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WHAT IS A PUBLIC INFORMATION SYSTEM?

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Abstract

Public information systems are information systems available for public use. There are public information systems both in the public sector and in the private sector, and both citizens and businesses may be users of such systems. Public information systems are analysed from several perspectives as regards users and usages, data contents, and technical, organisational, and legal aspects. Some proposals concerning future research in this truly interdisciplinary and application-oriented research area are presented.

Keywords: public information system, public management information system, e-government, e-democracy, e-business, e-commerce, e-society, metadata, information system architecture, data warehouse, citizen perspective, confidentiality, privacy, publicity, mass media, standards

1. Introduction

Public information systems are information systems available for public use. This is a brief and simple definition, and it is relatively adequate. Interestingly, a somewhat longer version of this definition has already been already in [Orman, 1989]. Orman defines public information systems as "systems designed for use by the general public, rather than specialists in a particular field or organization". He identifies three generations of public information systems: 1. information packaging systems, which provide minimal sharing, 2. information retrieval systems, with provision for the sharing of data but not of processes, and 3. information processing systems, which provide maximal sharing of data and processes. Public information packaging systems include automated bank tellers, library checkout systems, and airline reservation systems. Orman goes on to predict (note that the article was written before the general availability of the Internet) that the major impact of information retrieval systems will be in public education. Automated information processing systems for public use were still in their early stages at this time, and Orman assumes that "the infrastructure of terminals, public access ports, and telecommunication systems have to be provided via public investment if these technologies are to become commercially feasible". The massive and spontaneous penetration of personal computers and the Internet among the general public, which took place just a few years later, made that particular prediction by Orman completely obsolete. Considering the practical impact of public information systems during the last decade, one may only speculate about what the implications of another ten years of developments are for citizens, businesses, and society as a whole.

"Public management information systems" is a concept and research area related to, and partly overlapping with "public information systems". [Bozeman and Bretschneider, 1986] is a seminal article about public management information systems. A public management information system is usually defined as an information system used in public management, that is, by organisations belonging to the public sector. As a consequence of this definition, private information systems are defined as information systems used by organisations belonging to the private sector, mainly profit-seeking private businesses. Bozeman and Bretschneider argue in their article that there are important differences between public and private information systems. This view has been modulated by later research, as discussed in [Rocheleau and Wu, 2002]. Even Bozeman himself states in [Bozeman, 1987] that "all organizations are public" – "an organization is public to the extent that it exerts or is constrained by political authority."

The definition of public information systems as information systems available for public use (regardless of whether the information system belongs to the public or to the private sector) leaves open a number of questions which will be discussed here.[1] Some relevant questions are:

1. What is "public use"?
2. Do public information systems deal with public data (only)?
3. Should public information systems (and their outputs) be public goods - free of charge?
4. To what extent are public information systems associated with public authorities and institutions?

The starting point here will be a list of (types of) information system applications mentioned as examples of public information systems:[2]

- information systems making public data and other "utility data" available to the public, e.g. official statistics, maps, directories, dictionaries, encyclopaedias, catalogues of goods and services, events, standards, patents, etc
- information systems supporting individual actors (persons, companies, etc), who need/want to perform a certain task vis-a-vis a public authority or institution; tasks initiated and controlled by a citizen/customer/client/patient. . .: customer task management systems or case management systems (in Swedish: "ärendehanteringssystem")

[1] It may be debated, whether it is possible, or even desirable to give a precise definition of a research field. Maybe the inclusion/exclusion rule should be a bit "fuzzy" in order to encourage rather than discourage contributions that may not be considered to be "the mainstream". However, it may be desirable for a research community to at least agree upon what could be regarded as "the core" of a research area.

[2] The basic concepts of "information" and "information systems" may themselves need some explanation. Strictly speaking, information exists only in human minds. Human beings use data (representations) to store and communicate information, e.g. spoken or written language, digital data representations, etc. Information systems always include people and information, but they may also include man-made artefacts such as computers, data, and computer-supported data processing systems, supporting and amplifying the human mind in mental operations. See also [Sundgren and Steneskog, 2003].

- information systems supporting social processes involving both citizens, public authorities, and other actors (companies etc), e.g. democratic processes, processes around children's schooling, etc
- information systems supporting business tasks of public authorities and institutions vis-à-vis individual actors (persons, companies, etc); e.g. police tasks, medical/social care tasks, etc: agency task management system (cf customer task management system)
- news media, "the fourth estate", and their systems for informing the general public, scrutinising power, and advocating citizen interests
- information systems supporting other public information systems, infrastructural systems, e.g. information systems updating and maintaining the databases and archives of public information systems, systems co-ordinating agency task management and customer task management, overcoming stovepipe organisations on the agency side

Now we turn to a more systematic approach for defining concepts. As for other concepts, that of a "public information system" may be analysed from three perspectives:

- a pragmatic perspective: why, and for wat purposes, are public information systems required?
- a semantic perspective: what are the contents of public information systems?
- a syntactic perspective: how are public information systems constructed?

The three perspectives correspond to three levels of solutions, or three "platforms" as illustrated by Figure 1 (obtained from an original version created by Stefan Nilsson-Gistvik).

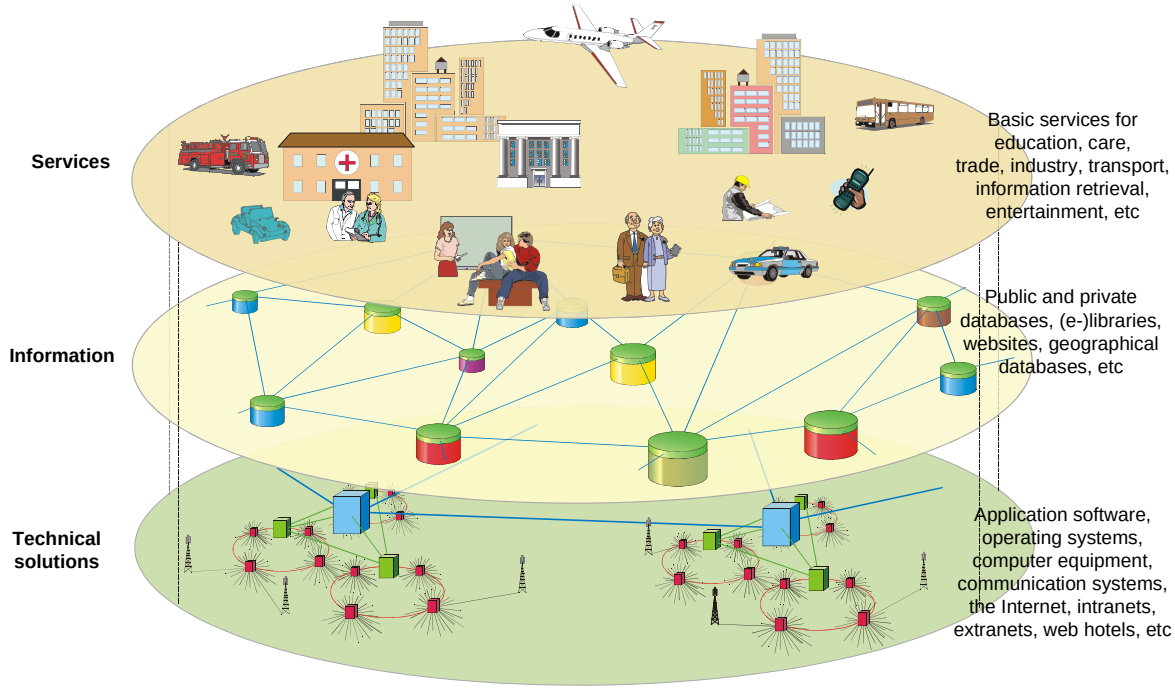

Figure 1. Solution levels in public information systems.

2. Purposes, Usages, and Users of Public Information Systems

The discussion in this section corresponds to the *Services* level in Figure 1.

The purpose of a public information system is to provide some kind of service or support to a public process, or process involving "the general public" or "society at large". In contrast, a "non-public" or private information system provides services to some rather specific users closely associated with a particular organisation, performing some specific tasks that are often internal to the organisation, e.g. internal administrative processes.

Who is "the general public"? Basically "the public" is a collective of people, e.g. the citizens of a society. We may broaden the concept to also include collectives of other actors, e.g. companies, especially small companies and organisations, which may often have needs vis-a-vis public authorities that are similar in nature to the needs of individual people. Thus, for example, both citizens and companies find themselves in situations where they have to perform a particular process (chain of tasks) vis-à-vis one or more authorities in order to obtain some kind of decision, e.g. a permit, a payment, etc.

In addition, there are certain categories of professionals, who are often thought of as representatives or "advocates" of "the general public" and "society at large", e.g. journalists, politicians, and researchers.

The actors involved in a public information system will usually belong to the following three categories:

C: private persons and households/families in their roles as citizens, clients, customers
B: business companies and other types of organisations, e.g. non-profit organisations
G: government agencies and institutions on different levels (central, regional, local)

The typical roles of the different actors and the interactions between them are illustrated by Figure 2.

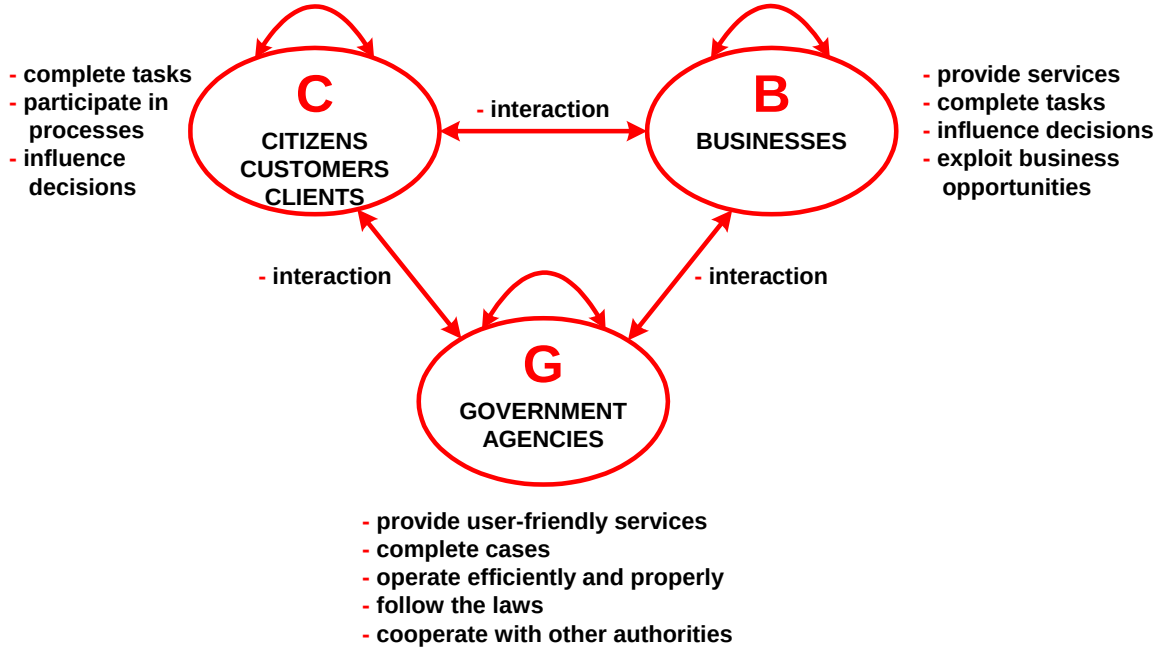

Figure 2. Actors and interactions in public information systems.

Figure 2 also indicates how different actors interact with each other:

- citizens interact with government agencies and businesses, and with other persons
- businesses interact with government agencies and with customers (persons and businesses)
- government agencies interact with citizens and businesses, and with other government agencies

Thus there are six kinds of interactions:

- citizen/government interactions (C↔G)
- business/government interactions (B↔G)
- citizen/business interactions (C↔B)
- citizen/citizen interactions (P↔P)
- business/business interactions (B↔B)
- agency/agency interactions (G↔G)

We may look at these interactions and relationships from three perspectives:

- a citizen perspective
- a business perspective
- a government perspective

Table 1 summarises, on a general level, the typical interactions between the three kinds of actors, as seen from each one of the three perspectives. Cell (X, Y) in the table describes interactions between Actor X and Actor Y, as seen from the perspective of Actor X.

In some situations the interactions may include not only one or two categories of actors, but all three of them: citizens, businesses, and government agencies interacting within one and the same process, e.g. a participation process aiming at a decision concerning where a business is going to be located.

How are public information systems related to "trendy" concepts such as "e-government", "e-democracy", and "e-commerce"? First of all, "public information system" is not intended to be a trendy concept. Public information systems have always existed, as long as human beings have existed as social creatures, trying to achieve common goals in an organised way. With the advent of computers, public information systems, as with all kinds of information systems, can reap the benefits of a new powerful technical tool, which may enhance the data processing capacity of the human mind. The "e-terms" (e-government, etc) stress the positive potentials of using computerised information systems in all fields of modern society and the necessity to exploits these potentials. The research field of public information systems obviously also recognises these positive potentials, but, in addition, recognises the fact that there are many other important aspects and challenges associated with computer-supported public information systems, e.g. the necessity for such systems to offer different kinds of communication modes for different kinds of users, including non-technical modes, and modes including technical tools other than computers. It also recognises other challenges to be met in a computerised society: needs to protect privacy and security, for example, and the need to tackle the vulnerability of a society that is increasingly dependent on digitalised information and computerised information systems.

	CITIZEN	BUSINESS	GOVERNMENT
CITIZEN	Citizens communicate and cooperate between themselves, e.g. shared car usage, on-line communities (bulletin boards, chat rooms, blogs, games, etc). Cf journalists and traditional media (public service and commercial).[3]	Citizens find and acquire products and services from businesses.	Citizens obtain services from government agencies and fulfil duties towards them (e.g. pay taxes and serve sentences in prison). Citizens participate in decision processes and social processes with government representatives.
BUSINESS	Businesses serve citizens with or without being paid for it.	Businesses trade goods and services between themselves and cooperate and/or compete and struggle with each other.	Businesses obtain services and support from government agencies and fulfil duties towards them. Businesses participate in decision processes with government representatives. Businesses serve government agencies.
GOVERNMENT	Government agencies provide services and support to citizens; they check that the citizens follow the laws and take repressive actions, as required by the laws	Government agencies provide services and support to businesses and check that the business follow the laws	Government agencies cooperate between themselves, e.g. in order to provide more complete services towards citizens and businesses.

Table 1. Interactions between citizens, businesses, and government agencies as seen from a citizen perspective, a business perspective, and a government perspective.

Table 2 illustrates the position of the concepts of "e-government", "e-commerce", etc, within the broader field of public information systems, using the structure established in Figure 1.

[3] Journalists and traditional newsmedia – "the fourth estate" – are often supposed to have roles as "proxy citizens", protecting citizen rights, consumer rights, etc, against "big government" and "big business". It is possible that on-going developments in modern "e-societies" will empower the individual citizens to protect their own interests in a more efficient way even without the assistance of proxies. What is perfectly clear is that individual citizens will not as dependent on mass media as they were before, in order to express their opinions publicly and make them widely available for open debate.

	CITIZEN	BUSINESS	GOVERNMENT
CITIZEN	e- communities (on-line communities)	e-commerce: "business-to-customer" (B2C)	e-government e-democracy
BUSINESS	e-commerce: "business-to-customer" (B2C)	e-commerce: "business-to-business" (B2B)	e-government
GOVERNMENT	e-government e-democracy	e-government	e-government

Table 2. The position of some often used "e-terms" within the broader field of public information systems.

When we look at a particular relationship in table 1 from two perspectives, we will discover certain potential conflicts of interest that have to be reconciled, if a public information system supporting the relationship is to be successful. For example, we may look at a citizen/government relationship, or a business/government relationship. A citizen or a company may have a given task to complete, for example applying and obtaining some kind of permit. The citizen (or the representative of the company) would like to complete the task without interruption, and without having to turn to more than one contact point on the governmental side, even if the processing of the application requires several government agencies to be involved, each one with their particular responsibilities specified by laws and regulations. Each government agency, on the other hand, will primarily look at the parts of the case, for which it is responsible, and attempt to find the most efficient way of finalising that part – from its point of view. Each government agency may even make great efforts to develop a very user-friendly interface for its own interactions with the user. However, none of the agencies involved will necessarily deal with the total efficiency from the user's perspective. The agencies involved may not even consider the overall efficiency of the government activities as such, viewed together. All these deficiencies are due to the traditional, so-called stovepipe organisation of the government, where the government (on the national, regional, or local level) is broken down into ministries, sectors, agencies, etc, in a strictly hierarchical way, ignoring the fact that many socio-economical activities in a modern society do not fit into such a rigid pattern.

It is an interesting and largely unsolved problem to organise governments on different levels in such a way as to overcome the structural clash between what is ideal from a citizen's perspective, and what is most rational and efficient from the government's point of view. In addition to rationality, efficiency, and user-friendliness, government bodies must also ensure quality and uniformity in their management of cases; they must treat all subjects alike, and according to the law. This may be difficult to achieve within a single organisation, and certainly much more complicated, if cases have to cross organisational borders in order to be completed. Who will take the overall responsibility for the case – the single case from the citizen's (or the business's) point of view? New organisational forms and procedures must be found in order to integrate processes across organisational borders, while

preserving transparency and a clear allocation of responsibilities. It is certainly not sufficient to merely tell governmental agencies that "they must cooperate".

As has already been mentioned, businesses may be involved in public information systems not only as clients, obtainers of government services, but they may themselves be service providers vis-à-vis citizens and other businesses, including non-profit organisations and government agencies. This will happen in so-called business-to-customer (B2C) and business-to-business (B2B) systems, to the extent that such systems can be regarded as public information systems.

Is it reasonable to regard an information system belonging in its entirety to the *private* sector as a *public* information system?[4] Yes it is – to the extent that the information system is open to use by "the general public", or at least to (a more or less volatile set of) customers outside the business owning the information system, and about whom the business does not have detailed knowledge. Such information systems really have similar characteristics to those of information systems in the public sector serving the public at large, although their users may be called "clients" or "citizens" rather than "customers". For example, a company selling goods and services to a broad collective of customers, persons and/or companies, using the Internet to receive exposure for its products, and to receive and process orders, is in a very similar situation to that of a public authority or institution providing services to the public. Thus it seems justifiable and rational to also regard such systems as public information systems. It could be noted that even though the products and services provided by B2C or B2B systems will not typically be free of charge, the functionality of the system and the information about the products and services will usually be made available to potential customers free of charge.

Some public information systems will provide services in a much broader sense than merely helping a citizen or a company to complete some very concrete task. For example, a public information system may support social and democratic processes by providing tools for making those processes more useful and rewarding from the point of view of all process participants. Important roles of such information systems and tools are to assist participants in

- communicating more effectively with one another (on-line communities etc), privately or in cooperation with mass media
- obtaining relevant information through so-called business intelligence activities, searching the web, collecting additional data by surveys, etc
- combining and evaluating data obtained from different sources through different kinds of analyses, supported by adequate software
- identifying different decision/action alternatives
- performing sensitivity and risk analyses vis-à-vis different decision/action alternatives and different uncertainty levels of the data at hand
- reconciling differences as regards values and preferences between the participants, so as to make it possible for them to arrive at an "optimal" or "satisfactory" decision

[4] Cf the discussion of private vs public *management* information systems in the introduction to this article.

3. Information Contents of Public Information Systems

The discussion in this section corresponds to the *Information* level in Figure 1.

As discussed in the previous section, a public information system supports tasks (e.g. management of "cases") and processes (e.g. decision processes), in which different types of actors are involved in different roles (citizens/clients/customers, businesses, governmental agencies). In fulfilling its supporting role, the public information system and its users will require access to data. Furthermore, the information system processes will themselves generate data. If properly designed and organised, the generated data may be reused by other processes, thus improving the efficiency and quality of those processes.

	OPERATIVE DATA (FACTS)	**PROCEDURAL DATA (RULES)**	**ANALYTICAL (DIRECTIVE) DATA**	**METADATA**	**PROCESS DATA (PARADATA)**	**ARCHIVAL DATA (RECORDS)**
USE	data about individual actors or cases; data necessary for the task or process supported by the PIS	laws, regulations, and instructions to be followed in the processing of individual cases	statistics, indicators, and other data of importance for the quality of the process supported by the PIS	data informing about the contents, meaning, purpose, quality, availability, etc, of other data	reuse of paradata from the same process or other process instances or other processes	reuse of archival data from other processes (see below)
PRODUCE	collected from external sources or obtained from databases and archives maintained by separate processes	obtained from separate regulatory processes and design processes	produced by separate processes and information systems that may be part of the infrastructure supporting the PIS under consideration	generated by design and documentation processes	data informing about the functioning and performance of processes (may be regarded as a kind of metadata) – generated by processes in operation	data extracted from or generated by operative processes, saved to reflect and document present processes for future use and analyses

Table 3. Categorisation of the data used and produced by a public information system (PIS).

The data used and produced by a public information system may be categorised in different ways. Table 3 illustrates one possible categorisation. Some explanations may be necessary:

- *Operative data* are data that are necessary in an absolute sense for the processing and completion of a particular task. For example, in an e-commerce application, the buyer must provide name, address, product/service ordered, etc, and the seller must provide availability and price information, among other things. Operative data may be provided by a process participant during the execution of the task, or they may be obtained from an already existing database, but they must be

provided one way or the other – there is no room for negotiation of the necessity of the data.

- *Directive data*, in contrast to operative data, are not necessary, in an absolute sense, for the proper functioning of the supported process, but directive or *analytical data*, as they are also called, are supposed to be valuable for the efficiency of the process, and for the quality of the results. For example, statistical data and indicators in some form or other (single figures, tables, graphs, etc) are often used in decision processes, the presumption being the improvement of the quality of the decisions.

- *Procedural data* are descriptions and other representations of rules of some kind. They may emanate from legislation processes, administrative processes, or design processes, for example. Sometimes the rules are embedded in the software used by a data processing system, sometimes the rules are more clearly separated from the procedures by being stored in separate "knowledge bases" interfacing procedural algorithms and processes.[5]

- *Metadata* are briefly defined as "data about data". The relationship between data and metadata may often be quite straightforward, as for example when metadata describe certain technical aspects of stored data. The relationship between data and metadata, as well as the form of the metadata, may be much more complex when the metadata aim at describing the contents and meaning of data, the quality of data as regards relevance, accuracy, comparability with other data, etc. Metadata should help people with tasks such as

    - understanding other people in communication processes; the communication processes may be direct (face-to-face) or indirect (through data stored in databases, for example)
    - retrieving data they are looking for – the *exploratory* role of metadata
    - interpreting data – the *explanatory* role of metadata
    - performing specific tasks and operations – the *instructional* role of metadata

- *Process data*, or *paradata* as they are also called, are data that are fed back from the process they inform about. For example, paradata may inform about whether a certain transaction was successfully processed or not, and if not, what kind of error occurred. Paradata may be used to signal problems in the design or operation of a public information system, and they may be used as a point of departure for improvements. Paradata may also be systematically collected in order to see how different kinds of actors behave on vis-à-vis a website: who the users are, their degree of satisfaction, etc. Whereas paradata primarily inform about (the performance of) processes, they indirectly also inform about (the quality of) data produced by the processes. Thus paradata may be regarded as a subcategory of metadata.

[5] Embedding rules in software tools, one way or the other, may actually be a very efficient way of making people follow the rules. As soon as we use such a tool, we will automatically follow the embedded rules, probably without thinking very much about it. It is much more difficult to make people follow rules, if compliance is made dependent on good will and disciplined behaviour.

- *Archival data*, also called *records* by modern archivists, should have a more important role in future systems than they usually have today. If properly collected and organised, archival data should become the permanently stored reflection of the real-world processes (C↔G, B↔G, C↔B, P↔P, B↔B, G↔G) that are supported by public information systems. In order to make archival processes as little resource-consuming as possible, they should be integrated with the business processes, about which they inform, and they should be automatically generated by those processes. Such an approach would also ensure completeness and good quality of the archived records.

In summary then, a public information system should primarily contain the data necessary for fulfilling the tasks of the system in question. For example, a system helping a citizen or a company to obtain a government permit of some kind should contain as much relevant information as possible to enable the government to make its decision. The government authority may already be in possession of certain data about the applicant, and if so, the system does not have to ask the applicant for this data – but it may offer the applicant the possibility of checking that the data are correct. The system should also contain rule-based information relevant to the case to be managed, e.g. laws and policies.

As the processing of a case vis-à-vis a particular client proceeds, the system must store and remember data it has obtained from the client and other intermediary data. Even after the case has been completed, data concerning the case has to be preserved in a well organised way for legitimate and required future use, including analytical work and research. Ideally the operative databases of a public information system should be well integrated with a more global archival system, in which records are stored reflecting the case management processes – the business operations – supported by the public information system.

As with other information systems, public information systems must contain metadata describing the (primary) data in the system – "data about data". For example, a government system providing services to a wide range of users must contain good explanations concerning the concepts and terms used in the communication with the users.

An information system may itself generate useful metadata about its own operations. Such metadata, also called "process data" or "paradata", may be very helpful in order to improve the functioning of the system, both from the user's point of view and from the point of view of the agency responsible for the information system. For example, systematically generated process data may assist in the discovery of the types of problems users typically run into when performing their tasks, or even whether different categories of users run into different kinds of problems.

The information content of a public information system will normally be organised into different types of databases: fact databases, rule-based knowledge bases, geographical databases, metadatabases, etc. Some data may be stored directly on websites. For more complex information systems it may be necessary to organise rather sophisticated links and data/metadata exchange procedures between databases owned by different organisations.

Looking back at Figure 1, we may conclude that the data just mentioned and exemplified should be organised as a physical or virtual data warehouse, a networked

infrastructure that is available for serving a large number of public information system applications.

Now let us turn to some specific questions often asked about the contents of public information systems.

To what extent are the data in a public information system "public data"? Different countries have different laws with regards to the publishing of data. In a country such as Sweden, all data handled by authorities are public data, available to anyone, unless there is a specific law making the data secret. However, even in Sweden, public information systems usually contain, in addition to public data, that which is not open to the public. For example, a system supporting a task or a case concerning a particular individual or company will contain non-public, confidential data about the citizen (customer/client) concerned. Nevertheless, the information system as such may be regarded as a public information system, as long as the system as such, and many of the services it offers, are available for public use.

Publicity, confidentiality, and privacy issues in connection with computer-supported information systems – "the right of privacy versus the need to know"; Barabba [1975] – have been debated for several decades in many countries all over the world. Interestingly, the country which was once the frontline defender of privacy, personal freedom, and human rights has now positioned itself differently in its eagerness to fight terrorism.

Figure 3 illustrates the information contents of a very large privately owned and marketed public information system in the United States; sources: [ChoicePoint, 2005], [Washington Post, 2005], and [Fienberg, 2005].

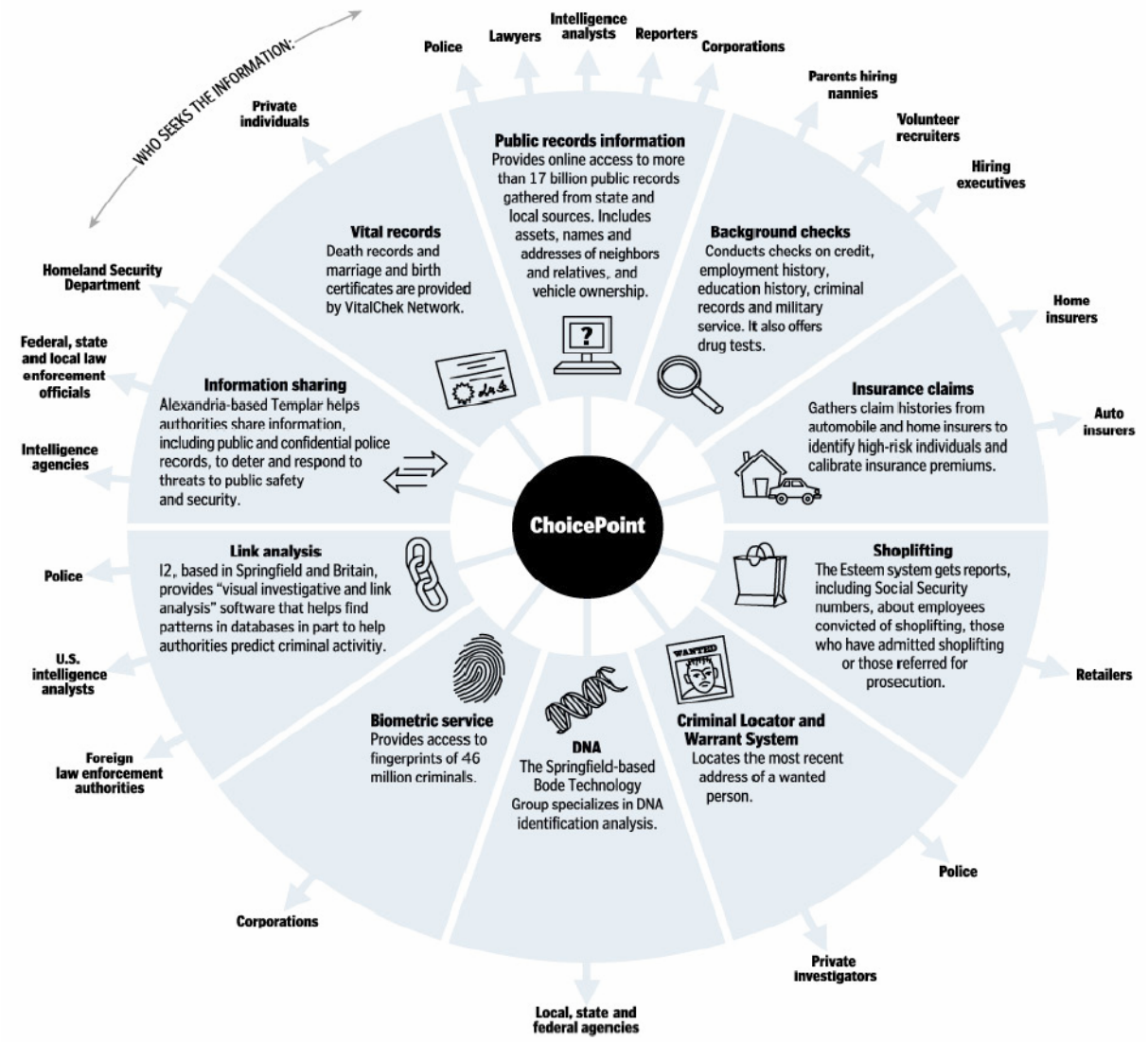

Figure 3. ChoicePoint Data Sources and Clients. Source: Washington Post, January 20, 2005 via [ChoicePoint, 2005] and [Fienberg, 2005].

Should public data be free of charge for the users? Thanks to modern, Internet-based techniques it has become economically feasible to make many public information systems, and their outputs, available to their users (citizens, companies, etc) free of charge. This means that the functionalities and data outputs of public information systems may often be regarded as public goods or free utilities. However, sometimes it may be justifiable, or even necessary, to charge users for the functions performed and the outputs provided by public information systems.

It is becoming more and more common, that it is not only desirable from the users' point of view, but also cost-effective from the service-providers' point of view, to make the use of public information systems free of charge. The main reasons are:

- once the initial investments in a public information system have been made, and the system is in operation, the cost of adding another user is typically very low, close to zero
- the cost of reproducing electronic data, and making an extra copy available via the Internet, is also close to zero

- the cost of charging is often rather high and could easily offset a substantial amount of the revenues that could realistically be obtained by charging the users

Economists were analysing these kinds of situations long before the existence of computerised information systems, e.g. in connection with technical infrastructures and collective goods such as roads, bridges, public transports, public libraries. Actually, public data and public information services should, in principle, be treated analogously to other public goods and services. Sometimes it is desirable, justifiable, and rational to provide the information services of a public information system free of charge, sometimes it is not.

4. Technical Problems and Solutions

At the technical level (cf. Figure 1 earlier in this article), there are few important differences between public information systems and other types of information systems. However, there is one aspect that could be worth mentioning. As was already mentioned, government agencies are usually organised in so-called stovepipes, or silos, both internally and between themselves; the contacts between stovepipes are often weak and retained at a very formal level. This makes it difficult to create user-friendly and efficient processes for managing user requests requiring the attention of several departments or even several agencies, and the citizen/company may have to approach each department/agency separately and do all the necessary coordination himself/herself. The technical problems resulting from this can be illustrated by a public information system from the private sector. Suppose you want to make all arrangements for a holiday trip but do not necessarily want to buy a whole package from only one travel agency. You need to book a hotel and make an airplane reservation. You do not want to complete the airplane reservation until you are sure you have got a binding hotel reservation and vice versa.

It is not likely that the problems caused by organisational stovepipes can be overcome by means of traditional, hierarchical coordination and control. Fortunately, there are new solutions that may help to solve at least the technical aspects of these problems. The Internet itself is probably the best example of a network structure that works surprisingly well without any central control, or at least with the very minimum of such control based on mutual agreements between the actors in the network. The agreements concern interfaces and data exchange protocols rather than the contents and the processes using the network infrastructure. These principles are being further developed in on-going research & development and standardisation efforts with labels such as

- ontologies, concept models, information models, data models
- UML, XML, XBRL: standards for models and exchange formats
- technical, semantical, organisational, and legal interoperability
- IDABC: Interoperable Delivery of European eGovernment Services to public Administrations, Businesses, and Citizens; European Commission [2005]
- OASIS: Organization for the Advancement of Structured Information Standards; OASIS [2005]
- open systems, loosely coupled systems, web services, service-oriented architecture (SOA)

Many of these topics and issues are closely related to topics and issues on the information level (e.g. metadata); cf section 2 of this article. A common approach to all these problems in connection with public information systems, is that solutions have to be based on the assumption that the overall information system architecture is a true network architecture, where all exchange of data, metadata, and control between processes has to be managed without the involvement of central control. All nodes in the network are equal, and they must be able to cooperate on this basis. The potential rewards for solving information system problems on the basis of this assumption are enormous: there will be little need for huge central organisations, large degrees of freedom for the local nodes, and at the same time the whole information potential of physically dispersed data will be available and understandable for everyone anywhere in the network.

5. Organisation and Legislation

In our discussion in the previous section of technical issues in connection with public information systems we repeatedly touched upon organisational problems. This is not by chance. In order to be able to develop complex public information systems of good quality and cost efficiency for all parties involved – citizens, businesses, and governments – we must pay quite a lot of attention to organisational matters. New organisational forms and new legislation may have to be created in order to cope with some of the problems that are still major obstacles to the development of public information systems, not least the e-government systems in the public sector, which are so important for our common future. Who takes the ultimate responsibility for a citizen-initiated process that involves several legally independent organisations? How could we solve urgent identification and authorisation problems in the fastest, cheapest, and safest way? Some countries (e.g. Denmark) have been more successful than others in solving such problems – and we must learn from each other.

6. Some Characteristics of Public Information Systems

In summary, public information systems distinguish themselves from other information systems by means of certain characteristics, e.g.

- the user community is large, partially unknown, and usually heterogeneous
- because of the user heterogeneity, several channels between users and producers often have to be available in parallel
- since the users are partially unknown (and changing over time), rather sophisticated methods have to be used in order to develop and continuously alter the system according to user behaviour and user preferences
- many public information systems will fit the description of a public good and will thus be associated with the problems of collective financing
- public information systems will often contain both public data and highly sensitive private data (about persons and/or companies)
- many public information systems have to be viewed and analysed both from a user/customer/client perspective and from a producer/authority/organisation perspective; the requirements will not be identical, and they may sometimes even be contradictory; such intrinsic conflicts have to be managed – it is usually impossible to completely eliminate them

- public information systems serving citizens and companies, who have a task to complete, must often be able to communicate in a seamless manner with information systems belonging to different "stovepipes" in one or more organisations/agencies
- public information systems are often dependent on well functioning and well integrated information infrastructures in the responsible organisations; these infrastructures must ensure that the public information systems concerned are all continuously and correctly kept up-to-date with regards to the data they rely on

7. Research Implications

This article has analysed public information systems from different perspectives, and we have discussed and exemplified possible purposes and contents of such systems, as well as technical solutions and organisational and legal matters. In just a few sentences public information systems could be defined as information systems that

- provide services to the public (people and companies/organisations)
- empower citizens and companies/organisations to exercise democratic influence
- support governments on all levels to perform their tasks in an efficient and reliable way
- capture, preserve, and make available useful data for analysis, planning, and research

Public information systems call for research on a wide range of topics, such as

- user-centred design, usability, usefulness, citizen perspectives
- customer relations, different forms of interactions
- integration and segregation
- decision support systems, risk and decision analysis
- governance and democracy, political prerequisites
- cooperation between public administrations
- digital archives
- multimedia communications
- quality and security

The interdisciplinary nature of such studies is obvious. Contributions are needed from all kinds of scientific disciplines: humanistic, juridical, psychological, social, political, economic, informatics, technical, medical, mathematical, and philosophical.

Institutions engaging in research on public information systems should attempt to link researchers and other professionals who share an interest in the process, nature, significance, and implications of public information systems design. They should create forums and arenas for cooperative work and debates between excellent researchers from different disciplines, between researchers and practitioners, and between people from different cultures and different parts of the world.

What kind of “products” should be the result of successful research on an interdisciplinary and practically relevant theme such as “public information systems”? One interesting type of output could be well composed *toolboxes* for designing and analysing real-world public information systems. The tools in the toolboxes could be

- well selected and well described theories

- well designed and well proven methods, solutions, and best practices
- software tools that have proved to be useful for implementing theories, methods, etc

All components in a toolbox need not necessarily be the result of developments within the research program. On the contrary, a substantial and highly significant contribution of the research program may be to demonstrate how already available theoretical knowledge and practical tools may be combined into useful and theoretically sound solutions of important practical problems in the field of public information systems.

Another purpose of a toolbox may be to evaluate, compare, and improve the quality and efficiency of proposed or existing solutions in the field of public information systems. For example, it may be possible to develop existing evaluation schemes of e-government solutions into more extensive frameworks, providing more constructive help for those responsible for such solutions.[6]

The toolbox may contain different compartments for different functions and processes, different kinds of users, different types of applications, etc. Sometimes the outputs from a research program could become even more concrete: solution skeletons for a particular type of application, software specifications, prototypes. A research project will typically not result in actual, full-scale software products, but it could very well lead to such products, for example as a result, co-operation with commercial companies may already be initiated during the life-time of the research project.

One of the characteristics of public information systems is that they must be able to adapt themselves to changing needs and preferences of the users. Since the users are typically very heterogeneous as regards prerequisites and needs, and since they are also by and large unknown at design time, planned experiments should be a normal ingredient in the design and more or less on-going redesign of a public information system. It appears to be a good idea for an institution carrying out research on public information systems to establish a scientifically sound environment for such experiments, a test bed or laboratory for public information systems.

Referring back to Figure 1 and Figure 2, we may infer that research results are required, covering

- all three levels of solutions/platforms: services, information, and technical solutions
- all three categories of actors and their different tasks and interactions: citizens, companies, and government authorities

Since public information systems should be a major concern for politicians, information systems practitioners, and the public at large, it is more important than ever that research on such systems is relevant in the sense discussed by many authors[7] during the debate on “rigour versus relevance”. The toolbox concept and the idea of a laboratory for planned experiments, as just presented, could stimulate the research to become more relevant than it might possibly be otherwise.

[6] An example of work in this direction is Rönnqvist & Sundström (2005) starting from a model developed by the Swedish Agency for Public Management, Statskontoret (2004).
[7] See for example Benbasat, I., Zmud, R.W. (1999), Lee, A. (1999), and Wainwright, D. (2000).

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