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Completed Research Paper

Abstract

As academic scholars in an applied field our central mission is to develop theory that both contributes knowledge to the *academic discipline* and applies that knowledge to *practice.* However, our efforts in this regard are being impacted by communication deficits that in turn limit the effectiveness of our theories. The goal of this paper is twofold: a *diagnostic* one, which reviews the causes of the communication deficits but primarily a *therapeutic* one whereby we propose a course of treatment for content and presentation issues. While the '*ultimate criterion'* for determining the effectiveness of theory is market acceptance this does not prevent us in this paper from putting forward principles, a model, and a method to assist the IS scholar in building *effective theory*. These tools are derived after considered reflection on the ancient craft and more recent science of map-making. We finish by asking ourselves and our readers whether we need a *design science of theory-building*.

Introduction

With theory-building seen as the basic aim of all science, it is difficult to overstate the importance of theory to the scientific endeavour (c.f.Colquitt & Zapata-Phelan, 2007). Scholars

use theory to describe, explain and predict the phenomenon, as well as communicate its intricacies to others (Cook & Campbell, 1979; Kuhn, 1996). As academic scholars in an applied field our central mission is to develop theory that both contributes knowledge to the *academic discipline* and applies that knowledge to *practice* (Simon, 1967; Van de Ven et al., 1989). But the heterogeneity of those consuming our research can be problematic with a number of serious communication gaps ensuing. Hirschheim and Klein (2003) categorise these 'disconnects' in terms of those afflicting the external *practice* stakeholders and the internal *academic* stakeholders.

Taking Shapiro (2007 p. 249) as our point of departure, we posit that these communication weaknesses can be attributed to either a *knowledge translation problem* whereby our research findings are not being converted into a form that can be readily consumed by our stakeholders or rather more fundamentally as a *knowledge production problem* whereby our research is not in the first instance being aligned with the needs of our stakeholders. Both afflictions are endemic in our research efforts (*ibid*). The symptoms of the former are a *presentation issue* whereby our theories cannot be understood by our stakeholders and the latter a *content issue* whereby we are not producing theories relevant to our stakeholders (Klimoski, 1991).

Extant literature pays little heed to these issues and indeed it is disconcerting to find that the virtues of so called *good theory* (c.f. Wacker, 1998) are divorced from principles of effective presentation and content. We wonder how we can possibly prognose a theory to be 'good' when it can suffer from disconnects that severely blunt its effectiveness and make it incomprehensible and/or irrelevant to our stakeholders. The effectiveness of theory, which is detected from its cognitive impact on the reader, is attributable to the quality of both its *presentation* and its *content.* Instead of or in addition to *good theory*, we call on scholars to re-focus their efforts on

building what we refer to as *effective theory*, which is incrementally and iteratively designed in order to be useful for its intended purpose and appropriate to its audience. But the discourse on theory-building in Information Systems (IS) is akin to the proverbial rabbit that finds itself caught in the headlights of an oncoming car. We are told that urgency is required as our academic field is in a state of decline owing to weakness in our theory-building efforts. Yet inertia persists and there continues to be surprisingly little discussion in our field of what constitutes theory and even less of how we should go about building it. Instead of waiting flatfooted, this paper seeks to address this anomaly.

The exploration of theory-building in this paper is inclusive. The discussion is not specific to the adoption of a particular ontological or epistemological position. Consistent with Gregor (2006) we take a broad view of theory and we do not restrict the discussion to anyone of the five types of theory. In these ways the paper is intended to appeal to as wide a range of scholars as possible.

The remainder of this paper is structured as follows. We begin by introducing the theoretical foundations for the conceptual work in this paper. The next section outlines the nature of the translation and production problems facing scholars when building theory. We follow this with an exploration of map-making and map-reading to seek out insights useful for informing effective theory-building. In the penultimate section we outline a framework for building effective theories. The paper concludes with a discussion of and concluding remarks on what the content of this paper might mean for future research.

Theoretical foundations

In this section we outline the theoretical foundations underling the conceptual work undertaken in the remainder of the paper.

State of theory-building in IS

Issues of identity and legitimacy are important in all academic fields, including the IS field. The strengthening of identity and legitimacy among stakeholders is a mark of a field's growing maturity (King & Lyytinen, 2006). While arguments continue into the role theory-building plays in the attainment of identity and legitimacy, it is almost impossible to find anyone in the debate who argues that theory is unimportant, or that strengthening the field's principal theories is undesirable. Instead there appears to be "*broad agreement on the general value of theory, per se"* as it can enhance the field's cognitive or pragmatic legitimacy (King & Lyytinen, 2006 p. 349). In other words while it may be impossible to conclude that theory can be equated with legitimacy it is at least contributory to the legitimacy of the field as perceived by internal and external stakeholders. But these perceptions depend on the *social salience* of the topics studied as well as the presence of strong results and the ability to maintain disciplinary plasticity (Lyytinen & King, 2004). Research is salient to the internal community if it adds to the current theoretical frameworks of the discipline and to the external community if it solves real life problems faced by practitioners and improves their work efficiency and effectiveness (Bakshi & Krishna, 2007). Ultimately, legitimacy of an academic field comes from receptive stakeholders agreeing that the field provides them with relevant research of real value (King & Lyytinen, 2006). "*At the end of the day, the future of the IS field will boil down to the simple question, Does the IS field really matter? If so, how does it matter, and to whom?*" (*ibid* p. 351).

Benbasat and Zmud (1999) relate the issue of relevanc*e* to the need for effective communication. With regard to external stakeholders they state that "*[i]n order for IS research to be more relevant, IS academics should portray the outputs of their research in ways such that it might be utilized by practitioners*" (p. 11). However, the issue is not limited to communication with external stakeholders as there is a "*double communication deficit*" (p. 260) between IS and both its internal *and* external stakeholders with the result that "*they do not look for enlightenment through IS research*" (p. 92) (Hirschheim & Klein, 2003). There is an urgent "*need to strengthen the communicative functions of our research ...*" (*ibid* p. 253). We posit that it is only when we promote the importance of *effective theory* that we bridge the disconnects hampering development of our field.

Maps and Theory

Maps[1] are one of the oldest forms of human communication and have long been used by people to orientate themselves in both their natural and spiritual worlds (Okada et al., 2008). A map *is not* the territory it depicts (Korzybski, 1948), but is instead a *representational model* of a geographic reality. In other words map-makers depict "*one kind of space in another kind of space*" (Berendt et al., 1998 p. 3). But maps are also effective cognitive devices, which allow the map-reader "*to perform operations that cannot be performed directly in the represented space*" (*ibid* p. 3). According to MacEachren (1992a) evidence shows that cognitive representations generated from maps are, firstly, image-like and, secondly, can be mentally manipulated and scanned for information. Learning an area from a map has been shown to sometimes result in mental images that allow for more accurate estimations than learning the area by being in it (MacEachren, 1992b). For example, Lloyd (1989) demonstrates how ten minutes of studying a

[1] There are many meanings of the word 'map' Here we're concerned with maps that represent a geographical reality.

map results in more accurate distance and direction estimates than ten years of living in the area depicted by the map. However, mental images derived from map-reading can also suffer from limitations such as orientation rigidity whereby the map-reader struggles to re-orient the image in order to judge directions to a possible destination (MacEachren, 1992b). Nevertheless, maps are generally successful in communicating geographic knowledge and are also effective in increasing understanding and solving geographic problems even for novice map readers (Barkowsky & Freksa, 1997; Krygier & Wood, 2005).

A close association between maps and theory has been noted with some scholars, such as Geller (1991 p. 42), suggesting that "*[m]aps are a metaphor for science*". There appears to be consensus among theory-building authorities (e.g. Campbell, 1990; Dubin, 1978; Wacker, 1998; Whetten, 1989) that theory has four basic components: *constructs*, *relationships*, *domain limitations*, and *predictions*. In addition, a *good theory* has the virtues of *uniqueness*, *parsimony*, *conservatism*, *generalizability*, *fecundity*, *internal consistency*, *empirical riskiness*, and *abstraction* (Wacker, 1998). Juxtaposing the characteristics of maps and the components of theory – see Table 1 - we conclude that there are indeed striking parallels between maps and theories which justify adoption of the former as a metaphor for the latter. We suggest that maps and map-making are useful metaphors through which to explore theories and theory-building efforts.

Table 1. A Review of the Characteristics of Maps against the Components of Theory

Component of Theory	Brief Description of Purpose	Characteristic of a Map (after: Barkowsky & Freksa, 1997; Berendt *et al.*, 1998; Krygier & Wood, 2005)
Construct	Defines the constructs included in and excluded from the theory.	A map is a visual representation of a geographical space consisting of cartographic *entities*, indicated by pre-defined symbols, placed in a bounded space. A meta-knowledge defines and guides interpretation of the cartographic entities.
Relationship	Defines and explains the relationships among the constructs.	The map is a visual representation of the spatial relationships between the positions of actual objects in geographic space. Again a meta-knowledge defines and guides interpretation of the cartographic relationships.
Domain Limitations	Specifies the conditions under which the theory is expected to hold.	Maps are bounded to a particular geographic space and to a particular point in time. But the map-maker's personal experience and intellectual abilities, as well as cultural, political, and economic dimensions, also bound the map.
Predictions	Gives specific predictions that can be tested to determine if the theory holds in certain contexts.	Maps are not simple representations but visual propositions that affirm for each cartographic entity that '*this is there*'. Indeed maps may post things that don't yet exist, things that have ceased existing, or that are outside the realm of existence.

Problems in building useful theory

In this section we discuss the issues that impact our ability to communicate effectively our theories to our stakeholders.

A theory must be constructed so that it provides utility through useful explanation and prediction. An explanation establishes the substantive meaning of constructs, variables, and their linkages, while a prediction tests that substantive meaning by comparing it to empirical evidence (Bacharach, 1989). The strength of the theory's explanation and prediction is derived from the *accuracy* of its relationships (Burton-Jones et al., 2004) as well as the *domain* or extent of explanations and predictions derived from those relationships (Campbell, 1990; Lynham, 2002; Van de Ven et al., 1989; Whetten, 1989). Theory should be applicable to as broad a domain as possible (e.g. Metcalfe, 2004; Wacker, 1998; Weick, 1989; Weick, 1999). The domain of a theory is determined by its *generalizability* and *abstraction*, which address questions of *Who*, *Where*, and *When* (Whetten, 1989). A theory's generalizability can be defined as the extent to which a theory can be applied to existing populations (Wacker, 2008a), whereby the wider the population to which the theory applies, the more general the theory is. For example, an

explanation of why people appear overly abrupt when using email would be less general than an explanation of their behaviour across all forms of electronic or asynchronous communications (Metcalfe, 2004). On the other hand, abstraction can be defined as the extent to which a theory's application is void of time and space requirements (Wacker, 2008a), whereby the more independent the theory is of time and space, the more abstract it is. Thus a narrow domain decreases the generalizability and the abstractness of the theory, while a broader domain increases it's generalizability and abstractness (Bacharach, 1989; Wacker, 2008b). Generalisability and abstraction mostly work together so that higher "*generalizability requires a higher level of abstraction*" (Bacharach, 1989 p. 500). In this paper we use the term *generality* to refer to the combination of generalisability and abstraction. High generality is not achieved without a cost in terms of other aspects of theory.

Translation Problem and Presentation Effectiveness

The question that concerns us in this section is how theory-builders should address the *translation problem* to ensure the *presentational effectiveness* of theories and hence maximise their usefulness. We define presentational effectiveness as the ability of our theories to *effectively* convey the maximum number of ideas to our intended audience with the minimum amount of ink. We remind the reader that the intended audience of research can be made up of both internal and external stakeholders.

The ability of language and especially scientific language to transfer ideas is eroding due to its increasing complexity and specialisation (Daft, 1980; Rynes et al., 2001). In addition, language is restricted in the number of dimensions through which it conveys information. Language when aural is sequential owing to the sound waves arriving in sequence at the ear of the listener.

Language when visual is also sequential as the eyes of the reader process words in the order they appear on the page. These sequential representations are sometimes referred to as one-dimensional whereas visual representations are two- or three-dimensional (Crapo et al., 2000). Visual representations can be processed by the visual portions of the human brain (Larkin & Simon, 1987), which can discern within milliseconds visual features such as motion, colour, intensity, size, intersection, closure, orientation, lighting direction, and distance (Crapo et al., 2000). The result is that we usually interpret stimuli reaching our eyes in at least a three-dimensional manner (Crapo et al., 2000).

But "*[o]ur ability to process and think about information relating to the three dimensional world is not limited to what we see*" (Crapo et al., 2000 p. 220). For example if we are asked to compare two objects that are out of sight then our minds are able to create mental images of both from which we can draw conclusions. But as the complexity of the image increases, we struggle to effectively construct, maintain, and manipulate it in memory (Finke, 1990). Hence *"[t]he capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required"* (Simon, 1957 p. 198). For this reason use of mental images to understand and solve complex problems becomes "*increasingly inferior to our ability to use an external visualization to solve the same problem*" (Crapo et al., 2000 p. 220). Pinker (1999) suggests that the ability of the human mind in such circumstances can be improved with the assistance of appropriate visualizations[2]. A model is a visualization that offers an "*external and explicit representation of part of reality as seen by the people who wish to use that model to understand, to change, to manage, and to control that part of reality in some way or other*" (Pidd, 1999 p. 120).

[2] This paper distinguishes the words *visual, visualization,* and *model,* which refer to representations external of the human mind, from the words *image* and *imagery,* which refer to mental images.

Despite presentation being an integral part of many definitions of theory, it remains largely ignored in the academic discourse on theory-building. There is a serious dearth of academic discourse on how we should present theory to the reader and how we should overcome the limitations of the sequential representations of spoken and written words in depicting a "*world ... [that] does not function in linear order*" (Mintzberg, 2005 p. 13). Given that the "*visual is often more effective than the verbal*" (p. 212), Krygier & Wood (2009) wonder how we can deem the visual to be "*so inappropriate as formal academic discourse*" (p. 214). Conversely in map-making "*the* [visual] *is the message*" (Krygier, 2008). Through its long history of designing and producing effective visual representations (Berendt et al., 1998), map-making has much to offer the scientific community (Geller, 1991; MacEachren & Kraak, 1997) in wrestling with presentation issues. We return to this point in the next section.

Production Problem and Content Effectiveness

The question that concerns us in this section is how we should address the *production problem* to ensure the *content effectiveness* of our theories. We define content effectiveness as the ability of our theories to *effectively* produce information appropriate to our intended audience and their needs. For example "*[t]ranslating findings in ways that are understandable to broader audiences will be more appreciated when these findings relate to phenomena that matter to the message receivers*" (Shapiro et al., 2007 p. 249). Therefore, effective theory-building is not just a matter of overcoming the translation problem through achieving presentational effectiveness but also a question of achieving content effectiveness or as Klimoski (1991 p. 264) suggests ensuring the "*quality of the ideas themselves*". But the effectiveness of the ideas is moderated by questions of generality, simplicity, and accuracy.

Unfortunately there is disagreement among theory-building authorities as to the optimum level of generality, simplicity, and accuracy in theories. Mintzberg (2005 p. 19) wonders "*[w]hat ... is the problem with a sample of one ... Piaget studied his own children; a physicist once split a single atom. Who cares, if the results are insightful*". But this is obviously a problem for most other theory-building authorities with Popper (1959) among others (e.g. Metcalfe, 2004; Wacker, 1998; Weick, 1989; Weick, 1999) suggesting that theory should be applicable to as broad a domain as possible. They advocate that scholars increase the domain of application of their theories with the result that as time progresses fields of research climb towards increasing generality (Wacker, 1998). But high generality results in theories that are largely *context-free* "*despite the fact that the context out of which they have been developed is often very rich*" (Bartunek, 2007 p. 1327). Mahoney & Sanchez (2004 p. 35) identifies the *principle of contextualism*, which "*recognizes that there is a context-dependent gap between concepts of universal theory and concepts useful in a specific context*". This makes the former highly erratic in accuracy across different contexts (Markus & Robey, 1988). A call for the contextualism of theories is therefore gaining voice (e.g. Barnes et al., 1994; Mahoney & Sanchez, 2004; Merton, 1967; Schneberger et al., 2009; Weick, 1974). While contextualism increases the accuracy of a theory, it also demands increased detail at the expense of simplicity. But Wacker (1998 p. 366) questions the usefulness of detailed theory owing to its complexity and the fact that it "*only applies to a few instances"*. Likewise Colville et al. (1999) warn that practitioners may find complex theories uninteresting, which may mean that they are unlikely to use them. Likewise Colville et al. (1999) warn that practitioners may find a complex theory uninteresting, which may mean that they are unlikely to use it. So while contextualism might contribute to the accuracy of theories in specific contexts, if it remains unchecked it can also limit their use. Extant literature,

therefore, takes the reader, who has the misfortune to seek its guidance on issues of generality, simplicity, and accuracy in theory-building, around in proverbial circles and offers no clear way forward.

The literature does, however, allow us surmise, as do Thorngate (1976), Sutton et al. (1995), and Weick et al. (2005), that generality, simplicity, and accuracy cannot be achieved concurrently within a single theory. Increased generality demands simplicity, which is achieved at the expense of accuracy. On the other hand, reduced generality is associated with more complexity and more accuracy. Therefore "*no one theorist can have it all, "all" being an explanation that is general, accurate, and simple"* (Weick, 2005). Theory-builders must, therefore, be pragmatic and have no option but to make tradeoffs between generality, simplicity, and accuracy (Sutton & Staw, 1995). But extant literature provides little assistance to scholars faced with the challenge of building effective theory under a barrage of strong and oftentimes conflicting interdependencies between generality, simplicity, and accuracy. For centuries map-makers have successfully grappled with these issues and it can provide theory-builders with useful cues as to how to rise above this content conundrum. We return to this point in the next section.

Map Making's contribution to effective theory-building

In this section we focus on map-making in order to glean insights that might assist us in addressing the communication issues highlighted in the previous section.

The process of map-making consists of transforming the map-maker's conceptualisation of geographical reality into a map (Barkowsky & Freksa, 1997). On the other hand, the process of map-reading consists of the map-reader inversely transforming the map into a mental image of

the original geographical reality (*ibid*). These relate to processes of encoding and decoding geographic information respectively. As "*maps function, for better or worse, via their visual appearance*" (Montello, 2002 p. 286) then their appearance is designed and evaluated iteratively in order to ensure their positive impact on the map-reader. *Map effectiveness,* as originally intended by Robinson (1952), is the ability of the map to capture and portray relevant information in a way that the map-user can analyse and interpret (Kitchin et al., 2009). To ensure their effectiveness, maps are evaluated to "*understand the effects of design decisions on the minds of map users*" (Montello, 2002 p. 285).

It is not possible to depict geographical areas, which are large, complex, and full of natural and man-made features, at their actual size nor would it be possible to show their full detail. Maps are designed to serve certain specific purposes and therefore represent only a select set of the spatial features of geographic areas (Berendt et al., 1998). For these reasons maps are strategically reduced in *scale* and *generalized* in order to emphasize some aspects of the geographic area but to deemphasize or omit everything else (Krygier & Wood, 2005). The *scale* of the map is the mathematical relationship between the size of the map and the size of the geographic area it represents. As the map-maker reduces the scale fewer individual features can be displayed on the map. The correct choice of scale depends on the purpose of the map. Generalization is necessary in order to cope with display restrictions, ensure that the cartographic entities are visually recognizable at the given scale, and prioritise the cartographic entities according to the purpose of the map (Barkowsky & Freksa, 1997; Li & Openshaw, 1993). Generalization can be achieved through five operations: (1) selective omission, (2) simplification, (3) combination, (4) exaggeration, and (5) displacement (Keates, 1989). Each approach may be valid in different circumstances depending on the purpose of the map. Map

accuracy refers to the amount (or lack) of distortion in the representation of features. Large-scale maps tend to show less area but in more detail through less generalization, while small-scale maps tend to show larger areas but in less detail through increased generalization. The smaller the scale is then the larger the degree of adjustment that is required and, therefore, the greater the misrepresentation that results (Li & Openshaw, 1993). However, this misrepresentation may be necessary in order for the map to ensure the legibility of objects of interest – all within the limited scale of the map. When addressing the issue of accuracy, the question may, therefore, not be whether the map is *accurate* but whether the map is *appropriate* for its intended purpose.

Map-making efforts are informed by both craft, which has been developed over centuries through trial and error, and more recently science that offers a more scientific understanding, such as provided by cognitive science (Jenks, 1987; Montello, 2002). As previously suggested the craft and science of map-making are likely to be of use to us in our attempts to arrive at a set of principles for building of effective theory. We now use these insights to derive a framework for building effective theory.

Framework for building Effective Theory

Effectiveness is *designed into* an emerging theory by searching through alternative *presentation* and *content* options for addressing a problem and evaluating their (perceived) cognitive impact on the audience. The emerging theory is not effective if it is inappropriate in presentation or content and thereby fails in having the desired impact on the audience. In other words effective theory-building is a *design process* - see Figure 1 - driven by a research problem and the search for an effective theory to address the problem. The research problem emerges from the

environment (Simon, 1996) which in the case of IS research is composed of people, organizations, and existing or planned technologies (Silver et al., 1995).

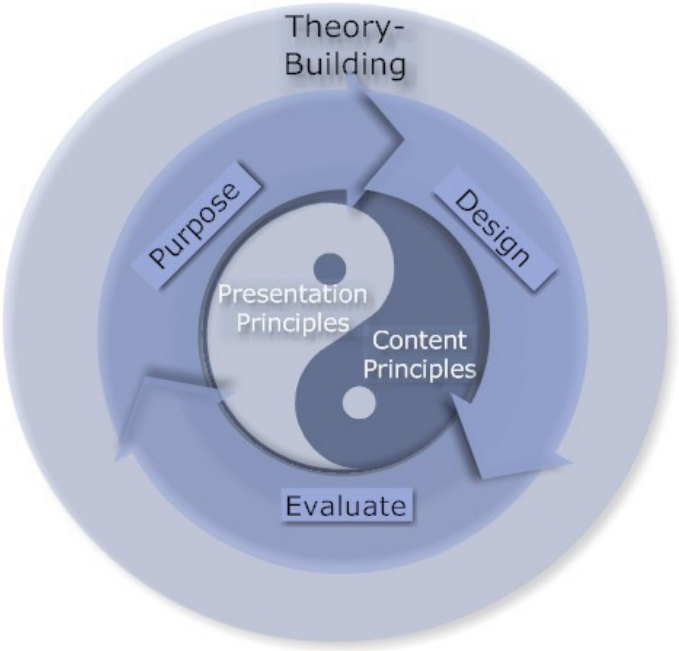

Figure 1 – Model of Effective Theory-Building

Characterising theory-building as a design process is noteworthy in a number of regards. Firstly it implies that theories are purposefully *created* rather than deductively *discovered* as much of the scientific literature would have us believe (Mintzberg, 2005). We are not the first to claim that theories are created rather than discovered (e.g. Hempel, 1965) but we feel we are among the first in IS to make the *purposeful design of theory* the focal point of our work. Secondly, it implies that theory-building is inherently iterative and incremental consisting of "*the purposeful process or recurring cycle by which coherent descriptions, explanations, and representations of observed or experienced phenomena are generated, verified, and refined*" (Lynham, 2000 p. 161). Thirdly, it implies the search is for an effective theory rather than a true theory (or in the words of Simon (1996) for a *satisficing* solution rather than an *optimum* solution). Fourthly it

implies that the resulting theory must be *evaluated* to ensure it appropriately addresses the research question for the given audience. In other words the perspective of the scholar must continuously shift between the *design* and the *evaluation* of the emerging theory. Besides the *utility* of the theory, it should also be *novel* and so it must either address a heretofore unsolved problem or address a known problem in a more effective manner. Fifthly, *representation* has a profound impact on design work and the search for an effective representation is crucial to both finding an effective solution as well as communicating it (Hevner et al., 2004; Simon, 1996). We therefore reiterate that the visual has a key role to play in theory-building.

This approach resonates with the design process in design science, which also consists of two expert activities, build and evaluate, that produce an innovative artefact for a specific purpose as well as evaluate how well the artefact performs (March & Smith, 1995; Hevner et al., 2004). The evaluation of the artefact provides feedback information and a better understanding of the problem in order to improve both the quality of the artefact and the effectiveness of the design process (Hevner et al., 2004). This build-and-evaluate loop is typically iterated a number of times before the final design artefact is generated (Markus *et al*. 2002). In Figure 2 we synthesise these two sources (i.e. map-making and design science) by superimposing the relevance, design, and rigour cycles of Hevner (2007) over the effective theory-building process outlined above to create a model of effective theory-building.

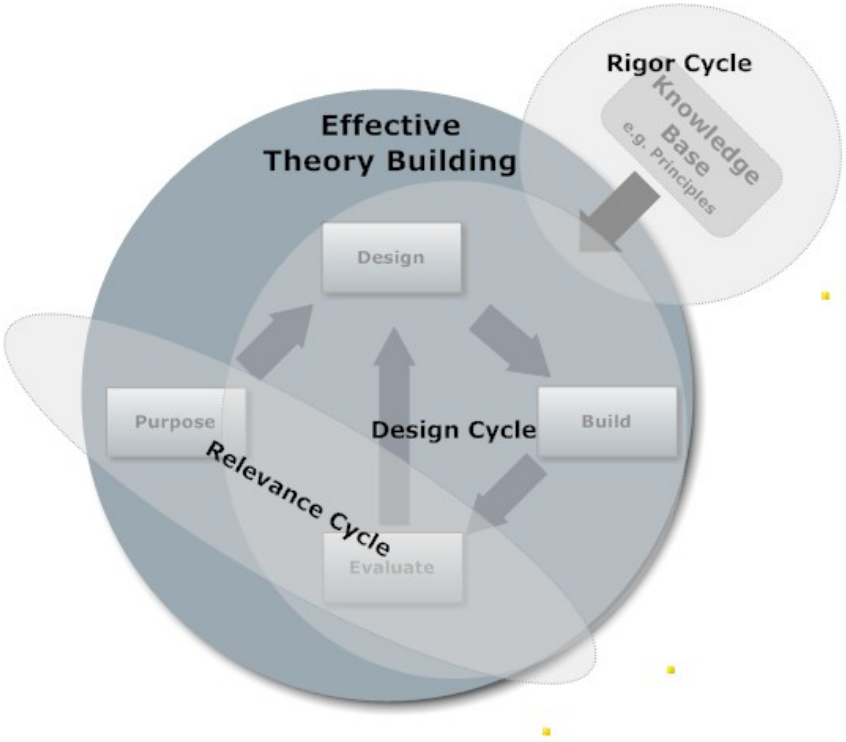

Figure 2 - Process for Effective Theory-Building

Peffers et al., 2007) performs a review of seven papers presenting processes for design science research, which they distil down to six design process tasks. Hevner et al. (2004) provides seven guidelines for the practice of high quality design science research. In Table 2 we juxtapose these activities and guidelines and the three stages of effective theory-building highlighted from above. The result is a detailed description of a process of effective theory building.

Table 2: Process of Effective Theory-Building

Building stage	*Activity*	*Description*	*Design Science Guidelines*
Purpose	Problem and audience identification. Motivation	The scholar must define the specific research problem, identify the intended audience, and justify the value of the theory. Justifying the value of the theory motivates the scholar and the intended audience to pursue the theory-building and to accept the need for the resulting theory.	There must be a 'specified problem domain' (Guideline 2).
	Objectives of the theory	The objectives of the theory may in some cases be inferred from the problem definition. But in other cases the identified problem does not necessarily translate directly into objectives for the theory because the process of theory-building is necessarily one of partial and incremental solutions that do not solve the entirety of the problem.	The artefact must be 'innovative, purposeful' (Guideline 1).
Design and Build	Design	These activities generate ideas as to satisfactory content and presentation for the proposed theory in order for it to achieve its objectives for its intended audience.	Design consists of 'a problem space is constructed and a mechanism posed or enacted to find an effective solution' (Guideline 6).
	Development	Once the scholar settles on a particular idea, an instantiation of the theory is developed. The scholar learns from the act of 'thinking' and 'doing' and may well return to generate further ideas before settling on a particular instantiation.	The resulting artefact 'must be rigorously defined, formally represented, coherent, and internally consistent' (Guideline 5) and 'it must yield utility for the specified problem'.
Evaluate	Demonstration / Evaluation	Steps to determine the appropriateness of the instantiation can range from internal evaluation that takes place in the imagination of the scholar to show that the instantiation might work for the given problem and audience, to a more formal external evaluation to show that the instantiation does indeed have a positive cognitive impact on the intended audience. The latter may involve activities such as (1) demonstration of the instantiation to immediate colleagues or to a wider audience of stakeholders, or (2) communication of the instantiation to a wider audience and observing or reviewing their response to it. It is important to realise that it is insufficient for the theory to be simply validated as 'true' but instead it must be evaluated to be 'effective'. In fact the former is not possible for social sciences and so the focus should remain on the latter. At the end of this stage the scholar may decide whether to iterate back to the previous stage (in order to improve the effectiveness of the instantiation) or proceed with wider dissemination of the instantiation and leave further improvement to subsequent efforts.	'Evaluation of the artifact is crucial' (Guideline 3) and the result must solve 'a heretofore unsolved problem or … a known problem in a more effective or efficient manner' (Guideline 4).
	Communication	The scholar must communicate and diffuse the resulting knowledge. The scholar communicates the problem and its importance, the theory, its utility and novelty, the rigor of its design, and its effectiveness to internal and/or external stakeholders.	Ultimately 'the results of the design-science research must be communicated effectively' (Guideline 7)

While this process might appear to be structured in a sequential order, there is no expectation that scholars would always proceed in a sequential manner from top to bottom. In reality, they may actually start at almost any step and move onward. There is also a danger that one might think that the approach to ensuring the effectiveness of theory is simple trial and error. While the approach does encourage learning by doing, this isn't the whole story. Theory is at the heart of design science so much so that scholars, such as Iivari (2007 p. 49), argue that it is the presence of a kernel theory that distinguishes design science research from other design efforts. Here the kernel theory should provide principles to guide scholars in ensuring the content and presentation effectiveness of their theories while simultaneously making tradeoffs between generality, simplicity, and accuracy.

We outline various principles – see Table 3 which is also derived from the insights from map-making presented earlier - to guide the design and evaluation of the emerging theory. Essentially all these principles can be boiled down to ensuring that all decisions in the design and evaluation of theory (such as the required level of generality, accuracy, and simplicity as well as its presentation) must be driven by the intended purpose and the ultimate audience (which jointly we refer to as a question of ensuring that the theory is *purposeful*). Some of the advice offered by these principles for *effective theory* is at cross purposes with extant literature and particularly the guidelines for *good theory* (c.f. Wacker, 1998). For example, Wacker (1998 p. 365) states that *"[i]f one theory can be applied to one type of environment and another theory can be applied to many environments, then the second theory is a more virtuous theory since it can be more widely applied*". On the other hand we state that theory should be limited and prioritised. However, once we introduce the anchor point of *purposefulness* the apparent contradiction dissolves. We posit that generalisation and abstractness are contingent on purposefulness, meaning that their levels

should be dictated by the purpose of the theory and its audience. In other words the theory should be general and abstract only to the degree that it continues to achieve its purpose. Unfortunately, extant literature omits the anchor point of purposefulness and instead suggests that the function of research is to create theories of high generality. Gregor (2006 p. 7) states that "*abstraction and generalisation ... are thought to be at the core of a theory*". We respectfully disagree and suggest that purposefulness should be at the core of all theory. The *raison d'être* of research is to be useful. If the outcome of a search for usefulness is a theory also of high abstraction and high generalisation then great but we believe that useful theories are likely to be of a more limited domain – because of the previously noted trade-offs between generality, simplicity and accuracy. A more limited domain ensures a degree of accuracy and simplicity that may be necessary in order to ensure usefulness. It may also puzzle some readers why we include a principle stating that an effective theory is inaccurate. All theories are uncertain and are no more than approximate representations of a reality (Gregor, 2002). No theory can therefore be wholly true or accurate. When creating *effective theories* through limiting, prioritizing, or simplifying reality, we knowingly introduce inaccuracies as a side-effect. These side-effects are necessary in order for the theory to retain its usefulness. We, therefore, suggest that the accuracy of our theories should be downplayed in favour of their appropriateness. While Wacker (1998) recognizes that "*[a] 'good' theory may not be a 'true' theory*", we concur but add that no theory can be true but it can at least be *effective.* The impact of *good theory* in the absence of effective representation and content is at best limited. The illusive search for truth or goodness should be secondary to a more pragmatic search for purposefulness.

Table 3. Deriving 'Principles for effective theory-building' from Map-making

Principle	Lesson from effective map-making	Example from map-making	Implication for theory-building
An effective map/theory is purposeful	Before making an effective map, the map-maker clearly identifies the purpose of the map and the audience for whom it is to be produced.	A street map would be of limited value to a map-reader who must navigate an underground rail system. While it may be of correct area and scale it serves a different purpose which limits its usefulness.	The function of theory-building is not to build general, accurate and or simple theory per se but to produce purposeful theory. Effective theory is purposeful to a given audience.
An effective map/theory is designed	Effective maps do not simply get made but are designed to be purposeful to an audience.	All useful maps are designed.	Effective theory-building is a design process that seeks appropriate (for a purpose and audience) rather than true theory.
An effective map/theory is evaluated	Effective maps regularly undergo various forms of evaluation to assess their effectiveness among their intended audience.	All useful maps are evaluated.	Effective theory-building is a design process that continuously evaluates the appropriateness (for a purpose and audience) of theory.
An effective map/theory is visual	The effectiveness of maps as cognitive devices is down to their visual appearance. Visual excellence ensures that complex ideas are communicated with clarity, precision, and efficiency.	All maps are visual.	While traditional theories are over reliant on language, effective theory embraces the effectiveness of the visual as a means of communication of its purpose to its audience.
An effective map/theory limits	Effective maps are strategically *scaled* to represent only a select geographic area, a limited set of its spatial features, and in limited detail.	A small-scale map that shows a town as little more than a dot or a large-scale map that shows a single building is of no use to a pedestrian, who must navigate a few blocks. The scales of the maps limit their usefulness to the pedestrian.	Traditional theory is not equally effective across a multitude of domains. Effective theory is limited in its domain so as to be appropriate for a purpose and to its audience.
An effective map/theory prioritizes	Effective maps are strategically *generalized* to prioritize certain aspects of the geographic area whereby important things are visible and look important.	A street map of a town that prioritizes features such as culverts, manholes, pipes and cables is of limited use to a pedestrian who must navigate a few blocks. The lack of prioritization of the map limits its usefulness to the pedestrian.	Traditional theory does not always prioritise appropriately. Effective theory highlights those theoretic features that are appropriate for a purpose and its audience.
An effective map/theory simplifies	Effective maps are also strategically *generalized* to omit less important aspects, prevent overlapping features, and ensure the features are visually recognizable.	A street map of a town should exclude engineering features and include the positions of pedestrian crossings in order to be useful to a pedestrian.	Traditional theory does not always simplify appropriately. Effective theory simplifies in peripheral areas but retains its detail in areas central to its purpose and its audience.
An effective map/theory is inaccurate	Owing to prioritization and simplification, effective maps are inaccurate especially in relation to less prioritised features. Such misrepresentation may be necessary in order for the map to retain legibility.	Gas mains and electric cables often run in close proximity along streets. An engineering map of a town may display both by moving one relative to the other provided resulting inaccuracy does not prevent the map from achieving its purpose.	Traditional theories are neither true nor accurate. Effective theory is also imprecise but is appropriately detailed and precise in those areas central to its purpose and its audience.

Discussion and Concluding Remarks for Further Research

This paper makes contributions at several levels, which we discuss here. One contribution is that scholars should benefit both from the discussion of content and presentation issues that afflict theory-building efforts and from the derivation of principles guiding theory effectiveness. The result should be a realisation of the limitations of *good theory* and an increased awareness of the need for *effective theory*. IS scholars are provided with "*a long list of potential criteria for 'good theory'"* (Gregor, 2006 p. 25). Although there is no general agreement among theory-building authorities concerning the relative importance of each criterion, there is consensus on what the criteria or virtues of *good theory* are (Wacker, 1998). While these are highly significant for theory-building "*there are always trade-offs among virtues*", which demands value judgments from the scholar (Wacker, 1998 p. 367). It is the intention of this paper not to argue against these virtues of *good theory* but to provide an overarching framework to guide the scholar in making these trade-offs. Whereas the criteria for *good theory* are rather idealistic and non-harmonious, the principles for *effective theory* are intended to be realistic and harmonious. All decisions the scholar makes should be guided by the purpose of the theory and its intended audience. This provides the scholar with a clear anchor point for all decision-making regarding the content and presentation of theory. This anchor point is notably missing from the discourse on *good theory*. A further contribution of this paper is to provide scholars with a process for building effective theories.

A further contribution of this paper is to provide scholars with a framework for building effective theories. To the best of our knowledge this is the first such method provided within the extant IS literature. The framework includes a conceptual model of effective theory-building (see Figure 1), a process for effective theory-building (see Table 2), and a kernel theory or principles for effective theory-building (see Table 3). Following the advice of March & Smith (1995 p. 258) who suggest that "*[i]nstantiations demonstrate the feasibility and effectiveness of the models and methods they contain*" we released a worked example of such an instantiation to the academic community (c.f. O'Raghallaigh et al., 2010). In O'Raghallaigh et al. (2010) we followed the blueprint presented here to build a typology of academic and practical significance for innovation studies. A next step is to evaluate the resulting typology to ensure its effectiveness as a theory.

Another contribution is that we move the design and evaluation of theory centre stage. At a pragmatic level our call for *effective theory* requires that our community focuses more of its collective attention on the craft of building theory as well as sharpens its awareness of the factors that impact the effectiveness of the resulting theories. Theories are not simply built but must be carefully and methodically designed and subsequently evaluated to ensure fitness for purpose. This resonates with Gregor's (Gregor, 2009 p. 1) recent call for theorizing to "*be considered in a holistic manner that links two modes of theorizing: an* ***interior mode*** *with the* ***how*** *of artifact construction studied and an* ***exterior mode*** *with the* ***what*** *of existing artifacts studied*" (emphasis in the original). Further she states (p. 2) that *"[t]hese two modes are seen as 'two sides to a coin'; they are intertwined and both contribute to the development of knowledge concerning artifacts in a practical science*". We need to understand the *how* of theory-building as well as the *what* of theory-building and one way of doing this is to see theory as that artefact referred to by

Gregor above. We need to understand which features of a theory make it a success or failure as well as why and how the theory works for a given audience. In other words we need not just to build and evaluate but also to "*theorize and then justify theories about those artefacts*" (March & Smith, 1995 p. 259).

Extending this line of enquiry, we ask whether theory itself can be an artefact in the sense of design science. Peffers et al. (2007 p. 49) states that the artefact in design science can be "*any designed object with an embedded solution to an understood research problem*". Iivari (2007 p. 50) suggests that "*[o]ne could maintain that [design science] has a lot in common with theory building, which has been of considerable interest in the methodology of science*" but other than noting their similarities they do not pursue the question of their relatedness. While there now appears to be widespread acceptance that we can build theory from within design science, the interesting question of a *design science of theory* has not been pursued. Although this question is likely to lead to challenging ontological, epistemological, and methodological concerns for some scholars, we nonetheless feel it is a question worth pursuing. "*[D]esign theory can ... be produced by researchers who reflect at second-hand on what others have done in constructing artefacts*" (Gregor, 2009 p. 6). We feel that theory-building has a lot to learn from considered reflections on exemplars of not just well built theory but also poorly built theory. Gregor (2009 p. 7) suggests that "*systemization of knowledge gained through practice is a legitimate academic activity and one that has led to a number of influential design theories*". We need to systematically extract and abstract design principles for theory-building from extant literature. Our field is in urgent need of the knowledge base that would result from such an initiative. On this note we leave you the reader to reflect and adjudicate on the merits of this call to action.

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