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How is e-Government Progressing? A Data Driven Approach to E-government Monitoring

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Abstract: As ICT provide a lot of possibilities, high expectancies exist towards the electronic public service provision. All governments are increasingly establishing their e-strategies. Nevertheless, both in research as among practitioners, some questions are formulated towards the current approaches. E-government policy has to deal with two main challenges: how to offer new and better services for the same (or lower) budget and how to increase user uptake? The challenges relate to both the efficiency of e-government, as its effectiveness. In order to further develop e-government strategies, governments need a thorough knowledge base to (a) to evaluate their current ways of working and (b) to found their activities of the future. In this paper we consider trends in e-government measurement and we discuss ongoing research towards the development of an e-government monitor for the Belgian government. This monitor will consist of different types of information from various sources, providing the necessary knowledge for all stakeholders involved to underpin their current and future e-strategies.

Keywords: e-government measurement, e-government monitor, indicators, efficiency and effectiveness, policy
Categories: L.0.0

1 Introduction

In the middle of the nineties the rise of the information and communication technologies (ICT) has started. Governments could not stand aloof from these trends and were forced – just as the private sector – to implement innovations and to explore new possibilities [Heeks, 2003]. E-government became the buzzword and was believed to be the driving force behind the modernization of public administration [Bekkers and Homburg, 2007]. After more than a decade, policy makers are offering services by hand of different electronic channels: the provision of information via the Internet, digital television or mobile devices. In addition, more complex services, such as the interaction with public servants or (electronic) full case handling are becoming

increasingly common in public e-services delivery. The future looks bright and the possibilities seem to be unlimited.

Large uptake of electronic public services in most Western countries, however, has not been achieved (yet). E-government still faces many challenges as it continues to develop [Jaeger and Thompson, 2003; Traunmüller and Wimmer, 2004]. The current status of the electronic services delivery opens up a lot of questions – both for practitioners as for researchers. Therefore, further progress of e-government needs a profound knowledge base: information about contextual variables, user needs, satisfaction of e-government, impact of e-services, etc.

In this paper ongoing research is discussed concerning the development of an e-government monitor in Belgium. The goal of this monitor is to bring together different sources of information that have an influence on e-government progress. Several scholars have emphasized the need of investigating both demand side as supply side [Van Dijk, Peters and Ebbers, 2008; Kunstelj, Jukic and Vintar, 2007]. By bringing these studies together in an e-gov monitor, all stakeholders involved will profit from this knowledge to further make effort of e-government development. In other words, monitoring e-government will serve not only policy purposes, but also the evaluation of the impact (on behalf of the users) of electronic delivery.

First of all, in this paper is argued why e-government monitoring and evaluation is increasingly put in the foreground especially with regard to e-government rethinking activities. Secondly, and additionally, the paradigm shift from efficiency to effectiveness is discussed. Thirdly, a short overview of e-government in Belgium is offered and the conceptual model of the e-government monitor is described. As this paper is part of an ongoing study, the results of a stakeholder analysis (with the main user groups of the e-government monitor) and the results of the application of Structural Equation Modeling (SEM) to the available data are discussed. We conclude by paying attention to the possible outcomes of this monitor and how the results of it can be used for policy purposes.

2 Re-evaluating e-government policy and its measurement

2.1 E-government policy: the shift from efficiency to effectiveness

There are many definitions of e-government and the term itself is not universally used. The differences are not just semantic and may reflect priorities in government strategies [Heeks and Bailur, 2007; Yildiz, 2007; Relyea, 2002]. Moreover, definitions and terms adopted by individual countries have shifted, as priorities have changed and as progress was made towards particular objectives. This is as it should be: the area is a dynamic one and policies as well as definitions need to remain relevant. The Organisation for Economic Co-operation and Development (OECD) defines e-government as: "*The use of information and communication technologies, and particularly the Internet, as a tool to achieve better government (p. 23).*" [OECD, 2003]. It can be stated that this is a more 'traditional' definition of e-government in which the focus is mainly on the government itself.

In line with the definition of above, e-government policy in Europe have focused several years on bringing online electronic public services and on benchmarking their availability and sophistication [Codagnone, 2008]. This is important knowledge,

however, it does not meet the criticism that too much attention is paid to the supply-side of e-government [Reddick, 2005; Kunstelj, et al., 2007]. Given the relatively low uptake of e-government – one of the main arguments to rethink the electronic service delivery – several authors made a plea for more user-centric development of e-government [Bertot and Jaeger, 2006; Bertot and Jaeger, 2008; Van Dijk, et al., 2008].

Closely related with the shift from a government orientation to a citizen orientation is the paradigm shift from efficiency to effectiveness. The latter refers to goals of government policy in general and e-government in particular. Millard [2008] distinguishes three types of goals concerning public policy: efficiency, that can be seen as the search for savings. Consequently, efficiency mainly deals with value for government. Effectiveness has more to do with the search for quality services and, as a result, the emphasis is on the value for the users (both citizens and businesses). Lastly, and more in general, governance is about the search for good governance, in which value for society is the key word.

The paradigm shift (equal attention for both efficiency and effectiveness) has partly orginated from the rethinking of e-services policy as well as the strategies concerning the evaluation of e-government (i.e. measurement activitities). Not only the supply-oriented approaches of e-government have come under criticism, critiques also exist towards the so-called supply side benchmarking [Bannister, 2007; Peters, Janssen and van Engers, 2005; Janssen, Rotthier, and Snijkers, 2004]. Codagnone and Undheim [2008] summarized the main lines of criticism of this: the overall relevance and validity of purely supply side approaches and the reliability, comparability and transparency of the methodologies used are questioned. In addition, the model of stages in development as well as the 20 basic online public services seem to be no longer sufficient for accurately evaluating e-government progress.

2.2 Measurement for knowledge!

Policy makers increasingly use electronic channels to deliver a wide range of information, interaction and transaction services at a growing level of sophistication. Consequently, the measurement of the progress of e-government development has become a hot topic in e-services policy [Heeks, 2006; Kunstelj and Vintar, 2004; Peters, et al., 2005]. It can be stated that these evaluation activities can serve a double goal: first of all, in the light of rethinking e-government and moving towards a more user-centric approach, not only the current provision of services should be evaluated. A thorough understanding of demand side is also important [Van Dijk, et al., 2008; Kunstelj, et al, 2007]. This relates to the question of effectiveness of e-government strategies. Secondly, governments are also under pressure to offer more and better services while spending less at the same time. This way, e-government is seen as a katalysator for a productivity-driven way of working [Millard, 2008].

It must be clear that the electronic service delivery as well as underlying businesses processes and information are quite complex whereby it is difficult for governments to determine adequate measures for evaluating the efficiency and effectiveness of the spending of their public money [Peters, et al. 2005; Kunstelj and Vintar, 2004]. Measurement for knowledge is thus an important – but difficult to achieve – challenge. Therefore, this must be based on a holistic framework of different information sources. The framework should be comprehensive on the one

hand, but be flexible to adapt to new trends and evolutions on the other hand [Centeno, Van Bavel and Burgelman et al, 2004]. Another point of attention is that e-government measurement strategies should be integrated in daily based activities. Once-only screenings of spending of government on IT or assessment of user needs and expectations prevent to develop long term e-government strategies [Kunstelj and Vintar, 2004; Bertot and Jaeger, 2006]. So, robust methodologies and measurement frameworks are needed.

Question remains what to measure and how to develop a holistic framework? Figure 1 depicts the classical conceptual framework for the measurement of the efficiency and effectiveness of public sector policies and services [Codagnone and Undheim, 2008].

This framework distinguishes three elements in the public service value chain: input, output and outcomes. According to Codagnone and Undheim [2008] input are all the monetary and non-monetary costs that go into the production of an output and in the achievement of outcomes. Output can be seen as the final product of processes and activities that is less influenced by external variables and more under the control of the producing unit. This way, efficiency can be seen as the input/output ratio. In addition, outcomes can be seen as the result of the input and output activitities, or, in other words, outcomes can be measured by the degree to which input and output are capable of achieving the intended results for different groups of stakeholders (citizens, businesses as well as governments).

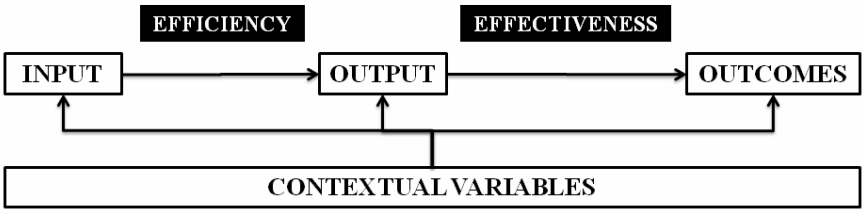

Figure 1: Basic framework – efficiency versus effectiveness

The relation between input, output and outcomes does not exist within a vacuum. Other variables may have an influence on input, output and outcomes as well as on efficiency and effectiveness. In general these variables can be aspects of regulation, public sector functioning, economic and social factors, cultural attitudes, politics, etc. [Codagnone and Undheim, 2008]. Especially with regard to e-government, these variables also may be related with (e-)readiness and other external variables [Millard, 2008].

3 Framework of an e-government monitor for Belgium

3.1 Context and general framework

E-government in Belgium is an important driver for public modernization. However, like in the neighbouring countries, a lot of work remains to be done. In the OECD

Peer Review Report of Belgium [OECD, 2008] it is stated that: "*Belgian governments could consider acquiring a systematic basis on knowledge of user needs and channel this knowledge into the design and development of targeted e-government services, with the purpose of making these services more attractive to users and more adapted to their true needs* (p. 19)." This is a clear call for more user-centric strategies. Other points of attention are the intergovernmental co-operation management strategies of integrated e-government (regarding the complex state structure) as well as reducing the digital divide (stimulating ICT access and use is necessary to make up arrears in comparison with other OECD countries), and are thus important challenges for the Belgian e-government policy [OECD, 2008].

The OECD Peer Review report highlights e-government monitoring activities as an important plan for action in Belgium. Some first initiatives have already started in the last few years. The Federal Government has monitored user needs (Fed-e-View/Citizen[1]) as well as the computerization of administrative departments (Fed-e-View/Administration[2]) since 2004 [OECD, 2008]. Another Fed-e-View study (focusing on e-government for businesses) is planned for the near future. The Fed-e-View studies are good initiatives, however, a systematic framework for monitoring and evaluating e-government is currently lacking. Hence, the development of an e-government monitor. Although this monitor can build on the experience of the Fed-e-View studies a holistic framework still needs to be set up.

More specifically, this framework should provide a complete overview of e-government progress. Therefore, the measurement initiatives regarding citizens' needs and expectations should be combined with a continuous assessment of the administration back-office development, as well as other aspectes related to the provision of electronic public services. In a nutshell, the proposed e-government monitor should pay attention to information concerning all different aspects of the e-government value chain.

3.2 What to measure?

One of the most important questions regarding the set up of an e-government monitor is what to measure, or, in other words, which domains can be distinguished? And how can adequate measurement indicators (as the basis of concrete data collection) be formulated? Based on prior research in this field [Codagnone and Undheim, 2008; Millard, 2008; Kunstelj and Vintar, 2004] a general framework has been developed. Figure 2 provides an overview of this framework. The five key domains are: contextual variables, input, output, outcomes and impact.

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[1] See: http://www.epractice.eu/cases/2158

[2] See: http://www.epractice.eu/cases/1877

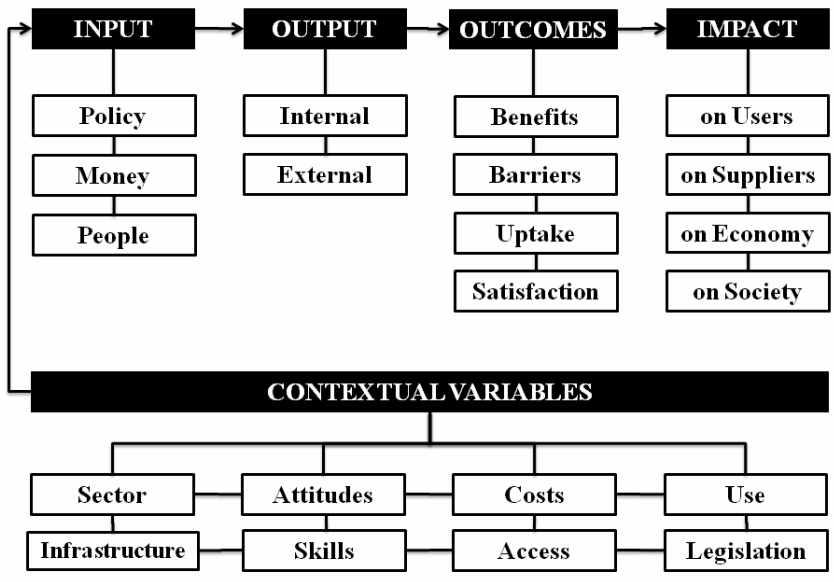

Figure 2: General framework of the Belgian eGov Monitor

On the figure it is illustrated how each domain can be subdivided in underlying blocks of indicators that will consist of different (key) indicators. In total, around 830 e-government measurement and evaluation indicators are formulated, corresponding with 160 key indicators. The indicators originate from different sources such as Eurostat, eUser, SIBIS, eGEP, etc. as well as the national statistics department (ADSEI – FOD Economie).

'*Contextual variables*' consist of different categories of indicators that have an indirect influence on e-government progress. It contains information about the ICT sector (e.g. employment and turnover, investment in ICT research, etc.), infrastructural variables (e.g. availability of internet access points, geographical coverage of Internet or GSM/iDTV by access platform, etc.), attitudes of users towards ICT (e.g. intentions to purchase ICT infrastructure, reasons for not having access to Internet, reasons for not using a computer, etc.), skills of users (e.g. levels of computer and Internet skills), costs (e.g. price of cheapest Internet access by access platform), levels of access to ICT of both citizens and businesses (e.g. level of internet access at home by access device, level of internet access in enterprises by type of connection, availability of ICT-equipped workstations in public administrations, etc.), use of ICT (e.g. computer use by individuals, Internet use in enterprises, use of ICT devices in public administrations, etc.) and legislation matters (e.g. the legal framework to regulate ICT). In sum, these contextual variables mainly correspond with e-readiness and related issues.

The block '*input*' deals with investments of government (monetary and non-monetary) with regard to e-government provision. Under the category 'policy' key indicators are listed such as 'the acceptance and implementation of strategic e-

government elements' or 'strategic policies regarding ICT'. The categories 'money' and 'people' are self-explanatory.

'*Output*' corresponds with two groups of indicators: 'internal' and 'external'. The first group assembles key indicators such as 'implementation of joined up service delivery' or 'the use of monitoring tools or the use of technical e-government components'. Under the second group, we have listed variables such as 'accessibility of government websites', 'availability of electronic public services by channel', 'online availability of basic public services for businesses by type of service', etc.

The blocks '*outcomes*' versus '*impact*' are less self-evident. Especially, it is the question which indicators should fall under outcomes and which under impact. We decided to see outcomes as the collective term for both issues preceding e-government acceptance (benefits and barriers), the uptake of electronic public services itself and the direct results of e-government usage (satisfaction). Examples of indicators measuring benefits are 'the ease of use of online public services', 'the perceived benefits for enterprises of using online public services', etc. 'Barriers' is the opposite category of benefits, containing indicators such as 'the perceived barriers for citizens to uptake e-government' or 'the perceived cost of e-government for enterprises', etc. The uptake of e-government can be measured using variables such as 'channels used by citizens for interaction with public authorities' or 'the use of basic online public services for enterprises by type of service', etc. Satisfaction is also a sub domain of outcomes and assembles key indicators such as 'citizens' evaluation of government websites' or 'satisfaction of enterprises using the Internet for interaction with public authorities', etc. Other projects such as eGEP [Codagnone and Boccardelli, 2006] view user satisfaction as a part of the impact of e-government. This contrasts with our perception of '*outcomes*' versus '*impact*'. Further research should validate the framework on that matter.

In this framework '*impact*' is perceived as the (direct or indirect) results of e-government uptake. Therefore, four categories can be distinguished: impact on users, impact on suppliers, impact on economy and impact on society.

3.3 How to measure and how to decide what to measure?

Regarding the development of the measurement framework, two issues need to be clarified: first of all, the frameworks consists of different types of variables. Some are quantitative of nature while others are more qualitative. We also have to be aware of the distinction between key indicators, indicators, sub indicators and composite indicators. Further research (during the search for data) should elaborate on this.

Second, it is important to decide what to include in the monitor and what not to include. Particularly, various indicators concerning e-government measurement exist. For the moment, our database consists of more than 800 indicators. In order to keep the monitor manageable, however, it is important to explore strategies to give prioritisation to indicators. Different approaches and techniques could help on this. A first approach is a top-down approach, meaning that (key) indicators could be selected by hand of input of experts. Via Delphi analysis [Linstone and Turoff, 1975], for instance, it becomes possible to move to consensus about which indicators (and underlying data) will be measured in the e-government monitor version 0.1. Afterwards, the framework could be elaborated to assemble more indicators depending on which data is (or will be) available. A second approach is bottom-up.

This way of working would be more data-driven as statistical techniques, such as Structural Equation Modeling (SEM), will be used in order to detect which (key) indicators having the most most impact while they are simultaneously covering the overall model. This approach was used in earlier research in which a model was developed for measuring user satisfaction of e-government [Verdegem and Verleye, 2009]. The application of SEM enabled to reduce a model consisting of 29 indicators to a shortlist of nine items still covering the full conceptual model.

In the next parts of the project both approaches will simultaneously be applied. Below the results of the application of both the top-down and the bottom-up approach are discussed.

4 Application of the top-down method: what are the opinions of the main user groups?

4.1 Methodology

As indicated above, in order to select the indicators that will be included in the first version of the e-government monitor, two approaches will be followed. The first method used, is the top-down approach in which e-government experts are involved.

First, the two main user groups for the e-government monitor were identified. These two groups were labelled 'administrations' and 'researchers'. The first user group consists of people (experts) from Belgian governments and agencies that are dealing with the development of e-government and ICT and/or its measurement. This group was brought together in a focus group interview (N=5).

The second user group consists of researchers from universities and research centres whose main scholarly interest is on e-government. We conducted personal interviews (N=5) in order to get a profound insight on their expectancies towards the e-government monitor.

The main aim of the focus group discussion and the interviews was to narrow down the list of more than 800 indicators concerning the measurement of the progress of e-government to a smaller list consisting of those indicators that are of prior interest to our user groups. To do this, the participants of the focus group and the interviewees were provided with a list consisting of the five domains of the model as shown in figure 2, with the underlying indicators per domain (N=21) and their key indicators (N=161).

First, they were asked to indicate which indicators would be the most interesting to be at their disposal in the e-government monitor. In a second phase they had to point out those key indicators (underlying the ones they selected in the first phase) they would like to have data about. This way, we tried to filter out those indicators that the user groups were less interested in.

Another part of the discussion and the interviews was about the presentation method of the final monitor (i.e. user interface, taxonomy, graphics etc.). A demo version of what the online platform could look like (based on mockups) and how it could be structured was shown. Questions were asked about their impression of the demo and what their expectations were.

4.2 Results

In this part we will discuss the opinions and reflections of the representatives of the administrations and researchers for each of the five domains in the conceptual model (contextual variables, input, output, outcomes and impact).

4.2.1 Contextual variables

The participants in the focus group with the administrations stated that they do not need detailed information on the indicators about 'infrastructure'. In their opinion there is no need to focus on it because in most countries 'infrastructure' is getting close to reaching 100%. Discussion rose regarding the inclusion of 'sector'. While some find it not necessary to include indicators about the ICT sector and that the first focus of the monitor should be purely on e-government, others deem it important that these are included because in their opinion one cannot set up an e-government strategy without knowing what is going on within the ICT sector. Another contextual variable that is not a priority to them is legislation.

Some of the researchers had a somewhat equal opinion regarding contextual variables. Indicators like infrastructure are basic information, but nothing more than a background. On the contrary, the other researchers we have interviewed so far find it very important that indicators about infrastructure and access are included, because this is important with regard to the research they are conducting.

4.2.2 Input

The administrations want input indicators to be available for Belgium, but also for all of its regions separately. This is especially relevant given the complex state structure in Belgium and, accordingly, the different policies of the regional governments concerning the electronic service provision.

But overall, both user groups indicated that input indicators are not really a priority.

One of the researchers made the comment that 'policy' is not really an input variable. In her opinion 'input' is about 'resources' (like money and people), while policy is more about the framework around e-government, which makes it more a contextual variable.

4.2.3 Output

With regard to output, most of the participants are interested in 'internal output'. An interesting point is that both researchers and administrations point at the integration of indicators on use of back-office information. This means the use of 'authentic data sources' such as social security data. The implication of these types of data can eliminate certain processes for the user. According to the participants this is rather important and should be more elaborated in the monitor.

4.2.4 Outcomes and impact

Both the administrations and the researchers made it quite clear that information and data about outcomes and impact is important to them, especially because it is difficult to measure impact and because there is not many data available.

4.2.5 Technical backbone of the e-government monitor

With regard to the online platform, all the participants agreed that the data should not be static, but rather dynamic. They think it should be possible for the e-government monitor users to manipulate the data, e.g. compare them by geographic or socio-demographic variables, visualize by drawing graphs or maps. Another point that was stated by the participants was that all of the indicators should be well described. A clear definition of what is measured by an indicator, how it is measured ... is necessary. So, an indicator handbook, e.g. SIBIS [2003], seems to be of vital importance.

5 Application of the bottom-up method:

5.1 Methodology

The second method used, was a bottom-up approach. Structural Equation Modeling (SEM) was applied to the data in order to determine whether a set of sub indicators all measuring the same underlying construct, being the indicator they are supposed to measure. The models that are developed within this analysis also give an indication of which sub indicator performs best in measuring this construct.

The applied statistical technique (SEM) allows for estimation of the goodness of fit of a hypothetical model given the data at hand. Estimating measurement models to validate conceptual (theoretical) models have a long tradition in marketing and consumer research. SEM offers a sub model (measurement model) to test assumptions regarding the strength of the relationships between indicators (items in the questionnaire) and the latent variables (the concepts), with simultaneous estimation of the correlations/covariation between the concepts.

Two series of sample data were used in the application of the bottom-up approach. The first set of data originates from a longitudinal panel research, consisting of three data waves, carried out among both internet users and non-internet users. The second set of data is being collected by the national statistics department of Belgium.

5.2 Results

We collected sub indicators in the data corresponding to several indicators within the conceptual model. Where this was possible, a SEM-model was built to test the assumption that the sub indicators do a good job in measuring the same underlying indicator. In figure 3 an example is shown of one of these models that were developed.

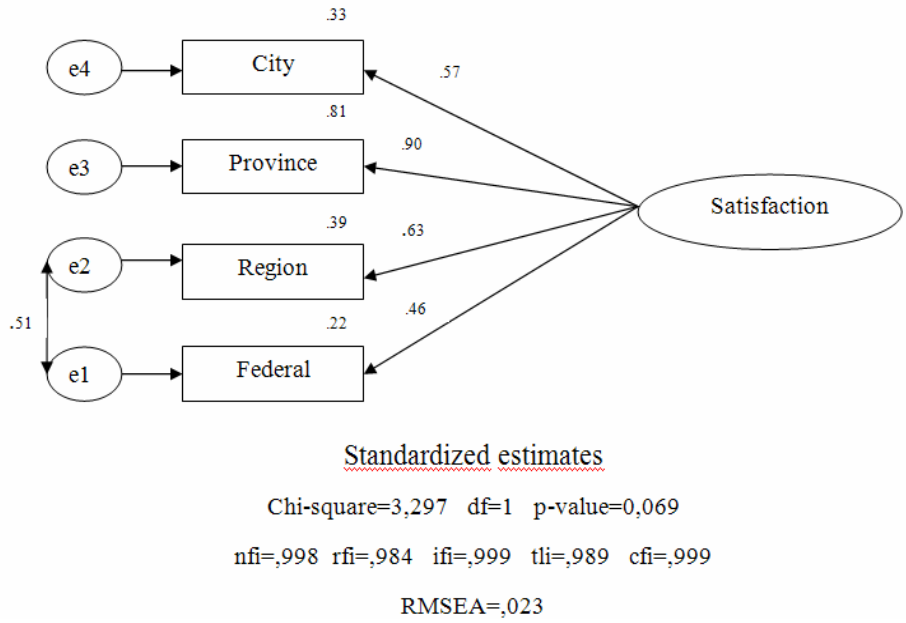

Figure 3: example of a Structural Equation Model

This SEM model is based on four variables (squares). These four variables are supposed to be sub indicators for the indicator "Citizens' evaluation of government websites". The question that was used to measure this was: "how satisfied are you with the website of your …":

- City (City);
- Province (Prov);
- Regional Government (Region);
- Federal Government (Federal);

For each of these websites the respondents were asked to give their evaluation on a scale ranging from 1 to 10, in which 1 corresponds with 'not satisfied at all' and 10 with 'very satisfied'.

The ellipse in the model is the latent variable (which means that it is not directly measured in the questionnaire) that is supposed to be measured by the four manifest variables (which means that they are directly measured in the questionnaire). The four small circles represent the measurement errors for each of the variables. The effect of Satisfaction on its four indicators is represented by the single arrows. The numbers on these arrows are the standardized regression coefficients. These coefficients have a value between -1 and 1. The higher their absolute value, the more important the corresponding variable is as a source of information about the underlying concept (Satisfaction). The number in the right upper corner of the manifest variables gives us the amount of variance explained by the latent variable. The double arrow between error e1 and e2 represents a correlation between these measurement errors. An error

correlation can only be added if an meaningful explanation can be found for it. The hypothesis in the example of Figure 3 is that citizens don't see a difference between the Federal and Regional government level, as they are both perceived as part of the national government.

Besides the detailed parameters on the model there are also a number of goodness of fit parameters that give a global evaluation of the model have to be assessed. For any model, the chi-square (Chi^2) should not be significant, the fit indices (nfi, rfi, ifi, tli and cfi) should have a value of at least 0.90 and the Rmsea should be lower than 0.05.

The model presented in figure 3 confirms that the four manifest variables measure the concept of satisfaction with government websites in a reliable way.

6 Conclusion

In this paper it is discussed why e-government measurement is increasingly important and how the conceptual framework of a Belgian e-government monitor can be developed. In a first phase it was investigated which indicators are of prior interest to the different user groups by means of focus groups and expert interviews. A second method that was applied to investigate this, was the statistical method SEM (Structural Equation Modeling).

Based on the qualitative research we already gained interesting input from the experts. It is clear though that this cannot be the only method used to come to a shortlist of indicators. For some indicators, there was an agreement amongst the participants that they had to be included. For other indicators there was not such a consensus. All depends on the focus of their research or job. That is why other methods are also being used. Some conclusions that can be made is that both user groups are not really interested in indicators about input. Outcomes and impact however, is something they definitely want data about, especially for impact because not much is available on those indicators.

Structural Equation Modeling helps us to validate indicators based on several sub indicators using statistics. Besides this statistical validation the models also give an indication of which sub indicator is the best in measuring the proposed variable.

We want to develop a measurement framework that is, on the one hand, comprehensive (covering the overall e-government value chain), but, on the other hand, also flexible regarding new developments in the future (e.g. new types of services or channels). The information and knowledge also need to be reported in an appropriate way. All stakeholders involved can only take profit of this monitor when its content is easily accessible and enables further analysis. The respondents in our qualitative research also pointed this out.

The e-government monitor thus needs a well-elaborated technical backbone. Therefore, in the research project attention is also given to the development of an online reporting environment. The tool should enable to report from different types of data (e.g. percentages, numbers, index, etc.), originating from different sources (different governments in Belgium and Europe, other data providers, etc This way, the instrument can eventually be used for long term evaluations and be enriched with benchmarking possibilities.

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