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An Approach to Design and Evaluation of eGovernment Theory for South Africa

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ABSTRACT

e-Government is used to provide improved government services, greater public service efficiencies and cost containment, utilising the ever-changing possibilities offered by ICTs. The field is considered by researchers to be in urgent need of theory development. This requires a suitably rigorous research framework. The principal objective of this study is to articulate and demonstrate an integrated generic research framework for e-Government theory for South Africa and which might also be of interest internationally. Pertinent aspects of the study are described to illustrate the proposed research framework, after which the full research methodology and its phases are presented. This work contributes to e-Government theory research by establishing and applying a rigorous application of Design Science Research (DSR) process steps of suggestion, design and observational as well as analytical evaluation of design theory artefacts in the field of e-Government theory.

Keywords: e-Government, Enterprise Architecture, DSR, TOGAF, e-Government Theory, e-Government Reference Architecture, Digital Government, Meta-research, Information Systems Theory

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1. INTRODUCTION

In South Africa, as in most developing countries, the progress of e-Government has been slower than was initially anticipated (PRC, 1998) and has been observed to be regressing in its achievements (Cloete, 2012). Aside from a simple and speculative maturity model of Layne & Lee (2001) there is no guiding theory to support the work of e-Government internationally (including South Africa) and the adoption of the Government Wide Enterprise Architecture framework (GWEA) based on the TOGAF standard of The Open Group, has been found to be largely unsuccessful (GITOC, 2009; TOGAF, 2011; Bannister & Connolly, 2015). A reference architecture gives guidance to the development of specific solution architectures developed for e-Government so that they achieve a government wide alignment with e-Government objectives. Although GWEA makes provision for inclusion of a reference architecture as part of the enterprise continuum, such a reference architecture is currently not a part of GWEA in the form in which it is normally understood by enterprise architects. Therefore, one can deduce that this objective of designing effective e-Government solutions may then not be achieved. Essential features to be achieved through e-Government system implementation include removal of unnecessary duplication of data, use of common access channels for service delivery to citizens and businesses and reuse of common government business processes, as well as on-going reengineering of service delivery processes across government (Cloete, 2012; Farelo & Morris, 2006; Mentz et al, 2014).

The lack of e-Government theory is seen to be a significant barrier to its development as a branch of information systems and providing guidelines for effective e-Government system implementations (Bannister & Connolly, 2015; Goldkuhl, 2016; Paulin, 2017). This study addresses the gap in knowledge of e-Government theory by proposing an e-Government theory in the form of a framework of twelve design theory artefacts, inclusive of a business level reference architecture based on the use of DSR as the core research methodology with its application adjusted in a way that promotes rigour in artefact evaluation.

Section 2 of this paper discusses the published work most closely related to this study, covering e-Government theory, enterprise architecture and research methodologies. When researching a new field, such as e-Government theory, it is important to undertake research into the research

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itself, referred to as meta-research, as the pursuit of robust scientific investigation is subject to change (Ioannidis, 2018). Section 3 of this paper discusses the meta-research aspect of this work. Section 4 continues by showing the implementation of the selected research methodology in this study. The various process steps constituting the DSR methodology are described in some detail, including the approach to qualitative data analysis as part of the observational evaluation of artefacts. Section 5 provides a discussion of the way the artefacts were conceived and designed while Section 6 gives a detailed exposition of the evaluation of the design theory artefacts through five cycles of evaluation. Cycles one and two are observational using questionnaires and qualitative data analysis. Cycles three to five are analytical examining the design artefacts against published theory criteria. Section 7 provides a discussion of the significance of the study and the contribution it makes to the field of e-Government theory. The paper concludes with Section 8 providing some direction for future research in e-Government theory.

2. RELATED WORK

The use of enterprise architecture for e-Government implementation is increasing around the world (Anthopoulos et al, 2010). The research community holds the view that e-Government and enterprise architecture are young and formative fields of theory and practice requiring more research (van der Raadt, 2011; Boucharas & Van Steenbergen, 2010). Not having an enterprise architecture framework in place and a theory for e-Government can produce detrimental effects (Anthopoulos et al, 2010; Bannister & Connolly, 2015; Paulin, 2017).

The South African government is structured in the three tiers of national, provincial and local, each with its areas of competence (DPSA, 2003). For practical reasons the scope of this research is limited to e-Government as practiced by the South African national government, Gauteng Provincial Government, which is one of nine provincial government of South Africa, and local government.

Over the past twenty years, the use of enterprise architecture (EA) has migrated to government organisations, and there is a growing realisation now in academic and government circles that e-Government cannot be effectively implemented without the use of EA (Mentz, 2014; Anthopoulos et al, 2010; DPSA, 2006).

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As is the case internationally, there is no guiding theory to support the work of e-Government in South Africa and the introduction of the Government Wide Enterprise Architecture framework (GWEA) based on the TOGAF architecture standard of The Open Group has been found to be largely unsuccessful so far making a scientific contribution in this regard desirable (Cloete, 2012). An exception appears to be the work of Twinoumurinzi & Visser (2004) who propose a measure of ICT effectiveness by means of the current public service principles.

Since the beginning of this study in 2014, research articles have been accumulated through automated alert facility of the Scopus database, using the broadest search terms; e-Government and Enterprise Architecture. This literature review contributed to the essential knowledge base. Scholars have questioned the viability of e-Government as a separate discipline without a suitable theory (Bannister & Connolly, 2015; Paulin, 2017; Haider et al, 2015). The relevance of this work is that it offers a rigorous research approach to filling two knowledge gaps in the field of e-Government theory as well as illustrating the application of the approach in the form of a study in the South African context. The study offers a tentative solution to two knowledge gaps, by providing a e-Government theory, inclusive of the applicable GWEA reference architecture in the form of a framework of twelve artefacts which were evaluated empirically and analytically suggesting that they provide a useful theoretical and practical orientation to e-Government practitioners in South Africa and possibly further afield (Baskerville et al, 2018; Kotze et al, 2015).

3. NECESSITY OF META-RESEARCH

Goldkuhl (2016) reports the need for an e-Government research methodology based on the adaptation of DSR. After due consideration of the arguments put forward, the one proposed by Goldkuhl (2016) was found unsuitable for e-Government theory research. Review of literature shows that the DSR methodology has been used in information systems research at the doctoral level and is a recognised and rigorous methodology particularly in those instances where theoretical constructs are proposed to fill an identified knowledge gap (Kotze et al, 2015). DSR methodology is accepted in information systems research as being able to generate scientific knowledge in the form of design artefacts and then to evaluate their acceptance for increasing the

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knowledge base of a particular research domain (Baskerville et al, 2018). The act of design is comprised of both an artefact and the process that produces it (Kotze et al, 2015). One reason for the current research acceptance of design science research is the availability of process models, which encapsulate a higher degree of research rigour. The purpose of a DSR process model is to specify the process steps to be undertaken by a researcher to ensure that the relevance, design and rigour cycles are considered in a logical fashion enhancing the quality of the research (Baskerville at al, 2018).

DSR is seen as pragmatic and directed at problem solving (Gregor & Hevner, 2013) and several models of DSR have been proposed by researchers (Hevner & Chatterjee, 2010). The models proposed by Peffers et al, (2008) and Vaishnavi & Kuechler (2016) were examined for applicability to this research. It was found that the DSR framework proposed by Vaishnavi & Kuechler (2016) could be used for e-Government theory, as it defined the appropriate design theory artefact criteria that could be used to evaluate the type of artefacts conceived by the researcher in the initial process step of suggestion. Vaishnavi & Kuechler (2016) assert that their process model for DSR is suitable for addressing the development of theory in the field of information systems and that DSR should lead to new, usually theoretical contributions to knowledge, which are valid and interesting. In the process of creating new knowledge, DSR relies on human processes of cognition, design, analysis, reflection and abstraction. Based on the prior work of Takeda et al (1990), the Vaishnavi & Kuechler (2016) DSR process model is depicted in Figure 1.

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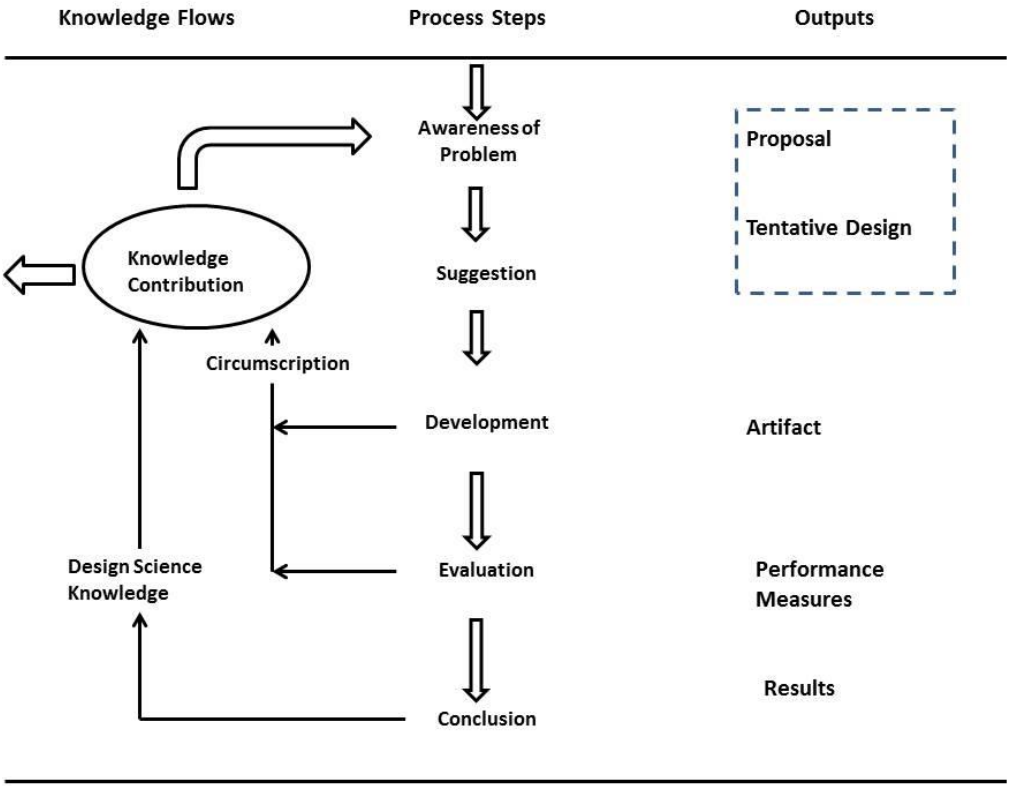

FIGURE 1 DESIGN SCIENCE RESEARCH PROCESS MODEL (DSR CYCLE) AFTER VAISHNAVI & KUECHLER (2016) ADAPTED FROM TAKEDA ET AL (1990)

The model comprises of five process steps, each of which specifies the outputs and the adoption of a mode of thinking which is found to be productive in generating the outcomes at each step of the process. DSR begins with the researcher becoming alert to a potential problem situation requiring a design solution. This perception can come about from one's personal experience and observations of a particular domain of knowledge or a specialised area within that domain, such as e-Government, in the domain of information systems (van der Merwe et al, 2017; Krauss, 2013). A researcher then explores available published research and other material to ascertain whether the perceived gap in knowledge is deserving of further study. The next step in DSR is to make use of reasoning to posit one or more design artefacts that may solve the problem. Once this contemplative or suggestive step has produced its tentative outputs, the next step of development is engaged in using primarily a deductive mental process to convert the design

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concepts of the previous step into more concrete forms of artefacts. The next DSR process step is to subject the design artefacts to an appropriate form of evaluation to show that they possess the attributes for which they were designed. This is a hypothesis-testing step in the DSR process, which is highly dependent on the nature of the artefact. An approach to evaluating an e-Government theory artefact may be, as is the case in this study, to present a description of the artefact to an experienced group of architects to determine its expected utility and validity.

Vaishnavi & Kuechler (2016) provide a comprehensive classification of the types of knowledge output which may be obtained from DSR. The class of output, referred to as theory, is used to designate knowledge which comprises of artefacts accompanied by further logical arguments and explanations that create a knowledge framework. This shows that the initial typology provided by March & Smith (1995) has now been extended by other researchers. Partial and incomplete theories of a descriptive or prescriptive type as well as architectures and frameworks are recognised as legitimate outputs of design science research (Vaishnavi & Kuechler, 2016; Gregor & Jones, 2007; Gregor & Hevner, 2013).

The Vaishnavi & Kuechler (2016) process step of evaluation seeks to evaluate the desirable attributes of artefacts which in this study is utility and validity. The final step of the DSR process is communication of research findings. Presentations of this research took place at various points. The poster presentation at the SAICSIST'2015 conference at Stellenbosch University was followed by a presentation at the postgraduate research seminar at UNISA in 2015 (Vidmar and Kotzé, 2015; Vidmar and Kotzé, 2015a). A presentation has been done to the Open Group's EA Forum and to the subcommittee of the South African governments IT Officers Council (GITOC), dealing with e-Government governance, architecture and compliance (Vidmar, 2019; Didiza and Sebeduga, 2019).

Formal and informal interactions with other scholars suggested that some form of prior information system theory was required to justify the conception of the artefacts in the DSR process step of suggestion. This led to the examination and adoption of Bourdieu's seminal work on Theory of Practice which has previously been applied to field of information systems research (Bourdieu, 1990; Krauss, 2013) and this forms the kernel theory for the artefact suggestion and

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initial design in this study covered in section 5. In addition, scholars have published theoretical criteria that could be used to evaluate analytically the theory artefacts (Vaishnavi & Kuechler, 2016; Hevner et al, 2004). Specific theoretical criteria have been proposed for evaluation of e-Government theory by Bannister & Connolly (2015) and on the application of enterprise architecture by Mentz et al, (2014). This made it obligatory to complement the first two design artefact evaluation cycles, from the initial empirical approach based on two semi-structured interviews and qualitative data analysis, with further three analytical evaluation cycles based on the above sets of criteria.

4. RESEARCH METHODOLOGY AND ITS APPLICATION TO SOUTH AFRICA

The empirical component of the research involves two semi-structured interview cycles with selected experts and is followed by a further three cycles of analytical evaluation. The summarised view of the design of this research work is shown in Figure 2 and explanatory Table 1 below.

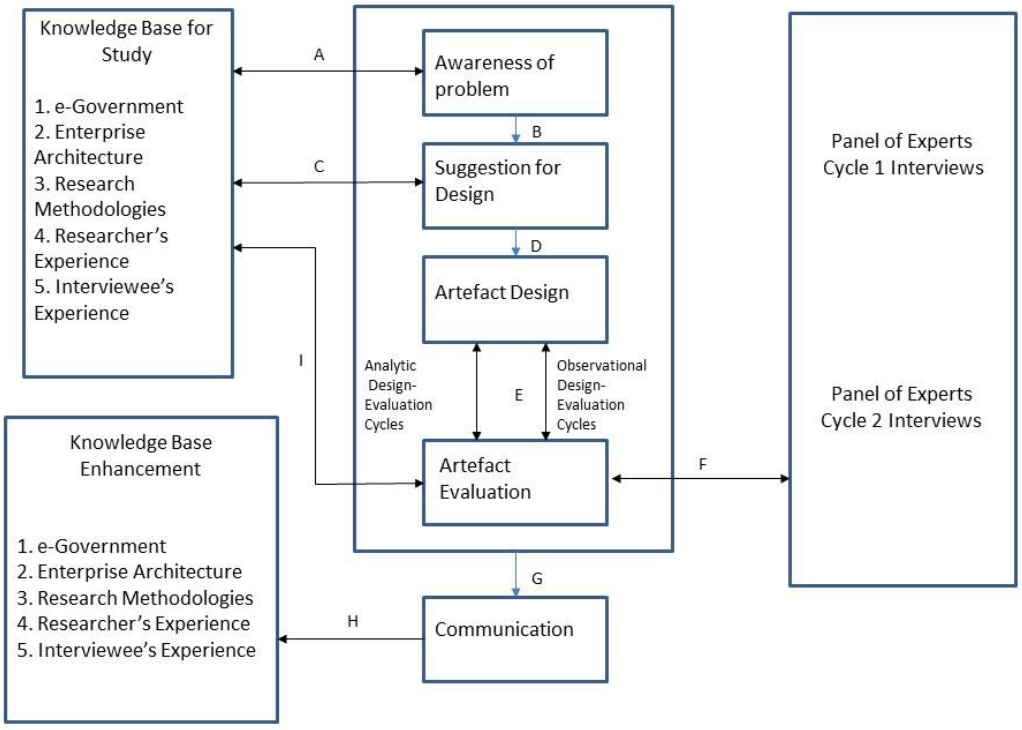

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FIGURE 2 RESEARCHER'S DSR PROCESS FOLLOWED IN THIS STUDY

The labels A to I in the figure show the interactions that take place between the various components of the selected process model based on that of Vaishnavi & Kuechler (2016). The central rectangle of the figure encompasses the four DSR process steps of awareness, suggestion, design and evaluation executed from top to bottom. The left of the figure shows the knowledge base with its categories and which is enhanced by the results of this study. Table 1 below references the preceding figure and provides the reader with a brief synopsis of the activity flow of the applied DSR research methodology.

Table 1: Researcher's DSR Process Steps

DSR Step for this Work	Step Description
Awareness of the Problem	The researcher identifies the general area of this study and identifies the required knowledge base as being e-Government, Enterprise Architecture, Research Methodologies and researcher's experience, as shown by the interaction labelled as A.
Suggestion for Design	Having identified the problem to be researched the next step of Suggestion for Design is entered, shown as label B, requiring contemplation of the type of solutions that might be required to solve the problem with reference to the knowledge base. The conception of a set of artefacts eventually allows entry into the next step of Artefact Design, shown as D.
Artefact Design	Having obtained design ideas from the previous step, a series of design artefacts is developed until it appears to the researcher that a feasible solution to the problem has been designed as shown by the labels C and D.
Artefact Evaluation	Since the designed artefacts are for use by enterprise architects working to implement e-Government applications in South Africa the evaluation of design artefacts using the observational method is to take place based on semi-structured interviews with a panel of experienced and qualified experts in e-Government and enterprise architecture. Based on the thematic qualitative data analysis of the results, cycles of observational evaluation method continue until the artefact utility has been evaluated within the limits of this research.

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DSR Step for this Work	Step Description
	Following the conclusion of the design-evaluation cycles using observational evaluation three more cycles are to be performed using the analytical method to evaluate whether or not the proposed e-Government theory artefacts meet the criteria for theory artefact in the DSR framework as well as in e-Government information systems and in the context of enterprise architecture theory. The design-evaluation cycles are shown as labels E, F and I.
Communication	The conclusion of the design-evaluation cycles permits the researcher to enter into the final Communication step of the process, labelled as G. The scientific knowledge added by this work will be deposited in the knowledge base and further communicated to the research community and may contribute to other researchers work in e-Government, enterprise architecture and use of the DSR research methodology. This is shown by the label H.

Ethical clearance for the research was obtained from the University of South Africa to safeguard the interests and security of the interview participants and the collected data. This work is limited to participation from interviewees from South African national government, the Gauteng province of South Africa which is one of nine provinces but economically the most active, and IT consulting industry.

5. ARTEFACT SUGGESTION AND DESIGN

When in the course of the research the point was reached of discovering a gap in the current knowledge related to the absence of e-Government theory including reference architecture, the researcher engaged in a process of reflection where the observation of the deficit in the state of e-Government theory was surprising and brought about the recollection of the researcher's experience as Government CIO (GCIO) which eventually led to the inference that some or all of the artefacts conceived during that period of practice might have some theoretical validity (Farelo, 2005; DPSA, 2006).

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Gregor & Hevner (2013) allude to the necessity of use of kernel theories in the design of artefacts. In this context, and as discussed by Krauss (2013), there is acknowledgement amongst researchers in social sciences, drawing on the Theory of Practice of Bourdieu (1990), that any theory that seeks to influence a cultural environment should be influenced by the immersion of the researcher in such a cultural environment and that theory and practice should inform each other. Bourdieu (1990) shows in his work how human nature requires the effective interplay of knowledge and the practical use of that knowledge. The researcher was immersed as a practitioner in the cultural work of e-Government in South Africa for nearly three years. It was in the course of learning and socialising with fellow e-Government practitioners that the researcher conceived artefacts that would enable the exercise of practical leadership and implementation support for an e-Government program in the future. These artefacts were socialized and appeared valid during an extensive period of consultation in government, but have not so far been practically implemented (Farelo, 2005; DPSA, 2006). The proposed novel artefacts therefore have a provable grounding in the practical experience of e-Government in South Africa (Gregor & Hevner, 2013; DPSA, 2001).

As ideas arose in the mind of the researcher in the second DSR process step of suggestion they were logically evaluated as recommended by Vaishnavi & Kuechler (2016); "In a sense evaluation takes place continuously in a design process (research or otherwise) since a large number of "micro-evaluations" take place at every design detail decision. Each decision is followed by a "thought experiment" in which that part of the design is mentally exercised by the designer."

This reflection resulted in the initial design of eleven design theory artefacts, in the form of architecture models with associated descriptions which were submitted to five design-evaluation cycles, which then terminated in a composite design theory framework artefact comprised of twelve component artefacts, termed the e-Government Framework, summarised in Figure 3.

The starting state of e-Government theory research is shown in the upper part of Figure 3 where the knowledge base was constituted comprised of government reports, policies, national and international research literature and the researcher's and interviewees' experience of e-Government. The data analysis in cycle 1 showed the need for a twelfth design artefact, called

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the e-Government capability map. The twelve artefacts were then evaluated through the remaining cycles 2 to 5 without any structural change but with some descriptive changes to clarify issues mentioned by the interviewees. The end state of e-Government theory is shown in the bottom part of Figure 3 where the final e-Government theory artefact is a framework of twelve component design theory artefacts and is shown as the conclusion of the design-evaluation cycle 5 in Figure 3. Each of the framework component artefacts designed by the researcher is briefly described below with a fuller exposition provided in Vidmar (2019).

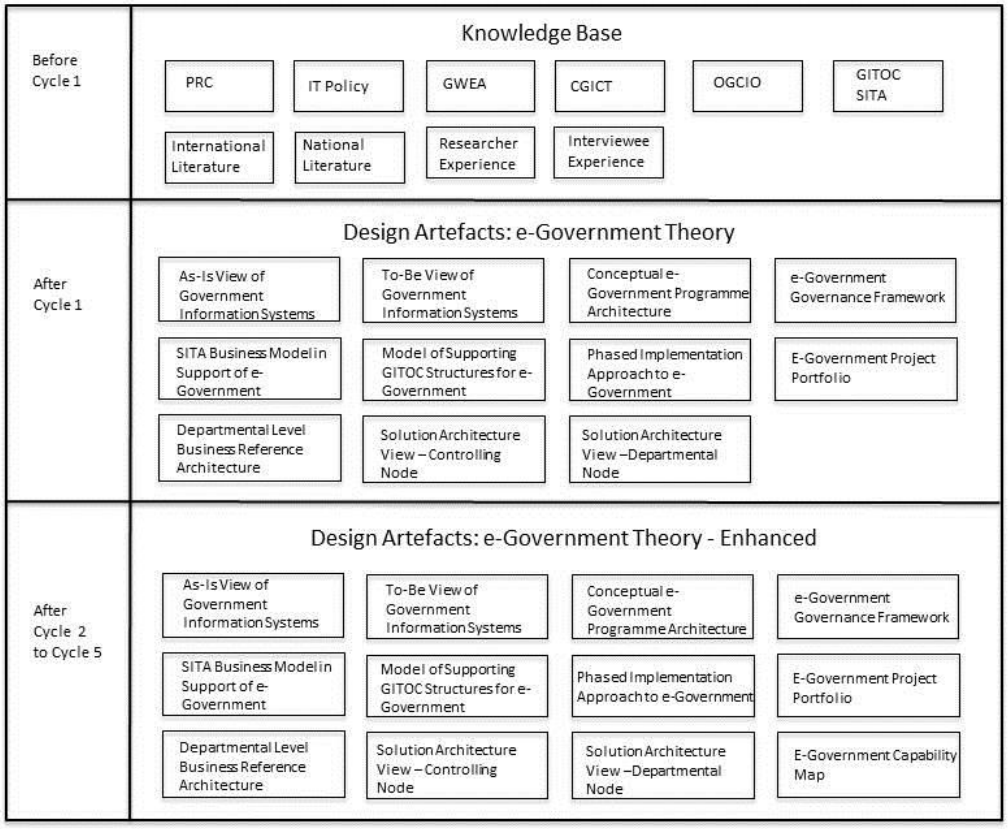

FIGURE 3 CYCLE 1 TO CYCLE 5 ARTEFACT CONTRIBUTION RESULTING IN E-GOVERNMENT THEORY FRAMEWORK

Component 1: As-Is View of Government Information Systems. This As-Is component artefact acts as a baseline description of the current structure of information systems in

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government, revealing the nature of the major problems that e-Government is designed to solve. This includes multiple access channels to government and extensive system, process and data duplication and lack of system integration across government information systems making government service delivery problematic.

Component 2: The To-Be View of e-Government in South Africa. This component reveals the essential features and properties of the broad e-Government information systems solution and acts as a representation of the goals to be achieved by enterprise architects and e-Government decision makers. This includes integration and consolidation of systems, establishment and reuse of authoritative sources of data throughout government, use of shared processes to support reengineered e-Government services and a single access point to government with government having a single view of any legal entity, such as citizen, business, etc. Similarly, citizens and businesses may gain a more simple and holistic view of government.

Component 3: Conceptual e-Government Programme Architecture. This component shows how the proposed e-Government programme can be established on a solid foundation building up from the core ideals of a developmental state and informed by policy, strategy, architecture and the government's public service ethic.

Component 4: e-Government Governance Framework. This component shows how the governance for the proposed government-wide e-Government programme can be achieved with assigned authority and accountability and providing for stakeholder participation in the context of South African government.

Component 5: SITA Business Model in Support of e-Government. This component shows that as the mandated and established entity SITA may play its designated role as an e-Government implementation agency, not in isolation, but as part of the overall e-Government programme.

Component 6: Model of Supporting GITOC Structures for e-Government. This component shows the vital coordinating and consultative role played by GITOC in the e-Government programme to ensure government-wide endorsement and alignment with the e-Government programme amongst the ICT leaders in government.

Component 7: Phased Implementation Approach to e-Government. This component promotes a stepwise application implementation approach for e-Government with progressive

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sophistication and investment in e-Government information systems solutions consistent with international practice. This artefact is based on what appears as the solely existing e-Government theoretical concept, proposed by Layne & Lee (2001), (Bannister & Connolly (2015).

Component 8: e-Government Project Portfolio. This component promotes the summary view of e-Government applications as they mature through the designated steps of development in support of the recognised e-Government stakeholder classes, including the public service itself.

Component 9: Departmental Level Business Reference Architecture. This component is the proposed high level business reference architecture at the business level which is intended to guide e-Government enterprise architects in the design of e-Government systems in a way that promotes the reuse of authoritative sources of data, reusable business processes across government departments and interfaced with standardised and well managed interface channels for service delivery.

Component 10: Solution Architecture View – Controlling Node. This component is provided as an example of how the reference architecture can be translated into a technology-based solution in the case of a controlling node in the networked departments forming part of e-Government as a whole.

Component 11: Solution Architecture View – Departmental Level Node. This component is provided as an example of how the reference architecture can be translated into a technology-based solution in the case of a government department node in the network of government departments forming part of e-Government as a whole and not performing any controlling node function.

Component 12: e-Government Capability Map*.* This component is included to provide a higher-level perspective of the proposed e-Government capabilities than just the reference architecture artefact, making it more suitable for non-technical e-Government stakeholders to understand e-Government while also supporting enterprise architects in their e-Government implementation role.

6. ARTEFACT EVALUATION

Five design-evaluation cycles were found to be necessary to obtain a rigorous evaluation of the

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design artefacts in this research work as illustrated in Figure 4 which shows the activities in the design-evaluation cycle iterations (Kotze et al, 2015)

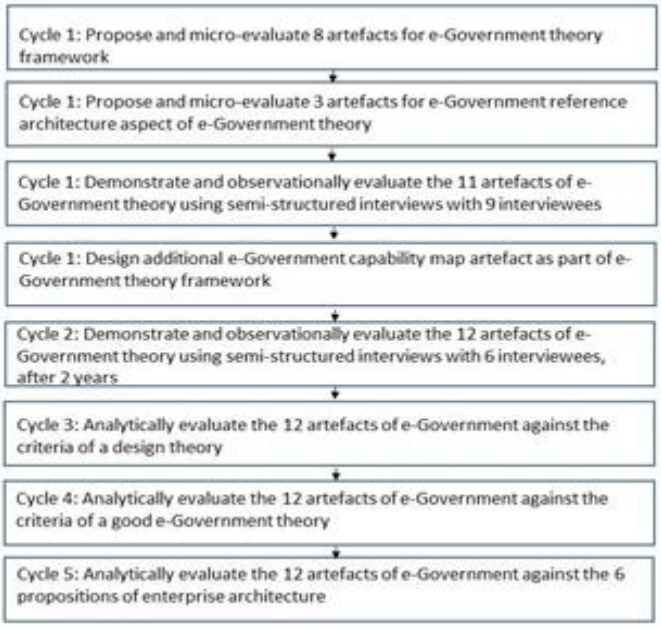

FIGURE 4 RESEARCHER'S DSR DESIGN-EVALUATION PROCESS FOLLOWED IN THIS STUDY

The interviewees selected for the observational portion of this study covered in Cycle 1 and 2 include people skilled in the practice and management of enterprise architecture and e-Government projects within the South African government and those in the private sector who support government in setting standards and adopting best practices. The demographics of the interviewees are summarised in Table 2 below.

Table 2: Cycle 1 and Cycle 2 Interviewee Demographics

Design-Evaluation Cycle	Number of Interview Participants	National Government	Gauteng Province	Local Government	Industry	Men	Women
Cycle 1	9	6	1	1	1	8	1
Cycle 2	6	4			2	5	1

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The first design-evaluation cycle is based on the observational evaluation method using a semi-structured interview of nine expert participants and 157,822 words of transcribed interview data were collected.

There is no single accepted approach to qualitative data analysis in general. Researchers provide what they consider to be useful guidelines in the process of deriving meaning from a large body of empirical data. According to Boeije (2010) qualitative data analysis requires the breaking up of collected data and its reassembly into relevant and meaningful pieces. Dawson (2009) provides an approach to qualitative data analysis consisting of several options. Induction is used to derive themes, which emerge from the interpretive analysis of data. This is referred to as thematic analysis.

Using thematic qualitative data analysis, each of the nine transcripts was carefully read and the meaning of the dialogue pertaining to each question was summarised by a set of statements that capture the meaning of the response. The resulting synthesised statements represent the codes, which are then further synthesised into memos through a further step of interpretation. One memo per question was created for each of the nine transcripts. All the memos were then synthesised and consolidated across the nine transcripts which resulted in one consolidated memo per question. Use was made of Atlas.ti and Microsoft Word to manipulate the textual data. Those consolidated memos were then allocated to sub-themes that emerged in the mind of the researcher from the reading of the consolidated memos. The sub-themes were then mapped to the two major a-priori themes which are critical south African e-government issues and GWEA issues. The sub-theme of theory was promoted to level of theme for the purpose of reporting the results in narrative form resulting in three themes. The numeric representation of this process of data deconstruction and reconstruction in cycle 1 is illustrated in Table 3.

Table 3: Data Deconstruction and Reconstruction

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Nine Transcripts	Number of codes assigned per transcript	Number of memos per transcript	Number of consolidated memos across 9 transcripts	Number of sub-themes across 9 transcripts	Number of themes across 9 transcripts
1	103	37	37	17	3
2	66	37			
3	93	37			
4	128	37			
5	74	37			
6	91	37			
7	101	37			
8	104	37			
9	102	37			
Total	862	333	37	17	3
Total Data Size 421 pages, 157,822 words	Total Data Size 83 pages 20,412 words	Total Data Size 51 pages, 13,225 words	Total Data Size 8 pages, 4125 words	Total Data Size 14 pages 7316 words	Total Data Size 23 pages 12,148 words

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The qualitative data analysis result indicated that e-Government in South Africa had an absence of theory and GWEA was not in effective practice, largely confirming prior South African research findings (Cloete, 2012). There was evident general support for the theory framework demonstrated to the participants consisting of the initial eleven artefacts, with the suggestion of including an additional design theory artefact, called the e-Government capability map.

After designing and adding the twelfth component artefact called the e-Government Capability Map to the theory framework, the second observational evaluation cycle was done based on a semi-structured interview of six experts and 23,045 words of transcribed data were collected. It focused more directly on evaluating the validity and utility of the twelve component artefacts using the criteria of a design theory as described by Vaishnavi & Kuechler (2016). The numeric representation of the process of data deconstruction and reconstruction in cycle 2 is illustrated in Table 4.

Table 4: Data Deconstruction and Reconstruction in Cycle 2

Six Transcripts	Number of codes assigned per transcript	Number of consolidated answer files across 6 transcripts	Number of sub-themes across 6 transcripts	Number of themes across 6 transcripts
1	45	12	17	2
2	50			
3	68			
4	41			
5	75			
6	64			
Total	343	12	17	2
Total Data Size, 56 pages, 23,045 words		Total Data Size, 64 pages 23,944 words	Total Data Size, 13 pages 6897 words	

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As these are theoretical artefacts, not yet in operation, other artefact criteria such as quality and efficacy, could not be evaluated (Gregor & Hevner, 2013). The subsequent qualitative data analysis result showed support for the validity and utility of the expanded framework with no further need for design changes.

In the third cycle the core components for an effective DSR design theory are evaluated logically by the researcher according to the profile of a design theory proposed by Vaishnavi & Kuechler (2016) in alignment with the research design of this work. From the analytical review of the artefacts there is agreement with all the seven components of a design theory according to Vaishnavi & Kuechler (2016). In the fourth cycle of DSR design-evaluation the researcher, using logic, evaluated the proposed e-Government theory component artefacts according to the features or virtues of a good theory for information systems, including e-Government, proposed by Bannister & Connolly (2015) and agreement was found between the proposed e-Government theory with all the virtues of a good theory within the limits of the research work. The additional method of analytical evaluation of architecture analysis is performed in the fifth design-evaluation cycle as the proposed artefacts are designed for use by enterprise architects and as indicated by Hevner et al (2004) they should fit into technical IT architecture. The only theory that appears relevant as a basis for such analysis currently is the set of enterprise architecture propositions of Mentz et al (2014). This study finds that the proposed e-Government theory effectively utilises enterprise architecture as a vehicle for e-Government implementation as the set of proposed artefacts agree with the stated propositions and hence no artefact design adaptations are required. This terminated the design-evaluation cycle allowing the communication of the research findings from the study.

7. DISCUSSION

The foregoing sections have shown how the designed components in the form of the Composite e-Government Theory Framework Artefact, were initially designed and evaluated empirically through the DSR observational evaluation method, using semi-structured interviews requiring their demonstration and evaluation through two design-evaluation cycles, and then further evaluated by means of three additional design-evaluation cycles of analytical evaluation by

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examining the theoretical artefacts in the light of the criteria currently applicable to design artefact theory and e-Government theory and application of enterprise architecture.

With reference to the recommended knowledge contribution framework for scholarly research discussed by Ngwenyama (2014), the contribution of this research work is theoretical because it proposes an evaluated theory of e-Government which has not been used before in the field of e-Government research in South Africa. Theory is a recognized form of knowledge contribution and the proposed framework is an example of a level 2 DSR contribution, referred to as nascent design theory by Gregor & Hevner (2013). It is also a contribution to practice in the field of e-Government as it appears capable of influencing the organisational, people and technical aspects of e-Government and acts as a guide to e-Government enterprise architects. The meta-research contribution of this study is to have selected and applied Design Science Research methodology in e-Government theory which is a new and complex research area of information systems, spanning e-Government and enterprise architecture (Baskerville et al, 2018; Vaishnavi & Kuechler, 2016; Paulin, 2017; Goldkuhl, 2016).

DSR recognises a variety of ways to evaluate the design artefact, including observationally and analytically depending on the nature of the artefact. This proved useful in this study because at the outset of a new theory proposal in the man-made field of information systems, it is very difficult to conceive how to measure quantitatively attributes of an artefact which has not yet been used in practice. Measures such as perceived validity and utility by knowledge domain experts and analytical analysis against accepted theory criteria were found relevant for the e-Government theory evaluation (Vaishnavi & Kuechler, 2016; Paulin, 2017).

The Theory of Practice of Bourdieu (1990) is the theoretical basis in this study that underpins and gives credence to the initial suggestion of the e-Government design theory artefacts as a direct consequence of the researcher's deep immersion in the practice of e-Government in South Africa.

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8. CONCLUSION AND FUTURE RESEARCH

The scientific study of e-Government is recognised as being new and important by the research community. Analysis of local and international literature by the researcher revealed a gap in the area of e-Government theory and reference architecture. Reviewing the state of e-Government development in South Africa from the unique perspective as a former government chief information officer, and by using a cohort of experienced e-Government and enterprise architecture experts and applicable theoretical criteria for purposes of artefact evaluation enabled the design of a e-Government theory framework comprised of twelve theoretical and technical component artefacts which address the identified gaps in knowledge of the theory of e-Government and also a gap in knowledge in the area of e-Government reference architecture in the context of GWEA. To do this the researcher designed a rigorous research framework for e-Government theory based on the use of DSR and observational and analytical evaluation of the proposed design theory artefacts. This is of significance to the researchers and practitioners' communities in South Africa and abroad by expanding upon existing research work in this field of study. With reference to the proposed framework artefacts and using the typology suggested by Gregor (2006) for information systems theory the proposed e-Government theory may be seen as a broad native theory in e-Government information systems including all classes of theory in an interrelated fashion as may be deduced from the brief description of the component artefacts. The theory is falsifiable and includes Type IV and Type V theory as it explains, predicts and is oriented towards design and action in the field of e-Government implementation (Baskerville et al, 2018).

For practical reasons this study limits itself to interview participants from Gauteng Province. Similar research may be undertaken to encompass the remaining eight provinces of South Africa.

This work gives rise to several opportunities for future research. Within South Africa and elsewhere, this research may be replicated to provide evidence which may falsify, amend or corroborate the proposed theory and propose a better one. To strengthen or modify or falsify this theory, future researchers might examine instances of successful e-Government implementations around the world to determine if there is any evidence of the use of such type of artefacts as proposed by this theory. A proof of concept exercise might be done to implement the proposed

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e-Government programme and obtain empirical evidence of the effectiveness of the theory in practice. Given the rapid innovation in the ICT field a different solution architecture artefact might be devised, perhaps using cloud and big data infrastructures. This would not falsify the theory but possibly make it more applicable. Future research could explore how a more effective practice of GWEA might be realised in government for optimum attainment of e-Government policy objectives.

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