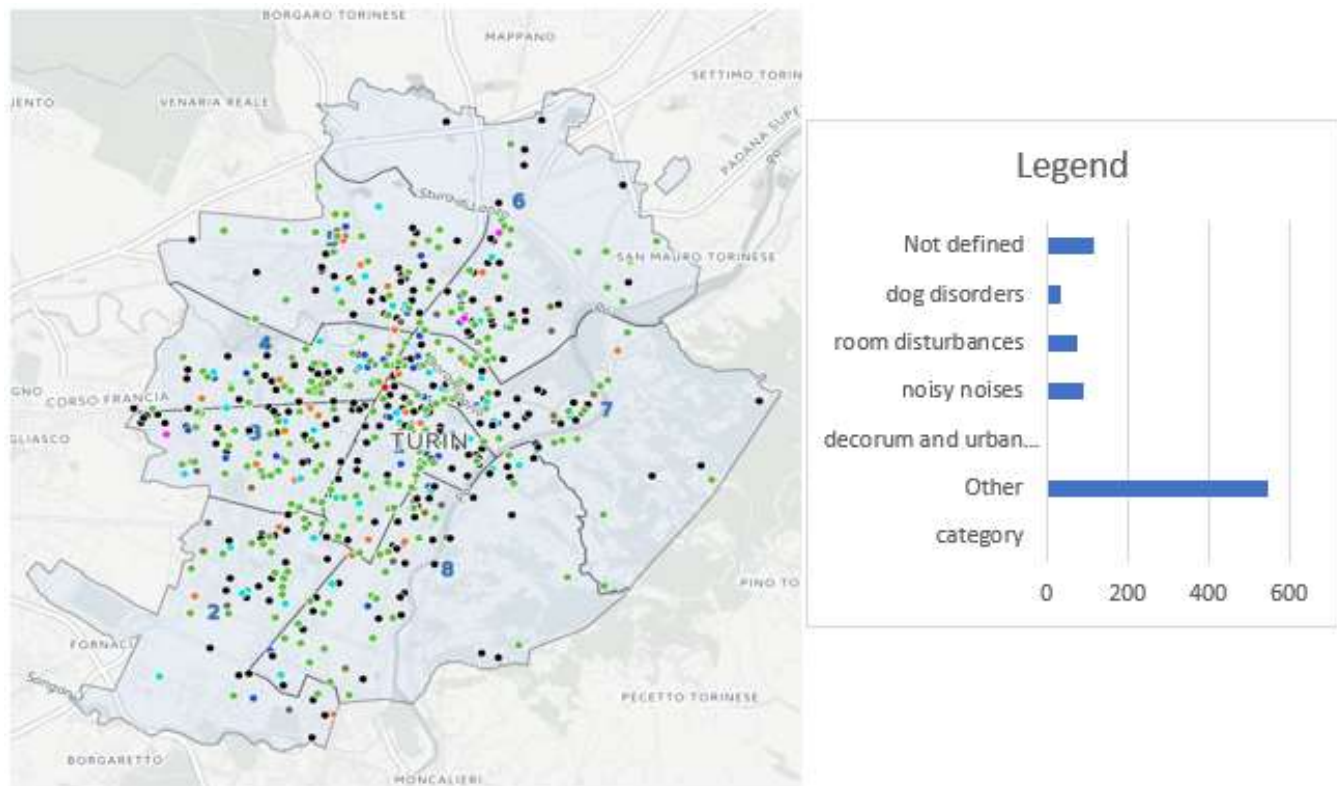
Figure 1. Map with geolocation of reports.
Description: black – other; green – public decency and urban decay; light blue – noise nuisance; dark blue – statutory nuisance from premises; red – disorderly behaviour; green – dog nuisance; orange – neighbour conflicts; grey – drug dealing; red – prostitution; purple – misuse of common areas. Source: produced from Turin Municipal Police data.

which must be taken into consideration. Also, Twitter's control system eliminates all content with offensive language or pornographic references, so the analyses made as outcome data are not actually compiled of big data because they have already been manipulated by filters. Another issue is that some users are registered as private or protected users and therefore not all content is easily accessible. A whole collection of data is excluded thanks to a security system and different levels of access. More specifically, it is estimated that only 10% of users allow full access to everyone and are said to have "gardenhouse" access (http://dev.Twitter.com/docs/straming-api/methods).
Starting from the integration and use of social media with big data and analysis tools like Yucca, we will see how the City of Turin employs new information and participatory tools such as a platform and a digital application, initially called dediciTorino.it and based Decide Madrid https://decide.madrid.es/ the website where citizens can express their views on a law, receive real-time information, suggest topics for discussion or projects, take part in participatory budgeting (Baierle, 2003; Nylen, 2002; Cabannes, 2004; Fung, 2006); all this through an integrated process (Figure 2).

Data quality as a system guaranteeing the veracity of information

The best philosophy and culture for quality should be achieved at two levels, through strategic management, which includes clear policies at Data Governance level and strategies to ensure and monitor the effectiveness of decisions. However, strategic guidelines are not everything. They also need to be applied at operational level, by those who use and receive the data, using proper planning and a downstream control system. The development of technologies and gradual digitisation is leading to the storage and management of increasingly larger quantities of data. However, the increasing amount of information requires increasing efforts in both the collection and the subsequent management. The spread and non-maintenance of these processes can cause great damage to the image and organisation of the company. Although proper maintenance of a data collection process leads to cost savings, as we will see later, it is also true that poor quality data can cause a plethora of negative consequences for public and private companies alike. The impact can be even catastrophic, if we consider the field of medicine. Failure to address this
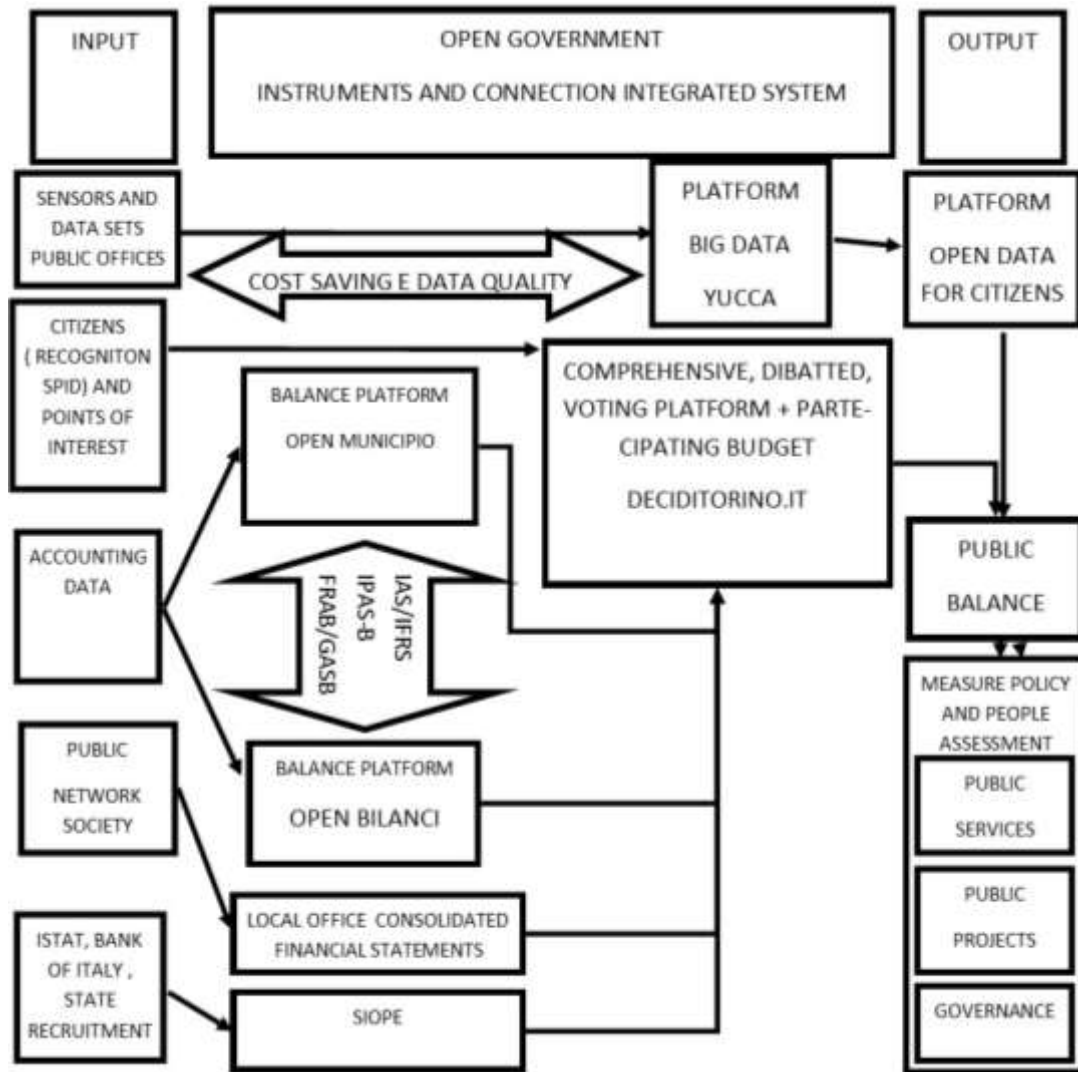
Figure 2. Description of the integrated model of transparency and accountability in local bodies with the aid of big data.
Source: Own data.

issue can have several implications: less customer satisfaction (this can lead to difficulties in relationships between customers and the company; for example, the company could lose a potential customer, if contractual conditions are breached, due to an error or organisational negligence; or, we only have to consider the consequences for an e-commerce company, if the delivery addresses of customers were missing); greater management costs (a calculation error in technical reserves made by an insurance company or in bank assets could lead to very high reintegration costs to meet the legal minimums); ineffective decision-making processes (if a marketing company fails to monitor its clients and contacts continually, it runs the risk of losing them); fewer services (if hospital records are lost, treatment might be slowed down, with potentially fatal

consequences); lower worker satisfaction (if a call centre database is not organised, workers might contact customers several times for the same information, leading to frustration if the customers' answers are negative).

The costs implications of these and other situations can be both financial (especially for the financial sector) and social (especially for the healthcare sector or the management of services provided by local authorities). If the inherent problem is not addressed, the data that companies possess and their management creates processes that are inefficient and highly distortive. This can lead to negative costs, such as maintenance costs, overtime costs, the cost of losing customers, increased data recovery costs, penalties, and healthcare or safety costs in terms of human saved lives (Gunter and Terry,

2005). According to one study, Data Quality costs may be higher or lower and are divided into two categories: on the one hand, the cost resulting from poor data quality, and on the other, the cost of improving Data Management Processes (Madnick et al., 2009).

The cost of low quality data may be direct or indirect. In the first case, this is the cost of checking, re-entering or compensation. In the second case, there are costs relating to a decline in reputation, bad decisions or failure to make investments or even forgotten investments. On the positive side, the costs of improving processes might relate to preventive measures, reporting, or repairs.

Preventive measures include monitoring, training and the development of quality standards; reporting includes analyses and reports, and finally, repairs costs are incurred for the planning and implementation of change processes. At this point, it may be useful to calculate the benefits of a change brought about by a change in internal Data Quality rules. These calculations can be done in several ways. The best-known benchmark is certainly ROI (Return on Investment), which is the ratio between the operating result and the net investment. This ratio can be expanded and applied sol:

$$\frac{Short-term\ savings\ from\ new\ Data\ Quality\ approach + Expected\ savings}{Cost\ of\ new\ Data\ Quality\ approach}$$

As healthcare is a multidisciplinary sector, the results must also be assessed in concert with other public bodies, with contributions from them in terms of costs and the distribution of competences. It is important to understand data quality instruments and when to use them, allocate specific data management roles within local companies to work close with software developers, and also guarantee levels of privacy. Furthermore, a Data Management programme is still needed in local authorities to determine who will have access to the data and for how long. Each person will have different access levels depending on their job.

These are aspects that the City of Turin is implementing, formalised by specific rules and a dedicated committee. Big data projects and a cost saving system are currently being implemented and financial assessments of the model are an integral part of reporting in European projects that are currently in progress and in which the City of Turin is either a partner or the lead. Those projects which will no longer be funded by European programmes in the future will need greater transparency, backed by concrete accountability; hence, financial assessment will be pivotal to their implementation.

Implications of the study and knowledge

The study starts from the need to identify with a view to development and future prospects as stated before by New Public Management and then by New Public Governance. Several authors have described the characteristics that the public group must possess in order to better respond to the accountability needs of the population and of the other stakeholders, but few have been able to put all the in-depth aspects in an innovative development perspective into a system. The article is part of the international discussion on the adoption of new technologies aimed at improving the public administration planning and control systems closely related to the need for accountability. In particular, the adaptations relating to

accounting aspects of the consolidation of the public group, the active participation systems adopted by public administrations in recent years, the free access to the budget data and the decision-making process with the direct convoying of citizens, the big data, geolocation and services, the use of social media for the collection of information and the use of sensors located throughout the city require special attention in the search for the best way to respond to the need for transparency and accessibility. The case study, identified for the implementation of the systems and technologies involved, allows the identification of possible success characteristics necessary to define a new model capable of responding to the governance needs of the citizen, manager politicians and other stakeholders.

The increasingly complicated group vision needs a systematization to allow the use of correct management levers. The complete accessibility to both quantitative and economic information has never been fully guaranteed and therefore does not allow a real development of New Public Governance, leading to criticisms and limitations aimed at specific theory. The future prospect foresees the adoption of a single and broader system that takes into account all the elements analyzed by the various authors, turning for the first time the attention to the need to assess the big data quality adopted from an economic point of view. Currently the literature on the topic at the level of the local public group is limited and we do not find case studies useful to simplify and verify the theories on improving the efficiency related to the use of data. The systematization of literature and findings on the various aspects allows us to have a complete vision useful to identify the system that can be adopted in public administrations with technologies and policies of similar transparency and accessibility.

Conclusions

New Public Governance is the basis for our analysis of

the group of public-sector and public service companies. It has furthered the involvement of citizens and of political governance in the management of resources. In order to manage the group while remaining accountable and guiding production choices, it is essential to have an overview and a guarantee of transparency. The first outcome of the study is that it highlighted how the use of open data based on big data and user-friendly platforms provides an overview of the accounting results of public bodies. Consolidated financial statements and other social reporting instruments social provide indications required for accountability purposes by networks of service companies. Given the complexity of the open government system, the local group needs a shared corpus of rules and accounting standards that can facilitate the organisation of internal and external control within public administrations by stakeholders acting as guarantors of the financial equilibrium of the public sector, and compliance with the hypotheses, with managerial transparency and the reliability of the accounting data. In addition to accounting information, there are performance benchmarks which, without effective instruments, cannot be interpreted usefully. The processing of big data plays a decisive role in the creation of a panel of easy-to-interpret benchmarks that provide an immediate overview of reality (Sébastien and Bauler, 2013).. As we have seen in the case study, incoming data on the big data platform is often of low quality, which prevents a proper assessment of expenditure and gives no guidance as to which services are most needed by the final users.   Without clear feedback, public managers are unable to make good decisions about the organisation of services and the management of spending. Some researchers (Mayer-Schönberger and Cukier, 2013) conclude that the existence of a data management is often not sufficient for effective management of organisations with increasing quantities of continuously updated data. The work of public managers is guided by the role of citizens who use the services and the service designers in the management of public resources. To this end, new platforms are useful for managing discussion, spending guidelines, participatory budgeting, integrated systems, continuous data processing, and the collection of information on social networks.

However, the management system must be able to take into consideration the numerous obstacles and limitations of all instruments linked to big data today. Savings generated by new approaches linked to cost saving and Data Quality processing may be a solution that can be applied to local public bodies. As we have seen, local companies need to conduct analyses of the financial benefits of implementing new instruments based on big data. The examples presented show that at this delicate stage, public bodies must invest to reduce the costs generated by poor quality data and to improve Data Management processes. Numerous features need to

be considered, but if these aspects are only looked at once the instruments and platforms have been defined, the cost of solving system errors are unsustainable, as are those linked to managing poor quality data. A single integrated system is the only instrument that can guarantee accountability and transparency through complete system outputs for stakeholders. The proposed system must be replicated and verified in the two contexts where the NPM has developed differently, therefore in the European public groups and in the Anglo-Saxon ones. The case study presents the limitation linked to the technological and structural characteristics of the local public group, which however can be generalized in similar public groups. In this phase of study it is not yet possible to provide evidence of economic evaluation linked to data quality but the evidence given by the private sector allows simple application deductions adaptable to the public context. In the context in question, the analysis shows that access difficulties to digital instruments for older citizens is counterbalanced by the fact that 91% of young people have the skills to use and interact with the new technologies linked to big data. Digital natives will be able to access all the transparency and accountability instruments in which the local public-sector company is currently investing, albeit at a time where still only part of the population has access to them (Chuen, 2015).

Formatting of funding sources

CONFLICT OF INTERESTS

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