Chapter 1

INDICATORS OF THE INTENSITY AND DEVELOPMENT OF E-GOVERNMENT BACK OFFICE

Mimoza Bogdanoska Jovanovska, Erman Nuša, Todorovski Ljupčo

Electronic government or e-government is an interdisciplinary scientific field that is on the intersection of computer, information, administrative, and political sciences. In the early stages, about two decades ago, the e-government research was focused on identifying opportunities and developing solutions based on information-communication technology in the public administration domain. More recently, the focus of researchers shifted from the development itself to measurement, evaluation, and benchmarking the development of e-government.

Researchers and practitioners have established a number of indicators and have integrated them in various benchmarks that can be used to assess the success of the process of e-government implementation (Commission of the European Communities 2002, List of eEurope 2002 benchmarking indicators, World Bank 2003). Note, however, that due to the focus of early e-government efforts on rapid achievement of visible results, the evaluation and benchmarking studies are mostly supply-oriented. Most frequently, they deal with the availability and maturity of e-government services (Bongers et al. 2003) and front-office aspects of e-government (Berntzen and Olsen 2009). Many indicators have been introduced with a narrow focus on measuring e-government output, i.e., the front-office implementations of services for citizens and businesses (Accenture 2007). According to Janssen (2010), these indicators provide "useful information from a user perspective, but do not provide any information on how well the back-end of e-government is organized and what can be learnt from others". Moreover, Banister (2007) claims that the narrow focus of e-government evaluation might lead to a slowdown of the development in many countries, especially "if indicators are poorly designed, they risk distorting government policies as countries may chase the benchmark rather than looking at real local and national needs".

Despite the focus of e-government evaluation on front office, a significant body of literature emphasizes the importance of the processes of information and process integration in the back office as the crucial machinery of government (Klischewski 2004). Other researchers (Kubicek et al. 2003, Janssen et al. 2004, Kunstelj and Vintar 2004, Heeks 2006, UN 2008) point out the importance of the improvement of the back-office processes and other hidden e-government aspects for the further development of all other aspects of e-government, including the front-office ones. All these researchers agree that there is a need to establish indicators of e-government development that, instead of focusing on the front office, will capture the development of the back-office, behind-the-scene information systems that support the management and administrative functions of the public institutions.

However, evaluation and benchmarking studies of back-office development are very rare and "the work on back-office measurement so far was limited" (UN 2009). Even more, some of the researches have explicitly excluded the back-office aspects since "it required a separate empirical approach and no adequate indicators could be found in other sources" (SIBIS 2003). Kunstelj and Vintar (2004) identify only six approaches to evaluating back office in their extensive comparative study of e-government evaluation: two with main focus and four with supplementary focus on back office. Bogdanoska-Jovanovska and Todorovski (2011) locate and compare only five back-office evaluation studies (KEeLAN 2002, Nordic Council of Ministers 2003, Birch 2003, Millard et al. 2004, and Gerhson 2008). These studies do not provide quantitative indicators of the back-office development and intensity; they rather measure the back-office connectivity and infrastructure, focusing mainly on connectivity and network preparedness as quantitative indicators.

The main problem addressed in this chapter and the main motivation for performing the work presented within is the lack of approaches that deal with the problem of benchmarking and evaluating development of the back-office aspects of e-government. To address this issue, we will design quantitative indicators of back-office development that would be easy to measure and serve as an extension of the existing e-government benchmarks that focus on the front-office aspects of the e-government development. The central idea is to observe and analyze the flow of information and documents in public administration. This flow can be captured in a form of virtual inter-organizational information-flow networks that can be analyzed using methods for social network analysis that result in a set of quantitative network properties.

To prove that the properties of the information-flow networks relate to the intensity and development-level of e-government back office, we follow what Yin (1984) has described as a case survey approach, in which multiple levels of analysis (such as individual, agency-institution, and network level) are used to develop an in-depth picture of a single case (Provan and Milward 1995). Thus, we focus on an in-depth analysis of the back office in the particular area of public administration, by following the delivery protocols for the public services in the area. We select four areas of public administration in the Republic of Macedonia, where we observe

recent changes and reforms related to the organization of the back-office infrastructure for delivery of public services. In each area, we perform a network-level comparison of the back office before and after the reform or change. Based on this analysis, we aim at identifying those properties of the information-flow networks that strongly correlate with the changes and thus can be used as indicators of back-office aspects of the e-government development.

The chapter is organized as follows. In the next section, we introduce the methodology for establishment and analysis of information-flow networks and illustrate its use on several simple public services. Section 1.2 reports on the results of the empirical test of the proposed methodology performed on public services in four public administration areas in the Republic of Macedonia. Section 1.3 discusses the relevance of the obtained results and puts them in the context of related work. Finally, Section 1.4 concludes the chapter with a summary of contributions and limitations of the presented work and outlines directions for further research.

1.1 METHODOLOGY FOR ESTABLISHMENT AND ANALYSIS OF INFORMATION-FLOW NETWORKS

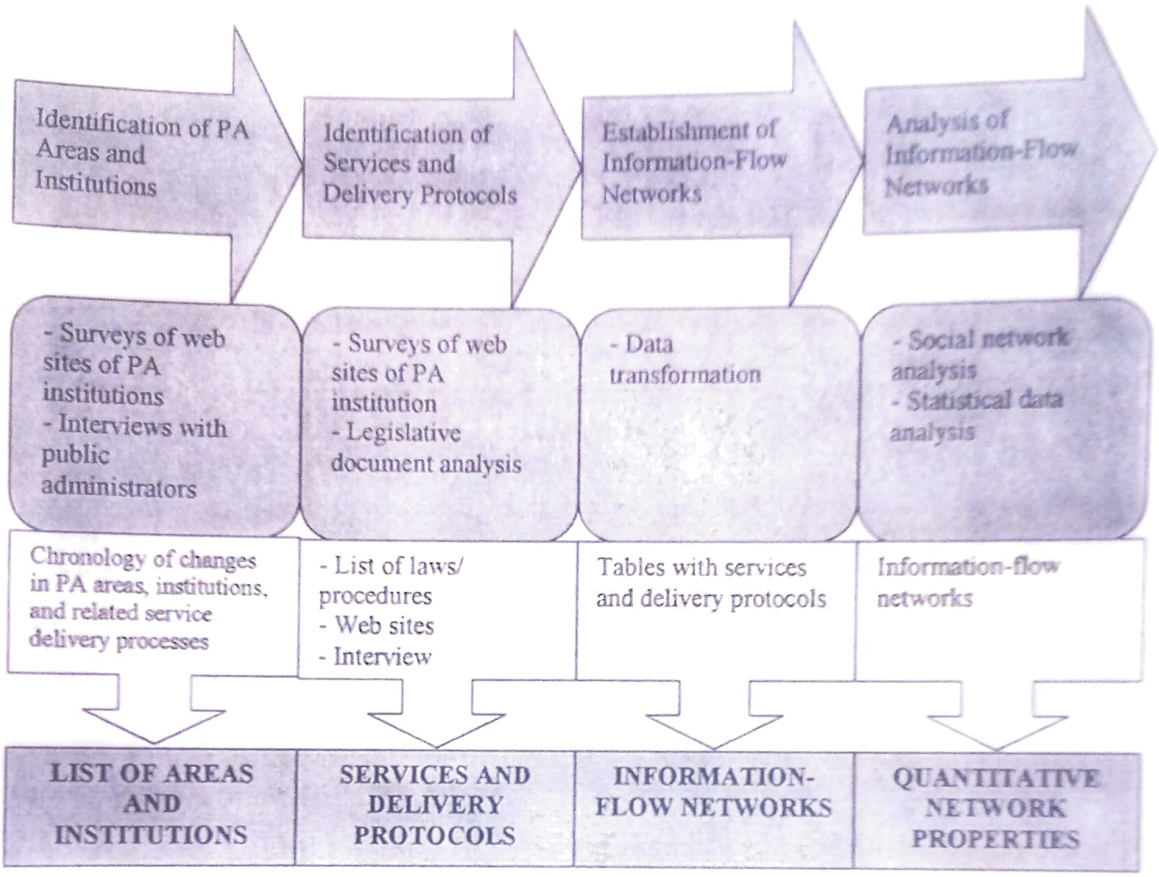
The central idea of the work presented in this chapter is to establish an evaluation framework for the back-office aspects of e-government that is based on following the flow of documents and information within the processes of service delivery. By observing the process of a service delivery, we establish an inter-organizational network where nodes correspond to the stakeholders involved in the delivery process, while edges represent the flow of documents and information among them. We hypothesize that the properties of these networks can serve as indicators of the development of the back office.

We base our network analysis on a large volume of qualitative and quantitative data collected from extensive number of analyses of Web sites and legislative documents, as well as interviews with public administrators. We first aggregate these data by service, then by institution and public administration area, with the purpose of reflecting the general properties of the back office in that area. The aggregate takes the form of an information-flow network, while the measurements correspond to a certain number of carefully selected properties of this network.

Before going into the specifics of the study case, which will be presented in the next section, we introduce the general methodology for establishment and analysis of information-flow networks. The methodological process that we use to establish information-flow networks consists of the four steps depicted in Figure 1:

- 1st step: Identification of public administration (PA) areas and institutions;
- 2nd step: Identification of the public services in the areas and the corresponding delivery protocols;
- 3rd step: Establishment of the information-flow networks;
- 4th step: Analysis of the information-flow networks.

Figure 1. The four steps (blue arrows) of the methodology for analysis of document-flow networks in public administration presented in terms of methods (grey round boxes), inputs (green arrow-shaped boxes), and outputs (pink boxes)



While Figure 1 provides a general overview of the methodology, each of the four methodological steps is presented in detail in the following subsection. Each of them follows the composition of the figure. We first identify the step by establishing its purpose, which is closely related to the intended output. In addition, we present the method for collecting the data that serves as an input for producing the outputs of the methodological step. The presentation of each step is accompanied by an example in the area of civil registry in the Republic of Macedonia.

1.1.1 Identification of Public Administration Areas and Institutions

The first step in the methodological process is the identification of the areas and institutions of public administration that we use as case studies for in-depth research of the corresponding back offices for the delivery of public services. As we have already noted, the title is closely related to the purpose of the methodological step.

so the output of this step is expected to be a list of the public administration areas and the corresponding public administration institutions.

Here, we develop a general methodology that can be applied to an arbitrarily selected public administration area offering different types of public services to citizens, businesses or both. However, for the purpose of this initial study, where focus is placed on illustrating the relation between the back-office changes and changes in a specific type of inter-organizational networks, we select public administration areas and institutions that have undergone a recent technical and/or organizational reform. Thus, we restrict our attention to public administration areas in the Republic of Macedonia, where significant reforms and changes have been undertaken in the period of ten years from 2000 to 2009. This is the period in which the first pioneer steps of introducing e-government in Macedonia have been taken in different public administration areas.

Bearing this first criterion in mind, we follow four criteria for area selection:

- Areas with significant institutional and/or technical changes of the organization of the public delivery processes in the last 10 years;
- Areas with different representative numbers of public services included: a) for citizens, b) for businesses, c) for both (citizens and businesses);
- Areas that involve a representative number of stakeholders from public administration and other sectors in the processes of service delivery;
- Areas with an easily identifiable shared back office, closely related to a single central institution.

To proceed with the selection process, we first perform an extensive study of web sites of national public administration institutions in the Republic of Macedonia. We first established a list of web site addresses and focused on the types of services each of them provided (in terms of citizens, businesses or both). In the period between January and August 2009, we performed a web survey of 33 public administration (PA) institutions, and drafted a chronology of organizational changes for each of them. Second, we conducted personal structured interviews with senior public administrators in these institutions. The questionnaires for these interviews were structured in a way that allowed the evaluation of the four selection criteria outlined above, with special focus on the draft chronology of recent changes in the organization of the service delivery processes and the corresponding organization of the back office. The public administrators provided in-depth explanations of the events in the draft chronology by identifying the changes in the service delivery processes. We performed the interviews in the period between September and December 2009.

The web site survey and the interviews enable us to collect qualitative information relevant for evaluating the selection criteria outlined at the beginning of this section and to select the PA areas for performing the case studies. We select four PA areas for the case studies. The first area of Civil Registry, organized around the Registrar Office, includes services for citizens; the second area of Business Registration,

organized around the Central Register, includes services for businesses, while the areas of State and Social Pensions and Taxations, organized around the Pension and Disability Insurance Fund and the Public Revenue Office, include services for both citizens and businesses. In the next section, we provide further details about the identified areas and the corresponding case studies (see also Table 4).

Note, finally, that the selection criteria used in this first step are completely independent of the next three steps in the methodology for the establishment and analysis of information-flow networks, presented in the following sections. When used in different benchmarking or evaluation contexts, the methodology can use a different set of criteria to select public administration areas and institutions.

1.1.2 Identification of Services and Delivery Protocols

The second step in the methodology process corresponds to the task of identifying the public services and the corresponding service delivery protocols in each of the PA areas listed at the output of the first step. Note that compiling an exhaustive list of all services in a certain PA area can be a difficult task, often rendered impossible due to the complexity of public administration. Namely, the public services at different levels of complexity can be identified in each area: from elementary ones that allow stakeholders to obtain a single document to more complex ones that correspond to stakeholders' particular interests or life events. For the purpose of this study, we limit our attention to the complex services affiliated with the central institution identified in each PA area.

To achieve this goal, we start by performing a survey of the central institution of the PA area. We conduct a more inclusive web search of other public administration web sites to locate legislative acts related to the specific PA area. In particular, we survey the web site of the central institution related to the PA area to obtain the initial list of public services and match them against the results of the web survey of the national-level portal of public services (Uslugi 2010) and web searches through the central web site of the Official Gazette of the Republic of Macedonia (Pravo 2010) to identify the related legislative acts and delivery protocols.

After collecting all legislative acts related to the PA area of interest, we performed an in-depth document analysis. The main purpose of this analysis was to locate the sections and articles of the legislative acts that outline the delivery protocols for public services in terms of the documents and applications that are necessary for the delivery of a specific process. Due to the high complexity of the inter-relations between different legislative acts and documents, it took us nine months from January to September 2010 to build an initial list of public services and delivery protocols for the four selected PA areas.

Table 1: Two examples of service delivery protocols. The table presents the delivery protocols for two public services in the area of civil registry, provided by the central institution of the Registrar Office of the Republic of Macedonia. Rows in the table refer to the document flow that takes place in the process of service delivery. The first (leftmost) column refers to the stakeholder that initiates the document flow (source), while the third column refers to the stakeholder that receives the document (destination of the document flow). The second column denotes the stakeholder type: PA denotes the public administration institution and OTHER denotes all the others. The fourth column identifies the type of the document flow channel: T denotes traditional and E denotes electronic. The fifth (rightmost) column refers to the document title. The first two rows of each service protocol refer to the service title and related legislative acts.

Service initiator	**Institution**		**Service channel**	**Document**
	Type	**Name**		
Service 1: Issuance of marital status certificate				
- Law on Register Records, the Official Gazette of the Republic of Macedonia No. 8/1995 (Article 28), 38/2002, 66/2007, 98/2008 (Article 1) and 67/2009.				
CITIZEN	PA	Registrar Office	T	Application (in person)
	OTHER	Notary	T	Application (by another person) certified by notary
	PA	Ministry of Interior Affairs	T	Identity card
	OTHER	Bank	T	Payment notice
Service 2: Registration of marriage that has not been concluded in the Republic of Macedonia				
- Law on Register Records, the Official Gazette of the Republic of Macedonia No. 8/95 (Article 20), 38/2002, 66/2007, 98/2008 (Article 1) and 67/2009; - Guidelines for managing, protecting and keeping the registrar books and manuscripts.				
CITIZEN	PA	Ministry of Interior Affairs	T	Identity card
	PA	Registrar Office	T	Marriage certificate
	PA	Registrar Office	T	Application for marriage registration
	OTHER	Bank	T	Payment notice issued by the bank
	OTHER	Notary	T	Verification of translated documents
REGISTRAR OFFICE	PA	State Statistical Office	T	Notice of marriages at the State Statistical Office

Based on these web surveys and the document analysis, we draft an initial list of the public services in the PA area of interest with the corresponding delivery protocols. In the next step, we have to check the delivery protocols, stemming from the legislative acts, against the actual practice of service delivery processes as performed by public administrators and their discrete decision rights in these

processes. To this end, we performed unstructured face-to-face interviews with the public administrators directly involved in the processes of service delivery. In this phase, we also took the opportunity to clarify dilemmas and open questions related to the numerous ambiguities in the legislative acts. The main focus of the interviews was on checking upon the documents that circulate between the stakeholders involved in the process of service delivery.

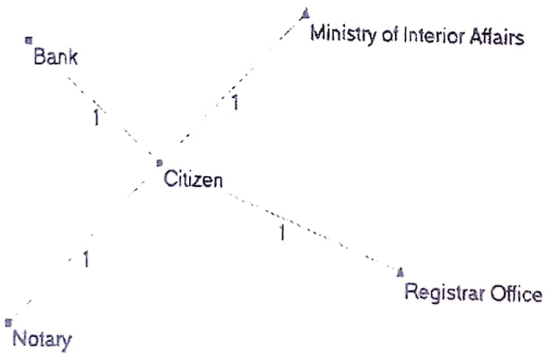
The result of the interviews was a final list of public services in the PA area of interest with the corresponding service delivery protocols. Each protocol identifies the documents involved in the process of public service delivery by identifying the title of the document, stating the institution that issues the document and its type (PA institution or other institutional stakeholder from the private or NGO sector) and the form of the document: traditional (T) or electronic (E).

Note that the service delivery protocols from Table 1 are also often used for modeling processes when reengineering business processes or developing information systems that support service delivery (Kovačič and Peček 2007). The information collected here is not sufficient for developing a complete model of the process, but a complete process model, if available, can be used to extract the delivery protocols needed for establishing information-flow networks.

1.1.3 Establishment of Information-Flow Networks

In the third methodological step, we transform the service protocols from Table 1 into information-flow networks. These are virtual inter-organizational networks of information and document flows in the public administration and e-government back office, i.e., the flow between public administration bodies and other stakeholders involved in the process of service delivery.

Figure 2: Information-flow network for the service "Issuance of marital status certificate".

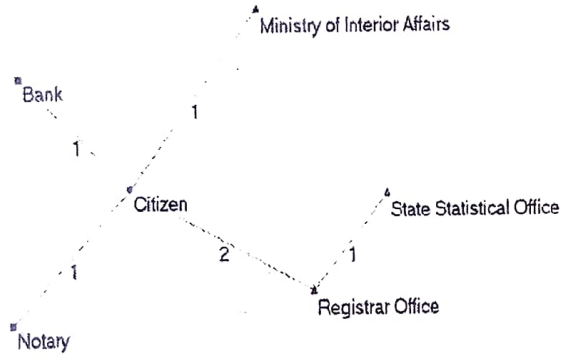


Thus, the nodes in the information-flow networks represent the stakeholders involved in the process of service delivery. In particular, the nodes involved in the delivery of the service "Issuance of marital status certificate" from Table 1 include the citizen interested in the marital status certificate, two PA institutions – the Registrar Office and the Ministry of Interior Affairs, and two OTHER institutions –

Notary and Bank. The edges in the information-flow networks correspond to the flow of information and documents between the stakeholders (nodes) involved in the process of service delivery. In the particular example of the marital status certificate from Table 1, there are four edges in the network, each corresponding to one of the document flows (rows) listed in the delivery protocol.

Information-flow networks can be used to visualize the service delivery protocols as depicted in Figure 2. The graph in the figure depicts the information-flow network for the example of issuing a marital status certificate from Table 1. For a visualization of the network, we use the Pajek software package (Batagelj and Mrvar 2007) for social network analysis. The nodes of the network in Figure 2 correspond to the five stakeholders involved in the delivery of the marital status certificate (i.e., the stakeholder listed in the first and third column of the delivery protocol table), while node shapes correspond to stakeholder types (i.e., second column of the delivery protocol table): triangle-shaped nodes represent PA institutions, circles represent Citizen, and boxes represent OTHER institutions. Edges represent the flow of documents and information by connecting nodes that correspond to the source and destination stakeholder for the particular document flow. Each row in Table 1 that corresponds to the service of issuing a marital status certificate is depicted as a single edge (information flow) in the network presented in Figure 2. The number next to the edge corresponds to the number of documents involved in the flow.

Figure 3: Information-flow network for the service "Registration of marriage that has not been concluded in the Republic of Macedonia".



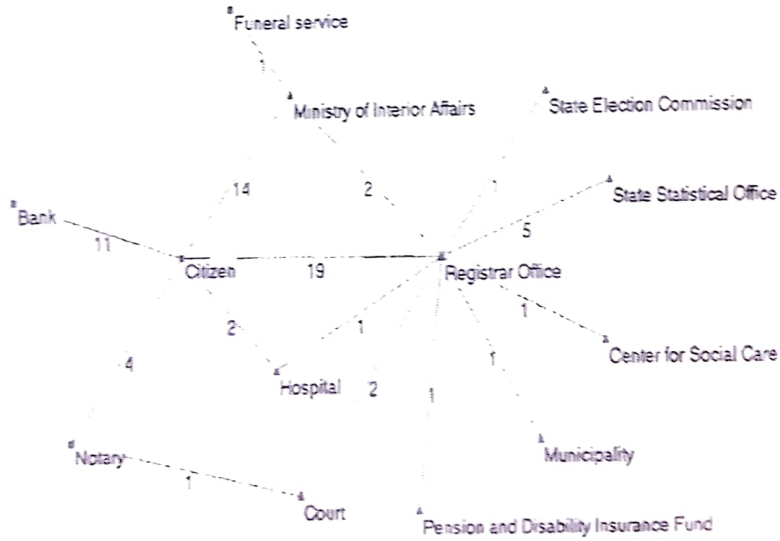
Similarly, Figure 3 depicts the information-flow network of Service 2 from Table 1. The network is established following the same procedure as for the previous one. In this particular case, we face a situation where two stakeholders – the citizen and the Registrar Office – exchange two documents, so the number next to the corresponding network edge equals 2.

Figure 4 illustrates the process of integrating two networks for individual services into a joint one. More formally, the joint network is defined as follows. The set of nodes in the joint network is the union of the sets of nodes in the networks of

individual services. The set of edges in the joint network is the union of the sets of edges in the networks of individual services. The number next to the edge in the joint network equals the sum of the numbers next to the same edge in the networks of individual services. Following this simple procedure, we can integrate an arbitrary number of networks of individual services into a joint single network, corresponding to the whole PA area.

Figure 4: Joint information-flow network for the two services of "Issuance of free marital status certificate" and "Registration of marriage that has not been concluded in the Republic of Macedonia".

Figure 5: Joint information-flow network for the public administration area of civil registry in the Republic of Macedonia.



The layout of the joint network in Figure 4 (for the two services from Table 1) is identical to the one from Figure 3 that depicts the individual network for Service 2, since the set of nodes of the network in Figure 3 already includes all the nodes of the

network from Figure 2. Note, however, the difference in the numbers next to the edges: they equal the sum of the numbers next to the corresponding edges in each of the networks for individual services. Following the procedure for establishing joint networks for multiple services, we can build the joint network for the 12 services in the whole civil registry area, depicted in Figure 5.

1.1.4 Analysis of the Information-Flow Networks

In the fourth, final step of the methodology, we analyze the properties of the information-flow network. To this end, we apply social network analysis methods. Before going into details about properties being measured, we present a brief introduction into social network analysis.

1.1.4.1 Social Network Analysis

Social network analysis (SNA) examines the structure of relationships between social entities. A fundamental axiom in network analysis is the notion that actors are not independent but rather influence one another. According to Borgatti and Li (2009), there are many aspects of and mechanisms for this, but perhaps the most commonly invoked is the mechanism of direct transmission or flows. One of the definitions describes SNA as "analysis of social relations" in networks by using "a set of mathematical methods and distinctive methodology that encompass specific techniques for collecting data, statistical analysis and visual representation" (Nooy et al 2005). According to this, SNA has become a powerful methodological tool alongside statistics, with a main goal of "detecting and interpreting patterns of social ties among actors".

The key concept in SNA is the term *network*. Some general definitions refer to the term as "a set of actors connected by a set of ties" (Borgatti and Foster 2003) or "a set of socially-relevant nodes connected by one or more relations" (Marin and Wellman 2010). Social-relevant *nodes* are elements of the social network. They can be also referred to as *actors*, *nodes*, *points*, or *vertices*. As elements or members in the social network, nodes are "units that are connected by the relations whose patterns are being studied" (Marin and Wellman 2010). The actors can be single entities (people/persons, computers, concepts, URLs) or collective social units (group of people in a society, departments within a corporation, public service agencies, or nation/country/state). "*Ties* are connected pairs of actors" (Borgatti and Foster 2003) representing relations established between nodes. They can be also referred to as *lines*, *ties*, *edges*, *arcs*, *relations*, or *connections*. The range and type of ties can be quite extensive: collaborations, friendships, trade ties, web links, citations, resource flows, information flows, exchanges of social support, or any other possible connection between particular nodes (Wasserman and Faust 1994). Borgatti et al. (2009) identify flows as relations based on exchanges or transfers of resources, information, or influence between the network nodes.

We commonly represent networks as graphs in order to visualize connections between the nodes. Graphs and related mathematical theory also allows us to formally define and observe a range of network properties, such as distance,

direction and density (Scott 2000) or different types of network and node centrality (Freeman 1978). Network properties are generally classified in two groups of properties of the whole network and properties of the individual network nodes. What follows is a presentation of the network properties used in our study.

Network size. Marsden (1990) defines network size as a basic indicator of SNA. The term *size*, when applied to network, represents the count of the members in the network, i.e., the number of actors (nodes) or, less commonly, the number of edges.

Density is one of the most widely used concepts in graph theory (Scott 2000) and is defined as "the number of ties in a graph expressed as a proportion of the maximum possible number of ties" (Scott 2000). This is measured as the proportion of the actual number of links compared with the total possible number of links in each network. The greater the number of edges between positions, the higher the density (Morrissey et al 1994). The more points that are connected to one another, the higher the network density will be. The density index ranges from 0 (absence of edges) to 1 (all possible edges present). The maximum density of 1 is obtained if the graph is complete: the situation when each actor in a graph is connected directly to every other actor is called a *complete graph*. Such completion is very rare, even in very small networks. The concept of density is an attempt to summarize the overall distribution of ties in order to measure how far from this state of completion the graph is. So, network density denotes the strength of connections among units in a network (Marsden 1990).

Centralization as one of the most important structural attributes of whole social network (Freeman 1978) is a particular property of the graph structure as a whole. Centralization refers to the overall cohesion or integration of the graph that can be more or less centralized around a particular node or set of nodes (Scott 2000). Freeman (1978) relates the network centralization with the tendency of a single node to be more central than all others nodes in the network. Thus, the high (maximal) degree of centralization (1) is achieved when all nodes in the whole network are connected with all possible ties that can be established to one single node.

According to Nooy et al. (2005) the notions of centralization are strongly related to the simple idea of *distance* and *density*. In this sense, when studying the *centralization* of a network in relation to the idea of *distance*, the network is highly centralized if there exists a clear boundary between its central and peripheral parts. The concepts of *density* and *centralization* refer to differing aspects of the overall "compactness" of a graph. Density describes the general level of the cohesion in a graph, while centralization describes the extent to which this cohesion is organized around particular focal actors. Centralization and density are important complementary measures.

Centrality of individual nodes. While size, density, and centralization represent properties of the whole network, centrality measures are used to assess the properties of individual nodes. Centrality measures that are studied in SNA are:

- *Degree/Strength:* represents the amount of links that a particular node possesses in a network. The analogue to degree in a weighted network, strength is the sum of a node's edge weights;
- *Closeness:* represents the average distance of each node from all other nodes in the network; it determines how "close" a node is to other nodes in a network by measuring the sum of the shortest distances (geodesic paths) between that node and all other nodes in the network. Closeness lies in the interval [0.1]: nodes with closeness approaching 1 are nodes with a short distance from the other nodes, while nodes with low closeness are distant from the other nodes. For instance, if a node is directly connected to every other node, then its closeness is 1, while an isolated node has the closeness equal to 1/n.
- *Betweenness:* represents the number of the shortest paths in a network that traverse through that node; it determines the relative importance of a node by measuring the amount of traffic flowing through that node in comparison to other nodes in the network. This is done by measuring the fraction of paths connecting all pairs of nodes and containing the node of interest.

1.1.4.2 Properties of the Information-Flow Networks

We perform social network analysis of the information-flow networks, established in the third methodological step, in order to measure the entire network properties related to network size, density, and centrality, as well as properties of individual nodes related to their centrality. We measure the size of the network in terms of the number of nodes and number of edges. We measure the centrality of the network in terms of the network closeness and betweenness, while the degree, closeness, and betweenness of individual nodes are used to measure their centrality in the network.

Table 2 presents the measurements of these properties for the joint information-flow network for the public administration area of Civil Registry depicted in Figure 5. The first part of the table (a) reports five properties of the whole network: size in terms of the number of nodes and edges, density, and two aspects of network centrality – closeness and betweenness. The second part of the table (b) reports on three properties that measure the centrality of individual nodes in the network: degree, closeness, and betweenness. The first two columns in (b) refer to the node and its type, while the figures in the last three columns refer to the values of the three observed properties of the node.

For the purpose of comparative analysis of the networks, we aggregate the values of the network properties by network type (entire network or individual nodes) as presented in Table 3. The first part of the table with the properties of the whole

network is the same as Table 2(a), since all these properties have already been aggregated at the network level.

The aggregation of the values is realized in the part related to individual nodes. So we create three categories of stakeholders:

- "Citizen" corresponding to the initiator of the service; also the business owner in case of services for businesses;
- "PA institutions" include institutional stakeholders from the public administration domain;
- "OTHER institutions" include other institutional stakeholders, such as private companies, NGOs, or foundations.

Table 2: Properties of the joint information-flow network for the public administration area of civil registry in the Republic of Macedonia.

(a) Properties of the whole network

Network properties	Values
Size (number of nodes)	13
Size (number of edges)	16
Density	0.205
Closeness	0.673
Betweenness	0.721

(b) Properties of the individual network nodes

Stakeholder (node)	Node type	Degree	Closeness	Betweenness
Citizen		0.417	0.632	0.268
Hospital	PA	0.167	0.522	0.000
Registrar Office	PA	0.833	0.800	0.763
Ministry of Interior Affairs	PA	0.333	0.571	0.167
Bank	OTHER	0.083	0.400	0.000
State Statistical Office	PA	0.083	0.462	0.000
Notary	OTHER	0.167	0.429	0.015
Municipality	PA	0.083	0.462	0.000
Court	PA	0.167	0.500	0.045
Center for Social Care	PA	0.083	0.462	0.000
Funeral service	OTHER	0.083	0.375	0.000
Pension and Disability Insurance Fund	PA	0.083	0.462	0.000
State Election Commission	PA	0.083	0.462	0.000

For each category, we aggregate the properties of the nodes belonging to that category using the average as the aggregation function. For example, the degree of the category "OTHER institutions" in Table 3 equals the average degree of the three nodes belonging to this category: Bank, Notary, and Funeral service (see Table 2).

Table 3: Aggregated properties of the joint information-flow network for the public administration area of civil registry in the Republic of Macedonia.

		Network property	Value
Entire network		Size (#nodes)	13
		Size (#edges)	16
		Density	0.205
		Closeness	0.673
		Betweenness	0.721
Individual nodes	*Citizen*	Degree	0.417
		Closeness	0.632
		Betweenness	0.268
	PA institutions	Degree	0.213
		Closeness	0.522
		Betweenness	0.108
	OTHER institutions	Degree	0.111
		Closeness	0.401
		Betweenness	0.005

1.2 EMPIRICAL TEST OF THE METHODOLOGY

To test the utility of the presented methodology, we follow a three-level experimental setup. As already stated, the experimental setup follows the case survey approach (Yin 1984, Provan and Milward 1995). In particular, at the first level of the experiments, we select four public administration areas in the Republic of Macedonia. The selection takes into account the four criteria established in Section 1.1.1. Most importantly, we select areas where significant reforms have been observed in the last decade. These reforms are related to the change of the institutional setup or back-office organization in the processes of service delivery. At the second level of analysis, we apply the methodology for establishing information-flow networks in each of the selected public administration areas. For each area, we establish and analyze two networks corresponding to two situations: the *current* situation, which reflects the service delivery protocols after the reform, and the *prior* situation, reflecting the service delivery protocols before the reform in the selected public administration area. Moreover, we establish joint information-flow networks for the service delivery protocols in all four selected areas. Finally, at the third analysis level, we focus on the differences between the properties of the current and prior information-flow networks. As a result of the third-level analysis, we identify the properties of the information-flow networks that can be used as indicators of back-office development.

Table 4 presents the four selected areas of public administration used in the experiments: civil registry, business registration, social and state pensions, and taxation. The table identifies the central public administration institution in the particular area, presents the number of related public services, and the number of

stakeholder institutions involved (by institution type, PA and other institutions) in the processes of service delivery.

Table 4: The scope of the empirical test of the methodology

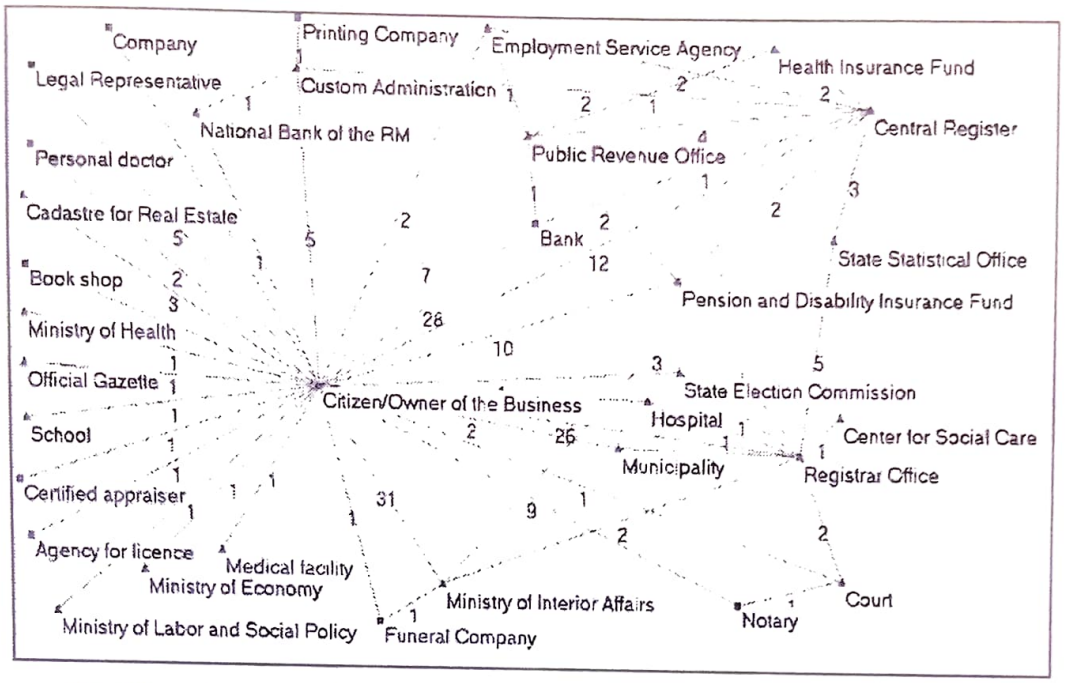
Services for	Area	Central Institution	Services	Number of institutional stakeholders	
				PA	OTHER
Citizen	Civil Registry	Registrar Office	12	9	3
Business	Business Registration	Central Register	13	10	6
Citizen and Business	State and Social Pensions	Pension and Disability Insurance Fund	8	11	4
	Taxation	Public Revenue Office	7	13	3
Total	4	4	40	-	-

In the civil registry area, the reform took place in 2010 and involved the establishment of the Registrar Office at its core. Similarly, in the business registration area, the reform took place in 2006 and involved the establishment of the Central Register at its core. The change in the area of Social and State Pensions is marked by a minor change that occurred as a result of the legislative reform: a single direct link that integrates the back-offices of two PA institutions – the Pension and Disability Insurance Fund and the Public Revenue Office. Finally, the reform of the taxation area took place in 2009 and involved the establishment of intensive back-office interconnections between several PA institutions, including the Central Register, the Health Insurance Fund, the Pension and Disability Insurance Fund, and the Employment Service Agency; as well as with the commercial banks involved in the service delivery processes of salary disbursement.

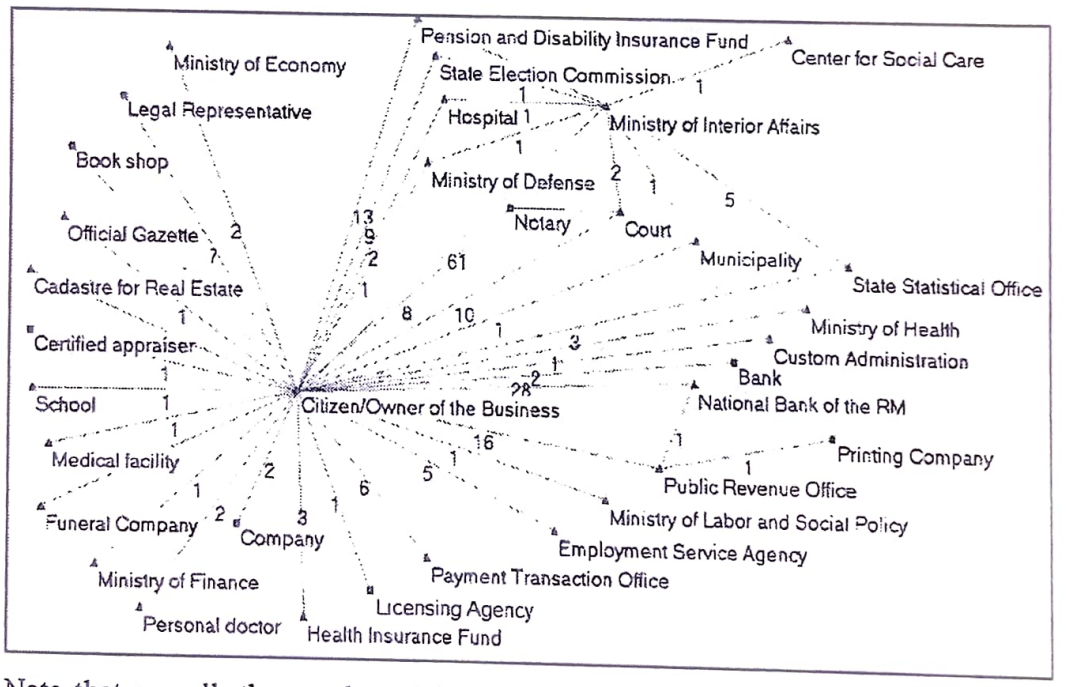
Table 10 presents the comparison of the properties of the current and prior networks in the civil registry area. The top five rows of the table report the values of the network properties that refer to the whole networks. The rows below report the values of the network properties that refer to individual nodes or group of nodes of the same type (citizen, PA institutions, and other institutions). The fourth and fifth columns (labeled with current and prior, respectively) report the network properties of the current and the prior network. The last three columns report on the difference of the properties in its absolute value and as a relative change in percentages. We also employ the Mann-Whitney test for assessing the statistical significance of the observed difference. The last column reports the p-value obtained with the Mann-Whitney test for cases where enough observational samples, i.e., nodes in the corresponding group of nodes, were available for performing the test.

Figure 6: The joint information-flow networks for the four public administration areas after (a) and before (b) implementing the reforms.

(a) The current network



(b) The prior network



Note that overall, the number of institutions involved in the processes of service delivery remains unchanged. When we observe the whole set of institutions in the joint network, the changes in the number observed for individual areas cancel each

other. On the other hand, the overall number of information-flow connections between institutions clearly increases by 26.2%. Thus, the overall density of the joint network increases and this increase is due to the increased interconnectivity among the institutional back offices.

Table 5: Comparison of the properties of the current and prior joint networks for the four public administration areas.

		Network property	Current	Prior	Difference and relative change		p-value
Whole network		Size (#nodes)	33	34	-1	-2.9%	
		Size (#edges)	53	42	11	26.2%	
		Density	0.100	0.075	0.026	34.0%	
		Closeness	0.827	0.917	-0.090	-9.8%	
		Betweenness	0.835	0.938	-0.103	-11.0%	
Groups of nodes	Citizen	Degree	0.875	0.939	-0.064	-6.9%	
		Closeness	0.889	0.943	-0.054	-5.7%	
		Betweenness	0.844	0.942	-0.098	-10.4%	
	PA	Degree	0.091	0.053	0.038	70.5%	**<0.001**
		Closeness	0.488	0.497	-0.009	-1.8%	0.272
		Betweenness	0.013	0.006	0.008	134.3%	0.085
	OTHER	Degree	0.044	0.034	0.010	28.3%	**0.003**
		Closeness	0.469	0.475	-0.006	-1.2%	0.064
		Betweenness	0.000	0.000	0.000	n/a	1.000

Moreover, there is a notable decrease of the whole network centralization both in terms of closeness (9.8%) and betweenness (11%). This indicates that the observed reforms lead to the decentralization of the responsibility in the decision-making, related to the processes of service delivery.

Note also that there is a notable decrease (between 6.9% and 10.4%) of the citizen centrality, the statistical significance of which cannot be estimated due to the small number (less than 5) of corresponding nodes in the networks. However, it is obvious that this change is due to the reduced responsibility and burden put on the citizen in the service delivery processes. Many documents that citizens had to take care of in the previous network are now being exchanged between other institutions directly through the communication channels among the corresponding back offices.

Finally, the reduction of the citizen burden is clearly reflected in the statistically significant and large increase of the average degree of the public administration (70.5%) and other institutions (28.3%) involved in the service delivery processes. On the other hand, we also observe a smaller and not so significant decrease of the closeness centrality. The decreased closeness of the nodes is due to the network decentralization, which is only partly compensated by the increased density of the network interconnections. Finally, the reduced role of the citizen in the network is also reflected in the huge increase of the average betweenness of the public administration institutions.

1.3 ANALYSIS AND DISCUSSION OF EMPIRICAL RESULTS

As the emphasis of our research is put on inter-organizational relations in public administration, which are observed via the information-flow of service delivery protocols, we concentrated on the centralization (and decentralization) measures of the observed networks. The longitudinal observation of the networks along the legislative changes indicates notable structural changes in the joint network for the four public administration areas. Note that the considered legislative reforms are of different types. While two of them deal with the institutional setup of the service delivery processes, the other two explicitly deal with the issues of back-office integration: one of them introduces minor and the other major back-office integration efforts for the institutions in both the public and private sector.

The network size property is usually used for basic information about the observed network. The changes in the number of nodes are directly related to the changes in the institutional setup for service delivery, while the changes in the number of edges typically correlate with back-office integration due to legislative reforms. However, a simple observation of the results relative to the size of the network (changes in the number of nodes or edges) refers only to the reorganization of the service delivery processes and not to the core, i.e., the content of the changes. A simple observation of these values does not provide an answer to the question whether these changes represent core reorganization changes in the interconnections between the stakeholders involved in the service delivery processes.

Another measure that we employ is the network density, i.e., the proportion of the actual and potential linkages among the network nodes. The network density in the information-flow networks identifies the extent to which different stakeholders participate in the service delivery: low values indicate a low-level interconnection between the stakeholders and high values indicate widespread interconnections. We have observed a notable increase of network density in the joint network. However, although network density is a valid measure for connectivity within the network, the produced values do not disclose what kinds of stakeholders are interconnected. The results only indicate that reforms induce higher-level stakeholder interconnection. Hence, we can conclude that this measure can be used but in combination with other network properties measures.

The interconnectivity of the network, measured in terms of the closeness centrality, points to network centralization if the values are high (values close to 1), and to decentralization if the values are low (values close to 0). Following a longitudinal observation of the network changes, the increase in the closeness values indicates increased network centralization. The closeness has a decreasing tendency; a fact that implies that the observed reforms cause decentralization of the information-flow networks. Similarly, the betweenness as a network property that measures the centrality of the entire network indicates the extent to which the network linkages are dominated by a central actor (values close to 1), versus a network in which the linkages are diffused and not channeled through one organization or a small subgroup of organizations (values close to 0). Thus, a high central network with one of the few high central nodes normally has high values for the betweenness, and vice

versa. The betweenness has a decreasing tendency that confirms the network decentralization observed above.

However, even though at first sight the whole-network centrality can be an appropriate indicator of the public administration maturity, we still do not have information about which nodes' roles have been changed. In other words, we have not managed to show that this centrality decrease (or decentralization) implies changes in public administration in the direction of increased back-office connectivity. For this purpose, we looked further into the properties of individual nodes and groups of nodes.

The change in the centrality measures of the "citizen" node clearly indicates the decrease in responsibility and burden related to his/her role in the service delivery processes. Reforms clearly reduce the citizens' role in these processes and move the responsibility burden towards the institutional stakeholders: public administration and other institutions.

Thus, the average degree and betweenness of the public administration institutions shows a large increase, while the average closeness shows a slight decrease. Our interpretation of these results is that due to the increased number of edges between PA institutions after the reforms, PA institutions have obtained a more central/responsible role, and those nodes are now 'more in-between' other nodes. The decreased value of closeness points to the fact that there is not enough closeness between the PA nodes, which indicates further room for improvements of the back-office integration of the public administration institutions in the Republic of Macedonia.

Similarly, the average degree of the nodes representing other institutions notably increases, while the other two measures of centrality remain almost unchanged. These observations might originate from the fact that a small number of other institutions, relative to the number of the PA institutions, are involved in the service delivery processes.

After discussing the changes of whole-network and individual-nodes properties, we can synthesize the analysis of the results as follows:

- The simple observation of the whole-network properties, in general, points to decentralization of the network. But, the whole network properties cannot be used as a single proper measure indicator of the back-office maturity, as they fail to explain what kind of changes have been realized in the network and why (size of network), what is interconnected (density and closeness) and how they are interconnected (betweenness).

Similar to Kratke's conclusion that "the methodological instruments used in network analysis for individual nodes offer plenty of opportunities to describe the 'positioning' of particular players or groups" (Kratke 2002), our discussion offers more convincing and "goal-directed" results, related to individual nodes.

- We observe a consistently decreasing role of the "citizen" as an individual node in the information-flow networks after the reforms. This decrease is

always compensated by an increased role of the PA institutions: the increase in the values of degree and betweenness signals that these nodes have obtained more important roles in the network, while the decrease in the values of closeness indicates a low level of connectivity of the PA nodes among themselves. The role of the other institutional stakeholders also increases, while the connectivity inside the group of other institutions remains unchanged.

The roles of the 'citizen' and the 'PA institutions' in the process of service delivery are opposite, depending on the type of public administration in which a particular service delivery is realized. Moreover, the structure of the network built by service delivery protocols depends on the type of public administration, as follows:

- The bureaucratic public administration delivers services in the traditional way, where a citizen takes the most active role. The citizen is in the center of the information-flow network; he/she is the one who realizes the information-flow between PA institutions, which is why the network, which is created by the service delivery protocols, is a very centralized network with the citizen being the "star", while
- the modern e-government "citizen-centered" public administration moves the activity towards the PA institutions by assuming much greater responsibility; PA institutions realize the information-flow amongst themselves via back-office interconnection. Citizen "loses" a great deal of his/her activities and consequently his/her central role in the network. In this case, the network with its service delivery protocols realized in those circumstances is decentralized.

Hence, because our results show that: a) the networks created after the reforms (the 'current' situation) are decentralized (the closeness and betweenness decrease) with a high level of links (the density increases), and b) the role of 'PA institutions' increases (PA institutions receive a more mediatory role), while at the same time the role of the 'citizen' decreases, we can conclude that the network properties which measure centrality and centralization can be used as appropriate indicators for measuring the development of the field. The drawing of network configurations related to service delivery protocols, with a longitudinal dimension (the 'current' and the 'prior' networks), gives an overview of network dynamics. Note that in the future, we can use these quantitative indicators for benchmarking the back-office development.

1.4 CONCLUSION

In this chapter, we focus on the task of benchmarking back-office aspects of e-government development. The overview of the state of the art in the area of e-government benchmarking and evaluation, presented earlier in the paper, shows that despite the important role of back office in public administration for the maturity of e-government, there is a lack of approaches to back-office benchmarking. The rare studies on back-office evaluation provide qualitative assessments that are difficult to

replicate in other sectors and countries. There is an obvious lack of quantitative and easy-to-measure indicators of the back-office intensity and development level.

To fill this gap, we have designed and presented a novel methodology for evaluating e-government back office that would result in simple and still relevant set of indicators of the back-office intensity and development level. The methodology is based on the central idea of information-flow networks, i.e., networks of the flow of documents and information between the stakeholders involved in the processes of the delivery of public services. The proposed methodology combines content analysis, interviews, and social network analysis methods to provide a simple procedure for establishing and analyzing the information-flow networks in public administration.

We illustrate the use of the methodology by building information-flow networks for the delivery protocols of 40 public services, stemming from four public administration areas in the Republic of Macedonia: Civil Registry, Business Registration, State and Social Pensions, and Taxation. Each public service is analyzed at two time points, before and after the implementation of a legislative reform in the corresponding area. In this way, we have established 90 information-flow networks: 80 correspond to individual public services (each of the 40 services has been analyzed before and after the reform), 8 networks represent the current and prior (pre-reform) situation in the four public administration areas included in the study, and finally, 2 joint networks representing all the areas simultaneously.

We then analyzed the scale and significance of the changes of the structure, topology, and properties of the two joint information-flow networks induced by the reforms. We were especially interested in the scale and significance of the change of the values of the basic network properties, such as size and density, as well as the more advanced centrality properties of the whole network and of the individual nodes. The results of the analysis led to the conclusion that legislative reforms and improvement of the institutional setup of the public administration back office have the following impact on the information-flow networks:

- Density of the information-flow networks increases;
- The centrality of the information-flow networks, measured in terms of the network closeness and betweenness, decreases;
- The centrality of the citizen node, measured in terms of its degree and betweenness in the information-flow network, decreases and moves towards increasing the average centrality of the network nodes representing public administration institutions;
- Nodes representing other (mostly private sector) institutions do not change their properties or the significance of the change cannot be evaluated due to the small number of such nodes in the information-flow networks considered here.

These conclusions clearly show that our methodology provides a set of indicators based on seven crucial properties of the information-flow networks. These

properties are: network density, network centrality in terms of closeness and betweenness, the centrality of the citizen node, and the average centrality of the public administration nodes in terms of degree and betweenness. All these network properties represent candidates for quantitative and easy-to-measure indicators of the back-office intensity within e-government. Since we obtain their values following a strict procedure, we can obtain their values in various sectors and countries at arbitrary time points; they can be integrated and used within regular e-government benchmarking efforts.

Let us conclude the chapter by emphasizing several limitations of the presented work and outlining the directions of further work necessary to address them. Our study is limited to the analysis of the back-office environment in four public administration areas in the Republic of Macedonia. An immediate venue for further research is to apply the proposed methodology for the establishment and analysis of information-flow networks in other countries with more mature back-office and service-delivery environments and therefore more mature e-government and other public administration areas. Application of the methodology in Slovenia would be an immediate step for further work. The results of these future applications would reconfirm the utility of the proposed methodology and the usefulness of the proposed indicators for back-office intensity and maturity evaluation and benchmarking. These studies can also be used to analyze the impact of the back-office maturity on the maturity and adoption of the front-office e-government services, hypothesized in many e-government evaluation studies.

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