e-Government Stage Models: A Contextual Critique

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Abstract

Since the first stage models of e-government were proposed around 2000, there have been at least 15 variants published in the academic and professional literature. This paper is a critical examination of these models which places them in the wider historical context of information systems stage and maturity modeling. It is argued that, with a small number of exceptions, most e-government stage models are theoretically weak being descriptive, not well grounded in empirical evidence and/or normative. If such models are to be useful, a different approach is required. A number of ideas for doing this are proposed.

1. Stage and Maturity Models

One of the most widely cited papers in the e-government literature is that written by Layne and Lee [53] published in Government Information Quarterly in 2001. In that paper the authors present a four stage model for the evolution of e-government. Similar models had previously been published by Baum and Di Maio [5] and Deloitte Research [18], however Layne and Lee’s paper was the first academic publication to present such a model and it spawned a series of “me-too” variants totaling (depending on how you count them) at least 15 to date. Poeppelbuss et al [77] analyze 76 different maturity models published in leading IS journals over the fifteen year period up to 2011. This paper discusses the findings from an examination of 51 such models published from 1973 onwards including all of the e-government maturity models published up to the time of writing. In this paper, two problems with latter are explored namely their failure adequately to take into account key factors such as politics and technology and the tendency of such models to be normative.

The concept of stage of development or maturity goes back a long way and was used in other disciplines such as psychology [44], [61], [76] and organization theory [2], [33] long before it was first applied in Information Systems (IS). The concept of IS stage modelling has its origins in organizational learning [48], [90], [95]. Two types of growth or learning are described in this literature: vertical and horizontal [12], [45]. Vertical growth, which occurs when the members of an organization challenge the organization’s underlying assumptions, values and procedures, attempting to replace them with new ones, provides the basis for stage modeling.

The first IS model of this nature was published by Nolan in 1973 [71]. The term that Nolan used was “stages of growth” model although the term ‘maturity model’ is today widely used. While there are subtle differences between these two terms, in this paper they terms will be used interchangeably. Furthermore, unless otherwise stated, the word ‘model(s)’ will be used exclusively to refer to stage model(s) and not to other types of e-government model.

2. Evolution of IS Stage Models

From the earliest days of information technology, there has been interest in its impact on organizations. Becker et al [6] claim that over 3,000 academic papers were published on this general topic in the 15 years up to 2010. Stage models are a significant subset of this literature and have attracted considerable academic interest. Furthermore, each successive wave of technology has resulted in new analyses [25]. While there is a number of frameworks that might be used to explore this topic, Hirschheim and Klein’s [40] three technological eras for IT: the mainframe era, the PC era and the Internet is a convenient segmentation and is adopted in what follows.

2.1 The Mainframe Era

From the perspective of stage modeling, the mainframe era begins in 1973, with the publication of Nolan’s model (referred to above), and runs up to the early 1980s. The impact of Nolan’s original model was both considerable and durable. According to Hamilton and Ives [34] nearly a decade after it was published Nolan’s paper was still among the top 15 papers most cited by IS researchers. Nolan (in collaboration with other authors) subsequently published a series of refinements of this original model [30], [72], [73].
While the original model had just four stages: *initiation, contagion, control and integration*; by 1979 Nolan had added two further stages: *data administration and maturity*. Nolan did not present the model as a prescriptive one, but rather as a guideline for managing the computer resource.

The first substantial assault on Nolan’s work was by Lucas and Sutton. It came after the second publication [30] and drew attention to statistical weaknesses in his research [55]. Subsequently King and Kraemer [38] found Nolan’s model wanting on empirical, theoretical and practical grounds, questioned the findings of the model and concluded that: “as a grounded theory the model fails” ([38], p474). They argued that the model was incomplete in its attempt to capture the larger organisational context within which computing occurs. Despite this criticism, the concept of stage modelling continued to develop in the academic literature [6], [27] as it provided a useful conceptual language for the assessment of current and the planning of future developments [7], [48].

Although Nolan did not use the term, his early models can be described as Information Systems Planning (ISP) models. This type of model was in time to evolve into the Enterprise Information System model. The first of these pure ISP models was put forward by Earl in 1983 and underwent a number of subsequent revisions [20], [21], [22] which ultimately yielded six stages of planning: *meeting business demands, IS/IT audit, business support, detailed planning, strategic advantage and business-IT strategy linkage*. Earl’s findings were based on case study investigations and action research.

Another ISP model was proposed by Bhabuta [8] who contended that organisations move through three stages of planning namely the delivery phase, the re-orientation phase and the re-organization phase. These models and other in this vein described elements of technical, organisational and managerial functions where ISP was the differentiating feature. They can be categorised as a form of design science model [65].

### 2.2 The PC Era

In the early 1980s as organizations moved towards distributed computing, maturity modelling shifted its focus to specific aspects of the organization. For instance, some models mapped how IS planning took place or how various aspects of IS governance and management evolved over time. From this work, a new type of model, the *Management and Governance* model emerged. McFarlan, McKenney and Pyburn [63] presented the first of these models in 1983. The McFarlan *et al* model is more prescriptive in the sense that it offers itself as a heuristic, to help ICT managers plan the introduction of new technology. This type of model has remained the commonest form of stage modelling. Most of the models in this category can be classified as behavioural science models.

In 1991 Galliers and Sutherland [29] drew together a number of these management and planning type models (specifically [8], [20], [21], [28], [29] and [39]) and consolidated them into a six-stage model describing a pathway of growing maturity in the management and use of IT within an organisation. The stages they identified were: *adhocracy, starting the foundations, centralised dictatorship, democratic dialectic and cooperation, entrepreneurial opportunity and integrated harmonious relationships*.

It was during this period that the Enterprise Information System models took full shape. These models are used to describe broad aspects of the organisation’s operations and information systems. The purpose of such research is to give a direction and focus to overall ICT expenditure. While calls for research into this problem have been persistent through each of the technological eras [25], [62], [63], [92], [103] not many researchers had attempted it. A few tried however and three models in this category have been proposed since [85], [92], [96], [97] and [98] including those emerging from the MIT90 project. It is notable that in almost four decades only three models were proposed which tried to describe the overall development of IS in organisations.

One of these Enterprise Information Systems models was produced by Ward and Griffith and further developed by Ward and Peppard. The first of these models [97] had three stages to which a fourth stage was subsequently added by Ward and Peppard [98]. This fourth stage they referred to as the era of IS capability. This last stage was described in more detail in a later contribution by Peppard and Ward [75] where they proposed a framework for this capability, one which incorporates 26 distinct competencies.

Finally during this period Burn [9] suggested a narrower six stage model for ISP. This was built on Earl’s model [21] and incorporated the stages-of-growth from Nolan’s models [71], [72], [73]. The model suggests that different types of planning are appropriate at each stage of growth within an organisation. Burn combined Nolan’s stages and Mintzberg’s [66] organizational structures and suggested the following planning methods for each of six stages; *bottom up, multiple, top down, top down/bottom up, inside out and multiple*. Burn’s model is a well thought out hypothesis, which is grounded in a review of the literature of the time; unfortunately the model was not tested empirically and is less than rigorous in its research approach.
2.3 The Internet Era

The Internet era in this context covers the period from the early 1990s up to the present. A review of the literature in this period identified 38 maturity models which were published over the period 1993 to 2012 (including all of the e-government stage models).

A significant departure from heretofore pattern of behavioural science models was introduced by Paulk et al [74]. Paulk worked at the Software Engineering Institute (SEI) at Carnegie Mellon University and developed a Capability Maturity Model (CMM). This was inspired by the ideas of Juran [43] and Deming [19] (also see [4]). The CMM is a framework, which describes a path for process improvement in the software development industry and as such is more accurately described as a computer science than an IS model, but it was to have an important influence on subsequent IS models (see below). The path has five levels where an organization has goals to meet at one level before it can progress to the next level. The levels are entitled: Initial, Repeatable, Defined, Controlled and Optimised. CMMI was intended to provide a coherent ordered set of incremental improvements, all of which had been demonstrated to be successful in the field, packaged into a roadmap that showed how effective practices could be built on one another in a logical progression [36]. The model was designed to be prescriptive.

From this point onwards maturity models were influenced by this template. CMM was the first of the true design science models. This type of model views the stages of development as stepping-stones for organizations to reach progressively more complex or better versions of themselves – whatever those might be. Design science models are described by Carcary [10] as being located between models and methods in that they offer descriptions of the current maturity level and guidelines on how organisations can achieve a higher level of maturity. Such models are not without risks. According to Hevner et al [37] design science research is perishable, with a shorter shelf life than behavioral science. The value of design science models can change with rapid advances in technology.

In 2002 an extended version of the CMM, the Capability Maturity Model Integrated or CMMI was released. CMMI is about process improvement and not just ICT or IS. A few years later the Innovation Value Institute (IVI) was founded by a number of organizations including Intel, Ernst and Young and the National University of Ireland Maynooth to develop a general purpose IT/IS maturity model. This model was called the Capability Maturity Framework (CMF) (now IT-CMF) and covers (at the time of writing) 33 capabilities at five levels [15]. The implicit assumption of both the CMMI and CMF models is that management intervention is the primary change mechanism for organizational growth. This is an important, but also a limiting assumption. This type of change mechanism is described by Van de Ven and Poole [94] as teleological. It is self-evident, however, that not all stage change is teleological. Change can occur for reasons other than deliberate action. The underlying philosophy of the IT-CMF (and the CMMI) is one of planned and controlled change. Experience shows, however, that not all change occurs this way.

Many of the governance models in the third era moved beyond ISP and into areas such as Process Improvement [35], Outsourcing, [88], Business/IT Relationship Management [60], General ICT Management [81], Software Maintenance [3], Knowledge Management [16], [31] and Innovation [101]. With the exception of [35], all of these remaining management and governance models are design science models reflecting the CMMI template.

In this era, a third type of model appeared. According to Ross et al [83] in many instances customised enterprise solutions did not meet the specific needs of departments. Organisations opted instead to acquire packaged software applications. This raised many questions regarding technical architectures and how to integrate data and processes across numerous messaging systems and data stores. Solutions around service oriented methods began to emerge in the IS field along with some focus on stages-of-growth models. From this development a number of Technical Architecture models emerged.

Technical Architecture models take a broad perspective on the organisation. The first such model was a four stage model proposed by Ross et al [83] in 2006. Two further models came later in that same year with the advent of Service Oriented Architecture [26], [59]. This was followed a few years later by Gottschalk’s ‘Whole of Government’ initiative [31].

The emergence of technical architecture models suggested a moving away from all-encompassing Enterprise Resource Planning (ERP) systems, to an environment where many and varied off-the-shelf systems are purchased and require integration into the overall enterprise architecture. The stage models in this category can be characterised as being predominantly prescriptive, with the exception of Ross and Weill’s model [83] which is descriptive. Ross and Weill’s stages are application silo architecture, standardised technology architecture, rationalised data architecture and modular architecture. This model is the only behavioural model presented in this category.

Towards the end of the PC era the problem of assimilation became more prominent and a fourth type of model appeared. Technology assimilation issues
became increasingly pressing in the third era as a result of the growing number of technologies and commercial software packages available. Problems of data incompatibility and data integrity across functional departments persisted [40]. More complex software solutions attempted to solve these problems with enterprise solutions [102] and, as software increased in complexity, problems of implementation and assimilation came to the fore for many organisations. As a result a number of Technology Assimilation models were proposed, describing the process of incorporation of specific technologies into organisational structures. ERP technology and its assimilation was the subject of two models [41], [57]. Other assimilation models encompassed Data Warehousing [99], Business Intelligence [56] and Business Process Management [82].

While some Technology Assimilation models were published before the CMMI template [58], [13], it was post CMMI that such models became popular. From this point forward, technology assimilation models adopted a design science approach beginning with a model brought out by KPMG in 1997. This type of model gained traction in both academic and industry arenas. It focused on the topic of e-business and Web technology assimilation, as did a number of other models over the next decade. Examples of such models include [24], [78], [79] and [11] which extended the Rao et al model [79].

Enterprise models continued to be proposed with two pieces of research from Teo and King and Teo [49], [89]. A number of monographs and books were also published on this type of model [74], [91], [97]. While this paper is not about ISP specifically or even management and governance models generally, it is worth observing that in both there is an underlying theme whereby specific bodies of knowledge are built with models, making additions to those models and culminating in substantial know-how to assist management with their task\(^1\).

In summary, nearly 40 years of research have resulted in a large number of IS maturity models. This research has considered 51 such models. Each of these models can be analysed by their time of publication and their orientation. The overall picture (including the e-government stage models which are discussed in the next section) is summarized in figure1.

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\(^1\) It is not suggested that these were the only conceptual frameworks used to build this ISP domain.

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We will now consider how e-government models fit into this picture.

3. e-Government Stage Models

e-Government stages-of-growth models have evolved in a manner similar to mainstream IS technology assimilation models to the extent that they are broadly presented as government agency assimilation models for Internet and web-based technology. What is also interesting is the fact that many of these models are hybrids between behavioural science and design science models, i.e. many of the models’ initial stages have been observed empirically, but the later stages are aspirational. As a consequence these models tend to be partly behavioural and partly created from design.

As noted in the opening section, the first and most cited academic model to date is that of Layne and Lee [53]. Layne and Lee define e-government as the use of web based technology and Internet applications to enhance the delivery of government information and services to citizens. With this definition in mind, they postulate a four-stage model of growth for e-government; a catalogue stage, a transaction stage, a vertical integration stage and a horizontal integration stage.

This model was followed in rapid succession by several others, in chronological order [38], [85], the United Nations (a series of such models between 2002 and 2012), the World Bank, [68], [69], [79], [12a], [87], [100], [86], [42], [1] and [50].

Most of these followed a similar pattern of behaviour and design. Moon (2002), for example, defined e-government as web-based service delivery and the establishment of central data storage for more efficient and cooperative interaction among
governmental agencies. Moon proposed five stages: information dissemination, two-way communication, service and financial transactions, vertical and horizontal integration and political participation the latter including online discussion and voting. As mentioned previously these e-government models are hybrids, sitting somewhere between being behavioural science models and design science models. The earlier stages are of Moon’s model clearly taken from empirical observation unlike the later stages which are directed toward an ideal design state for e-government.

In 2005 Siau and Long [86] synthesized a number of the e-government stage models which had appeared in the literature up to that time and created a new e-government stage model with five stages: web presence, interaction, transaction, transformation and e-democracy. The stages were similar to those in Moon’s model and did not offer much additional insight. The researchers applied a research method called meta-synthesis [70] which attempted to synthesize a new stages-of-growth model from six existing models. Such an approach can only be as good as the underlying models from which it is drawn and unfortunately most of the e-government models at that time followed a pattern in which the research methods were unclear. While the initial stages resonated with observation, later stages varied between the plausible and what can only be described as wishful thinking.

In the same year, Janssen and Van Veenstra [42], in a break from the assimilation approach, set out a five stage model of e-government which took a technical architecture perspective. The stages in this model were no integration, one-to-one messaging or transactional services, centralised repository among government agencies, message broker to deliver real-time services, more integrated and seamless services to citizens using orchestrated broker architecture. The model too can be categorized as a part behavioural, part design science model.

By the mid noughties, stage modelling had become established as a popular way of publishing in e-government. Andersen and Henriksen [1] extended Layne and Lee’s model by including additional dimensions, focusing on the customer rather than technological capability. They proposed a Public Sector Process Rebuilding model with two dimensions, but with four stages: cultivation, extension, maturity and revolution. Again, the last stage is aspirational. Governments, say the authors, are in a ‘long push’ to achieve this, but this claim is not grounded in concrete evidence.

In 2008 Coursey and Norris [14] reviewed the models up to that point and suggested that, for the most part, the descriptions in the models provide a reasonably accurate view of e-government in the early stages from initial web presence to information provision, to interactivity. Beyond this, however, they suggested, the models become “predictive and normative and their empirical accuracy declines precipitously” ([14] p. 523). Although Coursey and Norris’s research was carried out on some of the earlier models, this view coincides with that of Klievink and Janssen’s more recent research [51].

Klievink et al [52] also identify some of these shortfalls in current e-government stages-of-growth models. Stage models up to that time had described historical developments quite well, but few, if any, organisations have yet been observed to have gone through all stages. The authors are critical of the vision of existing models and say that further work is needed to bridge the gap between what they call premature and mature stages. The models, they argue, do not reflect the reality of e-government efforts. Most of the models were not built from observations or descriptions of real e-government initiatives. In that sense they were aspirational and are possibly a step too far. The higher stages of these models were not based on empirical evidence and did not describe why these changes happen or should be expected to happen.

Following this Klievink and Janssen [50] published a five stage model which focused less on individual agencies and more on a broader governmental approach to e-government. The model can be categorised as a design science model and is mostly about ideal future stages of development for government agencies. The model cannot be regarded as either descriptive or theoretical.

Two recent contributions to this literature are by Valdés et al [93] and Lee [54]. Valdés et al propose a nine stage maturity model. Lee undertakes a meta study of many (though not all) of the e-government stage models produced to that time and uses them to create a common frame of reference for all such models using five stages and two perspectives (client/service and operations/technology).

4. Critique

e-Government stage models share certain distinctive characteristics some of which are found in other IS stage models and some of which are not.

1. One key difference is that they apply to government in a wide sense. They are thus generic. The distinctive paths which might be followed by different forms of government agency are not considered. This causes a problem because government agencies are varied in role, function and structure and are likely to progress in different ways in different areas of the public sphere. Even where there is similarity in function, different agencies may progress
in different ways for a whole variety of reasons including political priorities and technical capability.

2. The models are mostly Technology Assimilation models. They report the ability of government agencies to absorb and apply technology. They are also prescriptive. Layne and Lee conclude their paper by stating that their four stages “...offer a path for governments to follow” [53, p135], but do not make a case why any government should follow their guidance.

3. Consequently most of these models are a mixture of the descriptive and the aspirational and/or predictive. The fact that government websites typically move from static provision of information to simple enquiry is readily observable. However the later later stages often seem to reflect authors’ hopes rather than be based on solid theory or sound reasoning. It may well be desirable that e-government leads to transformation and there may be reasons to believe that this may happen, but there is no logical reason to believe that the final and highest stage of such development will be e-democracy or participative democracy particularly since none of these models take into account politics or consider its impact.

4. As a consequence, e-government models are typically an odd mix of behavioural science and design science. As has been noted, design science models have become the dominant form in practice with the growth in popularity of the CMMI and the IT-CMF. While no equivalent has emerged for e-government, it is interesting to note that real government departments in Ireland seem more interested in mainstream products such as the IT-CMF than in academic e-government stage models [46]. It is worth noting too that the various benchmarking models including the UN models cited above also use this multi-level form of maturity staging.

5. All of the e-government stage model descriptions commence with the advent of web services and the Internet and broadly define e-government as web based delivery of government information. This outward facing view of e-government follows from the definition of e-government adopted. This is in marked contrast to most mainstream IS stage models (and many other e-government non-stage models) which look at IS either from an internal perspective or holistically. Other important technologies which may be used internally (analytics, AI, cloud computing, etc.) are outside the purview of these models.

6. The narrow definition of e-government used by researchers in the field has limited the scope of e-government stage models and this can obscure the risks or returns accruing to the ICT investment which relies on it. Many of the benefits and pitfalls of ICT investment are subtle and difficult to measure.

Remenyi et al [80] suggest that a multi-dimensional perspective should be adopted when attempting to measure value for money in ICT investment. This perspective is also lacking in many of these models.

7. There is little or no consideration of change mechanisms in any of these models. Mechanisms are generally to be assumed to be teleological, i.e. management driven. Understanding the mechanisms of change is important to understanding and predicting how e-government evolves which is a prerequisite to planning. This is currently a significant gap in the research field.

8. More seriously, some e-government stage models seek deliberately to redirect attention away from the fundamentals of how the use of IT evolves in organizations and towards the external world. Andersen and Henriksen make it clear that this is their objective when they write that “The proposed maturity model is changing the focus of e-government to the front-end of government and away from a technical integration issue, as is suggested in the Layne and Lee Model” [1, p246].

5. Conclusion

George Box once remarked that all models are wrong, but some are useful. It is ironic that when governments look to stage models for guidance, it is not to the e-government models that they turn, but benchmark stage models (and in Ireland’s case at least) the IT-CMF [46]. (None of this is to say that governments do not make use of other types of e-government model, but that is a different issue). A discussion of the appropriateness of the IT-CMF for government is beyond the scope of this paper, but there is no evidence that, with the notable exception of their use in benchmarking, public administrators are, so far at least, paying much attention to the e-government stage models found in the literature.

There are several implications and for e-government and for further research in this field. There is a need for a better understanding of not just how, but why e-government evolves in the way(s) that it does. The history of e-government is not short of failed initiatives, often a result of overreach, over optimism and/or a misguided faith in technological rationality. In developing e-government strategy there is value in understanding not only what stages e-government goes through, but also in how capabilities are built up layer by layer over time, in the mechanisms that drive each stage of development and in why they mandate each change. In other words there is a need for solid explanatory theory, i.e. a for a move beyond the descriptive and the normative. This
will require more research based on detailed study and empirical evidence and not just more meta studies or aspirational theorizing. From the perspectives of government, there is much to be said for learning from the successes of others. This is the underlying rationale for use the IT-CMF and comparable models and such models can provide a roadmap for harassed government CIOs. However they provide little insight into why; their message is prescriptive and one-size-fits-all. The academic research community should seek to go beyond this.

e-Government stage models need to be based on a broader conceptualisation of what e-government is, pay more attention to the mechanisms of change and in themselves mature from a mix of description and speculation to being grounded in good, practical theory. Then they may start to have more impact.

6. References


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