Public Service Intelligence: evaluating how the Public Sector can exploit Decision Support Systems

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This paper aims at exploring how ICTs can improve decision-making processes and subsequently service performances in public sector services. The authors focus on a specific class of Information Systems: Decision Support Systems (DSS) and Business Intelligence (BI). The research presented will lay the ground for investigating how the impact of these technologies on public services can be evaluated. The paper identifies the key factors influencing BI and DSS adoption and value generation in the public sector, focusing on a literature review. Furthermore, drawing on the identified key factors, the paper proposes a framework with the aim of identifying specific public service sectors where BI and DSS adoption could provide effective results.

1. Introduction

The current social context and though economy urge civil servants and policy makers both to improve services provided to the population and to reduce costs at the same time. Such trade-off (providing more with less) could be loosened by improving the decision making activities required by service design and delivery processes. Indeed, quick and fine tailored service adaptation to the population evolving needs can effectively contribute to reach the goal of providing more with less. But rapid and tailored adaptation stresses the decision making processes. Service delivery is one of the most important functions of Governments, Information and Communication Technologies (ICT) have been strongly exploited for supporting service delivery in the past years, nevertheless the ICT contribution to decision making in the public service sector is a research area not adequately explored.

The research presented in this paper draws on ICT adoption as an innovation driver in the public sector. Specifically, the authors would like to investigate ICT, decision-making activities, and their relationships by focusing on the question: which is the real added value provided by ICT to decision making activities in the public sector? Considering that some literature works present models and methodologies to calculate the value produced by ICT in the private sector (e.g. they address issues such as how to calculate the ICT impact on the organizational processes), the authors will investigate two further related research questions: can those approaches be smoothly applied to the public sector? Can the ICT impact on public organization decision making processes be evaluated in a similar way as in the private sector? These research questions stimulated the authors to define some framework guidelines trying to address the aforementioned issues.

ICT value measurement and impact evaluation are broadly discussed topics. Nevertheless, how Business Intelligence (BI) and Decision Support Systems (DSS) methodologies can create value in the public sector has been poorly investigated in the literature.

The research presented in this paper starts from a literature review to identify: 1) which factors can be drivers or barriers to adopt these technologies in the private sector; 2) if these factors are sound in the public sector; and 3) if the existing methodologies to evaluate ICT impact can be applied to BI and DSS in the public sector. Considering the latter point, the paper will analyze the existing BI and DSS value measurement methodologies, which have been developed focusing on the private sector. Their features will be assessed against the public sector distinctive aspects. Considering the first two points, the paper will identify a set of factors (classifying them as drivers or barriers for BI adoption) and will investigate how these factors can influence the BI and DSS contribution to value creation in the public sector.

The paper will show that although there is room for effective BI and DSS exploitation in the public services sector, their usage is very low therein. Furthermore the lack of reference cases is a very strong barrier to BI and DSS diffusion in the public services sector. Therefore, the authors will propose a framework to identify specific public service typologies where BI and DSS adoption could provide effective results. The framework is based on the public service distinctive features and on some variables found in literature. The framework will be evaluated against some public sector services: administrative services, (e.g. registry management), healthcare services, vocational training services, and public employment services.

The paper is structured as follows: Sec. 2 will provide an overview of the public sector focusing on decision-making processes and on public services improvement; Sec. 3 will provide an introduction to BI and DSS, an investigation on factors affecting their adoption in the public sector, and an overview on BI value measurement methods; Sec. 4 will introduce the framework to evaluate and classify public services, and finally Sec. 5 will draw the conclusions and future works.

2. The Public Sector context

The public sector is a very complex system. It can be described with the different types of public policies that organizations implement or by political and administrative dimensions (Peters, 2006), but also it can be described by the services that organizations deliver to citizens. Service research and literature provide several definitions of the public sector, in this paper the authors consider the public sector to include all organizations providing public services to the society as a whole. These types of services range from health services, and education, to social and cultural services, infrastructure, and so on. A shared classification of public sector services (NACE) includes: public administration, defense and compulsory social security, education, health and social work, other community, social and personal services.

It is worth to understand the public sector distinctive characteristics and to focus on the differences between the public and the private sectors in terms of objectives, information and knowledge exploitation, and decision-making processes.

An obvious difference between the public and private sectors is that the public sector is not profit driven and its primary goal is not to maximize profits (Røste; Miles, 2005; Euske, 2003). Nevertheless, this should not lead to believe that public sector employees and managers are not concerned about financial matters. Similarly to private companies, public organizations fight for funding and power, and mainly for costs saving, but operate in a political environment and basically work to reach political goals (Murray, 1975). Public organizations service delivery has to meet objectives regarding productivity, efficiency and quality of services.

According to (Halvorsen et al, 2005) public sector services depend on revenues that are allocated according to political decisions rather than market performances. The central government funds public sector activities to cover the costs. The national budget makes public sector activities possible, and its allocation defines the boundaries for such activities. Often public sector activities contents and scopes are far from being fully understood by citizens. Typically public administrations do not specify in details how funds are allocated and used. In particular, the way political goals are reached is influenced by decision-making processes which are mainly conditioned by available information and knowledge. Knowledge is essential to support decision-making activities and to deliver better services (McAdam; Reid, 2001). In the next sections we will provide a description of decision-making processes and issues related to public services improvement.

2.1. Decision-making process

In the literature the decision-making process and the contexts in which decisions are made are deeply studied (Fredrickson 1985; Hickson et al,1986; Dean; Sharfman, 1996; Nutt, 2011). Although several definitions are available, decision-making is generally considered as the study of identifying and choosing alternatives based on the values and preferences of the decision maker. Making a decision implies that several alternative choices have to be considered. At the same time, decision-making is a process with the aim of reducing uncertainty and doubt about alternatives to allow a reasonable choice to be made. This definition stresses the information-gathering needs of decision making. It is worth to note that uncertainty is reduced rather than eliminated. Very few decisions are made with absolute certainty because complete knowledge about all the alternatives and their effects is seldom available. Thus, every decision involves a certain amount of risk.

In literature decision-making process is often described with the three phases model defined by (Simon, 1960) and subsequently refined by (Mintzberg et al, 1976; Dewey, 1997; Hall, 2008;). The three phases are: Intelligence, Design and Choice. Intelligence deal with recognizing the need for a decision. Design focuses on identifying the alternatives, this phase begins when a decision need is identified and ends when a choice is ready to be made.

Moreover, in the context of services decision-making process activities are strongly based on knowledge sharing and involve different actors, the service users being the most important. To complete the analysis of decision-making processes it is necessary to consider the context where decisions are made, and also other variables influencing the decision processes. These variables can be different in public or private contexts.

The private sector is typically associated with market forces while the public sector is more shaped by political considerations: one is about "business" and the other is about "government"; one tends to be decentralized and the other centralized (Dillon et al, 2010). The typical public sector decision-making process begins with the definition of objectives or goals (Bozeman; Pandey, 2004). In the public sector decisions are often the result of compromise, bargaining and political debates. The process of making a decision is often more important than the decision itself. The result may not be the most cost-effective, but it is the result of a consensus developed to satisfy most of the constituents' interests. In fact, public sector decisions have many stakeholders who believe they have a right to participate in the process of making a decision. This type of decision-making must be able to cope with ubiquitous stakeholders, which gives to a broad range of people a voice in what will be done (Bozeman; Pandey, 2004).

Moreover, the public sector requirement for transparency increases the importance of clarity of objectives. Alternatives are generated and information is collected only after objectives have been defined. The nature and frequency of information collection is strongly influenced by the sector requirements and the specific decision context.

The variables and the factors mainly influencing the decision-making process can be summarized as internal and external (Dillon et al, 2010). The internal factors are: preferences and experience of the decision maker, confidence to act, understanding of the problem and definition of objectives. The external factors are: political context, number of stakeholders, availability of finance and quantity of information. Several other variables must be considered, not only related to decision-making processes. E.g., in the service context the whole service delivery process is to be taken into consideration, and the time of response is an important aspect to care about. All the decision involving the aforementioned variables are strongly influenced by information and knowledge availability. The more information and knowledge are available about the problem, the less the decision makers should rely on intuitiveness.

2.2. Public Services Improvement

Citizens demand for better services while supporting Public Administrations (PAs) with their taxes (Langergaard; Scheuer, 2009). Therefore, two requirements deserve special attention among PAs: cost reduction and service improvement, the latter involving concepts like service quality, effectiveness, and efficiency. According to several scholars effectiveness in PA refers to the ability to achieve the objectives by meeting customer needs. The efficiency is the ability to rationalize the use of resources while minimizing waste (Halvorsen et al, 2005).

Service improvement may require several actions: to modify the service processes, to improve the information quality, and possibly to carry out strategic knowledge management activities. Knowledge is a key factor in affecting service quality: knowledge is required to design, produce and deliver better services, furthermore knowledge may also represent the main output of some services.

Service quality improvement relies on evaluation, which requires useful and measurable indicators. As widely reported in the management literature, processes or services cannot be appropriately managed without measurements (Pyon, 2009).

In the private sector efficiency and effectiveness measures are ultimately related to profit maximization and to profitability for stakeholders. Therefore, in the private sector a classic performance metric is the return on investment (ROI) and the set of related indicators. However the public sector has not profit maximization as main objective, but rather it focuses on policy and service outcomes improvement. Unfortunately outcomes indicators are hard to identify since they are strictly domain dependent, and they are affected by the complex set of factors influencing the customer perception and service satisfaction, both in short and long terms (Djellal; Gallouj, 2009).

Public services performance evaluation activities have been carried out only in recent times (Afonso, 2006; Di Meglio et al, 2010). Two main approaches can be found in literature: the technical approach evaluates performances on the basis of productivity gains (Wölfl, 2005; Kox; Rubalcaba, 2007; Timmer et al, 2007); on the other hand, performances are evaluated according to management viewpoints (Osbourne; Gaebler, 1992; Boland; Fowler, 2000; Propper; Wilson, 2003; de Brujin, 2002). Service productivity measurement is a challenging issue in the service research. Measuring public service performances only on the basis of productive efficiency is undoubtedly a partial indicator of overall performance, on the other hand it is restrictive to consider only the economic indicators. Some scholars started adopting a more holistic perspective outlining innovation as a lever for improvement (Andersen; Corley, 2009). The use of performance indicators in PAs has generated innovation demands and expectations in public service delivery processes. The performance of public services has to take into account multiple objectives, such as accessibility, quality, and equality in services provision, that are even more difficult to measure. Finally, the outcome of public services depends not only on inputs and outputs, but also on a broader set of institutional, behavioral and regulatory issues (Di Meglio et al, 2010).

PAs should introduce innovation at different levels to improve services: organizational and administrative innovations, conceptual and policy innovations, innovations in service design processes, in the delivery processes, and in the systems of interaction (Halvorsen et al, 2005; Langergaard; Scheuer, 2009). Innovation in the public sector is mainly driven by the need to improve governance and service performance, including improved efficiency, in order to increase public value (Hartley, 2005). ICT is being promoted within government and PAs as a means of improving the efficiency and effectiveness of service delivery to produce value for internal and external stakeholders (Sanderson et al, 2000; Beynon-Davies, 2007).

Several methodologies and paradigms are available in the literature to evaluate the added value provided by ICT in the service sector. Few of them focus on calculating the ICT value in the public sector and fewer on BI and DSS. In the next sections the authors will show how BI and DSS can be used in the context of public services, how these systems can be exploited for improving services and what methodologies exist to measure their impact in the service context.

3. BI and DSS in the Public Sector

A commonly accepted definition of Business Intelligence can be found in (Golfarelli et al, 2004): “BI can be defined as the process of turning data into information and then into knowledge […] BI was born within the industrial world in the early 90’s, to satisfy

the managers' request for efficiently and effectively analyzing the enterprise data in order to better understand the situation of their business and improving the decision process".

According to (Lonnqvist; Pirttimäki, 2006) BI has the purpose to aid in controlling the stocks and the flows of business information around and within the organizations by identifying and processing the information into condensed and useful managerial knowledge and intelligence. BI presents business information in a timely and easily consumed way and provides the ability to reason and understand the meaning behind business information through, for example, discovery, analysis, and ad hoc querying (Azoff; Charlesworth, 2004). A BI system can be viewed as a DSS system focusing on data. The terms will be alternatively used in this paper. The paper focus on BI and DSS exploitation in the public sector for supporting several activities, including:

- Service management
- Policy formulation and enactment
- Planning and budgeting
- Disease surveillance and public health
- Identify tax fraud and money laundering
- Homeland security
- Crime prevention.

In the aforementioned activities, some of the main benefits BI provides to public organizations are improvement of their constituency's knowledge, the ability to obtain accurate measurements of action and policy effects. Such information can help policy makers not only to improve decision-making processes, but can also effectively contribute to enhance service efficiency and performance. To understand the added value and benefits BI gives to public sector it is necessary to analyze which factors and motivations affect BI adoption. Especially the factors influencing the improvement of the decision-making process and the service performances. The next subsections are dedicated to analyze these factors, comparing them in both the public and private sectors.

3.1. Factors affecting BI Adoption

A set of factors have been identified in the literature regarding the adoption of BI systems, they are drivers that motivate private organizations and managers in using this technology. These drivers include (Turban et al, 2008):

- Market related factors such as competition
- Consumer demand elements such as speed of delivery
- Technology inputs such as innovation
- Societal pressures such as government regulation

The list above shows the preliminary set of drivers that any business faces. More focused BI drivers such as Organizational Strategy, Organizational Goals, Commitment to Profitability, Shareholder Value Maximization come in to play at a later stage (Ramamurthy et al, 2007). These drivers are sound mainly in the private sector, but some of them can be applied also in the public sector. In fact, the Ramamurthy's drivers are related to the organizational structures, rather than to their specific objectives. Namely, the organizational commitment, the capacity to absorb innovation, the organization size and scope, and the quality of existing environment to collect and manage data can be cited. Considering these drivers, they can be extensively found in some Public Organizations typologies.

Different public organizations have started projects for integrating the content of several administrative archives into comprehensive repositories for statistical and analytical purposes, however in the public sector, the “BI portion” of the task often lags behind (i.e. the extraction of information and knowledge useful for decision making from the raw data). The delay of BI and DSS exploitation is only one of the differences between the public and the private sector.

BI and DSS exploitation in the public sector is far behind the private one. Several reasons can be added to explain this. (Nutt, 2006) has investigated the differences between public and private decision-making practices. Some of the differences found can also be used to explain the aforementioned lag.

- Private sector managers are more apt to support budget decisions made with analysis and less likely to rely on bargaining. Public sector managers are less likely to support budget decisions backed by analysis and more likely to support those that are derived from bargaining with agency people.
- Legislative mandates constrain budgets, in the past public sector leaders were limited or even prohibited from spending money to collect information for decision-making. Many PAs were prohibited from diverting funds from service delivery to collect data on emerging trends in service delivery. Even when information collection is now possible, professionals are reluctant to divert resources from service provision to collect such data.
- PAs have multiple goals, which can be vague, controversial, or both (Baker, 1969; Bozeman, 1984). Goal ambiguity makes performance outcomes unclear for public sector organizations.

Several scholars think that in public organizations performance and intelligence data are often missing and hard to collect, therefore strategic decisions are made with comparatively little data support, which limits knowledge about useful alternatives, e.g. (Nutt, 2006). Consequently decision-making process potentialities are restrained.

Although many of the limiting conditions just introduced still hold in the public, the pressure for obtaining knowledge about the population (and in real time), the need to offer better services with constrained resources have reduced the barriers for BI exploitation. Furthermore the cost of the technologies necessary to implement a BI/DSS projects has diminished significantly in the past years, making the development of such projects affordable by almost all levels of the PA.

BI is playing more and more a key role in successful performance management initiatives because it allows managers to easily access up-to-date information and provide

a comprehensive view of what is happening in their area of responsibility. The information that BI provides helps decision-makers and civil servants monitoring and managing service performances. Increasingly, public sector managers are using BI dashboards – visual displays that provide up-to-date indicators – and scorecards to track performance and budgets. In this way specific strategies can be defined and enacted by using a series of metrics and by setting thresholds that trigger alerts when they are exceeded.

In private organizations the introduction of BI has often acted as a catalyst to improve the data quality and to restructure the management processes, leading to big improvements in information accuracy and availability. The same goal is pursued in public sector organizations where data quality is felt as a big issue. For the past few years, BI has consistently ranked as a top priority for government CIOs (Khan et al, 2010). Moreover, BI strategies, technologies, and solution exploitations within the public sector lead to better outcomes. Through collecting and analyzing data, BI creates detailed reports that provide inestimable insights. The benefits of these analyses are manifold; they can help better managing an organization, improve performance and lower the cost of service delivery and so on. Nevertheless, the benefits of BI adoption are still hard to measure in terms of added value for improving services. In the next section a survey of literature on the field of BI measurement is provided.

3.2. Methodologies to measure the Value of BI

Once drivers and benefits of the BI adoption in the public sector have been identified, it is necessary to discuss which methods can be used to measure and evaluate the BI impact in improving public services.

In the BI literature several authors have identified BI measurement as an important task (Solomon, 1996; Viva, 2000) but scholars agree that it is a difficult task to carry out (Gartz, 2004; Hannula; Pirttimäki, 2003; Simon, 1998). According to a recent survey only few private organizations have any metrics in place for BI value measurement (Marin; Poulter, 2004).

According to some works in literature (Popovic et al, 2010; Williams; Williams, 2004; Lonnqvist; Pirttimäki, 2006) BI is an activity or a process like any other business process. Therefore, it is possible to apply business performance measurement methods to BI. BI measurement serves two main purposes: first, to prove that it is worth the investment, and second to help managing the BI process, i.e. to ensure that the BI products satisfy the users' needs and that the process is kept efficient. Before describing methods for measuring BI value, it is necessary to clarify the concept of value in this context. From the enterprise stakeholder point of view , the value of using BI is related to profit improvement; while from the BI (end) user point of view, the value is somehow related to perceived usefulness. Any BI value assessment requires to calculate the system cost and to define the expected benefits. Calculating BI costs requires calculating labor costs, software and hardware expenditure, external information purchases, and other related expenses. BI benefits measurement is not as simple as measuring the costs. Indeed, BI provides mainly non-financial, intangible benefits such as improved quality and timeliness information (Hannula; Pirttimäki, 2003). ROI calculation is the typical method to measure an investment value, however the “BI outputs” (e.g. information and knowledge) are very difficult to assess and quantify (Popovic et al, 2010). In literature (Davison, 2001) proposed the CI Meas-

urement Model (CIMM) to calculate the ROI of a BI project. This model identifies various non-financial measures of strategic outputs useful to quantify the success of a BI project, for example whether the targets set at the beginning of the project have been met, as well as the decision makers' satisfaction. The limit of this model is that it is based mainly on qualitative assessments.

Shifting from the private to the public sector, measuring the value of BI gets even more difficult for several reasons, firstly the lower importance given to profit and other financial indicators. Furthermore, the public sector is characterized by complex systems and multiple intangible variables which are difficult to measure.

Effectiveness and efficiency are considered among the main measures to assess in the public sector. The effectiveness of BI in public sector could be evaluated by exploiting the measures defined by (Herring, 1996) and (Sawka, 2000) for the private sector. These measures could help investigating the decision outcomes while taking into consideration the public sector specificities. Namely, the BI contribution could be evaluated by focusing on the specific decisions or actions (supported by the BI) and then looking at the benefit or detriment this decision brought to the related policy. This method identifies four paradigms: 1) BI can help in avoiding unnecessary costs, 2) decisions based on BI processes may lead to enhanced revenues (e.g., from taxes), 3) BI information may help in improving resource allocation, and 4) identification of the direct link between a BI decision and service performance.

The BI professional is the principal user of the information, therefore some of the most important BI measures focus on the efficiency of the personnel using BI, the resource allocation, the quality of the BI products and the user satisfaction. The CIMM model can be useful for this scope. Other methods to measure BI performance, mainly in the private sector are the Balanced Scorecard and the Performance Prism (Lonnqvist; Pirttimäki, 2006). Nevertheless they should be tailored to meet the public sector peculiarities, but this would require a huge effort and it is outside the scope of this paper.

Given the difficulty of finding "ready to use" methodologies to measure the effective results of BI impact in the public sector, the authors propose an alternative approach. This paper will provide a framework to identify which areas in the public sector could achieve more benefits with respect to the service delivery process by adopting BI and DSS. Once a set of services has been identified according to some structural dimensions, the next step will be to define metrics to measure the BI impact in those services (scope of future works). The next section is devoted to present this approach and the framework to identify public services suitable for an effective BI adoption.

4. The framework of public service Dimensions

The literature review presented on the public service distinctive features and the considerations made in the past sections on the adoption of BI and DSS in the public sector helped authors to sketch the present framework. This framework would support decision makers and civil servants to identify whether a public service can benefit by exploiting BI methodologies and DSS systems. Moreover, the framework aims at providing metrics to identify and possibly measure the value that BI and DSS could provide.

The framework proposed in this paper is based and has been influenced by some specific models and frameworks described in the information systems and services literature (Meyer; Curley, 1991; Hackathorn; Karimi, 1988; Prasad; Tata, 2006). It is worth to note the framework about knowledge and technology dimensions in the service sector defined by (Kang, 2006). Kang studied the different roles of technology and knowledge in services, and proposed a framework where services are classified in two categories:

- knowledge-embedded services, where the majority of knowledge is embedded in the service production system (i.e. the technology)
- knowledge-based services, where the majority of knowledge is held by the actors providing the service (e.g. knowledge intensive business services - KIBS).

The Kang framework is mainly aimed at classifying private sector services, but its logic can be applied to the public sector services. It is worth to take into account that several ICT-based public services are web-based services for which the boundary between the two Kang's classes is quite fuzzy. The authors propose to integrate the Kang classifications with some other dimensions in order to build a framework useful for classifying public services.

The resulting framework allows to evaluate (and to lay the ground for improvement of) ICT-based services focusing on the following aspects: cost savings, knowledge as value, improved policy and decision-making processes, data and information integration. The identified dimensions are: expenditure, knowledge intensity, decision-making intensity and automation degree. The knowledge-intensity and the automation degree dimensions are drawn upon the Kang framework logic. The knowledge-intensity evaluates the importance of knowledge within the service, while the automation degree evaluates how much ICT automates the information management processes, and conversely how much human intervention is required.

Services will be evaluated using some variables for each of the aforementioned dimensions. Knowledge-intensity is a complex dimension that can be composed by the following structural variables:

- breadth of domain (single vs multiple)
- change rate of domain(s) (low vs high)
- domain depth (common vs expert)
- comprehensiveness of systems outputs (limited vs extensive)
- breadth of information inputs (limited vs range)
- ambiguity of information inputs (low vs high)
- degree of information interdependence with outside organizations (limited to extensive)
- uncertainty of information inputs (none vs extensive).

These variables emanate from the works of (Meyer; Curley, 1991; Hackathorn; Karimi, 1988; Prasad; Tata, 2006). From the same works and (Fiedler et al, 1996;

Lee; Leifer, 1992) emanate also the automation degree dimension composed by following structural variables:

- diversity of platforms (single vs multiple)
- diversity of technology (limited vs extensive)
- database intensity (low vs high)
- database location (centralized vs distributed)
- diversity of information sources (few vs multiple)
- processor location (centralized vs distributed).

The expenditure dimension represents the total cost of software, hardware and technologies acquired by an organization to deliver a single service. While the last dimension, decision-making intensity, is the most difficult to define even if the related process is well known. Considering that in literature this type of dimension still lacks with a defined structure of variables, the authors propose the following set of variables composing the decisional intensity dimension according to the factors influencing the process (see section 2.1):

- availability of information
- complexity of the problem
- definition of objectives
- number of stakeholders
- time of response

The most of all these variables are intangible concepts difficult to quantify, but they characterize most of the public services actually delivered by the public administrations. Some public sector areas have been chosen to test the framework: administration, health, education and employment services. The framework has been tested basically on theoretic foundations and with insights achieved from authors experience. These areas provide knowledge intensive services and have different expenditure levels. Furthermore, the services supplied by these areas may have different degrees of ICT-based automation and different degrees of decision-making intensity. The public sector services considered for the present framework (and showed later in the quadrants) are:

- administrative services, e.g. registry certifications
- healthcare services
- vocational training services
- public employment services (PES).

The services are showed in the quadrants of Figure 1 and Figure 2. The Health services are characterized by high expenditure and high knowledge intensity; administrative services are less knowledge intensive but still have a high level of expendi-

ture, while the other services have low expenditure and a middle degree of knowledge intensity. Figure 1 classifies the services according to the Expenditure and Knowledge intensity dimension.

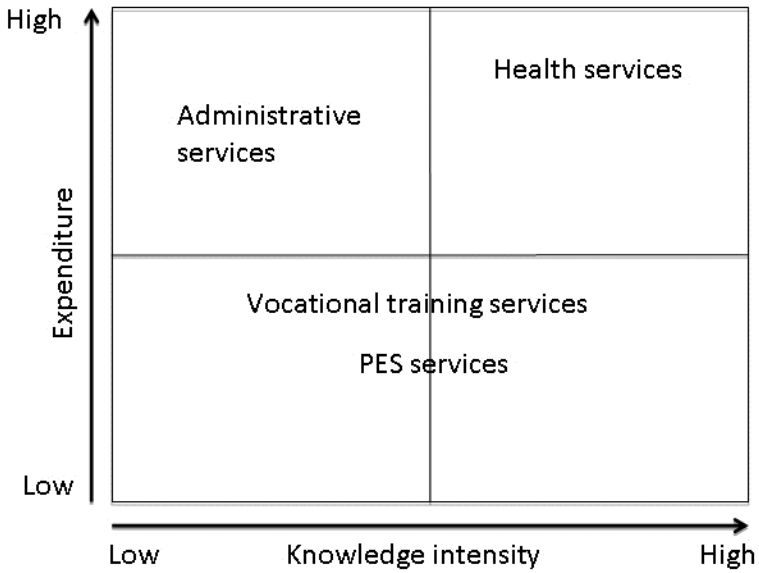

Fig. 1: Knowledge and expenditure dimensions

In the second quadrant (Figure 2) the same services are classified considering the other two dimensions, namely automation degree and decision-making intensity. According to these dimensions health services, PES and vocational training services have low level of automation, while health services have higher decision intensity than the others. Only the administrative services show a high degree of automation and low decision intensity.

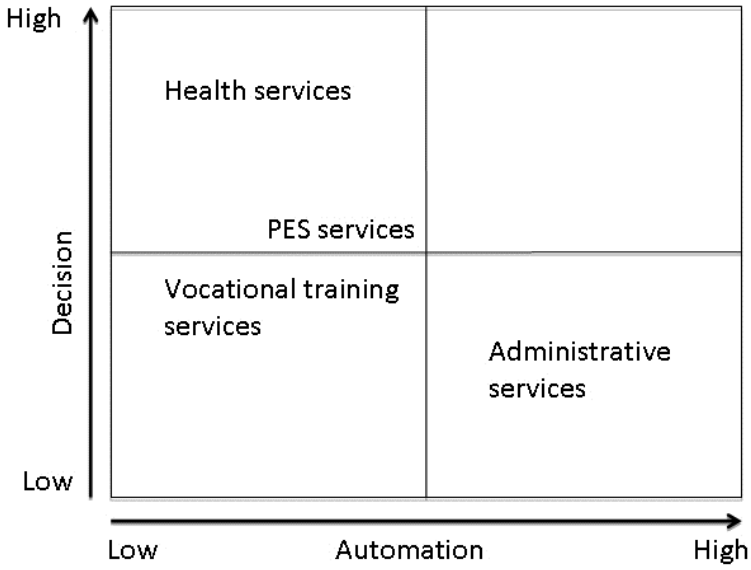

Fig. 2: Decision and automation dimensions

The development of a BI or a DSS system is a very resource consuming task, DSS and BI projects are on/off investments: they return positive results (i.e. they provide value to the decision-making activities) only if the decision maker's needs are correctly identified, useful indicators and measures are computed, data quality issues are resolved, the technological support is correctly deployed, the data provision system is user-friendly, and the decision-making processes and the overall service provisioning processes are affected. If only one of this aspects is not properly managed, the resulting decision support system will fail to provide an added value to its users. The costs and the probability of failure are lower when prior knowledge about the domain and the project are available in the users and in the ICT personnel involved in the project (e.g. because people already worked on similar contexts). However, fewer successful projects are available in the public sector compared to the private, because of the lack of DSS diffusion among the public sector discussed in the previous sections. For these reasons, it can be suggested to start DSS projects in the public domain where the probability of failure is low and where the expected benefits could be very high. The dimensions and the quadrants introduced with this framework help identifying the public sectors where DSS projects could provide tangible results lowering at the same time the probability to fail (and consequently to waste public funds). Namely public sectors (or services) having high knowledge intensity could benefit from the introduction of DSS systems, and the decision-making activities would benefit from the introduction of BI systems. The introduction of DSS systems could lead to huge savings in sectors having high expenditures, or could lead to a service level improvement without cost changes. Services or sector having a high degree of decision will have a relief from the introduction of DSS systems, while a high level of automation is an indicator of the availability of electronic data upon which the DSS can be more easily built. Indeed a lot of useful information can be identified and extracted with low effort when a lot of electronic data is available. Thus a high level of automation may contribute to lower the costs of a DSS project.

The public sector areas taken to test the framework are not the only areas where BI could provide benefits. BI technology could find a useful application in many other different areas of the public sector, including:

- Financial Systems
- Acquisition, Logistics and Supply Chain
- Health & Human Services
- Citizen Relationship Management
- Knowledge Management
- Intelligence Assessment
- Education & Campus Management.

Even in these further areas public organizations could benefit from improving decision-making processes and performances. Factors suggesting that BI adoption could provide effective results can be identified therein, namely the call for improved information management, knowledge sharing, and service production processes.

5. Conclusions

The research presented in this paper focuses on BI and DSS adoption in public sector services, and on the methodologies to evaluate the BI and DSS impact on both decision-making processes and subsequent service improvements. A literature survey on public sector services and ICT impact evaluation on the private sector helped to lay the ground for a service measurement and evaluation methodology. Nevertheless the authors concluded that some more research effort is required.

Drivers and motivations to use BI in public services have been proposed starting from an analysis of BI and DSS adoption in public sector. Some dimensions, useful to classify public services, have been identified as well. These dimensions shape an initial framework which help to evaluate whether BI and DSS introduction can provide effective results for a specific service sector.

Moreover, the framework has identified dimensions of analysis to assess the BI impact on public services. The quadrants proposed in the paper will contribute to identify areas within the public services sector where BI adoption could be effective to improve the service efficiency and effectiveness. BI and DSS are very useful in areas having high expenditures, knowledge, and decision intensity degrees (e.g. the healthcare sector). In future works the identified variables composing the four dimensions will be deeply studied, the measurement issues (with quantitative or qualitative analysis) will be investigated. Moreover the framework will be tested with empirical data.

6. References

Afonso, A.; Schuknecht, L.; Tanzi, V. (2006): Public Sector Efficiency: Evidence for New EU Member States and Emerging Markets. Working Paper Series 581.

Andersen, B.; Corley, M. (2009): Productivity and the Service Sector: Theories, Concepts and Measurements. Edward Elgar.

Azoff, M.; Charlesworth, I. (2004): The New Business Intelligence. A European Perspective. Butler Group, White Paper.

Baker, R. (1969): Organizational theory in the public sector. Journal of Management Studies, Vol. 6, No.1.

Beynon-Davies, P. (2007): Models for eGovernment. Transforming Government: people, process and policy 1 (1).

Boland, T.; Fowler, A. (2000): A systems perspective of performance management in public sector organisations. The International Journal of Public Sector Management 13 (5), pp 417-446.

Bozeman, B. (1984): Dimensions of "publicness": An approach to public organization theory. New directions in public administration 46.

Bozeman, B.; Pandey, S. K. (2004): Public Management Decision Making: Effects of Decision Content. Public Administration Review 64, pp. 553-565.

Davison, L. (2001): Measuring Competitive Intelligence Effectiveness: Insights from the Advertising Industry. Competitive Intelligence Review 12 (4).

Dean, J.; Sharfman, M. (1996): Does decision making matter? A study of strategic decision making effectiveness. Academy of Management Journal 39 (2), pp. 368-96.

De Brujin H. (2002): Performance measurement in the public sector: strategies to cope with the risks of performance measurement. The International Journal of Public Sector Management 15 (7), pp 578-594.

Dewey, J. (1997): How we think. Dover Pubns.

Dillon, S.; Buchanan, J.; Corner, J. (2010): Comparing Public and Private Sector Decision Making: Problem Structuring and Information Quality Issues. In proceedings of the 45th Annual Conference of the ORSNZ, pp. 229-237.

Di Meglio G.; Stare M.; Maroto A.; Rubalcaba L. (2010): Public services in the enlarged EU: An assessment of performance and efficiency. In Proceedings of RESER2010, Goteborg, Sweden.

Djellal, F.; Gallouj, F. (2009): Public services and the productivity challenge. ServPPIN Project, Deliverable 2.1-A2.1.

Euske, K.J. (2003): Public, private, not-for-profit: everybody is unique?. Measuring Business Excellence 7 (4), pp. 5-11.

Fredrickson, J.W. (1985): Effects of decision motive and organizational performance on strategic decision processes. Academy of Management Journal 28, pp. 821-43.

Fiedler, D.F.; Grover, V.; Teng, J.T.C. (1996): An empirical derived taxonomy of information technology structure and its relationship to organizational structure. Journal of Management Information Systems 13 (1), pp. 10-43.

Gartz, U. (2004): Enterprise Information Management. In Raisinghani, M. (Ed.) Business Intelligence in the Digital Economy: Opportunities, Limitations and Risks., Hershey, PA: Idea Group Publishing.

Golfarelli, M.; Rizzi, S.; Cella, I. (2004): Beyond data warehousing: what's next in business intelligence?. In Proceedings of the 7th ACM international workshop on Data warehousing and OLAP, ACM.

Hackathorn, R.D.; Karimi, J. (1988): A framework for comparing information engineering methods. MIS Quarterly 5 (3), pp. 205-20.

Hall, D. (2008): Decision Makers and Their Need for Support. In: Handbook on Decision Support Systems 1.

Halvorsen, T.; Hauknes, J.; Miles I.; Røste, R. (2005): On the Differences Between public and private sector innovation. Public Report 9.

Hannula, M.; Pirttimäki, V. (2003): Business Intelligence - Empirical Study on the Top 50 Finnish Companies. Journal of American Academy of Business 2 (2), pp 593-599.

Hartley, J. (2005): Innovation in Governance and Public Services: Past and Present. Public Money and Management, pp. 27-34.

Herring, J. (1996): Measuring the Value of Competitive Intelligence: Accessing and Communicating CI's Value to Your Organization. SCIP Monograph Series, Alexandria, VA.

Hickson, D.J.; Butler, R.; Gray, D.; Mallory, G.; Wilson, D. (1986): Top Decisions: Strategic Decision Making in Organizations. San Francisco, CA: Jossey-Bass.

Khan, A.M.A.; Amin, N.; Lambrou, N. (2010): Drivers and Barriers to Business Intelligence Adoption: A Case of Pakistan. In Proceedings of the European and Mediterranean Conference on Information Systems (EMCIS2010), Abu Dhabi, UAE.

Kang, H. (2006): Technology management in services: knowledge-based vs. knowledge-embedded services. Strategic Change 15 (2), pp 67-74.

Kox, H.; Rubalcaba, L. (2007): The Contribution of Business Services to European Economic Growth. In Rubalcaba; Kox (ed.) Business Services in European Economic Growth, Palgrave/Macmillan, pp. 74-94.

Langergaard, L.L.; Scheuer, J.D. (2009): Specificities of public sector service innovation. ServPPIN Deliverable 2.1.

Lee, S.; Leifer, R.P. (1992): A framework for linking the structure of information systems with organizational requirements for information sharing. Journal of Management Information Systems 8 (4), pp. 27-44.

Lonnqvist, A.; Pirttimäki, V. (2006): The measurement of business intelligence. Information Systems Management 23 (1).

Marin, J.; Poulter, A. (2004): Dissemination of Competitive Intelligence. Journal of Information Science 30 (2), pp 165-180.

McAdam, R.; Reid, R. (2001): A comparison of public and private sector perceptions and use of knowledge management. Journal of European Industrial Training 24 (6), p. 317.

Meyer, M.C.; Curley, K.F. (1991): An applied framework for classifying the complexity of knowledge-based systems. MIS Quarterly 15 (4), pp. 455-72.

Mintzberg, H.; Raisinghani D.; Theoret A. (1976): The structure of "unstructured" decision processes. Administrative science quarterly, pp. 246–275.

Murray, M.A. (1975): Comparing Public and Private Management: An Exploratory Essay. Public Administration Review 35 (4), pp. 364-371.

NACE, Statistical Classification of Economic Activities in the European Community, [online] http://ec.europa.eu/competition/mergers/cases/index/nace_all.html.

Nutt, P. (2006): Comparing public and private sector decision-making practices. Journal of Public Administration Research and Theory 16 (2).

Nutt, P. (2011): Making decision-making research matter: some issues and remedies. Management Research Review 34 (1), pp. 5-16.

Osbourne, D.; Gaebler, T. (1992): Reinventing Government. Addison-Wesley.

Peters, B. G. (2006): Understanding the Public Sector: The Significance of Size and Complexity?. The Asia Pacific Journal of Public Administration 28 (2), pp. 99-116.

Popovic, A.; Turk, T.; Jaklic, J. (2010): Conceptual Model of Business Value of Business Intelligence Systems. Journal of Contemporary Management Issues 15 (1).

Prasad, S.; Tata, J. (2006): A framework for information services: benchmarking for countries and companies. Benchmarking: An International Journal 13 (3), pp. 311-323.

Propper, C.; Wilson, D. (2003): The use and usefulness of performance measures in the public sector. CMPO Working Paper Series 3 (73).

Pyon, C.U.; Lee, M.J.; Park, S.C. (2009): Decision support system for service quality management using customer knowledge in public service organization. Expert Systems with Applications 36, pp. 8227-8238.

Ramamurthy, K.R. (2007): An empirical investigation of the key determinants of data warehouse adoption. Decision Support Systems 44 (4), pp 817-841.

Røste, R.; Miles, I. (2005): Difference between public and private sector innovation. Publin Report.

Sanderson, I.; Bovaird, T.; Davies, P.; Martin, S.; Foreman, A. (2000): Made to Measure: Evaluation in Practice in Local Government. Local Government Management Board, London.

Sawka, K. (2000): Are We Valuable?. Competitive Intelligence Magazine 3 (2).

Simon, H. (1960): The new science of management decision. Harper, NJ, USA.

Simon, N.J. (1998): Determining Measures of Success. Competitive Intelligence Magazine 1 (2), pp 45-48.

Solomon, M. (1996): The Intelligence Asset-Building Process. Competitive Intelligence Review 7 (4), pp 69-76.

Timmer, P.M.; O'Mahony M.; van Ark, B. (2007): EUKLEMS Growth and Productivity Accounts: Overview. [online] www.euklems.net.

Turban, E.; Sharda, R.; Aronson, J.; King, D. (2008): Business Intelligence: A Managerial Approach. Pearson Prentice Hall.

Viva Business Intelligence Inc. (2000): Measuring the Benefits of Business Intelligence. Pro-How Paper 2.

Williams, S.; Williams, N. (2004): Capturing ROI through Business-Centric BI Development Methods. DM Review.

Wölfl, A. (2005): The service economy in OECD countries. STI Working Paper 3.

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