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"AN OVERVIEW OF EXISTING LITERATURE ON PUBLIC E-SERVICES"

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An overview of existing literature on public e-services

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Abstract Public e-services are a broad and growing research field in which scholars and practitioners from different domains are involved. However, the increasing attention devoted to public e-services only partially captures the extreme variety of aspects and implications of the diffusion of information and communication technologies at all levels of public administrations. The paper aims to develop a meta-analysis of the literature on the delivery, diffusion, adoption and impact of public e-services and examines differences in methodologies, approaches and key indicators across five service categories: eGovernment, eEducation, eHealth, Infomobility and eProcurement. We examined 751 articles appeared in 2000-2010 in the top international academic journals listed in the SSCI-ISI, as classified in the following fields: Communication, Economics, Education, Environmental Studies, Geography, Health Policy & Services, Information Science & Library Science, Law, Management, Planning & Development, Public Administration, Transportation and Urban Studies. We highlight a significant heterogeneity in scientific production across service domains, indicators used, and affiliation of authors. We also show an increasing diffusion of quantitative methods applied to different research fields which still appears to be constrained by data limitations. The overall picture emerging from the analysis is one characterized by largely unexplored service domains as well as scarcely analyzed issues both across and within individual service categories. Thus many research opportunities seem to emerge and need to be exploited from different disciplinary perspectives in this field of analysis.

JEL Classification: H830, 0330, O380

Keywords: bibliometrics; meta-analysis; innovation in services; public e-services

1. Introduction

The widespread diffusion of Information and Communication Technologies (ICT) has changed the perception of the role of services in economic activities and society as a whole. Indeed these technologies allow the availability, provision and accessibility of high-quality value added services in real-time, virtually anyplace and allow an unprecedented involvement of a variety of user categories at all levels, including individual citizens, firms and other institutions. An extensive literature has focused on the diffusion of e-services, as part of a process of structural change and innovation in services which is proceeding hand in hand with the increasing role of knowledge as a fundamental driver of growth (Camacho et al., 2007; Kox et al., 2007; Gallouj et al., 2010)[1]. Within this general context, the diffusion of ICT in the public sector and the

[1] Though there is no universally accepted definition of e-services (Rajshekhar et al., 2004), the following conceptualization proposed by Ruyter et al. (2001) is worth of mentioning: *"E-service is an interactive, content-centered and Internet-based customer service, driven by the customer and integrated with related organizational customer support processes and technologies with the goal of strengthening the customer-service provider relationship"*.

development of web-based public services has become a recognized research domain and has been gaining importance in the analysis of institutional change and public policy.

In this paper we analyze the pace and direction of research on public e-services over the past decade, and to identify key issues emerging from different streams of literature in this field. More precisely, we will:

- assess the intensity and growth over time of academic research in the field of public e-services;
- investigate the relative importance of research efforts in five service categories (eGovernment, eEducation, eHealth, Infomobility and eProcurement);
- evaluate differences in methodologies and key indicators used across these categories;
- analyze the geographical focus of research on public e-services;
- examine patterns of authorship by academic background and area of origin.

To pursue this set of objectives, we examined some 751 articles on the diffusion, adoption and socio-economic impact of public e-services appeared in academic journals listed in the Social Science Citation Index (SSCI) of the Institute for Scientific Information (ISI) over the 2000-2010 period, as classified in the following fields: Communication, Economics, Education, Environmental Studies, Geography, Health Policy & Services, Information Science & Library Science, Law, Management, Planning & Development, Public Administration, Transportation and Urban Studies.

Articles are classified according to the institutional affiliations of authors and co-authors, to the range of public e-services covered, and to the methodologies used. This overview should help identify research challenges and opportunities in the field, following the belief that analyzing the past should allow us to prepare for the future (Webster and Watson, 2002).

The remainder of this paper is organized as follows. In the next section we briefly review relevant bibliometric studies which may help develop an appropriate framework for subsequent analysis of public e-service literature. In section 3, 4 and 5 the research methodology used is outlined, and then the results obtained in the empirical research are analyzed. Finally, the main conclusions of this study are summarized and some questions on future trends in this area are highlighted for discussion.

2. Literature review

A relatively long tradition in bibliometrics, starting from the seminal contribution by Alan Pritchard in 1969, has focused on such key methodological issues as the identification of the historical roots of a particular field of study, the prediction of future research trends and the analysis of critical knowledge gaps (Broadus, 1987; Nour, 1985; Shapiro, 1992; Sellen, 1993). The idea underlying these studies is that examining patterns of academic research in a systematic way should help discern the direction taken in a discipline, highlight possible inadequacies of analytical approaches, provide a crucial starting point for novel scholarly work and greatly facilitate the enhancement of knowledge.

Until recently, few works have reviewed extant literature on public e-services and more generally on Information Systems (Webster and Watson, 2002). One reason for this has to do with the youth of these research areas. Moreover the lack of review works reflects the complexity and inter-disciplinary nature of this research area spanning from Computer Science to Information & Library Science to Education, Environmental/Transportation studies, Health Science, Management/Economics, and Public Administration sciences, to cite just the most relevant fields. In this direction Malone and Crowston (1994) provide an excellent, albeit rare, example of a review work covering different areas like computer science, economics, operations research,

organization theory, and biology. Löfstedt (2005) develops a map of some of the current researches in the field of eGovernment and analyses how different aspects, methods and scientific approaches in the field are connected to each other, and this mirrors into extensive networks involving researchers from different research areas. Thus, scholars focusing on eGovernment might have to rely on a variety of disciplinary backgrounds (e.g. organization theory, social science, informatics, computer science, public administration, business administration, economics, political science, law, government professionals, library science), and their approaches may well differ depending on the starting point and on the problem domain chosen. This implies that constructing a review on Information Systems fields, and on Public e-services in particular, is a challenging process because we often need to draw on theories, methods and data from a variety of fields.

Scholars in the field of Public Administration studies have addressed several issues that are relevant to the analysis of public e-services. Much like other fields, review works on Public Administrations have generally identified the quality of research with the impact factor of journals in which scientific publications appear (Lan and Anders, 2000; Plümper and Radaelli, 2004). Stalling and Ferris (1988) stated that highly rated journals were the most qualified locus of dissemination of academic research. Furthermore, they highlighted the excessive use of qualitative methods such as case studies and non-empirical research which might undermine the precision and objectivity of analyses. They concluded that research methodologies used in public administration studies needed to be made more accurate to attain a better acceptability in academic terms: research should be based on sound empirical bases and not only on impressionistic evidence (Houston and Delevan, 1990). Although both quantitative and qualitative approaches contribute to knowledge accumulation, there is a clear need for more studies applying quantitative research methods rather than qualitative ones (Bailey, 1992).

More specific literature on public e-services has largely focused on the domain of eGovernment wherein scholars have generated an increasing volume of research over the past two decades (Grönlund, 2004). E-government has long been a field of investigation for practitioners, whose main interest was to explore new challenges and opportunities offered by new information systems and creative services. Initially based on empirical insights from practice, in the early 1990's eGovernment conferences used to be practitioner-oriented with some academic invited keynote speakers. Rapidly, more academia-oriented conferences emerged, and the body of eGovernment related knowledge grew rapidly. Reviews on this e-service domain have highlighted several methodological and analytical issues that are worth mentioning. Yildiz (2007) discusses the limitations of prior research in this area, partly stemming from the fact that the concept itself of e-Government was vaguely defined, and points out the need for more accurate empirical studies which would lead to a re-consideration of dominant theories and to a re-design of concepts and analytical categories. Heeks and Bailur (2007) examine the proceedings of a number of scientific conferences in Europe as well as articles published in two ISI indexed journals and focus on the theoretical foundations underlying these works. Grönlund (2010) points out that both policy makers and researchers need new interpretive models to meet the current and future challenges in the field of eGovernment. In their view, scholars should better understand the relations between technical change, organizational imperatives and priorities expressed by governments, which in turn reflect pressures from civil society and political lobbies. Overall, eGovernment has received increasing attention from different points of view: authors considered the maturity of research in this field in terms of the accurateness and relevance of models used (Grönlund and Andersons, 2006), studied the variety of methodological approaches (Andersen and Henriksen, 2005), characterized research communities by identifying the most prolific scholars, their disciplinary backgrounds, their preferred methods and their patterns of publication (Dwivedi, 2009; Scholl, 2009).

Apart from the relatively numerous surveys on eGovernment, to the best of our knowledge there are very few works extensively reviewing the literature on other public e-services and virtually no studies analyzing works across different e-service categories. Our purpose is to fill in this gap and provide a comparative analyisis of extant literature on the development of the

following public e-service categories: eGovernment, eEducation, eHealth, Infomobility and eProcurement.

This work should thus yield a valuable overview of the current state of the art in this complex and multi-disciplinary research domain, and highlight methodological and analytical gaps to be filled in.

3. The selection of journals

While some bibliometric studies focus on different research outputs, including doctoral dissertations, books or other sources of knowledge dissemination (Rice et al., 2002), we restrict the analysis to publications in academic journals (including e-journals), following a practice that is becoming more and more common in the literature (Braadbaart and Yusnandarshah, 2008). There are several reasons underlying this preference:

- High quality research normally ends up being published in journals earlier and more frequently than elsewhere (Webster and Watson, 2002)[2];
- Journal publications play a key role in dissemination of academic research (Stalling and Ferris, 1988; Houston and Delevan, 1990);
- Journals (including on line publications) are increasingly replacing books especially in the broad field of analysis of ICT based innovation (Ullah et al., 2008; Kriebel and Lapham, 2008; Nord and Nord, 1995).

Moreover, following Lan and Anders (2000), our survey will exclude the analysis of some specific categories of journal publications which do not directly refer to authors' research work, such as: letters to the editor, brief communications and commentaries, editorial notes, symposiums presentations and book reviews.

As a starting point we used the Web of Science (the electronic version of the Social Sciences Citation Index) to identify articles in the leading journals that should be included in our review.

Because public e-services is an interdisciplinary field straddling multiple disciplines, our search was not circumscribed to journals classified by SSCI within the Information Systems discipline, but also extended the analysis to a number of other broad research fields. Table 1 lists all 56 research fields recorded in the Social Science Citation Index. In the same table we highlighted in bold characters the 14 fields which we deemed to be most relevant for a comprehensive review of extant publications on the development of public e-services.

[TABLE 1 HERE]

For each of the 14 research fields identified in Table 1 we identified the top 30 SSCI – ISI indexed journals[3] as ranked by impact factor (Gordon, 1982), thus yielding a total of 408 periodic publications used as a basis for our research. Over the 2000-2010 period these journals published a total of 175,519 articles, which we scanned electronically by means of keywords, as illustrated in section 4 below[4].

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[2] Legge and Devore (1987) argue that being published in a journal is *per se* a valid indicator of the quality of academic productivity.

[3] Only Transportation field has a total of less than 30 journals.

[4] We checked some research fields related to the 14 examined and we observed that there are several overlappings: 10 journals out of 30 classified in the field of Management also appear in the field of Business; 2 journals out of 30 total classified in the field of Public Administration also appear in the field of Political Science, while 2 are also registered as Social Sciences – Interdisciplinary; 4 journals out of 30 classified in the field of Public Environmental and Occupational Health also appear in the field of Health Policy and Services. Thereafter, we conducted some checks on the two journals with the highest impact factor in the

4. Search model and keyword selection

According to Webster and Watson (2002) "*a systematic search should ensure that you accumulate a relatively complete census of relevant literature"*. To this end we conducted an iterative search process based on standard on-line library facilities[5]. In particular, 11 leading journal databases accessible on-line were used to electronically scan journal articles published by the 408 periodic publications identified.

To identify relevant public e-services articles, a keyword search throughout full texts of the whole population of articles was conducted. Keywords included are the following: "e-government", "electronic government", "e-health", "electronic health", "health information systems", "e-education", "e-learning", "ICT in Schools", "intelligent transportation systems", "infomobility", "e-procurement", "electronic procurement". This data collection model yielded a total of 2,460 articles where at least one of these keywords was mentioned in the title.

The 2,460 articles selected through the procedure described above were further scanned to identify those publications that addressed issues relating to the diffusion, adoption and impact of public e-services, and separated them from those focused on implementation, technological development, modeling, and re-engineering aspects of public e-services. To do this, following a standard methodology (Plümper and Radaelli, 2004; Hartley and Kostoff, 2003), the title, abstract and keywords of the articles were examined.

Articles relating to the first set of research issues (diffusion, adoption and impact) were identified by checking whether in each of the publications selected up to this stage there existed one or more specific keywords, including inter alia the following: adoption and diffusion, benchmarking, social inclusion, readiness, front office, back office, on line availability/delivery, user participation, procurement strategies, logistics, intelligent transportation systems, intelligent/sustainable transportation, open learning environments/processes, internet-based learning, health services, local public health.

Following the same procedure, we identified articles relating to the second set of research issues (implementation, development and re-engineering) by checking whether in each of the articles selected up to this stage there existed one or more specific keywords, including inter alia the following: application repository, automation, B2B, business process modeling, G2G, ICT/IT architecture, information systems, infrastructure, interoperability, language technology/processing, ontologies, semantic web standards/technologies, service development, service oriented architecture, systems engineering, testing methodologies[6].

Taking into account our research objectives, we decided to focus our attention on the articles we identified as related to the first set of research issues (751 out of 2,460 = 29.53%), and did not consider at all the other articles that were mainly related to the second set of research issues (1,709 out of 2,460 = 70.47%). In fact, as suggested by Löfstedt (2005) in a similar context, the latter set of articles can be expected to be concerned exclusively or primarily with technical aspects, which are by and large beyond the scope of this review work.

Table 2 classifies the 751 articles on public-services published in the last ten years, as obtained from this scanning procedure, according to the main research fields they focus on. The most commonly covered fields are: Public Administration (41.9%) and Information and Library Systems (28.9%); while the least covered are: Transportation/Environmental and Urban Studies (5.1%), Education and Educational Research (4.8%), Management (2.8%)[7]. Works on

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research fields related (Business, Political Science, Public Environmental and Occupational Health, Social Sciences – Interdisciplinary) and we found no article meeting the scanning criteria described in section 4.

[5] The on - line library services at the University of Urbino, Italy, were used as the main search platform.

[6] The full list of key-words, in both research issues, is available on request.

[7] We combined three fields that had affinities (Environmental Studies, Transportation and Urban Studies) and we did not consider the research fields wherein no article on public e-services could be found according to our scanning criteria described in section 4 (Communication, Economics, Education – Special, Geography, Law, Planning & Development). Thus, the final list of research fields reduces from 14 to 6.

eGovernment and Infomobility have appeared in journals covering the widest range of research domains (four research fields out of six are involved). Hence they seem to have attracted scholars originating from the largest variety of disciplines.

[TABLE 2 HERE]

Appendix **Tables A.1** and **Table A.2** report the distribution of articles on public e-services found in each SSCI - ISI research field. We found that the top journals in different research fields (Communication, Economics, Education – Special, Geography, Law, Planning & Development) did not publish any article on public e-services according to our search criteria.

5. Empirical analysis

5.1 Research methodology

One of the main challenges when reviewing extant literature is the classification of articles according to some common criteria. This task can be particularly troublesome if articles span across different research fields which do not share any specific paradigms, models nor theories. The approach to the literature will necessarily be eclectic in nature, while the selection of concepts and indicators guiding the review might easily be considered to be arbitrary.

Conscious of these limitations, we organized data on 751 articles into a new database following the classification scheme illustrated in table 3. We organised the reviewed articles according to their focus on some quali-quantitative indicators which were examined in previous studies (Grönlund and Andersson, 2006; Snijkers et al., 2007; Dwivedi, 2009). Articles were thus classified in terms of their use of the following key indicators: *input indicators*, measuring the resources that countries invest in the development of public e-services; *output indicators*, measuring the delivery of public e-services, their integration and advancement; *usage indicators*, measuring the actual adoption of public e-services; *impact indicators* concerning changes in the efficiency of services (e.g. reductions in processing time or waiting time) or effects on society as a whole; *environmental indicators*, measuring the context specific conditions at the national, regional or local levels favouring or hampering the development, diffusion and adoption of public e-services.

[TABLE 3 HERE]

5.2 Analysis of results

We found a strong heterogeneity in the availability of published articles on public e-services across different research domains (Table 4): eGovernment gathers more than half of all publications (56.06%) followed by a lower percentage from the eHealth domain (22.77%). Remaining domains (eEducation, Infomobility and eProcurement) gather less than 10% of total articles.

Given that our sample focuses on articles appeared in top journals, the average impact factor is obviously high (1.84). However, there are significant differences across service platforms, with journal impact factor spanning on average from 1.5 in the case of eEducation to more than 2 in the case of eHealth and eProcurement.

Table 4 also shows that articles published on e-services (in all domains/platforms) frequently involve more than one author. The domain of e-Education exhibits the highest number of co-

authors per article (4.3), while the lowest rate of collaboration (1.84 authors per article) can be observed in the case of e-Procurement. Publications on e-Government and e-Health, which are the most numerous in our sample, have a similar co-authorship pattern (3.1 and 3.4 co-authors per article respectively). This evidence is by and large consistent with previous bibliometric studies which revealed that single-author papers account for only 12% of publications on e-Health, while papers with more than two authors were found to account for 39% of total articles (Ullah et al. 2008).

[TABLE 4 HERE]

Figure 1 shows that the number of published articles steadily increased over the last ten years revealing a growing attention to public e-services field among researchers, with works on eGovernment platform/domain exhibiting the highest growth rates.

[FIGURE 1 HERE]

In Table 5 we see that the largest share of research studies on public e-services published in high impact journals is authored by scholars affiliated to European research institutions (43.54%), particularly those based in following countries: Belgium, Denmark, Finland, Germany, Greece, Italy, Spain, Sweden, The Netherlands and UK. Next, for numerical importance (32.76%) are researchers affiliated to institutions of North America. Researchers from Asia and Australia also account for a significant share of total publications (4.79% and 5.86%), with the highest number of authors originating from institutions based in Thailand (Bangkok), Japan, Malaysia, New Zealand, Australia and Singapore. Scholars from institutions in Africa account for a very low share of total publications in this field (1.86%). It is not unusual to see collaborations among researchers from universities located in different geographical areas. European researchers are the most involved in works on public e-services in collaboration with researchers from other continents (e.g. Europe + North America: 4.13% ; Europe + Asia: 1.07%; etc). Moreover, Table 5 shows that European and North American researchers span across all categories of public e-services. By contrast, the few contributions of institutions based in Africa are concentrated in the domains of eEducation and eHealth. Finally, eGovernment is the most attractive domain for researchers from all geographical areas, followed by Infomobility. Articles involving researchers from different continents are slowly growing in number, and account for slightly more than 50 papers out of the 751 considered in the examined decade. For more details see Figure A.1 and Figure A.2 in Appendix.

[TABLE 5 HERE]

As illustrated in table 6, research on public e-services involves a heterogeneous academic community, with the greatest share of scholars belonging to departments of Law/Public Administration (34.35%) followed by Computer Science/Information Systems (25.70%), and by Health/life Sciences (16.51%). Table 6 also shows that researchers with different backgrounds specialise in different public e-service platforms. For example, scholars affiliated to departments of Computer Science/Information System focus on eGovernment, while those belonging to departments of Communication/Education sciences pay greater attention to eEducation, those from institutions active in life Sciences specialise in research on eHealth, and those from departments of Environment/Geographycal Studies focus on Infomobility (Intelligent Transport Systems). Scholars from departments of Law/Public Administration and of Economics/Management are active in research on both eGovernment and eProcurement.

Public e-services issues are also examined from multi-disciplinary perspectives. Altogether articles authored by scholars with different academic backgrounds add up to less than 15% of the overall number of published works we surveyed. This relatively low percentage might reflect

actual difficulties encountered by scholars in combining distant scientific approaches and methods (Bruce et al., 2004). However, one should mention, that scholars from departments of computer science/information systems are considerably involved in interdisciplinary works, especially in collaboration with researchers in such disciplines as Health/life sciences and Law/Public Administration sciences.

The share of interdisciplinary works has grown significantly, although they still amount to slightly more than 100 articles out of the 751 considered across all e-service categories in the examined decade. For more details see Figure A.3 and Figure A.4 in Appendix.

[TABLE 6 HERE]

As shown in Table 7, the majority of reviewed articles have a geographical focus on Europe (51.26%), followed by North America (29.03%) and Asia (7.06%), while studies covering all geographical areas (world) are just a few (0.80%). The latter result is affected by the difficulty of finding comparable data across different countries and geographical areas. A similar pattern is also found for Europe: the number of articles falls with the number of countries covered.

[TABLE 7 HERE]

As mentioned in section 2, many authors have highlighted a relative scarcity of works applying quantitative research methods to the analysis of public e-services (Houston and Delevan, 1990; Bailey, 1992).

Figure 2 illustrates a significant increase in the number of articles using quantitative methods as the main analytical tools, which have become the largest share of published works appearing in top journals after year 2004. This trend seems to be consolidating over time, with the number of studies using mostly qualitative methods being stable since 2005 (less than 20 articles per year throughout all the different research fields we monitored), thus representing a lower and lower share of total publications. We also tried to separate studies which do not rely on sound evidence, no matter whether analyzed with quantitative or qualitative methods, which we dubbed as "illustrative/impressionistic", and found that their presence in top journals has been clearly diminishing in the second half of the decade, possibly reflecting that applied research on public e-services is gradually reaching a greater maturity.

[FIGURE 2 HERE]

Researches using quantitative methods produce the largest number of published works spanning all categories of public e-services, except for Infomobility where illustrative/impressionistic approaches prevail and quantitative approaches are not used (Figure 3). By contrast, quantitative methods are much more used in studies on eGovernment as compared to other platforms.

[FIGURE 3 HERE]

Table 8 illustrates the variety of statistical methods used in quantitative studies. Apart from descriptive statistics, the most commonly used are multivariate techniques, in particular correlations and factorial analyses.

A lower albeit growing number of studies carry out conditional distribution analyses spanning from partial least-squares regressions to panel-data techniques, multiple regression analysis, linear regressions and binary logistic regressions. In terms of individual platforms, the latter set of methods seem to be more diffused in studies on eHealth, eGovernment and eProcurement. Univariate and multivariate statistics dominate in published works on eGovernment followed by eHealth and eEducation. As far as the methodologies used for data collection are concerned, web-

search and telephone interviews overbear in the case of eGovernment, while studies on Infomobility, eProcurement, eEducation, and eHealth are most often based on information collected through questionnaires, face to face and telephone interviews.

[TABLE 8 HERE]

Five main classes of indicators can be singled out in the e-service literature: input indicators, output indicators, usage indicators, impact indicators and contextual indicators, Let us discuss them in some details.

Input indicators measure the resources that countries have invested in the development of public e-services (e.g. public IT spending per capita or as a percentage of GDP). Our research shows two results (Table 9): first, this type of indicators is not present in any category of public e-services if taken individually but only when considered jointly with the output indicators; second, service domains that take over both indicators are those of eGovernment and eHealth, but with different absolute intensities (much higher for eGovernment).

Output indicators measure the on line availability and degree of interactivity[8] of public e-services delivered. Delivery is one of the most salient issues considered in studies on public e-services (21.04% of all recorded articles deal with this aspect), while only a few works analyze processes of service upgrading and the integration between back-office and front office dimensions.

Most published works on eGovernment devote attention to front office services and particularly to the type of on line services currently being offered, the level of accessibility, usability and security of e-services. These studies suggest that a considerable heterogeneity exists across countries, regions and cities in the delivery of on-line public services. A few articles focus on back-office services, while slightly more than 10% of total publications in this field take into account both front office and back office solutions (technology and organizational aspects).

In the Infomobility platform articles, mainly based on descriptive statistics and case studies, focus on the delivery of intelligent transport services facilitating efficient and sustainable mobility such as the introduction of electronic travel guide devices[9], on-line scheduling, ticketing, reservation services and travel information systems[10]. As far as back office services are concerned, three issues dominate: the existence of datasets on public transportation (e.g. integrating information on schedules, tariffs and ticketing), the degree of integration of infomobility services, the standardisation and interoperability of data-sources and integrated Bus operating systems[11].

Table 9 shows that a few studies have looked at the delivery and availability of eProcurement services. Researchers concentrated their attention mainly on one or more stages of the procurement process such as: Web-based information dissemination, eTendering, eMarketplace, eBidding and eReverse/Auctions[12]. On the back office side we have identified several key themes such as: systems integration (sending and receiving real time information to other information systems), security and authentication (infrastructure authentication like digital signatures and authorization) and process re-engineering (transparency improvement, automated invoice payment). The

[8] According to standard classifications, the degree of interactivity can be measured in terms of: simple information dissemination, one-way communication, two-way interaction, service provision and financial transactions

[9] The electronic travel guide is a web based device that provides commuters with information on bus routes, schedules and fares. The information will enable commuters to plan their travel based on several criteria including prices, number of transfers and the shortest traveling time.

[10] Display panels are installed at station platforms, concourses, entrances and interchanges to display traffic information.

[11] The system makes use of the Global Positioning System (GPS) to track buses, which allow the provision of accurate information on bus arrival and departure time at every bus stop.

[12] In an ordinary auction (also known as a forward auction), buyers compete to obtain a good or service, and the price typically increases over time. In a reverse auction, sellers compete to obtain business, and prices typically decrease over time.

diffusion of these elements is examined based on descriptive statistics or regression analysis. Many studies highlight that relatively "simple" services/applications – i.e. whose development does not imply the introduction of complex technologies, procedures or institutional/legal changes - are more rapidly diffused. Public Administrations that are more likely to develop eProcurement tools tend to be larger, managerially innovative, and to have a strong centralized procurement office. Overall, most studies highlight that eProcurement is a promising service platform, but managerial and technical challenges still remain and need to be dealt with to favour its diffusion.

Usage indicators measure the actual adoption of public e-services (ICT and public e-services penetration rates, Satisfaction levels of users, Non user and users' profiles). Some studies, criticize works uniquely based on input and/or output indicators as these do not capture whether services developed by PAs eventually reach individual citizens, families, firms and other institutions, and whether they are actually used by them. Besides overcoming this drawback, usage indicators provide a good monitoring tool for public sector to design e-service diffusion strategies. Our results show that usage indicators are present in studies on eGovernment, eEducation, eProcurement and eHealth (Table 9). In the case of the first domain usage indicators are mainly focused on: the accessibility of eGovernment sites; the characteristics of citizens using ICTs to communicate with public administrations; demand side determinants of eGovernment diffusion; the utilisation and effectiveness of information posted on public web sites; barriers to e-service development and potential effects of the digital divide on eGovernment adoption; demographic characteristics of population as a factor affecting the use of e-services and factors affecting their adoption.

Most of these studies are roughly consistent with existing theories of technology adoption. In particular, the Technology Acceptance Model (TAM) by Davis et al. (1989), which was primarily developed to explain the behaviour of new end users of information systems, is most influential in works focusing on the adoption of web based applications (Gefen et al. 2000) and also in case of e-services. Venkatesh et al. (2003) developed the Unified Theory of Acceptance and Use of Technology (UTAUT) model to consolidate previous TAM related studies. In the UTAUT model, measures of expected efforts and performance of adopters were introduced to incorporate the constructs of perceived usefulness and ease of use in the original TAM study. Besides TAM and UTAUT, Stakeholder (Freeman, 1984; Donaldson et al., 1995) and Actor-network theories (Callon et al., 1986; Callon, 1999) are also frequently cited.

While these models have a high consideration in top journals of management and related disciplines, other influential models dealing with the economic role of users of technology (Rosenberg, 1982; Von Hippel, 1988; Lundvall, 1988; Baptista, 1999; Stoneman et al., 2010) are marginally present in the examined literature. In fact, no top journal of applied economics is included in our list, given that studies on public e-services were virtually absent in this field.

In the other domains (eEducation and eHealth) articles use less sophisticated analytical approaches, but in some cases they do refer to existing theories. In the case of eHealth category, articles focus on factors affecting the adoption of specific services. It is observed that their adoption is not as rapid as expected, since positive returns depend on different factors ranging from implementation challenges to the evolution of legislative and procurement processes, and to the perceptions of the expected positive results among all involved stakeholders. More specifically, some articles focus on the adoption of Electronic Health Records. The variety of elements affecting the adoption of Electronic Health Records or ePrescription systems makes it difficult to design a comprehensive methodology to asses all the financial, organizational and technological factors leading to the actual adoption of eHealth systems. Some of the articles focusing on the role of users in the development of eHealth formalize probabilistic models of patients' survival (a standard measure in the literature). Moreover, there are articles dealing with the adoption rates for specific services such as: on line ordering of health products, on line booking services, on line health information search, on line self help, and access to other health institutions' systems. On the other hand, several studies examined whether and how the actual use of e-services affects the overall costs paid by patients for medical assistance. Based on multiple regression analyses, these studies found that users of the eHealth system had lower medical

expenditure (as a result of fewer hospital visits) for lifestyle-related illness than non-users. There are also articles dealing with factors facilitating and hindering the implementation and adoption of eHealth services and devices. These articles identify three major types of barriers/facilitators: (1) technology design factors, (2) professional interactions, and (3) organizational factors. Other studies examine how eHealth "readiness", i.e. the availability of ICT infrastructure by public administrations, affect the actual use of eHealth services, and assess the potential eHealth use rates associated with the technological level of available infrastructures. Finally, a few articles focus on the quality of electronic connections between different actors involved in health services, including laboratories, general practitioner practices, hospitals, insurance companies, pharmacies, and clinics.

Studies on eEducation have highlighted that progress in the use of ICT in education and training has been very uneven across and within countries especially in terms of e-maturity[13]. Training in ICT usage has entered students' curricula in many countries, and has become a fundamental tool for teaching and learning across a wide range of subject areas. In other countries however, ICT adoption in education institutions is at an early stage: it has enhanced learning processes and favored the diffusion of eLearning practices (ICT enabled learning), but no great improvements in learning and teaching can be observed yet. To capture this heterogeneity across and within countries, some studies have gone beyond a mere count of ICT tools available in educational institutions, and attempt to identify and measure students' use of ICT for educational purposes both at school and at home. Moreover, there are many studies describing how the use of ICT can favour the development new competencies and learning abilities. For example, ICT has the potential to enable teachers and students to construct rich multi-sensory, interactive environments with almost unlimited teaching and learning potential. On the other hand, many studies have also identified barriers to ICT uptake in schools. The following factors that impede the successful implementation of ICT in teaching have been identified:

- *Teacher-level barriers*, i.e. teachers' poor ICT competence, low motivation and lack of confidence in using new technologies which may hinder their levels of engagement in ICT. These are directly related to the quality and quantity of resources devoted to teacher training programmes;
- *School level barriers*, i.e. limited access to ICT (due to a lack or poor organization of ICT resources), poor quality and inadequate maintenance of hardware as well as unsuitable educational software, which may also put a brake to the usage of ICT by teachers. Moreover, the absence of an explicit ICT strategy of educational institutions may undermine ICT use by teachers;
- *System-level barriers, i.e.* rigidities characterizing national educational systems impeding the integration of ICT into everyday's learning activities.

A further group of articles in our sample focuses on teachers' motivation that is a critical and often neglected factor in ICT adoption. There are considerable differences across countries in terms of strategies adopted for motivating teachers. Actions should be built into policies that encourage teachers to use ICT more – and more effectively. Policies in this area should include measures raising the confidence levels of teachers (sufficient on-site support, appropriate in-service and initial teacher training in ICT) but also means to incentive, recognize and reward the use of ICT (such as appraisal schemes, making good ICT use part of career paths, or benefits for teachers engaged in ICT related projects).

As far as eProcurement is concerned, the vast majority of the reviewed articles focus on single factors affecting the adoption of these services, e.g. the number of private suppliers participating in a public on-line bidding event. Only a few papers surveyed contained statistical tests of specific relationships between variables. Most studies in our sample did not rely on any discernable theory. Among few works that explicitly refer to some interpretive frameworks, the focus is most frequently on theories of innovation diffusion/technology adoption. Applying a

[13] E-maturity indicates the extent to which organizations make strategic and effective use ICT in order to improve educational outcomes.

diffusion/adoption perspective, some scholars estimated the implementation rate of public eProcurement systems; others conducted exploratory studies to understand the political, socio-economic, demographic and geographic factors affecting the adoption of eProcurement practices. Other researchers focused on the involvement and training of end users and on characteristics and behaviour of suppliers of e-services (suppliers' skills and e-readiness, suppliers' adoption of ICT devices and communication strategies).

Impact indicators capture the actual satisfaction of end users, or more generally how public e-services affect their well-being. Different from "usage indicators" which are mainly focused on the rate and direction of e-service adoption, impact indicators measure the effects of such adoption on communities, citizens, firms and other institutions. They capture the actual satisfaction of end users, or more generally how public e-services affect their well-being.

Impact indicators are present in about one fifth of all the reviewed articles (20.77%), slightly less than works using output indicators (21.04%) and much less than studies focusing on usage indicators (38.88%). Nevertheless this relative scarcity of publications addressing the impact of e-services largely reflects the fact that articles on eGovernment, which are the largest share of all reviewed works, rarely focus on these issues. By contrast, impact indicators represent an important fraction of published works in the other e-service categories, and particularly in the case of Infomobility, eHealth and eEducation.

With reference to the latter service category (eEducation), some articles examine the impact of ICT investment on learning and teaching. Although, it is difficult to establish a causal relationship between computers and educational outcomes, a few studies have attempted to do so, and there is some evidence that investment in ICT impacts on learner performance, on learning and on teaching. At the same time, some articles identify activities that enable teachers to save time and to increase their own productivity, especially in preparing and updating daily lessons, personalizing educational plans for slower students and for students with disabilities or special learning problems, and devising new methods of student evaluation. Nevertheless, some studies highlight that ICT will not always nor necessarily have a positive impact on learning: (1) The introduction of ICT will need time to positively affect educational achievement and the benefits associated with the use of ICT as an additional pedagogical tool may be hard to measure; (2) in order to generate positive effects, public institutions need to design and implement a comprehensive eLearning policy that integrates teacher training (in terms of adequate pedagogical methods and ICT skills) and educational multi-media materials development as well as appropriately designed curricula. Some studies examine the various stages of ICT implementation in educational institutions. Here, researchers often distinguish the impact of ICT at the level of infrastructures (back office), of contents transferred to students, and of training processes. Considering a continuous life cycle or value chain for ICT, the production of contents is the very first step, followed by encryption of contents — or content treatment— and their integration in the pedagogical process.

As for eHealth, some articles have developed cost–benefit analyses based on case studies. Specific efforts were made to analyze the direct and investment costs associated with the development and implementation of web services, and to estimate the expected benefits in terms of quality, access and operational efficiency of health care. These studies also involved sensitivity analyses to benefits, costs and productivity effects associated to alternative utilization scenarios. According to these works, identifying the economic and financial benefits of eHealth requires a consideration of the overall operational context within which these applications and services are implemented. Most importantly, an extensive literature highlights that the development of successful eHealth services goes hand in hand with managerial and organizational transformations of public administrations.

As regards Infomobility, studies on the impact of ICT on transportation services are mostly based on impressionistic evidence. The dominant view is that the diffusion of infomobility is associated with the breakdown of trade barriers, and with the development of new patterns of travel. Key aspects analyzed in these works are: (1) changes in mobility behavior; (2) the role of

ICT in the structural transformation of cities and urban systems; and (3) the impact of intelligent transport systems in facilitating efficient and sustainable mobility.

Studies on eProcurement are mainly concerned with efficiency improvements associated with these services, due to lower transaction costs and shrinking idle times, to the higher speed of procurement processes, and improved management of information. Extant literature highlights that eProcurement and associated eBusiness systems will increase the tendency towards "arms' length", market transactions because the barriers to entry in electronic transactions are low. Indeed, the electronic brokerage effects of eProcurement reduce search costs. Consequently, eProcurement adoption would result into a movement away from close, hierarchical relationships to more short-term, market relationships.

Other reviewed articles focus on the benefits that could be generated by the eProcurement deployment such as: faster ordering, wider choice of vendors, greater control over procurement spending and better employee compliance, more accessible Internet alternatives for buyers, less paperwork and simplified administrative procedures, and re-engineered procurement workflows. The emerging view is that eProcurement is an effective policy tool to increase country level productivity, remove domestic barriers to international trade, and improve efficiency.

The context or environment indicators measure some of the preconditions for a successful implementation of public e-services. They mostly have to do with ICT infrastructure, ICT skills, and with institutional conditions, e.g. in terms of trust and legal environment. ICT infrastructure is one of the basic requirements of e-services and can be measured by indicators such as internet penetration rates, broadband penetration, internet access tariffs, amount of public access points, and the like. ICT skills have do to with the way a country's population is able to handle ICT. A further categorization here distinguishes ICT skills among citizens, businesses and civil servants. A final group of published works focuses on a country's legal environment which significantly affects on line identification, on line safety and on line privacy.

As observed in the case of input indicators, also **context indicators** are not present in any category of public e-services if taken individually but only when considered jointly with other indicators (output and usage indicators). From this perspective, one may observe that **output and context indicators** play a role in analyses of eGovernment and eEducation, but with different intensities (much higher in the case of works on eGovernment).

Some articles focus on how infrastructure and network access conditions affect eEducation, with a specific attention to the availability of computer hardware, the pupil-computer ratio, average number of computers per school and levels of connectivity and bandwidth. The availability of computers in most EU countries is substantial, almost all secondary schools have access to the Internet. In general, all studies on eEducation show that ICT penetration in schools is continuously increasing.

Research on eGovernment generally use public data sources to analyze context and output indicators. Several methodologies were used in these studies. First, national or local government websites were analyzed to evaluate service availability as well as their content, and quality. The presence or absence of specific features contributed to determine a country's level of progress. Second, statistical or econometric analyses were carried out comparing the ICT infrastructure and human capital endowments for many countries worldwide. Some articles add further context indicators such as: the introduction of specific laws governing Internet use, mobile phone subscription rates, Internet security, technical skills of the workforce, level of education, level of Internet literacy, degree of entrepreneurship and innovation. Here, the development of synthetic/composite indicators is frequent. In summary, those measures contribute to a wider understanding of the key factors that help to improve service delivery and enhance eGovernment projects.

[TABLE 9 HERE]

A considerable attention is paid to front office issues (amount of on line service delivery), while back office analysis (improvement, re-engineering and Informatization of processes needed to deliver front office services) is neglected and left behind (Millard et al., 2004). One reason is the difficulty of measuring back office activities: many technical and organizational elements should be taken into account to capture this aspect of e-service development. Moreover, measurement is complicated by the heterogeneity of back office requirements for any given level of front office service delivery (Janssen, 2010).

Our results confirm this trend (Figure 4) except for eEducation and eHealth, where back office issues dominate, and Infomobility where analyses of front office services and of combinations of front and back office issues have an approximate equal share of articles. What is more worrysome is that, in the case of eGovernment which is the most investigated domain, the largest share of articles focus on front office issues, completely disregarding the complementarities with back office issues.

In summary, it is widely acknowledged that there is a strong need for investing in both front and back office dimensions so as to enhance a more effective introduction of new technologies in public sector; however extant literature has paid limited attention to the interactions between these two service activities. This crucial point has emerged in the literature on the development of organizations, which has emphasized the essential role of skills that characterize the different components of an organizational structure and their dynamic complementarities (Helfat et al., 2007). In the specific case of public organizations, the use of new technologies for more efficient work organization and exchange of information within the administrative structures (back office) is a complementary and essential asset for the delivery of public e-services (front office) to end-users.

[FIGURE 4 HERE]

6. Conclusions

This paper reviewed 751 refereed journal articles which we found to be dealing with public e-services, and examined them along several key dimensions, including time distribution of published works, affiliations of authors, themes investigated, geographic focus and research methods. Results were discussed and directions for future research were explored. While many studies on public e-services have already been conducted, the unexploited potential is still large. This paper should inter alia motivate researchers, practitioners and policy makers to explore this exciting area even further, filling up the research gaps we identified.

The results highlighted that, in the last decade, there has been a rapid growth in the volume of research output in this field. Although the interest raised by public e-services mirrors into the notable increase of articles published in leading journals with international impact, it remains that research in some domains is still at a very initial stage.

While a remarkable attention has been focused on eGovernment, virtually none of the reviewed articles analyze more than one of the following five domains: Infomobility, eEducation, eHealth, eProcurement and eGovernment.

Most researchers have their institutional affiliations either in Europe or in North America. Moreover researchers in this field seldom publish in collaboration with colleagues from universities located in different geographical and disciplinary areas.

A large fraction of scholars carrying out research on public e-services are specialized in Law/Public Administration, Computer Science/Information System, although articles written by authors from areas such as Health/Life, Economics/Management and Communication/Education disciplines are also to be found.

The heterogeneity of academic backgrounds also translates into a diversity and richness of methodological approaches across researchers. Our results show that researches conducted are

more quantitative than qualitative. In some circumstances, a combination of different statistical techniques is used to explore correlations and causal relations between key variables, spanning from multivariate techniques to regressions.

The reviewed articles primarily cover e-service development in Europe, followed by studies with a geographic focus on North America, while broad cross country studies are not frequent at all. Probably, the latter result reflects the difficulty of finding comparable data across different countries or geographical areas.

We have shown some remarkable differences across public e-service categories. Research on *Infomobility* is penalized by a limited availability of data and is still characterized by a low number of articles published in relatively low impact factor journals. Conceptual articles prevail, while empirical research is rather scanty in this domain. Poor attention is being paid to front office issues. Researchers reveal a relatively high interest in the development of these services in Asian countries, massively use case studies, and largely focus on impact indicators. The *eGovernment* domain is characterized by a massive and growing attention, a dominance of quantitative studies mainly carried out by scholars from Law/Public Administration and Computer Science/Information System departments (although collaborations with Economics/Management, Statistics and Communication/Education fields are relevant). Articles in this domain are generally published in medium-high impact factor journals. Attention is being paid more to front office than to back office issues and interactions between the two service categories are largely neglected. Much attention of scholars is devoted to European countries, and to combinations of output and usage indicators. The *eHealth* domain attracts a growing number of scholars mainly from European institutions. The reviewed articles in this domain get published in journals with the highest impact factor. Much attention is given to back office issues. Most studies are quantitative in nature and mainly involve researchers from Health/Life Science departments (although co-authorships with computer scientists are relevant), who primarily develop output and usage indicators. The *eEducation* domain is characterized by relatively few publications, mainly authored by scholars carrying out research in the fields of Education and Communication sciences. These articles appear in journals with a relatively low impact factor, and their geographic focus is on EU countries. Quantitative methods prevail, and attention is mainly given to back office issues and usage indicators. Finally, *eProcurement* domain is also characterized by relatively few articles. However, they appear in academic journals with a higher impact factor. Most of these articles are written by North American researchers, mainly with a background in the fields of Law and Administration sciences, co-authorships are a rare event (although collaborations with computers scientists are relevant), the geographic focus of analysis is mostly on American countries and usage indicators are the most diffused in this domain.

Some recommendations emerge from the analysis. Stronger links between researchers active in different geographical areas and countries would be desirable. Moreover, cross fertilization from different research fields should be promoted, drawing ideas and methods from a wide range of disciplines including: Information Systems and Public Administration science, Public and Political science, Economics and Management, Education and Training disciplines, Environmental and Transportation studies, Health and Life science, Communication and media studies. More research should be devoted to comparing different public e-service categories, implying joint efforts in data collection and a knowledge accumulation. Most of available datasets are presently the result of *ad hoc* initiatives undertaken by national government agencies, research centers or individual scholars. As a consequence, the datasets available for adoption, delivery and impact of public e-services are rather limited, dispersed and hard to compare and integrate. Greater standardization of official statistics is badly needed and a wider extension and coverage of international data collection should be pursued as a primary goal for all e-service categories.

An important contribution of this study is the construction of a first systematic bibliometric dataset on journal articles analyzing the development of a wide range of public e-services, going well beyond the widely explored domain of eGovernment. However, the dataset is far from being exhaustive and some limitations exist. The range of journals to be covered should probably be extended, to capture valuable research which does not gain access to ISI coded top reviews. The

set of keywords to be used in the search process could be refined and expanded to include more areas of interest. Data should be gathered also on other sources and publication categories, including working papers, conferences proceedings, and books. We tried and break the path, there is ample scope for future research in this promising field.

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Tables and Figures

Table 1. Total research fields in the Social Science Citation Index (SSCI - ISI)

Research field Name	1) Anthropology, 2) Area Studies, 3) Business**,** 4) Business - Finance, **5) Communication,** 6) Criminology & Penology, 7) Demography, **8) Economics, 9) Education & Educational Research, 10) Education - Special, 11) Environmental Studies,** 12) Ergonomics, 13) Ethics, 14) Ethnic Studies, 15) Family Studies, **16) Geography,** 17) Gerontology, **18) Health Policy & Services,** 19) History, 20) History & Philosophy Of Science, 21) History of Social Sciences, 22) Hospitality – Leisure – Sport & Tourism, 23) Industrial Relations & Labor, **24) Information Science & Library Science,** 25) International Relations, **26) Law,** 27) Linguistics, **28) Management,** 29) Nursing, **30) Planning & Development,** 31) Political Science, 32) Psychiatry, 33) Psychology - Applied, 34) Psychology – Biological, 35) Psychology – Clinical, 36) Psychology – Developmental, 37) Psychology – Educational, 38) Psychology – Experimental, 39) Psychology – 40) Mathematical, 41) Psychology – Multidisciplinary, 42) Psychology – Psychoanalysis, 43) Psychology – Social, **44) Public Administration,** 45) Public - Environmental & Occupational Health, 46) Rehabilitation, 47) Social Issues, 48) Social Sciences – Biomedical, 49) Social Sciences – Interdisciplinary, 50) Social Sciences - Mathematical Methods, 51) Social Work, 52) Sociology, 53) Substance Abuse, **54) Transportation, 55) Urban Studies,** 56) Women's Studies

Table 2. Articles on public e-services found in each SSCI - ISI research field (2000-2010)

Research field	**Number and percentage of articles**					
	total	**eGovernment**	**eEducation**	**eHealth**	**Infomobility**	**eProcurement**
Management	21 (2.8%)	10 (2.4%)	0	0	3 (6.3%)	8 (12.1%)
Information and Library Systems	217 (28.9%)	158 (37.5%)	2 (4.4%)	45 (26.3%)	6 (12.5%)	6 (9.1%)
Public Administration	315 (41.9%)	251 (59.6%)	9 (20.0%)	2 (1.2%)	1 (2.1%)	52 (78.8%)
Education and Educational Research	36 (4.8%)	2 (0.5%)	34 (75.6%)	0	0	0
Health Policy and Services	124 (16.5%)	0	0	124 (72.5%)	0	0
Transportation/Environmental and Urban Studies	38 (5.1%)	0	0	0	38 (79.2%)	0
Total	751 (100%)	421 (100%)	45 (100%)	171 (100%)	48 (100%)	66 (100%)

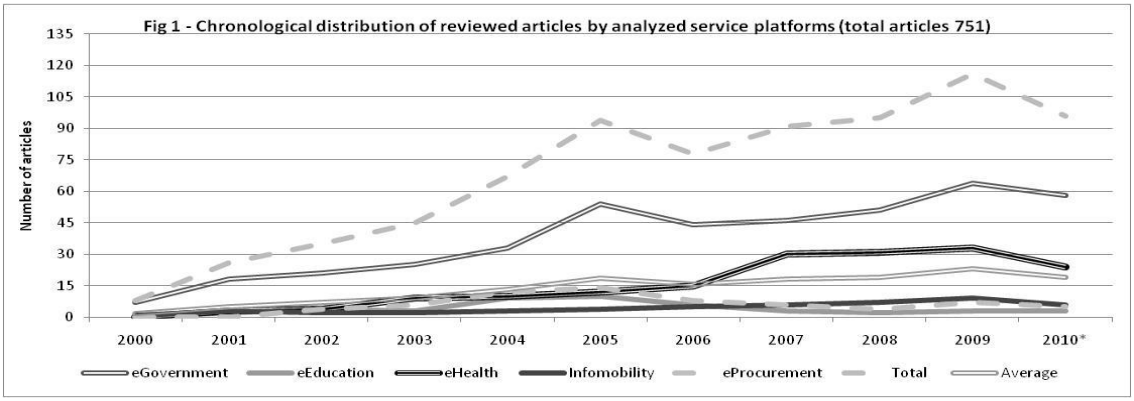
Table 3. Methodological Scheme used to classify the 751 reviewed articles

1) Journal title	**2) Impact factor of the journal**	**3) Number and name of Authors and Co-authors**	**4) Geographic origin of authors by localization of their institutions of affiliation** -Europe -North America -South America -Asia -Australia -Africa	**5) Publication year**
6) Academic affiliation of authors -Economics/Management -Computer Science/Information System -Law/Public Administration -Statistics -Communication/Education Studies -Health/Life Sciences -Environment/Geographycal studies	**7) Sample design** -Size of data samples -Number of case studies	**8) Methodological approach** -Qualitative -Quantitative -Illustrative/impressionistic	**9) Methodology used to collect information/data (qualitative and quantitative studies)** -Web search -Telephone interviews -Face to face interviews -Questionnaire	**10) Back-office vs. Front-office issues**
11) Data treatment techniques used (in the case of quantitative studies only) -Univariate and multivariate statistics -Conditional distribution analysis	**12) Service domains examined** -eGovernment -eEducation -eHealth -Infomobility -eProcurement	**13) Geographical areas covered by the study** -One EU country -2/14 EU Countries -15 EU Countries -27 EU Countries -Europe -North America -South America -Asia -Australia		

		-Africa -World		
14) Key indicators used				
14.1) Input indicator -Amount of financial resources devoted to eGovernment/eEducation/eHealth/Infomobility/eProcurement -eGovernment/eEducation/eHealth/Infomobility/eProcurement spending as % of GDP -Amount of resources devoted to Research and Development -Amount of public resources devoted to internet infrastructure			**14.2) Output indicator** -Public organizations that have a web site -Public organization websites that offer e-services -Typology of public e-services offered (eGovernment/eEducation/eHealth/Infomobility/eProcurement) -Availability and use of information systems, specialized tools for public organizations -Informatization, integration and interoperability of databases or back office	
14.3) Usage/adoption indicators -ICT penetration rates (internet, LAN, intranet, mobile phone, e-mail, pc, etc.) -Public e-services penetration rates (eGovernment/eEducation/eHealth/Infomobility/eProcurement) -Measurement of behavioural intention included the intention and predicted use of public e-services (perceived usefulness, perceived ease of use, perceived image, perceived relative advantage, trust of the Internet, trust of the public organizations) -Satisfaction levels of users - Non user and users' profiles (attitudes on ICT use, barriers, etc..)			**14.4) Impact indicators** -Reduction of waiting time -Decrease in case processing time -Evaluation of the ICT impacts on the organization and operational processes -Productivity improvement and cost reduction **14.5) Context/Environmental indicators** -ICT infrastructure (broadband penetration, internet access tariffs, amount of public access points) -Competencies / ICT skills embodied in personnel employed in the public organizations -Competences / ICT skills embodied in users (citizens, students, pupils, parents, patients, pharmacies, business, commuters, passengers) -ICT training of public organizations	

Table 4. General information on reviewed literature by public e-service platform analyzed (2000-2010)

	Total	eGovernment	eEducation	eHealth	Infomobility	eProcurement
Total articles	751	421	45	171	48	66
Percentages	100.00	56.06	5.99	22.77	6.39	8.79
Average impact factor	1.84	1.85	1.56	2.04	1.73	2.02
Average number of co-authors	3.03	3.10	4.30	3.40	2.50	1.84



* The survey considers only the first half of 2010

Table 5. Geographical distribution of articles on public e-services, by institutional affiliation of authors and co-authors (absolute and percentage values)

	Total	eGovernment	eEducation	eHealth	Infomobility	eProcurement
Europe	327 (43.54%)	175 (41.57%)	24 (53.33%)	87 (50.88%)	17 (35.42%)	24 (36.36%)
North America*	246 (32.76%)	136 (32.30%)	11 (24.44%)	55 (32.16%)	8 (16.67%)	36 (54.55%)
South America**	18 (2.40)	15 (3.56)	1 (2.22)	2 (1.17)	0	0
Asia	36 (4.79%)	18 (4.28%)	1 (2.22%)	9 (5.26%)	8 (16.67%)	0
Australia	44 (5.86)	28 (6.65)	5 (11.11)	9 (5.26)	2 (4.17)	0
Africa	14 (1.86%)	2 (0.48%)	3 (6.67%)	9 (5.26%)	0	0
Europe + North America	31 (4.13)	20 (4.75)	0	0	5 (10.42)	6 (9.09)
Europe + South America	6 (0.80%)	5 (1.19%)	0	0	1 (2.08%)	0
Europe + North America + Africa	6 (0.80%)	6 (1.43%)	0	0	0	0
Europe + Asia	8 (1.07%)	5 (1.19%)	0	0	3 (6.25%)	0
Europe + Africa	3 (0.40%)	3 (0.71%)	0	0	0	0
North America + Africa	12 (1.60%)	8 (1.90%)	0	0	4 (8.33%)	0
Total	751 (100%)	421 (100%)	45 (100%)	171 (100%)	48 (100%)	66 (100%)

*USA and Canada; ** Latin American Countries

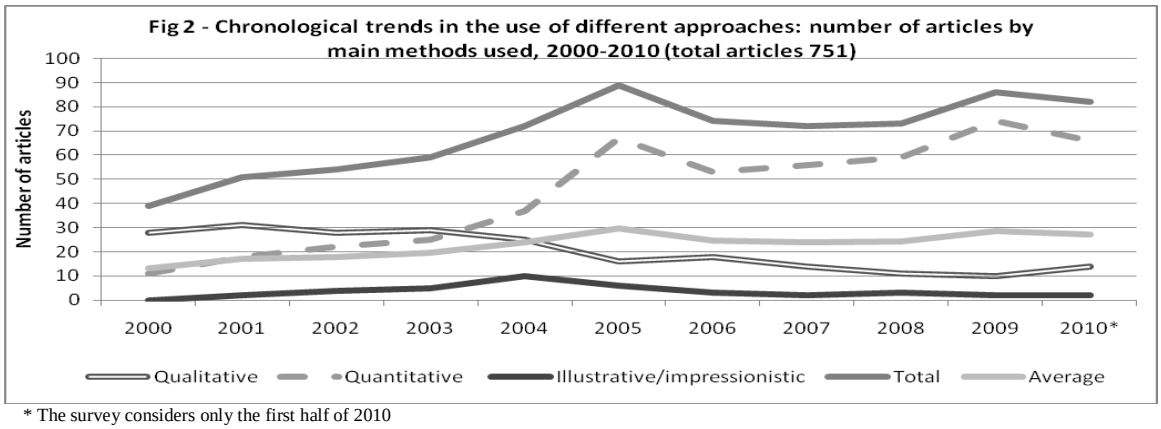
Table 6. Distribution of articles by academic affiliation of authors and by service platforms (absolute and percentage values)

	Total	eGovernment	eEducation	eHealth	Infomobility	eProcurement
Economics/Management	7 (0.93%)	4 (0.95%)	0	0	0	3 (4.55%)
Computer Science/Information System	193 (25.70%)	193 (45.84%)	0	0	0	0
Law/Public Administration	258 (34.35%)	206 (48.93%)	0	0	0	52 (78.79%)
Statistics	0	0	0	0	0	0
Communication/Education Studies	34 (4.53%)	0	34 (75.56%)	0	0	0
Health/life Sciences	124 (16.51%)	0	0	124 (72.51%)	0	0
Environment/Geographycal Studies	32 (4.26%)	0	0	0	32 (66.67%)	0
Economics/Management + Computer Science/Information System	6 (0.80%)	6 (1.43%)	0	0	0	0
Economics/Management + Law/Public Administration	5 (0.67%)	0	0	0	0	5 (7.58%)
Economics/Management + Environment/Geographical Studies	3 (0.40%)	0	0	0	3 (6.25%)	0
Computer Science/Information System + Law/Public Administration	18 (2.40%)	6 (1.43%)	0	0	6 (12.50%)	6 (9.09%)
Computer Science/Information System + Communication/Education Studies	4 (0.53%)	2 (0.48%)	2 (4.44%)	0	0	0
Computer Science/Information System + Health/life Sciences	45 (5.59%)	0	0	45 (26.32%)	0	0
Computer Science/Information System + Environment/Geographycal Studies	6 (0.80%)	0	0	0	6 (12.50%)	0
Law/Public Administration + Communication/Education Studies	9 (1.20%)	0	9 (20.0%)	0	0	0
Law/Public Administration + Health/life Sciences	2 (0.27%)	0	0	2 (1.17%)	0	0
Law/Public Administration + Environment/Geographical Studies	1 (0.13%)	0	0	0	1 (2.08%)	0
Statistics + Communication/Education Studies	4 (0.53%)	4 (0.95%)	0	0	0	0
Total	751 (100%)	421 (100%)	45 (100%)	171 (100%)	48 (100%)	66 (100%)

Table 7. Distribution of articles by geographical areas covered and by service platforms analyzed (absolute and percentage values)

	Total	eGovernment	eEducation	eHealth	Infomobility	eProcurement
One country EU	271 (36.09%)	176 (41.81%)	16 (35.56%)	49 (28.65%)	12 (25%)	18 (27.27%)
2-14 EU Countries	50 (6.66%)	35 (8.31%)	3 (6.67%)	12 (7.02%)	0	0
15 EU Countries	33 (4.39%)	24 (5.70%)	0	9 (5.26%)	0	0
27 EU Countries	31 (4.13%)	11 (2.61%)	9 (20%)	9 (5.26%)	0	2 (3.03%)
Total Europe	385 (51.26%)	246 (58.43%)	28 (62.22%)	79 (46.20%)	12 (25%)	20 (30.30%)
North America*	218 (29.03%)	109 (25.89%)	12 (26.67%)	43 (25.15%)	14 (29.17%)	40 (60.61%)
South America**	24 (3.20%)	20 (4.75%)	1 (2.22%)	3 (1.75%)	0	0
Asia	53 (7.06%)	14 (3.33%)	2 (4.44%)	15 (8.77%)	17 (35.42%)	5 (7.58%)
Australia	43 (5.73%)	20 (4.75%)	2 (4.44%)	15 (8.77%)	5 (10.42%)	1 (1.52%)
Africa	22 (2.93%)	6 (1.43%)	0	16 (9.36%)	0	0
World	6 (0.80%)	6 (1.43%)	0	0	0	0
Total	751 (100%)	421 (100%)	45 (100%)	171 (100%)	48 (100%)	66 (100%)

* USA and Canada; ** Latin American Countries



* The survey considers only the first half of 2010

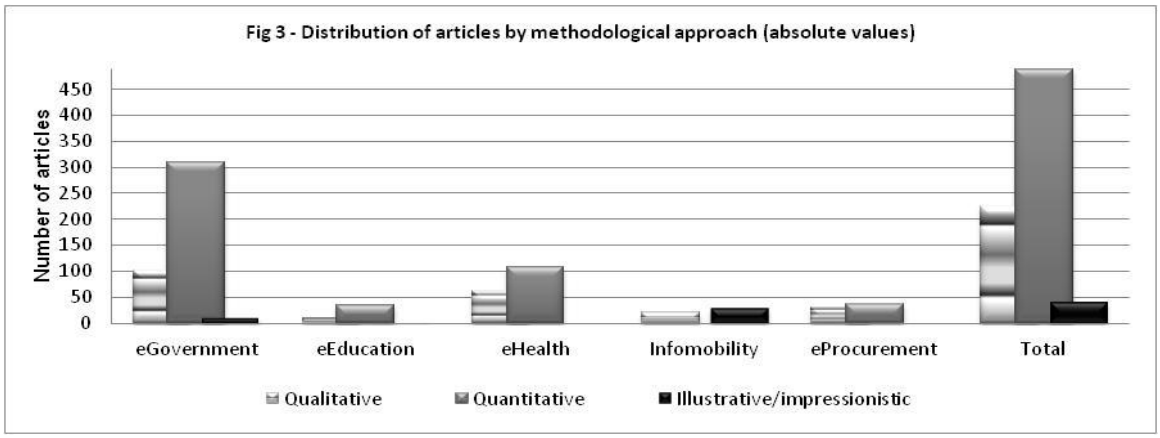


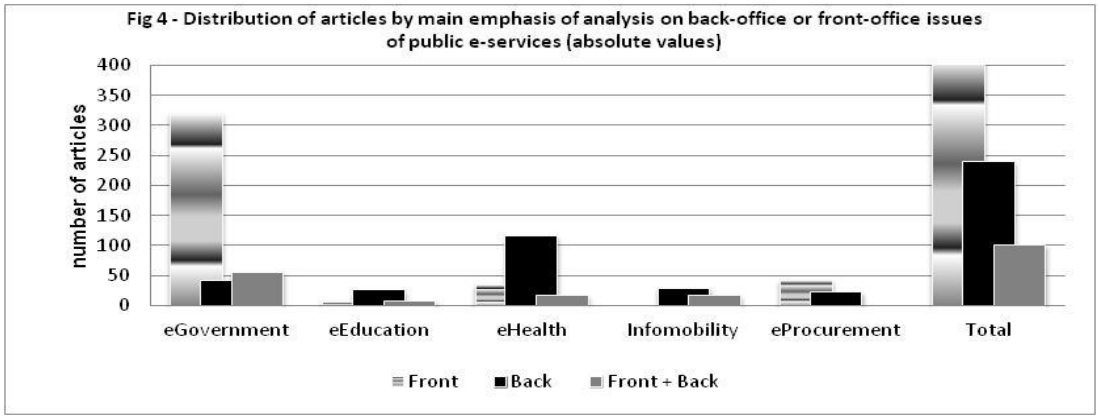
Table 8. Distribution of articles by data treatment-collect techniques and by service platforms (absolute and percentage values)

	Total	eGovernment	eEducation	eHealth	Infomobility	eProcurement
Univariate and multivariate statistics	375 (76.84%)	251 (80.97%)	34 (100%)	68 (62.96%)	0	22 (61.11%)
Conditional distribution analyses	113 (23.16%)	59 (19.03%)	0	40 (37.04%)	0	14 (38.89%)
Total*	**488 (100%)**	**310 (100%)**	**34 (100%)**	**108 (100%)**	**0**	**36 (100%)**
Web-search	236 (33.15%)	216 (52.43%)	3 (6.98%)	15 (8.77%)	0	2 (3.03%)
Telephone interviews	210 (29.49%)	100 (24.27%)	12 (27.91%)	70 (40.94%)	6 (30%)	22 (33.33%)
Face-to-face interviews	135 (18.96%)	30 (7.28%)	9 (20.93%)	52 (30.41%)	14 (70%)	30 (45.45%)
Questionnaire	83 (11.66%)	24 (5.83%)	17 (39.53%)	30 (17.54%)	0	12 (18.18%)
Web-search + Telephone interviews	35 (4.92%)	35 (8.50%)	0	0	0	0
Web-search + questionnaire	13 (1.83%)	7 (1.70%)	2 (4.65%)	4 (2.34%)	0	0
Total**	**712 (100%)**	**412 (100%)**	**43 (100%)**	**171 (100%)**	**20 (100%)**	**66 (100%)**

* Articles using only quantitative methods were considered; ** Articles using illustrative/impressionistic methods were not considered.

Table 9. Key indicators used in the articles viewed by service platforms (absolute and percentage values)

	Total	eGovernment	eEducation	eHealth	Infomobility	eProcurement
Input indicator	0	0	0	0	0	0
Output indicator	158 (21.04%)	122 (28.98%)	0	0	18 (37.50%)	18 (27.27%)
Usage indicator	292 (38.88%)	181 (42.99%)	18 (40.00%)	65 (38.01%)	0	28 (42.42%)
Impact indicator	156 (20.77%)	12 (2.85%)	15 (33.33%)	79 (46.20%)	30 (62.50%)	20 (30.30%)
Context indicator	0	0	0	0	0	0
Input + Output indicators	37 (4.93%)	27 (6.41%)	0	10 (5.85%)	0	0
Output +Context indicators	50 (6.66%)	42 (9.98%)	8 (17.78%)	0	0	0
Usage + Context indicators	34 (4.53%)	21 (4.99%)	4 (8.89%)	9 (5.26%)	0	0
Usage + Impact indicators	24 (3.20%)	16 (3.80%)	0	8 (4.68%)	0	0
Total	751 (100%)	421 (100%)	45 (100%)	171 (100%)	48 (100%)	66 (100%)



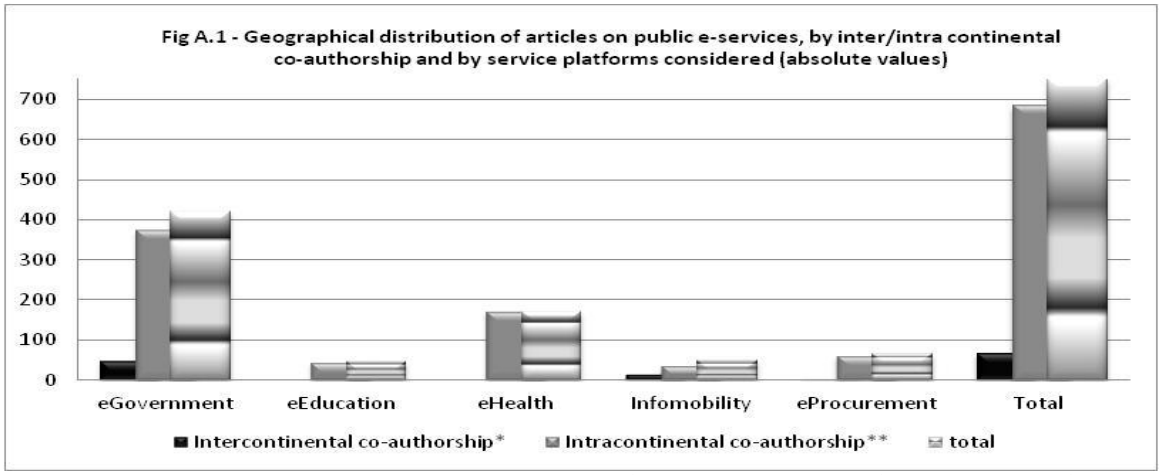
APPENDIX

Table A.1 – Distribution of articles on public e-services found in each SSCI - ISI research field

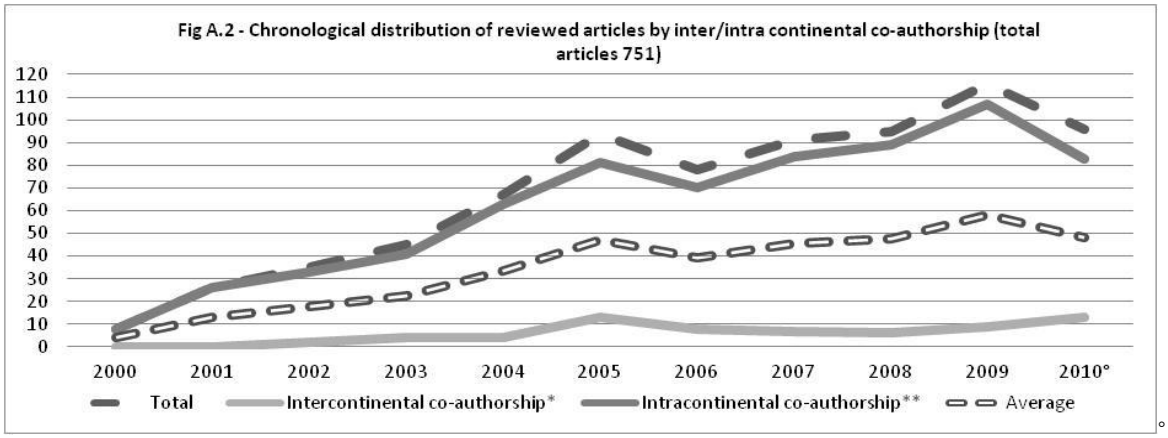
	Research field						
	Communication	**Economics**	**Education & Educational Research**	**Education - Special**	**Environmental Studies**	**Geography**	**Health Policy & Services**
Rank	**Abbreviated Journal Title**						
1	J COMPUT-MEDIAT COMM	J ECON LIT	REV EDUC RES	RES DEV DISABIL	ANNU REV ENV RESOUR	J ECON GEOGR	MILBANK Q
2	J COMMUN	Q J ECON	INT J COMP-SUPP COLL	AM J MENT RETARD	REV ENV ECON POLICY	PROG HUM GEOG	HEALTH AFFAIR
3	HUM COMMUN RES	J FINANC ECON	LANG LEARN TECHNOL	EXCEPT CHILDREN	GLOBAL ENVIRON CHANG	ECON GEOGR	MED CARE
4	PUBLIC UNDERST SCI	ECONOMETRICA	LEARN INSTR	RES AUTISM SPECT DIS	J ENVIRON ECON MANAG	T I BRIT GEOGR	VALUE HEALTH
5	CYBERPSYCHOL BEHAV	J POLIT ECON	J ENG EDUC	J FLUENCY DISORD	ENERG POLICY	GLOBAL ENVIRON CHANG	PSYCHIAT SERV
6	PUBLIC OPIN QUART	J FINANC	AM EDUC RES J	J SPEC EDUC	ECOL ECON	ANN ASSOC AM GEOGR	MED CARE RES REV
7	PERS RELATIONSHIP	REV ENV ECON POLICY	ACAD MANAG LEARN EDU	J POSIT BEHAV INTERV	LAND USE POLICY	APPL GEOGR	AM J MANAG CARE
8	COMMUN RES	J ECON PERSPECT	COMPUT EDUC	J EMOT BEHAV DISORD	LANDSCAPE URBAN PLAN	POLIT GEOGR	PHARMACOECONOMICS
9	NEW MEDIA SOC	EXP ECON	SCI STUD READ	J INTELL DISABIL RES	ENVIRONMENT	LANDSCAPE URBAN PLAN	IMPLEMENT SCI
10	DISCOURSE SOC	J ECON GROWTH	EARLY CHILD RES Q	J LEARN DISABIL-US	TOURISM MANAGE	ENVIRON PLANN D	HEALTH POLICY PLANN
11	POLIT COMMUN	REV ECON STUD	J RES SCI TEACH	ANN DYSLEXIA	ENERG J	ENVIRON PLANN A	HEALTH QUAL LIFE OUT
12	COMMUN THEOR	J ACCOUNT ECON	REV RES EDUC	J DEAF STUD DEAF EDU	ENVIRON PLANN D	PROF GEOGR	HEALTH SERV RES
13	COMMUN MONOGR	AM ECON REV	J LEARN SCI	HIGH ABIL STUD	ENVIRON PLANN A	EURASIAN GEOGR ECON	PSYCHOL PUBLIC POL L
14	HARV INT J PRESS/POL	ECON POLICY	EDUC EVAL POLICY AN	DYSLEXIA	ENVIRON IMPACT ASSES	GEOGR ANAL	FUTURE CHILD
15	J ADVERTISING	J INT ECON	SCI EDUC	INTELLECT DEV DISAB	J ENVIRON PSYCHOL	GEOFORUM	HEALTH ECON
16	INT J ADVERT	BROOKINGS PAP ECO AC	READ RES QUART	J EARLY INTERVENTION	ENVIRON URBAN	INT J GEOGR INF SCI	QUAL HEALTH RES
17	TECH COMMUN-STC	J LAW ECON ORGAN	REV HIGH EDUC	J INTELLECT DEV DIS	LAND ECON	AREA	J HEALTH ECON
18	SCI COMMUN	ECON J	J HIGH EDUC	LEARN DISABILITY Q	REG STUD	REG STUD	INT J QUAL HEALTH C
19	DISCOURSE STUD	J HUM RESOUR	SOCIOL EDUC	TOP EARLY CHILD SPEC	HARVARD ENVIRON LAW	SOC CULT GEOGR	HEALTH CARE MANAGE R
20	J SOC PERS RELAT	J DEV ECON	J TEACH EDUC	REM SPEC EDUC	CLIM POLICY	ANTIPODE	HEALTH EXPECT
21	TELECOMMUN POLICY	WORLD BANK ECON REV	INSTR SCI	EDUC TRAIN DEV DISAB	HUM ECOL	INT J URBAN REGIONAL	ADM POLICY MENT HLTH
22	J APPL COMMUN RES	J LAW ECON	J COMPUT ASSIST LEAR	INT REV RES MENT RET	PAP REG SCI	J TRANSP GEOGR	AIDS CARE
23	RES LANG SOC INTERAC	FOOD POLICY	SECOND LANG RES	VOLTA REV	MAR POLICY	PAP REG SCI	HEALTH PROMOT INT
24	PUBLIC CULTURE	J FINANC QUANT ANAL	AUSTRALAS J EDUC TEC	INFANT YOUNG CHILD	ENVIRON BEHAV	POPUL SPACE PLACE	HEALTH SOCIOL REV
25	MANAGE COMMUN Q	J BUS ECON STAT	EDUC ADMIN QUART	BRIT J DEV DISABIL	RESOUR ENERGY ECON	GLOBAL NETW	J AGING HEALTH
26	INT J PUBLIC OPIN R	ECON SOC	J RES MATH EDUC	GIFTED CHILD QUART	ENVIRON RESOUR ECON	GEOGR ANN B	J COMMUN HEALTH
27	IEEE T PROF COMMUN	IND CORP CHANGE	BRIT J EDUC TECHNOL	AM ANN DEAF	GLOBAL ENVIRON POLIT	GEOGR RES-AUST	HEALTH POLICY
28	J ADVERTISING RES	J LABOR ECON	ETR&D-EDUC TECH RES	INTERV SCH CLIN	URBAN STUD	J GEOGR SYST	EUR J HEALTH ECON
29	LANG COMMUN	J EUR ECON ASSOC	J RES READ	FOCUS EXCEPT CHILD	REG ENVIRON CHANGE	GEOGR J	J PUBLIC HEALTH POL
30	INTERACT STUD	SMALL BUS ECON	RES SCI EDUC	AJIDD-AM J INTELLECT	ENVIRON PLANN B	COMPUT ENVIRON URBAN	HEALTH COMMUN
Total articles	**0**	**0**	**36**	**0**	**3**	**0**	**124**

Table A.2 – Distribution of articles on public e-services found in each SSCI - ISI research field

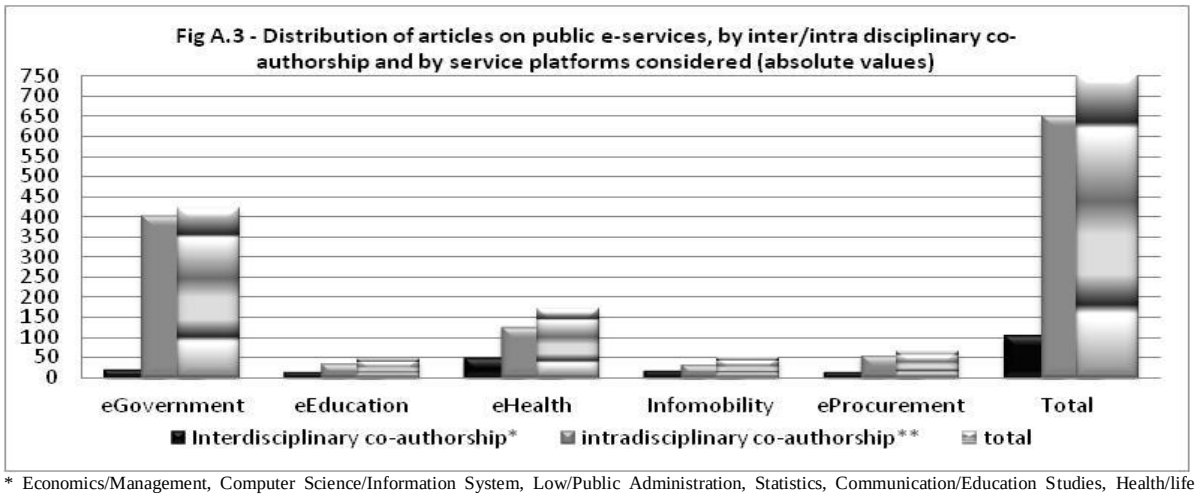
	Research field						
	Information Science & Library Science	**Law**	**Management**	**Planning & Development**	**Public Administration**	**Transportation**	**Urban Studies**
Rank	**Abbreviated Journal Title**						
1	MIS QUART	YALE LAW J	ACAD MANAGE REV	J RURAL STUD	PHILOS PUBLIC AFF	TRANSPORT RES B-METH	LANDSCAPE URBAN PLAN
2	J AM MED INFORM ASSN	HARVARD LAW REV	ACAD MANAGE J	RES POLICY	J PUBL ADM RES THEOR	TRANSPORTMETRICA	J URBAN ECON
3	J COMPUT-MEDIAT COMM	COLUMBIA LAW REV	MIS QUART	J AGRAR CHANGE	GOVERNANCE	TRANSPORT RES E-LOG	ENVIRON URBAN
4	J INFORMETR	STANFORD LAW REV	STRATEGIC MANAGE J	TECHNOL FORECAST SOC	J POLICY ANAL MANAG	TRANSPORT RES A-POL	J AM PLANN ASSOC
5	ANNU REV INFORM SCI	GEORGETOWN LAW J	J MANAGE	WORLD BANK ECON REV	CLIM POLICY	ACCIDENT ANAL PREV	INT J URBAN REGIONAL
6	INT J COMP-SUPP COLL	VA LAW REV	RES ORGAN BEHAV	LONG RANGE PLANN	J EUR PUBLIC POLICY	TRANSPORTATION	URBAN STUD
7	J AM SOC INF SCI TEC	LAW HUMAN BEHAV	PERS PSYCHOL	J AM PLANN ASSOC	J EUR SOC POLICY	TRANSPORT SCI	CITIES
8	INFORM MANAGE-AMSTER	TEX LAW REV	STRATEG ORGAN	WORLD BANK RES OBSER	PUBLIC ADMIN	TRANSPORT RES F-TRAF	J PLAN LIT
9	J ASSOC INF SYST	U PENN LAW REV	ADMIN SCI QUART	DEV CHANGE	PUBLIC ADMIN REV	J TRANSP GEOGR	EUR URBAN REG STUD
10	SCIENTOMETRICS	NORTHWESTU LAW REV	J INT BUS STUD	INT J URBAN REGIONAL	ADMIN SOC	J SAFETY RES	URBAN GEOGR
11	GOV INFORM Q	PSYCHOL PUBLIC POL L	J OPER MANAG	WORLD DEV	ENVIRON PLANN C	TRANSPORT RES D-TR E	URBAN AFF REV
12	J MANAGE INFORM SYST	MICH LAW REV	ORGAN SCI	J PLAN LIT	J SOC POLICY	TRANSPORT REV	HOUSING STUD
13	J INF TECHNOL	BOSTON U LAW REV	OMEGA-INT J MANAGE S	J REGIONAL SCI	SOC POLICY ADMIN	TRANSPORT POLICY	CITY COMMUNITY
14	INFORM SYST RES	CORNELL LAW REV	J MANAGE STUD	SUSTAIN DEV	PUBLIC MANAG REV	J AIR TRANSP MANAG	J HOUS ECON
15	INFORM PROCESS MANAG	J LAW ECON ORGAN	ORGAN BEHAV HUM DEC	ENTREP REGION DEV	AM REV PUBLIC ADM	J TRANSP ECON POLICY	INT REGIONAL SCI REV
16	J INF SCI	NOTRE DAME LAW REV	ORGAN RES METHODS	GROWTH CHANGE	POLICY SCI	INT J SUSTAIN TRANSP	REG SCI URBAN ECON
17	INT J GEOGR INF SCI	HARVARD INT LAW J	TECHNOVATION	SOC NATUR RESOUR	INT REV ADM SCI	ROAD TRANSP RES	HABITAT INT
18	HEALTH INFO LIBR J	UCLA LAW REV	DECISION SCI	INT REGIONAL SCI REV	LOCAL GOV STUD	INT J TRANSP ECON	URBAN EDUC
19	ONLINE INFORM REV	U CHICAGO LAW REV	SUPPLY CHAIN MANAG	DEV POLICY REV	J HOMEL SECUR EMERG		J URBAN AFF
20	INFORM SYST J	J LAW ECON	INT J MANAG REV	THIRD WORLD Q	CONTEMP ECON POLICY		J ARCHIT PLAN RES
21	J DOC	NEW YORK U LAW REV	INFORM MANAGE-AMSTER	STUD COMP INT DEV	AUST J PUBL ADMIN		J PLAN EDUC RES
22	J HEALTH COMMUN	MINN LAW REV	RES POLICY	J DEV STUD	POLICY POLIT		EUR PLAN STUD
23	LIBR INFORM SCI RES	DUKE LAW J	ACAD MANAG LEARN EDU	PROG PLANN	POLICY STUD J		J REAL ESTATE FINANC
24	INFORM TECHNOL MANAG	ANNU REV LAW SOC SCI	MANAGE SCI	ECON DEV CULT CHANGE	PUBLIC ADMIN DEVELOP		REAL ESTATE ECON
25	INFORM SOC	REGUL GOV	LEADERSHIP QUART	SOC POLICY ADMIN	ADMIN SOC WORK		ECON DEV Q
26	J ACAD LIBR	VANDERBILT LAW REV	M&SOM-MANUF SERV OP	HABITAT INT	PUBLIC MONEY MANAGE		J CONTEMP ETHNOGR
27	TELECOMMUN POLICY	LAW SOC REV	ORGAN STUD	DISASTERS	GEST POLIT PUBLICA		EURE
28	RES EVALUAT	CALIF LAW REV	J MANAGE INFORM SYST	POLICY SCI	CAN PUBLIC POL		J URBAN PLAN D-ASCE
29	SERIALS REV	AM CRIM LAW REV	CORP GOV	J PLAN EDUC RES	PUBLIC PERS MANAGE		HOUS POLICY DEBATE
30	PORTAL-LIBR ACAD	HARVARD ENVIRON LAW	J INF TECHNOL	LOCAL GOV STUD	CAN PUBLIC ADMIN		EDUC URBAN SOC
Total Articles	**217**	**0**	**21**	**0**	**315**	**33**	**2**



* Europe + North America, Europe + South America, Europe + North America + Africa, Europe + Asia, Europe + Africa, North America + Africa
** Europe, North America, South America, Asia, Australia, Africa

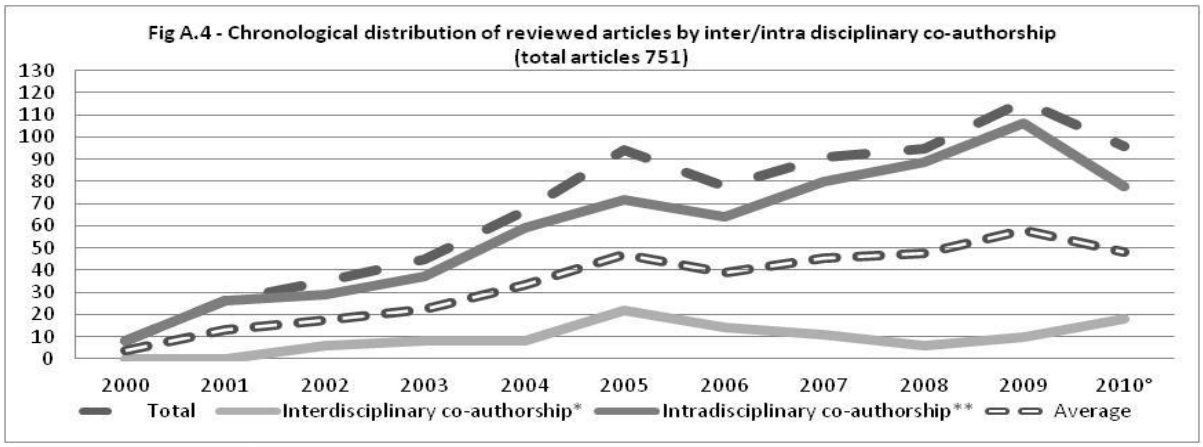


The survey considers only the first half of 2010
* Europe + North America, Europe + South America, Europe + North America + Africa, Europe + Asia, Europe + Africa, North America + Africa
** Europe, North America, South America, Asia, Australia, Africa



* Economics/Management, Computer Science/Information System, Low/Public Administration, Statistics, Communication/Education Studies, Health/life Sciences, Environment/Geographical Studies

** Economics/Management + Computer Science/Information System, Economics/Management + Low/Public Administration, Economics/Management + Environment/Geographical Studies, Computer Science/Information System + Low/Public Administration, Computer Science/Information System + Communication/Education Studies, Computer Science/Information System + Health/life Sciences, Computer Science/Information System + Environment/Geographical Studies, Low/Public Administration + Communication/Education Studies, Low/Public Administration + Health/life Sciences, Low/Public Administration + Environment/Geographical Studies, Statistics + Communication/Education Studies



° The survey considers only the first half of 2010

* Economics/Management, Computer Science/Information System, Low/Public Administration, Statistics, Communication/Education Studies, Health/life Sciences, Environment/Geographical Studies

** Economics/Management + Computer Science/Information System, Economics/Management + Low/Public Administration, Economics/Management + Environment/Geographical Studies, Computer Science/Information System + Low/Public Administration, Computer Science/Information System + Communication/Education Studies, Computer Science/Information System + Health/life Sciences, Computer Science/Information System + Environment/Geographical Studies, Low/Public Administration + Communication/Education Studies, Low/Public Administration + Health/life Sciences, Low/Public Administration + Environment/Geographical Studies, Statistics + Communication/Education Studies