THE DEVELOPMENT OF A B2G ONLINE AUTHENTICATION STANDARD:

A DESIGN PERSPECTIVE OF THE POLICY CONSULTATION PROCESS

John Campbell

School of Information Sciences and Engineering
University of Canberra
Canberra, Australia
john.campbell@canberra.edu.au

ABSTRACT

The primary focus in design science research is the development of innovative and useful system artifacts. Apart from IT-centric artifacts such as software and hardware, design research outputs can also include constructs, models, methods and better theories. However, there is very little published research concerned with these alternative artifact genres. The research reported in this paper focuses on one of these alternative design outputs that are of particular interest to information systems; the development of innovative technology standards. In this paper it is argued that much can be learnt from using a design science approach to analyze these types of information systems artifacts. A design science theory of punctuated action is presented and used to briefly explore the public consultation process in the development of a B2G online authentication standard for the Australian Federal Government.

Keywords: design science, method artifact, standards development, online authentication

INTRODUCTION

Design science is concerned with the creation and evaluation of innovative artifacts aimed at achieving human-defined goals and is founded on two fundamental development activities – build and evaluate (Simon 1981). While at first glance these two concepts appear intuitively straightforward, their operationalization can be quite complex as often there are sometimes any number of viable design solutions available. Also, the functionality of each of these design alternatives will be highly reliant on implementation context. Consequently, a failure to understand

implementation context can result in artifacts that are inappropriately designed or that have undesirable side effects (March and Smith 1995).

Design science research has not had the same recognition as behavioral science in the information systems literature. However, the approach is gaining greater appreciation and recognition as a core element in information systems research (see Burstein and Gregor 1999, Gregg et al. 2001, Hevner and March 2003, Hevner et al. 2004, March and Smith 1995, Markus et al. 2002, Nunamaker et al. 1991). In an information systems context, design science research involves the study of innovative design artifacts for the purpose of understanding, explaining, and improving the performance of information systems. A designed artifact can take many forms beyond computer-based systems and can include instantiations of organizational structure, work processes, information systems, strategic plans, standards, and public policy (Hevner et al. 2004).

The primary goal of this paper is to demonstrate how design science principles can be used as a means of understanding the development of inter-organizational standards by examining the public consultation process in the development of a B2G online authentication framework. In the following sections, design science is explained in the context of IT artifacts and information systems research. A theory of punctuated action (Simon 1977, Boland 2002) is advanced to better understand the implications that flow from distinct intelligence, choice and design configurations. The design implications for the public policy consultation process are considered and I conclude with a discussion on other research work that might provide additional insight for using design science in information systems research.

DESIGN SCIENCE IN INFORMATION SYSTEMS

Recently, Hevner in collaboration with others (Hevner and March 2003, Hevner et al. 2004) have developed a framework of information systems research that brings together the behavioral science and design science paradigms. Figure 1 describes this framework in which the building and evaluating of theories and artifacts define information systems research. Although Hevner et al. (2004) acknowledge that policies and work practices are valid examples of designed artefacts their model does not show how these objects are accommodated within their framework.

Figure 1 contains minor amendments to the original model so that it includes scope for documented design artefacts such as work practices, procedures and information systems policy

Relevance		Rigor

Environment   **IS Research**   **Knowledge**

People
- Roles
- Capabilities
- Characteristics

Organisations
- Strategy
- Structure
- Culture
- Process

Technology
- Infrastructure
- Architecture
- Applications

Develop/Build
- Theories
- Designed artifacts
  - Applications
  - Policies
  - Procedures

Assess   Refine

Justify/Evaluate
- Case studies
- Experiments
- Field studies
- Simulate/model
- Etc.

Foundations
- Theories
- Frameworks
- Models
- Methods
- Etc.

Methodologies
- Data analysis
- Measures
- Formalisms
- Validation
- Etc.

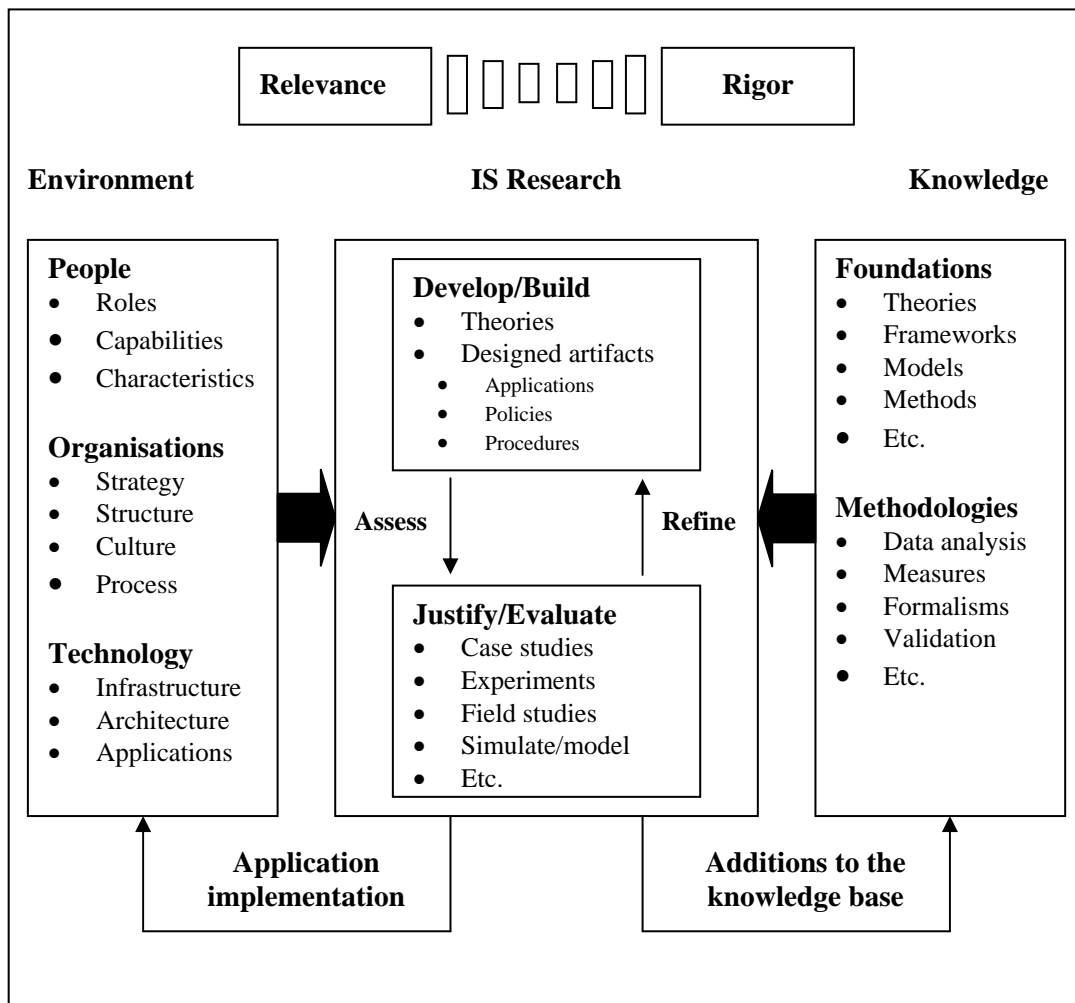**Application implementation**   **Additions to the knowledge base**

Figure 1. Information Systems Research Framework
(Adapted from Hevner et al. 2004)

Research activity is moderated by environment and by the knowledge base that can be applied. The environment is the problem space in which the phenomena of interest are located, and the knowledge base as a composition of information systems research foundations and methodologies. Information systems research is located at the centre of this framework where appropriate methodologies are chosen from a discipline knowledge base and applied according to business needs. Hevner et al. (2004) argue that better information systems research comes from combining and integrating behavioral science and design science.

From a behavioral science perspective, information systems research is viewed as a branch of the social sciences (Hevner et al. 2003, 2004). This view has developed from the traditional natural science perspective where the primary goal of research is to test and validate theories about the design of information systems. The evaluation and validation activities of research methods in the behavioral science paradigm include the familiar means of case studies, experiments, field studies and surveys. These are the traditional research methods used by information systems researchers to

identify and test theories. In contrast, the design science perspective in information systems research seeks to evaluate the utility or quality of the system artifact. System utility and quality must be clearly defined in order to undertake this evaluation. For example usability, functionality, completeness, consistency, accuracy, reliability, and performance are all potential system quality attributes (Hevner et al. 2004). However the overall goal of the evaluation is to not only assess system usability but also to provide guidelines for incremental improvement of the system artifact. Relevance is determined by how well information systems research addresses business needs while rigor is achieved through the appropriate application of foundation principles and methods.

While software and hardware are regarded as the core "working" artifacts in information systems (see Orlkowski and Lacono 2001, Weber 2003), there are other information systems artifacts that are also important components in the creation of innovative information technology systems (Sen 2006). These artifacts are constructs, models, methods (March and Smith 1995, Hevner et al. 2004) and better theories (Rossi and Sein 2003). Constructs define the conceptual vocabulary of a domain, models contain an expression of how constructs are related, methods provide a description on how to perform some task, and better theories are derived from experimental like proofs of concept or method during the design construction phase. The focus in this paper is on the application of design science in the development of an online B2G authentication framework – a method artifact. The following section establishes the theory of punctuated action based on distinct decision-making configurations of the intelligence, design and choice activities articulated in Herbert Simon's decision-making theory (Simon 1977, 1981).

DESIGN, INTELLIGENCE AND CHOICE IN DESIGNED ARTEFACTS

Simon (1977) described three interrelated decision-making activities in his book The New Science of Management Decision: intelligence, design and choice. Intelligence is a critical function directed towards identifying a problem or some deficit relating to an earlier design choice, or absence thereof, which is less than satisfactory. Intelligence alerts a decision-maker to the need for action in response to some new threat, opportunity, or to the need for change if a required objective is not being achieved. Design, is the combination of alternative actions that can be brought to bear to change an existing situation to better achieve desired objectives. Design includes an understanding of the medium, methods and processes available to the decision-maker as well as the potential implications and trade-offs between different design choices. Choice is the act of selecting a design alternative that will achieve desired objectives. Choice includes an appreciation for how competing alternatives will fit with other design choices and includes an appreciation of how the current conditions are likely to affect design alternatives. These three interdependent decision making activities are illustrated in Figure 2.
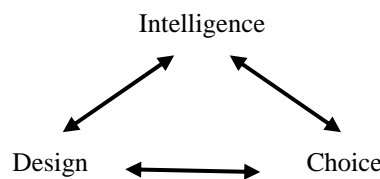

Figure 2: Interdependence of intelligence, design and choice in management

While intelligence, design and choice are interdependent elements in Simon's model, decision-makers experience each element as a separate form of action. In practice, each of the three elements is engaged in a way that brings that particular activity to the fore while the other two activities are forced into the background. Boland (2002: p. 3) observes that, " ... we attend to any one aspect from (or in light of) the others. While one aspect is in focal attention, the others are held in a subsidiary, or tacit, way. So that while the three are thoroughly interdependent, they are not simultaneously in focal attention, and we can therefore think of the three aspects as taking place separately and sequentially in management action." Each activity, in itself, is a complex decision-making process with each element containing its own intelligence, design and choice activities – phenomena Herbert Simon referred to as being "wheels within wheels."

Boland (2002) draws on Karl Weick's ideas of sense making to illuminate how individuals might punctuate decision making into sequential patterns of actions to produce plausible and coherent understandings of a given situation. In so doing, Boland is able to disentangle the circular pattern of influence depicted in Figure 2 to produce six distinctive ways that a decision maker can punctuate decision making action into specific sequences of intelligence, design and choice. In each of these punctuations one action happens first which then serves as the beginning of a narrative episode of acting in the world. Each action sequence reflects a sense of moving forward, making sense of a new situation or existing context, and then some form of adaptation as a consequence. These punctuated action sequences of intelligence, design, and choice are described below.

1. Rational Goal Seeking (Intelligence➜Design➜Choice)

This punctuated sequence corresponds with the classic view of rational goal seeking behavior and relies on the application of judicious intelligence to inform and guide organizational action. This is an instantiation of Herbert Simon's basic decision-making model where intelligence recognizes the need for intervention, design provides alternatives for consideration, and choice selects the best option (or one that satisfices). Although this punctuated action sequence does provide us with logical explanations for particular decision outcomes, it can also lead to ever finer levels of reductionism and detail that eventually become irrelevant to the human condition.

2. Happenstance Rationalization (Design➜Choice➜Intelligence)

This activity punctuation begins with an action or a given environmental state that constrains, at least to some extent, the possibilities for future action. This initial action or state is accepted in whole or in part as intelligence is applied to refine what has occurred, or to justify the initial choice action. This sequence of punctuated action can lead to the premature acceptance of choices that, in turn, leaves intelligence action to reinforce this happenstance through some process of rationalization. For example, a manager may have difficulty in ignoring the sunk costs associated with some pre-existing organizational strategy or investment when considering a future course of action.

3. Existential Introversion (Choice➜Intelligence➜Design)

In this punctuation, action begins with existential choice. It is then followed by an analysis of how to achieve this choice and then the design alternatives. This action punctuation might be characterized by the tinkering manager who fixes things that are not broken or has a solution to some yet to be discovered problem. Boland (2002) contends that this action punctuation provides for poor results, as the decision-maker tends to operate in isolation from the situation or context within which the action takes place. While poor outcomes might be the general rule, there are examples where existential introversion has won out. The rise and rise of the Microsoft organization is one example that readily comes to mind.

4. Deferred Design (Intelligence➜Choice➜Design)

This form of punctuation begins with the decision-maker sensing a situation in the environment and making choices for action. Subsequently, the decision-maker acquires knowledge or understanding of other courses of action that could have been followed. This action sequence is characterized by a delayed use of design. This punctuated action sequence is a failed version of the rational goal-seeking action described above. In this case, the decision-maker rushes to a decision only to later find that alternative designs might have been viable.

5. Situational Sensemaking (Design➜Intelligence➜Choice)

In the situational sensemaking punctuation, a design enactment comes to the actor first as raw action from the environment. The design enactment causes the decision maker to engage in a sensemaking process in which intelligence is applied to selecting those elements of the initiating action that are meaningful and acceptable. This intelligence activity precedes the choice of which meanings and structures to carry forward in subsequent instantiations. Boland (2002) describes this action punctuation as having parallels to Weick's sensemaking model of variation, selection, and retention (see Weick 1979: pp. 122-126). Interestingly, Simon (1977: p. 43) proposed that this action punctuation was highly appropriate where novel technologies were being considered.

6. Existential Heroism (Choice➜Design➜Intelligence)

In this form of punctuated sequence, existential choice is the primary driver of action as it is for the existential introversion type punctuation described above. However, the actor first chooses who or what they are, develop alternative designs, and then perfect these designs based on some self-defined criteria. Like the existential introvert, the existential hero makes no reference to the environment for feedback on goals. The environment is essentially ignored in favor of the existential choice of the individual.

The six punctuated action sequences described above will be used to briefly analyze the public consultation process in the development of a B2G online authentication framework currently being proposed by the Australian Federal Government. Australia can be described as a liberal democratic country where citizens and stakeholder interest groups are implicitly included in many government policy decision-making processes (Päivärinta and Sæbø 2006). The following section provides background information, details on the policy development process, and a description of the main thrust of the proposed authentication framework design.

E-GOVERNMENT AND THE ONLINE AUTHENTICATION FRAMEWORK

The Australian Government Authentication Framework (AGAF) is aimed at providing a whole-of-government approach to electronic authentication in all online B2G transactions and was released as a draft exposure document on 21 May 2004 (AGIMO 2004). The specific content and practical implications of the AGAF draft proposal are not central to the analysis presented in this paper. This is because the focus of analysis is the structure of the decision activity within the standards development process and not directly on the content of the policy itself. Nevertheless, the authentication framework is briefly discussed below along with relevant background information so as to define the context within which the online authentication standard is developed, and by which events the research is framed.

Although electronic government initiatives have lagged commercial applications of Internet technology, this position is rapidly changing with many national administrations aggressively pursuing online programs (West 2005, NZSSC 2004). Here in Australia, online business transactions with government provide significant reductions in B2G transaction costs and improvements in decision-making (NOIE 2003). The Australian Bureau of Statistics recently reported that seventy-seven percent of Australian businesses utilized the Internet in 2004-2005 with Internet-based business income rising to $40 billion during 2004-2005 up from $11 billion in 2001-2002 (ABS 2006). Not surprisingly, a rapid increase in the volume of B2G online transactions has accompanied these trends. For example, in 2002-2003 seventy-one percent of businesses using the Internet visited a government web site to access a range of online services including:

> The lodgment of taxation forms online (twenty-one percent of businesses)
> Online payments (twenty-eight percent of businesses)
> Information or services related to taxation (forty-two percent of businesses)
> Information on regulations (thirty-five percent of businesses)
> Information on employment (twenty-six percent of businesses)

The Australian Federal Government is endeavoring to build on the progress in e-government to date and move forward towards the vision of becoming a connected and responsive government by supporting activities in four core service-oriented areas (AGIMO 2006):

> Meeting the needs of citizens
> Consistent and unified points of access
> Achieving value for money
> Enhancing public sector capability.

With this increasing business and government interaction, there has emerged the need for the development of an authentication framework capable of supporting a trusted online environment where businesses can interact safely and securely with all federal government departments. Consequently, the Australian Government Information Management Office (AGIMO) released the Australian Government Electronic Authentication Framework Exposure Draft on 21 May 2004. The importance of a secure B2G transacting environment is highlighted by the following extract:

> When transacting online, there will be occasions where businesses and the government agency will need to be completely assured of each other's identity and the legitimacy of the assertions that are being made. These assertions may relate to a range of attributes such as identity, professional qualification, or that a person is authorized to conduct a specific transaction. The need for assurance is particularly important when funds or sensitive information is involved. The process of establishing the legitimacy of assertions, be they identity or other attributes, is the key element of business authentication."
> AGIMO (2004: p2)

Currently government agencies use a range of authentication technologies including passwords, digital certificates and Public Key Infrastructure. The AGAF draft document proposes a whole-of-government approach to user authentication in online B2G environments (AGIMO 2004). The stated objective of the framework is to ensure that Australian Government Agencies apply a consistent approach when deciding the level of authentication required for different types of online B2G transactions. Consumer to government transactions appear to be outside the terms of reference of the proposal at this stage but would seem to be a conceivable extension to the framework at some future point in time. The proposal explicitly recognizes that different authentication techniques will be required for different types of transactions based on some form of risk assessment. Figure 3 shows that low-risk transactions will require only low-level authentication while high-risk transactions will require high-level authentication mechanisms such as Public Key Infrastructure.
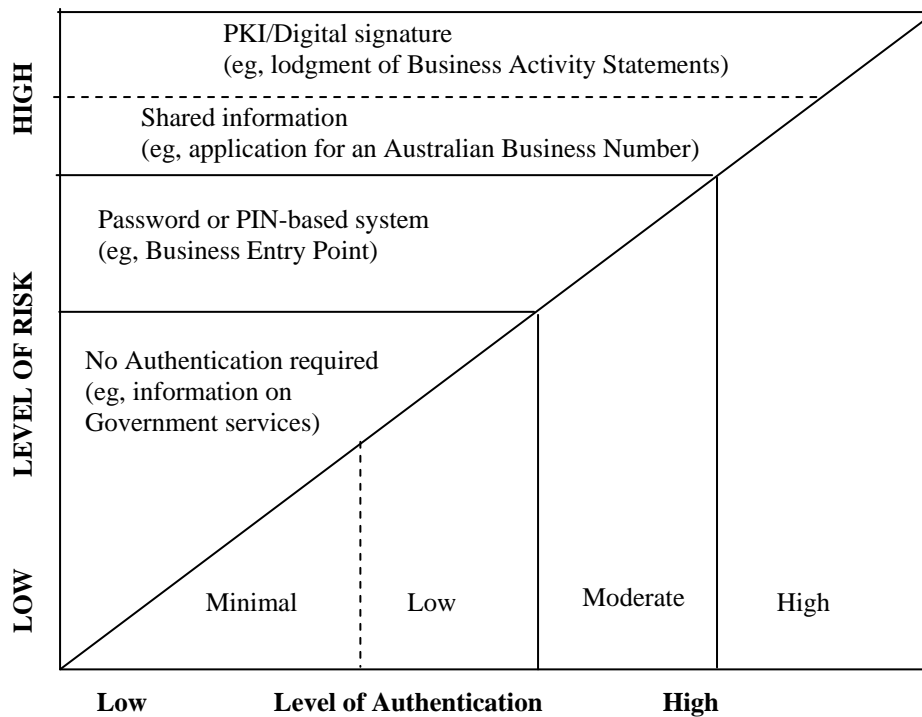
Figure 3: Authentication techniques and risk levels described within the AGAF draft proposal document

This section has provided a very brief introduction to the AGAF proposal and its implications for Australian businesses. Further policy details can be obtained directly from the draft document (AGIMO 2004). Also, a number of organizations have produced written responses to AGAF and some of these documents are publicly available (see for example ACCI 2004). The following section looks specifically at the AGAF public consultation process using the theory of punctuated action discussed earlier to structure the analysis.

AGAF POLICY AS DESIGN ARTEFACT

The overall objective of this section is to use the punctuated action theory to interpret the structure of the AGAF standard public consultation process. The general objective when applying this model is to test the usefulness of design science for framing the development of standards as a designed method artifact. The suitability of using design science as a lens for analyzing information systems standards development is addressed by asking the following:

What insight can design science provide to help better understand, predict and evaluate the Australian Government Authentication Framework development process? While it might be difficult to provide absolute predictions about AGAF policy development outcomes, we can nevertheless abstract system properties that are likely to arise out of a particular mode of system organisation.

For this study, we consider only the development of information systems policy in the context of design science as it relates to the public consultation process for the AGAF draft exposure document. A design science analysis can be applied to the whole of policy development process from conception through to implementation, and arguably beyond. Examining only the consultation process allows for deeper understanding of a core component of standards development at a critical point in time. Another advantage is that processes during this stage are readily observable due to the emphasis on public interaction and feedback. In contrast, other stages of the policy development process are undertaken internally by AGIMO, which make it very difficult to gain access to policy data, decision-making processes and outcomes. This is particularly so where a policy is likely to have significant implications in the wider business community.

DESIGN SCIENCE IMPLICATIONS FOR THE CONSULTATION PROCESS IN AGAF

POLICY DEVELOPMENT

"There is nothing a Government hates more than to be well-informed; for it makes the process of arriving at decisions much more complicated and difficult" John Maynard Keynes (Skidelsky 1992, p. 630).

Despite this populist view expressed by Keynes, participation has become a core principle of public sector governance in Australia and is seen as being achieved in practice by the engagement of experts, interested parties and stakeholder groups during various stages of public policy development and implementation (Catt and Murphy 2003). The participation process can take a number of forms, but most variations seek to ensure that communities and other affected groups have satisfactory input into the regulatory activities and practices of government agencies. While the responsibility for policy formulation and the final decision-making unquestionably rests with government, it is argued that better policies and greater community commitment can be realized from engaging the public in policy-making processes (OECD 2001). For the purposes of this study, the public consultation phase in the development of AGAF makes for an interesting juncture for analysis using design science. The theory of punctuated action will be used to assess the AGAF consultation process paying particular attention to how the process is constituted and to how this process might influence and shape policy outcomes.

After many years in development, the AGAF policy has reached a stage where an initial draft exposure document has been produced and released for public comment (for an historical perspective on the evolution of the framework see NOIE 1998, 2002 and AGIMO 2004). Various individuals and key stakeholder groups acting alone or in concert with others are then able to respond to the draft exposure by submitting a formal submission to AGIMO. After the due date for formal submissions, key contributors are then invited to participate in a business impact consultative group face-to-face session. This meeting is held in confidence with participants contributing to a general discussion on the strengths and weaknesses of the draft proposal. It is anticipated that policy is further adapted in the light of the feedback received before being prepared for ratification by the relevant departmental head or minister.

Applying punctuated action theory, the policy development process can be illustrated as in Figure 4. The internal environment within which the policy is formulated and communicated to the public is provided by the host government agency – in this case AGIMO. Here it is assumed that the policy development process initially follows Simon's rational goal seeking punctuation where Intelligence precedes design and choice (i.e., Intelligence ➔ Design ➔ Choice).

Standards Development: Consultation Process

Phase A   **Phase B**

Phase A: I ➔ D ➔ C

Phase B: ? D ➔ C ➔ I / D ➔ I ➔ C

Draft Exposure   **Public Submissions**

Public Consultation
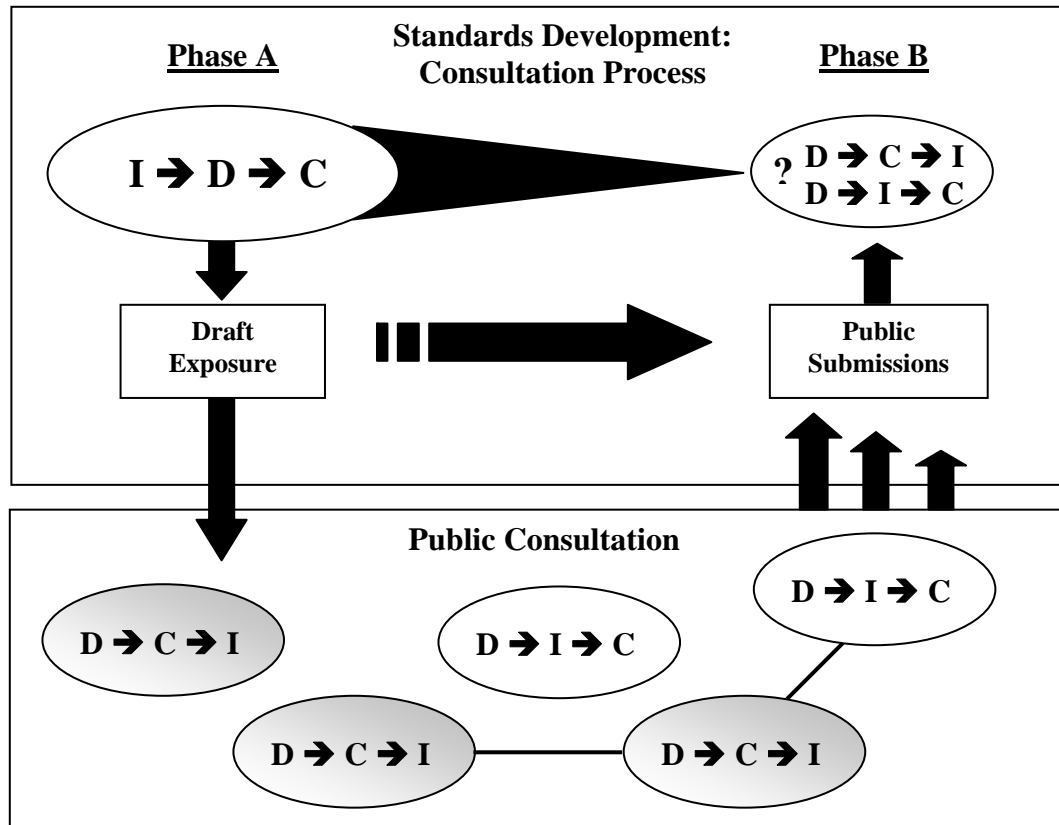
D ➔ C ➔ I

D ➔ I ➔ C

D ➔ I ➔ C

D ➔ C ➔ I

D ➔ C ➔ I

Figure 4: The Public Consultation Process in AGAF Standards Development.

Boland (2002) identifies this action narrative with many public policy developments. This view assumes that that there is some shared national goal and that a range of alternatives can be developed and that the approach that maximizes the national interest is selected. At first glance, the commonsensical nature of the rational goal seeking punctuation appears fundamentally attractive. While the strength of this approach is that it focuses attention on developing policy aimed at satisfying existing needs, its weakness is that it may not be as useful in emergent environments where policy development must be more forward-looking.

The structure of this punctuated action narrative also has implications for how much influence public consultation will have on the design of a standard. On the one hand, a draft exposure document that was determined on the basis of a rational goal seeking approach would, in theory, provide a solid design base upon which stakeholders could focus their comments and concerns (as implied in Phase A in Figure 4). On the other hand, the standards foci and scope will have been "hard-wired" to a great extent into the initial draft exposure document thereby restricting debate and legitimizing only incremental variations on the original design. This "design tautology" could be further exaggerated if elements of the policy are made more explicit in an attempt to preempt the specific concerns that might emerge from the public consultation process.

DISCUSSION

A very interesting pattern emerges from the public consultation phase with regard to stakeholder action narratives available with reference to punctuated action theory. As the design action is a given, a respondent can adopt only one of two distinct action narratives: (1) *Happenstance Rationalization* (Design ➔ Choice ➔ Intelligence), or (2) *Situational Sensemaking* (Design ➔ Intelligence ➔ Choice). Those submissions involving stakeholders acting collectively will most likely display elements of both punctuations. While *Happenstance Rationalization* may not be desirable, *Situational Sensemaking* behavior is likely to generate useful feedback and should therefore be encouraged. As mentioned already, there is some risk that the policy development cycle that resumes within the government agency (as depicted in Phase B) will not be entirely responsive to the unusual or extreme suggestions that might emerge from the public consultation process. This is particularly so if *Happenstance Rationalization* (Design ➔ Choice ➔ Intelligence) activity dominates this stage of the process. Nevertheless, restricting scope in this way may not be detrimental to the design process and could in fact have desirable outcomes. For example, restricting AGAF focus to B2G transactions will cause controversial suggestions such as extending the framework to include C2G transactions to fall outside the scope of public consultation.

The discussion presented in this paper provides only a brief demonstration of how the theory of punctuated action can be used to analyze the public consultation process in the design of information systems policy. Some comments are required regarding the assumptions used in this study. These include:

   The design, intelligence, choice actions can be broken up into discrete activity segments;

   The design, intelligence, choice actions follow a punctuated linear progression;

   The punctuated action process doesn't loop back onto itself (e.g., D➔I➔D➔C etc.)

   Any particular decision-making action might not occur within a three-part decision sequence
      (e.g., could be D➔C or C➔D)

These assumptions and other limitations require further research. Ideally, the preliminary analysis presented in this paper should be extended to fully map the evolution of the authentication framework into a formal standards artifact.

CONCLUSION

The question, "how do we get good policy?" inexorably leads us to a more pressing concern, "how do we get good policy design?" Carlsson (2002) argues that good policy design comes from removing obstacles to creativity and innovation through policy facilitation. Policy developers and organizational decision-makers alike will always be bound by the limits of rationality and also by the constraints of power, politics and social context. Design science may lead to better policy design by facilitating an appreciation of how different design mechanisms address desired and undesired outcomes from particular policy development processes. However little is really known about which theoretical models and frameworks are most appropriate for these types of design artifacts.

Herbert Simon spent a lifetime analyzing and describing human artifacts. His ideas on design science are particularly illuminating and justify their pre-eminence in design science research.

While Simon's ideas are compelling, there are of course alternative frameworks that may also prove useful. For example, the work of Stafford Beer (1968) appears well suited to design science problems yet his name hardly bears mention in mainstream design science literature. While Simon focuses on exploiting uncertainty through contingency, Beer's approach to designing the effective organization is aimed at reducing uncertainty through explicit control mechanisms. Despite these fundamental differences, both Simon and Beer share a common desire to further the development of self-sustaining and ethically responsible systems. Karl Weick's (1979) widely acclaimed view of sensemaking in adaptive systems also appears to be highly applicable to design science. As discussed earlier, the situational sensemaking punctuation (Design ➔ Intelligence ➔ Choice) described in this study is analogous to Weick's sensemaking model of variation, selection, and retention. However Weick's appreciation of consensual validation and sociocultural evolution may support a higher level of granularity for analyzing the design of policy and other artifacts. The appropriateness of these frameworks for understanding designed artifacts requires further research. Particularly where the designed artifact has social implications or is negotiated collectively as is generally the case in information systems standards development.

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