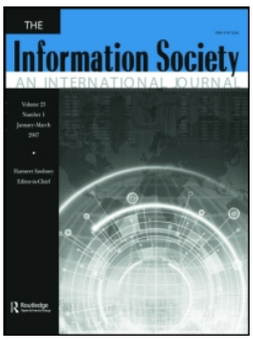
An empirical test of stage models of e-government development: evidence from Dutch municipalities



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An empirical test of stage models of e-government development: Evidence from Dutch municipalities

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ABSTRACT

In this article we empirically test stage models of e-government development. We use Lee's classification to make a distinction between four stages of e-government: informational, requests, personal, and e-democracy. We draw on a comprehensive data set on the adoption and development of e-government activities in 510 Dutch municipalities over the period 2004–2009. Our results show that progression through stages of e-government is mostly linear. However, it seems that a single dimension is insufficient to explain e-government development at the level of more specific features of e-government. Our analysis demonstrates that municipalities sometimes adopt certain e-government features at a later stage even if features of an earlier stage are not adopted at all. These findings suggest that municipalities can—at the level of e-government features—immediately proceed to later stages without having to pass through earlier stages. We conclude that stage models may have some value for benchmarking municipalities at the level of stages, but are inadequate in explaining or predicting the development of features at the different e-government stages.

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E-government; empirical test; municipalities; stage models

Governments around the world are increasingly relying on information technology, in particular the Internet, as a means to communicate with their citizens (Gallego-Álvarez, Rodriguez-Dominguez, and Garcia-Sánchez 2010) and with business (Reddick and Roy 2013). As a result, research on the adoption and implementation of e-government has been growing rapidly over the past few years (Heeks and Bailur 2007) and has produced a large variety of so-called stage models of e-government development (Layne and Lee 2001; Wescott 2001; Siau and Long 2005; Heeks and Bailur 2007; Coursey and Norris 2008; Lee 2010).

Typically, in these models the stages in e-government are distinguished according to increasing levels of managerial and/or technical complexity (Coursey and Norris 2008) and are mostly linked to cumulative processes of development (Lee 2010). It is assumed that more complex levels (technologically or operationally) can only been reached if less complex levels are implemented first. However, this linearity assumption has been criticized. As Lee (2010, 229) puts it, "Not every government has to go through stage 1 to stage 5 in terms of implementing e-government … systems … But when intermediate stages are skipped over, care should be taken. As the skipping is possible in terms on the technology side, it would not be easy to implement changes in services and processes in the real-world side (on citizen/service dimension)." Coursey and Norris (2008, 533) go a step further in stating, "E-government is not linear. Late adopters of e-government need not start at the most basic level of e-government. They can and do learn from the experiences of other governments and the private sector and begin with more sophisticated offerings." However, the empirical proof of these propositions has rarely been done.

In general, empirical validation of these models is rare (Coursey and Norris 2008; Klievink and Janssen 2009). In addition, there is hardly any empirical research checking the assumption of a linear e-government development process.

Within this context, we provide a systematic empirical test of a general stage model. Herein, in a modification of Lee's (2010) stage model, four stages of e-government are distinguished—informational, requests, personal, and e-democracy—and empirically tested with a Mokken scale analysis (Mokken 1971; van Schuur 2003).

The rest of the article proceeds as follows. We first discuss typical stage models and summarize their main

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assumptions.[1] Second, we focus on key assumptions of these models. Third, we describe the unique dataset on the development of e-government activities in the Netherlands during the period 2004–2009. Fourth, we use the Mokken model to examine whether or not the development of e-government follows linear patterns. Finally, we discuss the implications of our findings.

Theoretical background

E-government

Widely varied e-government definitions have been put forward, ranging from rather generic to very specific ones. Generic definitions focus on the use and application of information and communication technology (ICT) by governments to provide information and public services to citizens (Bannister 2007). Specific definitions, in contrast, have focused on the delivery of these services through the Internet or by other digital means (West 2004). In the latter mode, we take e-government as "utilizing the Internet and the world-wide-web for delivering government information and services to citizens" (Ronaghan 2002, 1). This definition includes services that enable interactive communication by residents and businesses, as long as they are provided by the (municipal) government.

Stage models

In accordance with the Layne and Lee's (2001) model, researchers have used stages as the template for examining barriers to development of e-government (Moon 2002; Bekkers and Homburg 2007; Savoldelli, Codagnone, and Misuraca 2014), evaluating the success of e-government initiatives (Gupta and Jana 2003), and studying changing the role of users with the advancement of e-government (Reddick 2005; Verdegem and Verleye 2009). Furthermore, extensions of Layne and Lee's model (2001) have been proposed that focus on the activity of users (Andersen and Henriksen 2006) or link national levels to local levels of e-government (Gil-Garcia and Martinez-Moyano 2007). Beyond Layne and Lee (2001), different streams of literature have suggested other stage models. They employ different nomenclatures but are quite similar in how they conceive the evolution of e-government (Coursey and Norris 2008; Layne and Lee 2001; Wescott 2001; Hiller and Bélanger 2001). Recently, e-government research has started including new actors (like universities) (Khan and Park 2013), smart cities (Lee and Lee 2014), and broadband infrastructure (Van der Wee et al. 2015; Sadowski 2017).

In sum, models have been based on the assumption that there is an evolution from "simple" to more "complex" forms of e-government, which can be distinguished along a number of dimensions such as technology, organizational form, or type of communication between citizen and government.

Although perspectives differ with respect to classifications of stages (West 2004; Andersen and Henriksen 2006; Siau and Long 2005; Layne and Lee 2001; Wescott 2001; Hiller and Bélanger 2001), they share some similarities (for a review see Lee 2010). Most models start with an initial stage where there is the presence of a website to provide information to citizens. Here communication is one-sided. In the next stage, a rudimentary form of two-way communication emerges, for example, e-mail. In the subsequent stage, there is the possibility to undertake financial transactions, such as online payment for a parking permit. The last stage is often, but not always, related to e-democracy, for example, online voting. At this stage, the e-democracy initiatives enable a gradual shift from a fully representative democracy to a partly participative democracy (Lee 2010).

Moving between different stages

We now discuss a number of propositions that have been put forward to explain progress through different stages. We do not provide an exhaustive review, but aim to spotlight the key points.

In Layne and Lee (2001), an underlying assumption has been that "e-government is an evolutionary phenomenon and therefore e-government initiatives should be accordingly derived and implemented" (123). In this model, four different stages of e-government are defined based on different technical and organizational challenges that governments face while implementing e-government. In their focus on front-end government and technical integration issues, Layne and Lee did not include possible benefits of interaction to users in terms of e-democracy or e-participation (Andersen and Henriksen 2006).

In a similar vein, Wescott (2001) developed a model based on observations of e-government in the Asia Pacific region. Like Layne and Lee's (2001), it sees the adoption of e-government stages as a linear process. However, in contrast to Layne and Lee (2001), it does not assume that all governments will eventually reach the last stage of e-government as there are potential barriers to adoption of advanced ICT, for example, with respect to transparency and openness (Bertot, Jaeger, and Grimes 2010; Kim, Kim, and Lee 2009).

Since these pioneering stage models, a number of authors have tried to synthesize the existing theoretical

literature and develop new conceptual approaches (Siau and Long 2005; Hiller and Bélanger 2001). An interesting view has been put forward by Siau and Long (2005), who propose a model that includes five stages: Web presence, interaction, transaction, transformation, and e-democracy. Here they make a new contribution in identification and articulation of the transformation stage, wherein governments alter the way they provide services. These transformations typically entail vertical integration between governments at different levels and horizontal integration between governments at different locations. In other words, governments at this stage work to create single portals where citizens can access all the services they need.

Siau and Long's model proposes that e-government progresses gradually, as opposed to progressing in stages. Although the word "stages" is still used, the boundaries of the stages are less clear and are overlapping and the "jump" from one stage to another is referred to as a "leap." Technology is the main barrier in the early stages, while later cultural and political factors are becoming more salient in the later stages.

Hiller and Bélanger (2001) put forward a stage model that incorporates an extra dimension that defines the type of relation between different actors. Six different types of relations are identified. For instance, they identify two different forms of government-to-citizen \relations: service-related relations and political relations. Also government-to-government and government-to-business relations are included in the model. Their main argument is that for each of the six relations e-government can be at a different stage.

In a qualitative review of 12 models of stages that were presented over the past 10 years, Lee (2010) notes that these models seem to be somewhat incongruent, as they take different perspectives on e-government. Lee synthesizes the 12 models, and identifies five "metaphors" in e-government. The first is "presenting," which refers to the simple presentation of information on a website, without much technical functionality. The second metaphor is "assimilating," which refers to assimilation of the possibilities of ICT with real-world situations, for example, development of interaction-based services emerging. The third metaphor is "reforming," which refers to the reformation and streamlining of administrative processes and services of government, for example, provision of new ways of conducting transactions. The fourth metaphor is "morphing," which refers to changes in the shape and scope of Web-based processes and services that are provided by government. Such changes have consequences for the operation of government itself as well. For example, the tasks of government officials change, since citizens become more participative, and standardized routine tasks are automated. The fifth metaphor is "e-governance." Citizens become more involved in the political and administrative processes.

Our study applies a modified model based on four stages described in the meta-synthesis by Lee (2010) (see Table 1). It was difficult to empirically distinguish between the last two stages of Lee's model, since the stages "morphing" and "e-governance" both involve increased interaction between citizen and government (participation and involvement). Hence, we merged these two stages into one stage: e-democracy. We then tested whether or not the development of e-government activities of Dutch municipalities follows these four stages. We renamed the stages to clarify which functions they should fulfill from the point of view of citizens. Based on the data, the focus has been on what Lee (2010) called the citizen's perspective. In general, we distinguished between the following stages: information provision, requests for permits and documents, personal service delivery, and e-democracy.

In the first stage there is one-way communication from the municipality to its citizen. Municipalities have a website that provides government-related information. The communication is one-way as no citizen feedback is possible. The second stage introduces the first form of interaction. Citizens are able to request permits and documents without having to go to a municipal office. In this stage there is simple form of two-way communication. In the third stage there is more extensive two-way communication, for example, a personal account on the municipal website. In the last stage the citizen is able to digitally participate in the democratic process. Here the two-way communication is no longer bound to issues concerning only a single individual. Citizens now have an opportunity to participate in the policy formulation process.

Table 1. E-governance stages: Lee (2010) model and modified model.

Stage	Metaphor	Operation/technology perspective	Citizen/service perspective	Operationalization in the present study
1	Presenting		Information	Information provision
2	Assimilating	Integration	Interaction	Requests for permits and documents
3	Reforming	Streamlining	Transaction	Personal service delivery
4	Morphing	Transformation	Participation	E-democracy
5	E-governance	Process management	Involvement	

Methodology

Selection of the Netherlands as a case study

Over the past 15 years, the Netherlands has consistently been considered a global and European e-government leader (United Nations 2001, 2008, 2010, 2014, 2016). The high level of e-government development in the Netherlands has been rooted in past and current investment in telecommunications infrastructure, human capital, and provision of online services (United Nations 2010). In December 2003, the Dutch government committed itself to a fundamental reorganization of the e-government sector based on the "Modernizing Government's program" (Ministry of the Interior and Kingdom Relations 2003). From 2004 onward, a number of e-government initiatives were undertaken to develop a digital Dutch Digital Identity (2005), make all governmental websites freely available to all citizens (2006), introduce a Citizen Service Number (2007), and introduce paper-free publication of government decisions (2008) (European Commission 2015), among others.

The administrative tradition in the Netherlands is based on decentralized activities with encouragement from the central government level. In keeping with this tradition, unlike some other countries, the Netherlands has not had a coherent approach for the transformation of the public sector as a whole through e-government. This has led to a wide variety of local e-government initiatives across the country (Organization for Economic Cooperation and Development [OECD] 2007). Also, the Dutch government has monitored this process closely. This combination of factors has yielded a valuable by-product for researchers: a unique data set. Consequently, research on e-government in the Netherlands has provided insights into many facets of e-government: issues related to user acceptance (van Dijk, Peters, and Ebbers 2008), user requirements (van Velsen et al. 2009), user interaction (Ebbers, Pieterson, and Noordman 2008), and client-centric approaches (Bekkers 2009; Beldad, de Jong, and Steehouder 2010; Janssen, Kuk, and Wagenaar 2008; van den Haak, de Jong, and Schellens 2009; van Dijk, Peters, and Ebbers 2008). However, differences in e-government projects across municipalities have rarely been analyzed. The availability of this unique data set makes the Netherlands an interesting site for testing whether the e-government development follows the (four) stages in a linear fashion, as expected by stage models.

Methods

To test stage models, we used data provided by the Dutch government agency "Informatie en Communicatie Technologie Uitvoeringsorganisatie" (ICTU; http://www.ictu.nl). This agency, established in 2001, is part of the Ministry of Home Affairs. Its main function is to support other government agencies to successfully implement information and communication technology. Since 2001, ICTU has been conducting annual research on ICT use in municipalities. The ICTU research is based on website content analyses. Predefined criteria determine how municipalities score on different aspects of their website. ICTU has measured more than 90 different website variables to determine a municipality's position with respect to ICT use.

Every year the ICTU administers a standardized survey questionnaire on the websites of Dutch municipalities. The surveys are filled in by ICTU employees after manually investigating all Dutch municipality websites. Over the past few years, some questions in the survey have been changed. The surveys from earlier periods (prior 2004) contain different questions compared to later surveys (from 2004 onward). In this study, we use data over the period 2004–2009. We did not include any data from surveys after 2009, as most e-government development took place during this period. The questions in the survey measure whether (or not) certain feature(s) are part of the website of a particular municipality. For example, a question on public announcements was formulated as follows: "Does the government agency publish periodic announcements according to governmental standards on their website?" The answer to each question is very specific, but always contains a "No" or "Yes" response. With respect to the question on public announcements, the categories are the following: "No", "Yes, and searchable," and "Yes, but not searchable." In other words, the answers to the questions included—in the case of a "Yes" response—additional information on the specific features of a particular e-government service. In order to allow the application of Mokken techniques, however, the answers to the questions in the questionnaire had to be dichotomized. In other words, we did not make any further distinction according to the degree of the "yes" answer. This allowed us to assign a specific score to a website feature of a particular municipality.

Based on the availability of questions over the period under investigation, we selected 13 variables (features) to measure the different e-government stages. The ICTU data set included, in total, more than 90 raw variables. However, information was lacking for number of variables over the period 2004–2009, which required us to exclude some variables (e.g., on search engines on municipal websites) based on availability (for more details about the ICTU data set see Toonders 2009).

Table 2. Four e-government concepts.

Information provision (informational e-government)	Requests of permits and documents (request e-government)
Governance information system Does the municipality disclose a governance information system on its website?	*GBA abstract application*[*] Is it possible to apply online for a GBA abstract?
Online municipality land use plan Does the municipality publicize at least one valid municipal land use plan on its website?	*Parking permit application* Is it possible to apply online for a parking permit?
FAQ list Does the website contain a frequently asked questions (FAQ) list?	*Objection submission* Is it possible to submit objections online?
Personal service delivery (personal e-government)	**E-democracy (e-democracy e-government)**
Product and services status Does the website provide the possibility to track the status of product and service requests?	*Citizen initiatives* Does the municipality provide information on how citizens can put topics on the agenda of the representative government body?
Personal account Does the website provide the possibility to make use of a personalized "ticket window"?	*Citizen panel* Does the municipality have a citizen panel and does it provide information about it?
Direct online payment Does the website provide the possibility to directly pay for requested products and services?	*Communal initiative* Does the municipality provide room on its website for communal initiatives?

[*]GBA: municipal personal records database (Dutch acronym for gemeentelijke basis administratie).

Furthermore, we had to exclude one variable on "forum and discussion list" due to theoretical reasons. Lee (2010, 224) commented on forums and discussion lists in the following way: "Technically, e-democracy does not have to happen after the service transformation. A simple bulletin board or opinion poll, which might be implemented at the interaction stage, would suffice as a basis for e-democracy." Forums and discussion lists are technically less complex than other e-democracy features, and are hence the "odd man out" at the e-democracy stage. Our data support this notion, as forum and discussion lists in general are adopted very early.[2]

Consequently, three variables per stage (see Table 2) were used to identify whether a municipality did reach a specific stage. Table 2 shows that these variables capture typical features of each stage.

The variables of the first stage, information provision, measure different types of information presented on the website. All variables represent e-government features based on one-way information provision from municipality to citizen. The second set of variables is used to identify the second stage, "requests for permissions and documents." They measure a more sophisticated form of e-government. Municipalities that have reached this stage allow their citizens to apply online for permits and documents. The e-government stage includes two-way communication between municipality and citizen. The third e-government stage, personal service delivery, also measures interaction between municipality and citizen, but this time the interaction is personalized. The website of municipalities having reached this stage presents information particularly composed for individual citizens. Online payment is an example of such personalized service. The variables measuring the last stage, e-democracy, indicate whether citizens can influence the democratic process in their municipality.

The 12 raw variables are dichotomous variables: Either a municipality uses a certain e-government feature or it does not. We used this information to construct the e-government stages. Since the models we test focus on transitions between stages and not complexity within stages, we applied a threshold model. Once a certain level of development has been reached—a certain feature has been adopted—then in our measurement a particular stage has been reached. Thus, in the threshold model either the development of a municipality's e-government activity reaches a certain stage or it does not. The rule that was applied accordingly to determine whether municipalities reach one of the four e-government concepts is straightforward. A municipality that uses at least one feature has reached a particular stage. If the municipality does not use any of the different features of the stage, this indicates that it did not reach the stage.

Results: Testing the stage model

Our data set on e-government development cover six different years. In effect, for each municipality six scoring patterns are available (see example in Table 3). If all patterns are included in the analysis, the duplicate patterns in adjacent years (e.g., year 2004 and year 2005 in Table 3) will gain extra weight in the final result. This is undesirable, as we are only interested in pattern changes, as they reflect advancement to a new stage e-government development. We therefore removed the duplicate scoring patterns in adjacent years, keeping only unique

Table 3. Example of scoring patterns for a single municipality.

	Informational e-government	Requests e-government	Personal e-government	E-democracy e-government
[municipality]2004	1	0	0	0
[municipality]2005	1	0	0	0
[municipality]2006	1	1	0	0
[municipality]2007	1	1	0	0
[municipality]2008	1	1	0	0
[municipality]2009	1	1	1	0

patterns for the analysis. After removing those 1703 duplicate cases, we were left with 1357 unique patterns for the 510 municipalities.

As a first step, we counted the number of patterns that are consistent with the stage model (e.g., 1111), and the number of patterns that are not consistent with the stage model (e.g., 1010). Simple counting of patterns results in a problem in instances where a "consistent" pattern occurs after an "inconsistent" pattern. For instance, a municipality first adopts e-democracy, and only then personal e-government. Thus, the municipality moves from a 1101 pattern to a 1111 pattern. In such a case, the last pattern 1111 should not be counted as consistent, since it follows from the inconsistent pattern 1101, and this development is not consistent with a stage model. Therefore, we removed 31 of such cases ("consistent" pattern after "inconsistent" pattern) from the data set. After removing the 31 cases, this procedure left us with 1326 observations from 510 municipalities.

To investigate the temporal order of adoption we calculated the mean year of adoption for every e-government item (see Table 4). From data in Table 4 it is clear that stage 1 on average is reached earlier than stage 2. The difference is about 2 years, which is substantial. By 2009 all municipalities had some form of information provision on their website. Stage 2 (requests of permissions and documents) was reached in mid 2005. By 2009 about 90% of all municipalities were at this stage. Municipalities achieved stage 3 (personal delivery stage) on average at the end of 2006. By 2009, 70% of all municipalities had reached this stage. On average, stage 4 (e-democracy) was attained by different municipalities in 2007. However, just 67% of the municipalities were able to enter this stage in 2009. These results are in line with a stage model. Based on these results, we conclude that the temporal order is in line with a stage model.

Table 4. Mean time of reaching e-government stages (aggregated over all municipalities).

Stage	E-government stage	Mean time	Percentage of municipalities reaching stage in year in 2009
1	Information provision	2004, March	100
2	Requests of permissions and documents	2005, April	90
3	Personal service delivery	2006, October	70
4	E-democracy	2007, February	67

A substantial number of municipalities may deviate from the linearity assumption (e.g., outliers that may reach specific stages late), which would not be detected by analyzing only mean adoption times. We therefore analyze the adoption patterns of all municipalities in more detail.

As can be seen in Table 5, about 86% of all unique patterns observed are consistent with the stage model, while the other 14% of the patterns are not consistent with the stage model. Furthermore, one inconsistent pattern occurs frequently. This is pattern 6, in which the e-democracy stage has been reached while the earlier personal service delivery stage has not (yet) been achieved. This happens in about 9% of all cases.[3]

Although the majority of the patterns are consistent, still deviating (inconsistent) patterns are observed. The existence of such deviating cases from the model is not a sufficient reason to reject the linearity assumption of stage models. We have to test whether or not the number of inconsistent cases is so large that the deviations can no longer be explained by chance. If the number of cases deviating from the perfect linearity assumption can no longer be explained by chance, then we have sufficient reason to argue that the stage models do not provide an adequate description of the development of municipal e-government activities in the Netherlands.

To test whether there is a significant deviation from the model, we use a Mokken model. This model is frequently used in political sciences and psychology, and can be regarded as a probabilistic version of the Guttman scale (Mokken 1971; van Schuur 2003). On a Guttman scale, items are ordered such that an individual who agrees with a particular item also agrees with items at a lower ranked order. Items correspond to stages in our model. In our case, if a municipality has reached the requests of permits and documents stage, it should have reached the information provision stage as well. Hence, the Guttman scale is a deterministic model. In this model a municipality that has adopted later stages should *always* have adopted earlier stages as well. The patterns depicted in Table 3 are all patterns that are consistent with a Guttman scale (e.g., 1110 or 1100).

Table 5. Frequency distribution of adoption patterns.

Pattern	Frequency	Percentage	Informational e-government	Requests e-government	Personal e-government	E-democracy e-gov
Consistent						
1	90	6.79	0	0	0	0
2	389	29.34	1	0	0	0
3	251	18.93	1	1	0	0
4	172	12.97	1	1	1	0
5	260	19.61	1	1	1	1
Total	1162	85.98				
Inconsistent						
6	125	9.43	1	1	0	1
7	15	1.13	1	0	0	1
8	5	0.38	1	0	1	1
9	10	0.75	0	1	0	0
10	7	0.53	1	0	1	0
11	2	0.15	0	1	1	0
Total	164	14.11				

The Mokken model is a probabilistic model that is based on Guttman errors. A Guttman error is a pattern that violates the perfect rank order. In our case a Guttman error occurs when a municipality does not progress linearly through the different stages but "skips" stages instead. For instance, a municipality that reached the personal service delivery stage should have passed the earlier information provision stage and requests for permits and document stage. If one (or both) stage(s) is/are skipped, then a Guttman error occurs (e.g., 1001 or 1011). The more often Guttman errors occur, the less probable it is that a meaningful rank order pattern is present in the data.

In order to calculate a coefficient that indicates the quality of the model, the number of observed Guttman errors and the number of statistically expected Guttman errors are used. The coefficient is the so-called Loevinger's H (see for technical details van Schuur 2003 or Molenaar et al. 1994). The lower the number of Guttman errors, the higher is the H coefficient. It is commonly accepted that strong scales should exceed an H value of 0.50. Moderate scales have H values between 0.40 and 0.50, and weak scales have values between 0.30 and 0.40 (Mokken 1971). The coefficient can also be calculated for single items to indicate whether they can be used without seriously violating the linearity assumption. Apart from the absolute value, the Mokken scale analysis also shows whether or not the coefficient significantly differs from zero.

Table 6 shows the results obtained from the Mokken analysis. The first column shows the four e-government stages. In total, 1326 patterns from 510 municipalities were analyzed. The third column represents the difficulty of the item, which is in fact the proportion of patterns in which a certain item is scored (i.e., a certain stage reached).[4]The fourth and fifth column represent the model errors grouped per stage. The rule of thumb suggests that the H coefficient should be higher than 0.30 in order to accept the set of items as a Mokken scale (van Schuur 2003). In this case, all item coefficients and the overall scale coefficient should reach at least the level of 0.30. Therefore, these four stages of e-government conform to the Mokken scale. The model H coefficient is 0.78, which indicates that this is a very strong scale. The scale coefficient is statistically highly significant ($z = 26.95$; $p < 0.0000$).[5] That means that the development of municipal e-government activities follows the linearity assumption of the four stages model.

However, there is more to consider. We used three specific e-government features per stage (see Table 2 for the specific features). We decided that a stage would be reached if the municipality had adopted at least one of the three corresponding features. This measurement procedure is rather crude. If one of the e-government features measuring a particular stage, for instance, information provision, is adopted rather early, then this particular feature may weigh too heavily. To get more insight into the specifics of e-government adoption we decided to also perform a Mokken analysis on the items or features that were used to construct our four e-government stages.

Table 6. Mokken analysis with four e-government stages.

Stage	Observations	Item difficulty	Observed Guttman Errors	Expected Guttman errors	Loevinger H coefficient
Information provision	1326	0.08	14	128.54	0.89
Request for permissions and documents	1326	0.38	44	387.82	0.87
Personal service delivery	1326	0.66	154	473.28	0.67
e-democracy	1326	0.69	160	454.48	0.65
Scale	1326		186	722.06	0.74

Table 7. Mokken scale analysis with 12 e-government features.

Stage	E-government feature	Average year of adoption	Item difficulty	Observed errors	Experimental errors	Loev-inger H
1	Governance information system	2003	0.14	323	869.63	0.63
1	FAQ list	2004	0.25	570	1355.11	0.59
1	Online municipality land use plan	2005	0.46	1223	2183.31	0.44
2	GBA abstract application	2005	0.49	853	2270.71	0.62
2	Objection submission	2005	0.55	1243	2330.64	0.47
2	Parking permit application	2005	0.64	1160	2293.78	0.49
3	Direct online payment	2006	0.69	818	2190.04	0.63
4	Citizen initiatives	2007	0.76	1008	1969.53	0.49
3	Product and services status	2006	0.83	728	1633.27	0.55
4	Communal initiative	2007	0.84	763	1561.80	0.51
3	Personal account	2007	0.87	602	1363.12	0.56
4	Citizen panel	2007	0.92	361	820.92	0.56
	Total			4826	10438.08	0.55

The results of this analysis are shown in Table 7. By looking at the average year of adoption and the proportion of municipalities that have adopted the specific e-government feature, these results suggest only partial support for the proposed stage model. Although the order of features that indicate stages 1 and 2 is clearly consistent with the stage models, the order of the features of the other two stages (three and four) is not.[6]

Conclusions

Our article contributes to the rather neglected area of empirical analysis of stage models of e-government (Coursey and Norris 2008). In particular, we test whether e-government develops via an orderly progression through stages, or in a more chaotic fashion. In using a modified version of Lee's stages model (2010), we distinguish between four different stages of e-government (information provision, requests of permits and documents, personal service delivery, and e-democracy). We empirically examine these stages by using a comprehensive data set on the adoption and development of e-government activities in 510 Dutch municipalities over the period 2004–2009 provided by ICTU. The data set containing more than 90 variables was designed to measure the position of Dutch municipalities with respect to their ICT use.

At the aggregate level, we were able to show that the linearity assumption underlying e-government development holds. In more detail, we found that the great majority of scoring patterns for each municipality were consistent with this assumption. The analysis demonstrated, in addition, that the temporal order of the different stages—attained by Dutch municipalities—was in line with stage models. Moreover, the statistical tests showed that there were no more Guttman errors than should be expected on the basis of chance alone, which provided statistical support for the linearity assumption of stage models.

At the level of different technical features of a particular e-government stage, however, the patterns became more complex compared to the aggregate level. A single dimension seems insufficient to explain the development of e-government at the level of technical features (not stages). For example, some municipalities implemented technical features of a later stage (e-democracy), before they actually adopted technical features of an earlier stage (personal service delivery or requests of permits and documents). In other words, there was just partial evidence for the linearity assumption of stage models at the level of particular technical e-government features.

According to the Dutch Civil Law of 1992 and the Municipalities Act of 2013, municipalities in the Netherlands are entitled to provide services to the public. In line with this legislation, a number of municipal initiatives have facilitated the implementation of e-government solutions in the Netherlands since 2000s. However, as these initiatives required legitimacy to justify investment, the actions of political actors (e.g., the forming of coalitions of different parties) and the speed of the political decision-making process (e.g., the efficiency of the interaction between governmental bureaucrats and politicians) were affecting the timing (and sometimes postponement) of these initiatives. As a result, some municipalities opted rather early for easy-to-install e-democracy features, such as forums and discussion lists, but postponed larger, more expensive investments in e-government initiatives. In other words, differences in the policy process at the municipal level might explain the deviation from the linearity assumption. This is in line with the literature on the impact of local politics on e-government (Bussell 2011; Ravi 2013).

One robust finding of the analysis has been that the linearity assumption holds, in particular, at the early e-government stages; that is, most municipalities started at stage 1 and proceeded to stage 2. This finding contradicts research by Coursey and Norris (2008) proposing that the early e-government stage can be skipped. They

argue as follows: "E-government is not linear. Late adopters of e-government need not to start at the most basic level of e-government. They can and do learn from the experiences of other governments and the private sector and begin with more sophisticated offerings" (Coursey and Norris 2008, 533). Similarly, Lee (2010) proposes that early stages can be skipped: "For example, one government might make transition directly from providing simple information (presenting) to a complex and complete morphing stage which may include interactive and transactional services and processes. This may happen frequently as information technologies and systems are easily replicable and reproducible." (Lee 2010, 229). In our study, we found the contrary: Municipalities are actually more likely to skip a stage in the later development of e-government.

Lee (2010) provides an explanation for the determinants affecting later stages of e-government. He argues, "With the help of other governments or consultants who have experience, a government can 'import' an advanced e-government system hoping to jump ahead in terms of developmental stages" (Lee 2010, 229). This idea may provide an explanation of our findings that later stages of e-government have different characteristics. External help and consultation are likely to be more important at the later stages, where the technology and process management are more complex. Hence, this would point to the possibility that at later stages e-government is more affected by coevolution in different (e.g., local, political, cultural) environments compared to earlier stages. Early research in this area had already pointed toward the fact that change in governmental administrations is also driven by processes of coevolution with political and cultural processes that are not related to any underlying technology (e.g., Dunleavy et al. 2006; Bekkers and Homburg 2007). In addition, processes of "mimicking" (i.e., imitating of e-government initiatives implemented in other municipalities) might play a role in occurrence of more coherent patterns of e-government evolution. In order to study the very specific and context dependent effects on e-government initiatives, political, socio-organizational, and institutional settings have to be taken into account (Bekkers and Homburg 2007).

Another possibility rarely discussed in the literature is that at later stages of e-government development, specific e-government features are more similar to each other in terms of technological complexity. At the early stages of e-government development, technologies are rather dissimilar in technological complexity. For instance, an online parking permit application is clearly more complex than an FAQ (frequently asked questions) list on a website. The technologies at later stages of e-government seem to be more similar with respect to technological complexity. This may explain why at the level of technical features the boundary between the third stage and the fourth stage is no longer clear-cut.

Limitations and future research

The strength of this study is that we provide large-scale systematic evidence of e-government development. However, a clear limitation is that we are rarely able to provider deeper insights into the mechanisms of e-government development. Although we observe that municipalities differ in their progression through stages, and with respect to e-government development in general, further studies have to provide the qualitative evidence to explain these findings.

Recent research has increasingly focused on factors affecting adoption and diffusion of e-government activities. Event history analysis is a promising technique that provides new insights into e-government development (Blossfeld, Golsch, and Rohwer 2007), which has just recently received some attention in e-government research. In contrast to a Mokken scale analysis, event history analysis explicitly takes the time of adoption into account. This allows creation of life tables, survival functions, and density functions. Based on these tables and functions, it is possible to calculate the time periods between the adoptions of different e-government features. Consequently, the expected time of adoption for a specific feature can be estimated. These predictions can provide valuable information for policymakers for making informed predictions on how rapidly e-government will develop. Unfortunately, our data set did not provide sufficient information for an event history analysis. To make a meaningful event history analysis, adoption data over the period of (at least) 15 subsequent years are desirable.

From a theoretical perspective, future e-government research can benefit from incorporating important research ideas from the literature on the diffusion of innovations. Stage models of e-government strongly focus on the characteristics of technical features. However, as Lee (2010) and Siau and Long (2005) indicate, there are other barriers to e-government diffusion. For instance, adoption costs of reorganizing bureaucracy may play a role at later phases of e-government (Siau and Long 2005). Moreover, research on the diffusion of innovations has shown that not only do characteristics of the innovation (technical features and organizational adoption costs) affect diffusion, but also the social networks of potential adopters influence the speed of diffusion (Rogers 2003). To foster e-government initiatives, it is highly likely that municipalities frequently interact with each other and exchange information about success and failure of these

initiatives. This additional information allows policymakers to make better adoption decisions.

In addition, researchers could also provide new insights if they study in greater detail municipalities that deviate from the linearity assumption of the stage model. For example, it would be interesting to know whether (or not) these municipalities differ in their service provision in terms of quality and efficiency compared to municipalities that follow the linearity assumption. In case future research would indicate that this deviation does not imply any disadvantages in service provision, policymakers could be confident in their adoption decisions to "jump" or "drop" certain features in their e-government initiatives.

Notes

1. This is not intended as a comprehensive review of the literature on stage models, as this has already been done elsewhere (see Lee 2010).
2. An earlier analysis we conducted, which is not shown here, included the "forums and discussion lists" item as an indicator of e-democracy and as a single feature of e-government, which led to these results.
3. We conducted the same analysis including the variable "forums and discussion lists" as an indicator of e-democracy. This resulted in a drastic increase of inconsistent patterns because, as mentioned earlier, "forums and discussions list" was adopted relatively early by many municipalities.
4. The number of patterns representing the time when a certain stage is reached does not equal the number of municipalities. In general, there is an average of 2.7 patterns per municipality.
5. Additional analyses of the so-called P++ and P– matrices, as well as the checking of nonintersecting item response curves with the help of restscore groups (Molenaar et al. 1994), reveal no serious violations of the assumptions of a Mokken scale.
6. We conducted this analysis including the "forums and discussion lists" as an e-government feature. This feature did not fit well—the H-coefficient was lower than 0.3 so it was not scalable; it was associated with many Guttman errors, that is, inconsistent patterns.

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