Systems, Signs & Actions
An International Journal on
Communication, Information Technology and Work
Vol. 5 (2011), No. 1, pp. 117–132
http://www.sysiac.org/

The design of *effective theory*

Paidi O'Raghallaigh [a], David Sammon [a], and Ciaran Murphy [a]

[a] Business Information Systems, University College Cork, Ireland

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. But the consumption of theories is not straightforward owing both to the cognitive limitations of the human mind and the ineffective cognitive designs of our theories – both of which limit the effectiveness of our theories. We outline the ontological position and the characteristics of the concept of *effective theory*, which is theory that is incrementally and iteratively designed in order to be purposeful – both in terms of its utility (which is largely a matter of content) but also in its communication (which is largely a question of presentation) to an audience. We realise that the research community may question our arguments on a number of philosophical grounds and we, therefore, take this opportunity to make the case for *effective theory* and to briefly outline an appropriate framework for its study.

Keywords: Theory, Effective Theory, Design Science, Philosophy, Practice

This paper is developed from the previous publication: O'Raghallaigh et al (2011) The Design of Effective Theory, accepted to the International Workshop on Practice Research, Helsinki.

Received: 31 August 2011; Revised: 21 November 2011; Accepted: 7 December 2011
Accepting Editor: Göran Goldkuhl

1 Introduction

Theory-building is the basic aim of all science and it is, therefore, difficult to overstate its importance to the scientific endeavour. It 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). Scholars use the theories resulting from the process to describe, explain, and predict phenomena, as well as to communicate their intricacies to others (Cook and Campbell 1979). As academic scholars in applied fields our central mission is to develop theories that both contribute knowledge to the academic discipline (i.e. our internal stakeholders) and apply that knowledge to practice (i.e. our external stakeholders) (Simon 1967). Research is salient to the internal stakeholders if it adds to the current theoretical frameworks of the discipline; and to the external stakeholders if it solves the real life problems faced by practitioners (Bakshi and Krishna 2007).

It is, therefore, necessary to produce theories that contribute knowledge to the academic discipline and also to apply that knowledge to practice. But both the pro-

duction and consumption of theories has not been straightforward owing to: (1) the heterogeneity of those producing and consuming the research; as well as both (2) the cognitive limitations of the human mind; and (3) the ineffective cognitive designs of the theories. These three factors have limited the impact of our theories and they raise serious questions as to how theories should be produced in order to be consumed more effectively. This paper tackles these questions through introducing the concept of *theory effectiveness*, which is a quality of theory that is detected from the cognitive impact of its design on the minds of its intended audience.

The problem to be addressed in this paper is to explain what the problems with theory-building are and how the academic community ought to address them in order to promote theory effectiveness and ultimately more effective theory consumption. It addresses this problem through satisfying three distinct objectives. The first objective is to re-examine how the academic community might determine the quality of theory but this time from the perspective of the audience for those theories. The second objective is to diagnose the problems afflicting the consumption of theories by their intended audiences. The third objective is to take this diagnosis and to outline a course of action for the future of effective theory-building.

2 Outline of the argument for effective theory

This section takes a critical look at the problems of logic and objectivity besetting the scientific theory-building endeavour and it describes the ontological perspective adopted by this study. It then introduces the concept of *theory effectiveness* and positions it within the resulting ontological and scientific landscapes.

2.1 The problems of logic and objectivity in science

Because all knowledge conceptions are ultimately fallible, the rigour and rationality of science must be brought to bear in order to offer some justification for them. This happens through *justification of theory*, which is the confrontation between knowledge conceptions and evidence and is where the rationality of science lies. Justification takes place both *internally* prior to a theory's dissemination and *externally* on its dissemination to the wider audience (Schilpp 1974). But a fundamental problem with the justification of theories and with science in general is that it is logically impossible to justify any theory. Neither one nor any number of verifications generated through a process of *theory verification* (no matter how robust or extensive) is sufficient to justify a theory as the very next test may well prove it to be false. For example, Einstein is believed to have asserted: "*No amount of experiments can ever prove me right; a single experiment may at anytime prove me wrong*". An alternative proposal for justifying theory is the process of *theory confirmation*, whereby the greater the number and variety of verifications then the greater the support for the theory and the higher the probability of it being true. However, this too is logically troublesome as it is unclear how one might relate a given number and range of tests to a meaningful measure of truthfulness. These conundrums led to Popper (1959) proposing a process of *theory falsification*, which asserts that while one can never verify or confirm a theory, one can demonstrate a theory to be false by observing just one contradictory piece of evidence. Scientific knowledge advances most rapidly through the development of new ideas and the subsequent attempts to falsify them through empirical enquiry (*ibid*). Theories and hypotheses can, therefore, only ever be provisionally ac-

cepted, since the possibility of falsification always lies around the next corner. Theories are, therefore, merely conjectures awaiting refutation (Popper 1962). But the fact that "… *the whole of science, of all things, should rest on foundations whose validity it is impossible to demonstrate has been found uniquely embarrassing*" (Magee 1973 p. 21).

In addition to these issues of logic, experimentation as the means of justification is also troublesome as it is far from objective. The theories we hold, whether explicit or implicit, form a language that we use to make sense of our observations of the world (Burton-Jones et al. 2004). Theory plays a number of roles in observations – it guides them, informs them, and gives meaning to them. This has led to the philosophical claim that observation is '*theory-laden*' - meaning different scholars using different theories can observe the same phenomenon yet see very different things (Hanson 1958). The result is that the "… *empirical basis of objective science has thus nothing 'absolute' about it*" (Popper 1959 p. 111).

Owing to these problems of logic and objectivity, our theories are always fallible - uncertain and no better than approximations of reality. This may not be a major issue provided theories benefit from feedback resulting from their exposure to rigorous and extensive external criticism. Indeed an openness to criticism is what demarcates science from non-science and it is through a process of rigorous criticism that science and the knowledge it generates progresses (Popper 1978). Science is, therefore, largely a social enterprise, and the dissemination and consumption of theory is, therefore, central to addressing the issues of logic and objectivity and in moving science forwards.

2.2 Theory within the three world views

Despite the word 'theory' being used repeatedly in their work, many scholars fail to provide an explicit explanation of their own view of theory (Gregor 2002b). This is a weakness that this study seeks to avoid and this section describes the ontological position that is adopted by this study in relation to theory. Theories can be regarded as "… *constructions about which there is relative consensus (or at least some movement towards consensus) among those competent (and in the case of more arcane material, trusted) to interpret the substance of the construction*" (Guba and Lincoln 1994 p. 113). Against this backdrop, this study adopts a stance on theory similar to that of Gregor (2002b), who views theory and theoretical knowledge as human inventions rather than discoveries, but where the resulting theories have an existence separate from the subjective understanding of individuals.

This stance is perhaps best explained by returning to the work of Popper (1978), who proposes that the universe consists of three different (but interacting) world views as outlined in Table 1. Popper sharply distinguishes between knowledge in the subjective sense and knowledge in the objective sense. Knowledge in the subjective sense is associated with world 2 thought processes (e.g. the mental thought processes involved in conceiving a theory) whereas knowledge in the objective sense is related to world 3 thought contents (e.g. the resulting abstract theory). The process of conceiving theories is, therefore, a transition from world 2 non-linguistic thought processes to world 3 linguistically formulated thought contents (Popper 1978).

Table 1: The Three Worlds of the Universe (after: Popper 1978)

Type	**Description**	**Nature of objects**	**Examples**
World 1	This is the physical world consisting of living and non-living physical bodies.	Concrete objects and effects	Stones, plants, animals, and humans; but also physical energy, such as radiation and magnetic forces.
World 2	This is the mental world consisting of mental or psychological states, processes, and experiences.	Subjective personal objects	Feelings, thoughts, decisions, perceptions, observations, etc.
World 3	This is the world consisting of the products of the human mind	Abstract objective objects	Languages, songs, stories, myths, symphonies, paintings, sculptures, maps, theories, etc.

World 3 thought contents are related to the other two world views in a number of important ways. First, the thought contents are the products of the thought processes – meaning that the world 3 abstract objects are the products of world 2 mental processes. For example, an abstract theory is the collective content from the thought processes of one or more individuals where there is some movement towards consensus on the content. Second, the thought contents are abstract objects most of which become *embodied*, or *physically realised*, in one or more physical objects – meaning that world 3 abstract objects are often realised as world 1 physical objects. For instance, elements from the content of an abstract theory may be embodied in physical objects, such as the scholar's original manuscript, copies of journals, conference presentations, etc. Third, a third party's awareness of the thought contents is increased through consuming the physical embodiments of those contents – meaning that world 3 abstract objects are consumed through their world 1 physical embodiments. For example, awareness of the content of an abstract theory is increased through a wider audience consuming its physical embodiments. Fourth, the thought contents give the thought processes the power to change the world – meaning that the impact of world 3 abstract objects on the world 1 is mediated by world 2 mental processes. This study, therefore, argues that theories exist independently of the human mind, but without its active participation they would never be created and they would remain largely private and inert. The human mind is, therefore, central to the processes of *both* theory production and theory consumption. Leaving issues of accessibility aside, theory consumption is, therefore, constrained by the limitations of the human mind and the inappropriate cognitive design of the theories being consumed.

2.3 Theory dissemination in the research process

Based on the three world views just discussed, theory takes two forms that can be readily distinguished. This study introduces the concepts of big-T and small-t theories, where big-T theory is the world 3 abstract object and small-t theories are the world 1 physical embodiment of that big-T theory. TenHouten and Kaplan (1973 p. 147) refer to the process by which scholars start with a vision but change it *"… into a point before the eyes … from entwined ideas at the edge of words to a linear order in*

which the ideas are unraveled and set forth in the form of a propositional argument … within written language". In other words a scholar takes a nonlinear vision and formulates it as a more linear big-T theory. Of course some correspondence with the vision is lost when it is converted into a big-T theory. At some further stage, the scholar may embody elements of the abstract big-T theory as one or more small-t theories, such as in research papers or a presentation at a conference. Again some correspondence with the big-T theory is lost when it is translated into small-t theories. As well as being ontologically distinct (in that they are from different world views), big-T and small-t theories differ in their purpose. The big-T theory is critical to representing aspects of a reality, while the small-t theory is critical to disseminating to an audience an understanding of that reality. Theory effectiveness, which is detected from the cognitive impact of theory design on the minds of its intended audience, is a quality of small-t theories.

The centrality of small-t theories and their effectiveness to scientific research should not be underestimated. Figure 1 is a simplified depiction of the process of scientific research that represents how big-T and small-t theories are related to each other and to the various research steps. On conceiving ideas within our minds, we decide to proceed with some, while discarding others. While the ideas remain as world 2 objects they are merely part of us. But by converting them into some language, we form them into a big-T theory (i.e. a world 3 object) and, therefore, a possible object of formal criticism. We subject these big-T theories to some form of internal justification before deciding to disseminate them to an outside audience. Widespread dissemination generally depends on embodying the big-T theory as one or more small-t theories. *"World 1 embodiments of world 3 objects, such as handwritten books, or printed books, or articles in journals, are extremely important; but they are important not as world 1 objects but as [embodiments of] world 3 objects … Of all these world 3 objects it is very characteristic that they can be improved by criticism. And it is very characteristic of them that the criticism may be cooperative: it can come from people who had nothing to do with the original idea*" (Popper 1978 p. 162-163). The ensuing criticism may result in the big-T theory being discarded, being re-conceptualised, or seeking further justification.

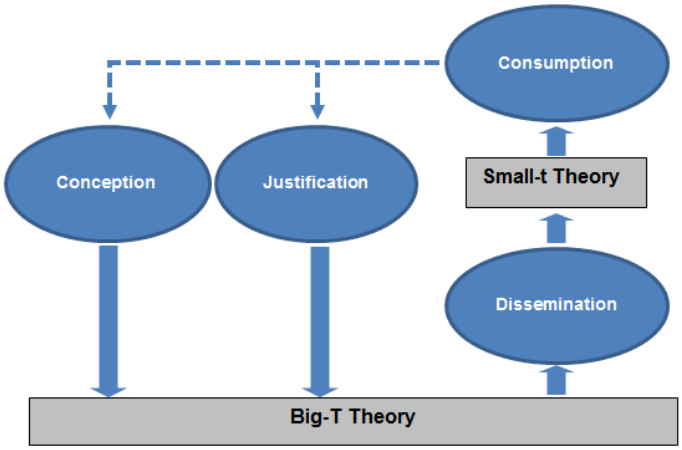

Figure 1: The Scientific Research Process

It is this openness to criticism that demarcates science from non-science and the dissemination of big-T theory (as one or more small-t theories) as central to scientific progress. It is only through effective dissemination that the big-T theories move from being objects of private interest to objects of community interest and that science moves towards a truly social affair.

2.4 Determining the quality of theory

The dissemination of small-t theories marks the point at which the scientific theory-building process moves from a private to a community affair. But the question remains as to how the small-t theories can be used to establish the quality of the Big-T theory from which they are derived. While big-T theories are abstract entities that serve to describe, explain, predict, as well as provide a basis for action in the real world, the general assumption is that science determines their quality in terms of their truth claims. Truth is a quality of the big-T theory but for which no '*objective yardstick*' exists (Popper 1978). The scholar "… *can never know for certain whether his findings are true, although he may sometimes establish with reasonable certainty that a theory is false*" (Popper 1965 p. 16). So while the idealistic goal of science is the pursuit of universal truth, most philosophers of science now agree that theories can never be proven to be true and that theories always remain conjectures (i.e. doxa) as opposed to indubitable knowledge (i.e. episteme) (Bacharach 1989). But in any case neither truth nor falsity is absolute in the sense that a big-T theory that is 'true' for some situations may be 'false' for other situations. For instance, Newtonian mechanics is deemed useful for studying the movement of macroscopic entities travelling at speeds not approaching the speed of light but once these assumptions are relaxed then its truthfulness becomes questionable owing to accuracy issues. So the quality of theories is neither objective nor absolute.

Compare this situation to what Popper (1978 p. 148-149) suggests about a musical symphony, which he suggests is a world 3 object that exists independently of the human mind but whose value can only be gauged indirectly from its world 1 physical embodiments: "… *there are better and worse performances of Beethoven's Fifth Symphony: better and worse live performances, better and worse records, better and worse tapes. … Of course, if a bad performance could be simply identified with one that deviates from Beethoven's original score, and a good performance with one that agrees with the score, then there would be no difficulty. However, it is quite possible that one of the best performances has here or there a minor lapse, and that one of the more clumsy performances agrees with the score in every place*". Instead "… *people would be used like iron filings in a magnetic field: their reactions would make visible an objective quality of the work of art. This, I suggest, is the true situation; and the reaction of the public is merely an indicator of the quality of the work of art*" (Popper 1978 p. 150). The result is an evaluation of the symphony that is both *subjective* in the sense that it is concerned with the world 2 reaction of the audience to its embodiments, but also *relative* in the sense that no two people in the audience will react identically to the same embodiment.

We extend this argument to the case of another world 3 object – big-T theory. Likewise it may be deemed to be great, but an objective measure of its value is impossible and there is no alternative but that its value is gauged indirectly from the reaction of an audience to its embodiments or, one step further removed, on their ability to use its embodiments to understand or change the world. The value of a big-

T theory is, therefore, essentially discerned from the ability of its small-t theories to provide an audience with effective descriptions, explanations, predictions, or prescriptions. This study, therefore, argues that the value of a big-T theory is gauged from the reaction of an audience to consuming its corresponding small-t theories. But small-t theories operate through the human mind and not all minds are equal (in terms of ability, needs, or desires), so the response of an audience to a small-t theory depends on the medium of communication as well as the membership of the audience. For instance, Einstein's original manuscript for the General Theory of Relativity was in German and largely inaccessible to the English-speaking scientific community. It was not until Eddington presented in English a number of articles about Einstein's theory that it was unveiled and explained to the non-German-speaking world that up until then remained largely unaware of his revolutionary work. This rather simple example illustrates how a small-t theory that has a design appropriate for one audience may at the same time be wholly inappropriate for another audience. Yet the underlying big-T theory may remain unchanged. In other words its value is determined from its small-t theories, and perception of those small-t theories is variable, subjective, and relative – even though the big-T theories may remain unchanged. The value of big-T theory is, therefore, closely tied to questions of the content and presentation of its small-t theories, which as we will now see are also the primary concerns of *theory effectiveness*.

2.5 The argument for theory effectiveness

Taking Shapiro (2007 p. 249) as our point of departure, we posit that dissemination deficits 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 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*, in that our theories cannot be understood by our stakeholders, and the latter a *content issue*, in that we are producing theories of little interest to our stakeholders (Klimoski 1991). Extant literature pays little heed to these issues and indeed it is disconcerting to find that the virtues of *good theory* (c.f. Quine and Ullian 1980) are largely divorced from principles of effective presentation and content.

Indeed the guidelines for good theory tend to be rather abstract and idealistic and their implementation is not without practical problems (O'Raghallaigh et al. 2010). For example many theory-building authorities (e.g. Metcalfe 2004; Popper 1959; Wacker 1998; Weick 1989, 1999) advocate that good theory should be applicable to as broad a domain as possible. They support the view that science progresses by increasing the domain of application of its theories. But behind this goal lays an intricate web of practical anomalies that the academic discourse fails to resolve (O'Raghallaigh et al. 2010). For instance, high generality implies 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). The *principle of contextualism*, therefore, states that there "*… is a context-dependent gap between concepts of universal theory and concepts useful in a specific context*" (Mahoney and Sanchez 2004 p. 35). The greater the gap the more difficult it is to relate the theory to a specific situation and the more erratic the theory is likely to be in its accuracy across different situations (Markus and Robey 1988). But conversely, increased contextuali-

sation demands additional detail usually at the expense of simplicity. This prompts Weick (2005) to observe that "… *no one theorist can have it all, 'all' being an explanation that is general, accurate, and simple"*. It is, therefore, unclear how we can reconcile calls for the contextualisation of theory with the scholarly demands for high generality, high simplicity and high accuracy.

Against this backdrop, we wonder how the scholarly community can possibly prognose a theory to be *good* when it can suffer from issues that render it incomprehensible and/or irrelevant to our stakeholders. Therefore, in addition to *good theory*, we call on scholars to focus their efforts on building *effective theory*, which is *incrementally and iteratively designed in order to be purposeful – both in terms of its utility (which is largely a matter of content) in solving problems of interest to an audience but also in its communication (which is largely a question of presentation) to the audience.* The effectiveness of theory, we argue, is a quality of its small-t theories that is detected from the cognitive impact of their design – and specifically in terms of their content and presentation - on its intended audience. Unlike *truth* which is oftentimes regarded as objective and absolute, *effectiveness* is subjective and relative. Theory effectiveness is *subjective* in that it is dependent on the perception of human minds and it is *relative* in that no two human minds will perceive it identically. Therefore, a theory that is effective for one audience may be wholly ineffective for another audience. But at the end of the day the quality of the big-T theory will be determined from the effectiveness of these small-t theories. The question then is how we should design small-t theories that are effective in content and presentation.

2.5.1 The generality, simplicity and accuracy of effective theory

Theory effectiveness is moderated by questions of generality, simplicity, and accuracy, such that *effective theories* tend to be of a limited domain (i.e. generality), which may be necessary to ensure a sufficient degree of accuracy and simplicity. But this clashes with the guidelines for *good theory*. 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*". However, once we introduce the anchor points of utility and communication the apparent contradiction dissolves. For instance, we posit that the theory should be general only to the degree that it remains purposeful – in both its utility and communication. Unfortunately, extant literature largely disregards utility and communication and instead suggests that the function of research is to create theories of ever higher generality per se. For example, Gregor (2006 p. 7) notes that "… *abstraction and generalisation … are thought to be at the core of a theory*". We respectfully disagree and suggest that utility and communication should be placed at the core of all theory. The *raison d'être* of research is after all to be useful and how can a theory be so if it is not relevant or it cannot be understood? We, therefore, argue that effective content and presentation are central to the value of all theory.

In addition to arguing that *effective theories* are likely to be of a limited domain, we also point out that they are untrue (or at least inaccurate) – a statement that some readers may find somewhat unsettling. For example, in order that 'truth' does not get overwhelmed in a map, '*white lies'* are essential and necessary (Crampton 2002). For

instance, gas mains and electric cables often run in such close proximity along streets that a small scale engineering map may only display both by moving the symbol for one relative to the other. Just as a map is both lie and truth, so too is a theory. When creating *effective theories* through limiting, prioritizing, or simplifying reality, we knowingly introduce inaccuracies as a side-effect. Yet these inaccuracies may be necessary to ensure the utility and communication of the theory. All theories are uncertain and they are no more than approximate representations of a reality (Gregor 2002a). We suggest that the accuracy of our theories may oftentimes need to be downplayed in favour of their utility and communication. However, we do need to "*police the boundary"* to ensure that *"… there is not too much lie nor insufficient truth*" (Crampton 2002 p. 19). While Wacker (1998) recognizes that a *good theory* may not be a 'true' theory, we concur but add that it should at least be *effective.* We, therefore, argue that in addition to the goodness of theory, we should be concerned with the effectiveness of theory.

3 Towards the effective design of theory

Having made an argument for effective theory, this section outlines the characteristics of effective theory before advocating a design approach towards building theory.

3.1 Effective theory-building as a wicked problem

As discussed in the previous section the evolution of a big-T theory can instigate a host of outcomes in the form of many small-t theories, whose appropriateness depends on the reactions of individual members of an audience to them. Theory-building is, therefore, essentially a wicked problem (c.f. Rittel and Webber 1973) where there is unlikely to be a single optimal small-t theory equally acceptable to all members of an audience. Table 2 builds from the discourse on wicked problem-solving and in particular on the work of Conklin (2006) to outline the characteristics of small-t theories.

Theories are not simply discovered but must be carefully and methodically designed and subsequently evaluated to ensure their appropriateness for an intended audience. But there is a paucity of advice in the extant literature to guide how small-t theories should be designed. In fact most scholars fail to recognise the role of design in theory-building and they prefer to think of theories as discoveries. Because there is no optimal small-t theory, scholars must instead settle for a satisfactory solution acceptable to the intended audience. Theory-building is, therefore, a design activity driven by the search for an appropriately designed small-t theory that meets the needs of an audience and where the perspective of the scholar must continually shift between the design and the evaluation of the emerging theory.

Table 2: Characteristics of Effective Theory-Building

Characteristic	**Description**
Each small-t theory is essentially unique and novel.	No two theories are equally effective for solving a problem in the eyes of an audience. In addition, a theory that is found to be effective for one audience is unlikely to be equally effective for another audience. The theory required for each new combination of problem and audience may, therefore, need to be new and each theory-building exercise may be unique and novel – meaning that scholars are essentially beginners when faced by a new problem and/or audience.
The small-t theory emerges through building and exposing it to its audience.	Each theory that is built exposes new aspects of the needs of the audience, which in turn can require further adjustments to the theory. Indeed, there is no definitive statement of the needs of the audience but instead its needs emerge through the feedback received when exposing it to the theory.
There is no right or wrong small-t theory and therefore 'no stopping rule' for theory-building.	As there is no definitive statement of the needs of the audience, neither can there be a definitive statement of what constitutes an optimal theory. There is 'no stopping rule' for the theory-building, which instead is more likely to end when either the theory is deemed to be good enough or when the theory-building runs out of resources, such as time or energy. In short there is no optimal theory.
The value of small-t theories must be determined from its audience.	The value of a theory is not objective and cannot be derived from some simple formula. Instead theories are assessed in a social context in which many stakeholders are entitled to judge the theories. These judgements may vary widely depending on the stakeholder's needs, values, and goals. It is, therefore, a matter of creativity to devise potential theories, and a matter of judgement to determine which are appropriate and should be pursued and implemented.

Therefore, when building theories scholars require a sharpened awareness of the factors that have the greatest impact on the effectiveness of those theories. This resonates with Gregor's (2009 p. 1) recent call for theorising 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*". Further she states that these two modes are 'two sides to a coin' and contribute to the development of a holistic knowledge concerning these artefacts. We extend her argument to the area of effective theory-building and we suggest that scholars should perceive small-t theories as design artefacts and that they should strive to understand both the *how* and *what* of their construction. Scholars should come to terms with general questions regarding how theory can be more effectively built but also which features of a theory make it a success or failure in the eyes and ears of our stakeholders. In other words, scholars should build a knowledge base by systematically extracting and abstracting design principles for theory-building from exemplars of what are perceived to be good and bad small-t theories.

As for all design activities, there is likely to be no small element of craft in the designing of small-t theories, but the focus here is on ensuring a scientific approach

that is "… *intellectually tough, analytic, partly formalizable, partly empirical and teachable"* (Simon 1996 p. 113). We therefore argue that we should extend our knowledge of effective theory-building through promoting a *design science of small-t theory-building*.

3.2 The science in designing theory[1]

Design is the process through which *"… we make and we test, and, where necessary, we modify. We are always present, as active agents. What we do is circular because that is the way we do it"* (Glanville 1999 p. 87). At every step and in every action, the scholar should be actively designing theory to be effective for an audience - in terms of both its utility and its communication. The resulting theory is evaluated to ensure it is effective in both its content and presentation for the given audience. The perspective of the scholar must, therefore, continually shift between the design and the evaluation of the emerging theory – so much so that the audience is to all intents and purposes a fundamental part of the theory-building process. This paper proposes a design approach that builds on design research[2], which is an approach that is increasingly accepted within the scientific community. While the natural science paradigm seeks to find what is true, the design research paradigm seeks to create what is effective (Hevner et al. 2004). Natural science is essentially a *"problem understanding paradigm"* and design science is a *"problem solving paradigm"* (Niehaves 2007). Rather than being in conflict with each other, both activities are complementary and they are encompassed under a broad notion of science (Simon 1996). For example, inquiry into the design process is informed by knowledge of the laws of natural science (in the form of kernel theories), both for an artefact's internal operations and its interactions with the external environment (Gregor and Jones 2007). Natural and design sciences are, therefore, essentially two sides of the one coin.

Design research encompasses elements of both *design practice* and *design science*. Design practice and design science are both problem solving activities whose differences lie in their contributions to the body of design knowledge. The prime focus of design practice is *artefact construction* through applying existing knowledge, while design science aims at *knowledge generation* through artefact construction (Niehaves 2007). The knowledge derived from both differ significantly in that the abstract design knowledge (generated intentionally from design science) is knowledge that is applicable to a wide class of situations and audiences, whereas the situational design knowledge (generated as a side-effect of design practice) is knowledge specific to a particular situation and audience (Goldkuhl and Lind 2010). But at the same time the two types of knowledge are intrinsically linked in that design science focuses on producing abstract design knowledge through either constructing new artefacts or observing already constructed artefacts, while on the other hand design practice focuses on using this abstract design knowledge to construct solutions to situated problems (*ibid*).

This means that design practice can be seen as an exploratory empirical part of design research, while design science is the theoretical part of design research. In other words design science receives its empirical grounding from observing design

[1] From this point forward when we use the word 'theory' we are, unless otherwise stated, referring to small-t theory

[2] The next section distinguishes between design research, design science, and design practice

practice, while at the same time design practice receives it theoretical grounding from design science explanations (Goldkuhl and Lind 2010). But for design research to be accepted as scientific it must generate abstract design knowledge that makes contributions to the academic knowledge base in the form of *design theories* (Walls et al. 1992). Design theories give explicit prescriptions on *how* to design an artefact and in addition, they draw on *kernel theories* in order to explain *why* a design should work (*ibid*). Iivari (2007 p. 49) considers "*… the existence of a kernel theory to be a defining characteristic of a 'design theory' … [and] without a sound kernel theory it is not justified to speak about 'design theory'*". However, recognising design theories as scientific remains contentious with some believing the word '*theory*' to be the reserve of the more traditional natural and human sciences. While acknowledging this divergence of views, Gregor (2006) adopts a broader perspective on what constitutes theory and argues that design research can, at least in some cases, contribute to a class of theory dealing with '*design and action*'.

3.2.1 A design theory for theory-building

The artefacts resulting from design research may include constructs, models, methods, and instantiations (March and Smith 1995). But can the instantiation be a theory – in other words can we have a design theory where the artefact under construction is also a theory? Peffers et al. (2007 p. 49) suggest that design research "*… involves a rigorous process to design artifacts to solve observed problems, to make research contributions, to evaluate the designs, and to communicate the results to appropriate audiences*" and that instantiations can be "*… any designed object with an embedded solution to an understood research problem*". Other leading authorities such as March and Smith (1995), Hevner et al. (2004), and Gregor and Jones (2007) offer similar definitions. If it is accepted that small-t theories are designed objects whose purpose it is to communicate the intricacies of a phenomenon to an audience, it would, therefore, seem beyond question that a small-t theory can indeed be an artefact in the design research sense of the word.

Figure 2 illustrates the relationships between the key components that result from using a design research approach to build small-t theories. The research problem definition and the small-t theory co-evolve cyclically, whereby the emerging small-t theory informs an understanding of the problem and the needs of the audience; the increasing understanding of the problem and the audience in turn informs the small-t theory. The audience is the source of the research problem definition but the small-t theory is built by academic scholars to address the problem for the given audience. The small-t theory receives it theoretical grounding from the kernel theories from the knowledge base. The kernel theories may be either academic theories or practitioner theories-in-use (Sarker and Lee 2002). Examples might include theories from cognitive science about how physical artefacts should be designed to optimise their use by humans. At the same time the kernel theories receive their empirical grounding from the small-t theories and their effectiveness in addressing the research problem for the given audience. The emerging knowledge regarding the design of the small-t theory is guided by and guides the design theory. The design theory explains to the academic community how small-t theories should be built for optimal impact on the audience while addressing the problem.

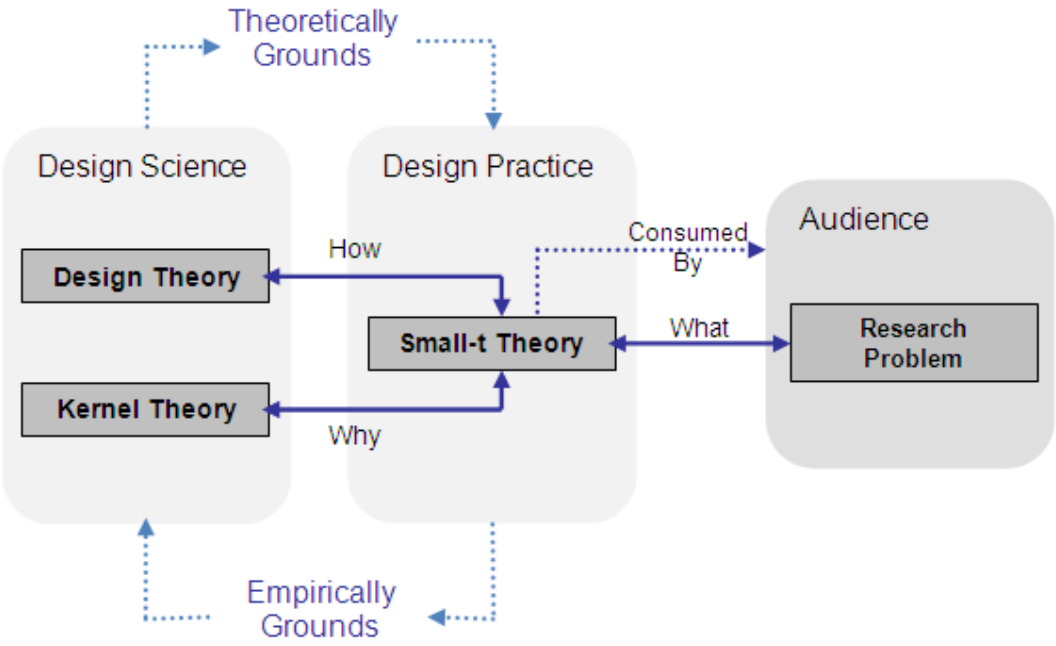

Figure 2: Design Approach to Building Small-t Theories

4 Concluding remark

In summary, *effective theory* is concerned with closing the disconnection between the theory being constructed and the needs of our stakeholders[3]. Scientific theories tend to be general solutions to general problems, whereas the needs of an audience tend towards specific solutions to specific problems. Therefore, e*ffective theory* is concerned with providing theories that meet the specific needs of an audience in terms of both its content and presentation, while at the same time supporting the simultaneous progression of science as a body of abstract knowledge. Effective theory-building instigates a host of potential outcomes and where the appropriateness of each depends on the perspectives of many stakeholders – both internal and external. There is unlikely to be an ideal theory acceptable equally to all stakeholders - instead we aim for a satisfactory theory. We call on scholars to scientifically inquire into the process by which effective theories can be designed. Thus we are calling for a design science of effective theory-building.

In presenting our philosophical position, we believe we provide a firm grounding for our calls to focus more of our collective attention on effective theory-building. 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-building* has not been pursued in the extant literature. 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 the "… *systemization of knowl-*

[3] We recognize that the audience for scientific theory can be both internal and external stakeholders and we make no attempt to prioritise one over the other as *both* are critical to the scientific endeavour.

edge 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 need of the knowledge base that would result from such an initiative. We see no obvious ontological or epistemological issues blocking such an approach but we leave it up to the reader to judge the value in our call for action.

References

Bacharach, S. B. 1989. "Organizational Theories: Some Criteria for Evaluation." Academy of Management Review 14(4):496–515.

Bakshi, S. and S. Krishna. 2007. "Crisis in the Information Systems Discipline: A Reflection." In 18th Australasian Conference on Information Systems. Toowoomba, Australia.

Bartunek, J. M. 2007. "Academic-Practitioner Collaboration Need Not Require Joint or Relevant Research: Toward a Relational Scholarship of Integration." Academy of management journal 50(6):1323-1333.

Burton-Jones, A., E. R. McLean and E. Monod. 2004. "In Pursuit of MIS Theories: Process, Variance, and Systems." Working Paper, Department of Computer Information Systems, Georgia State University.

Conklin, J. 2006. "Wicked Problems and Social Complexity." CogNexus Institute. Available at: http://cognexus.org/wpf/wickedproblems.pdf.

Cook, T. D. and D. T. Campbell. 1979. Quasi-Experimentation: Design and Analysis Issues for Field Studies. Boston, MA., USA: Houghton Mifflin.

Crampton, J. 2002. "Thinking Philosophically in Cartography: Towards a Critical Politics of Mapping." Cartographic Perspectives 42:12-31.

Glanville, R. 1999. "Researching design and designing research." Design issues 15(2):80-91.

Goldkuhl, G. and M. Lind. 2010. "A Multi-Grounded Design Research Process." In The 5th International Conference Ion Design Science Research in Information Systems and Technology (DESRIST) eds. R. Winter, J.L. Zhao and S. Aier. St.Gallen, Switzerland: Berlin: Springer.

Gregor, S. 2002a. "Design Theory in Information Systems." Australian Journal of Information Systems 10:14–22.

Gregor, S. 2002b. "A Theory of Theories in Information Systems." In Information Systems Foundations: Building the Theoretical Base, eds. S. Gregor and D. Hart. Canberra, Australia: Australian National University.

Gregor, S. 2006. "The Nature of Theory in Information Systems." Mis Quarterly 30(3):611-642.

Gregor, S. 2009. "Building Theory in the Sciences of the Artificial." In The 4th International Conference on Design Science Research in Information Systems and Technology (DESRIST). Malvern, PA, USA: ACM.

Gregor, S. and D. Jones. 2007. "The Anatomy of a Design Theory." Journal of the Association for Information Systems 8(5):312–335.

Guba, E. G. and Y. S. Lincoln. 1994. "Competing Paradigms in Qualitative Research." In Handbook of qualitative research, eds. K. Denzin and Y. S. Lincoln. London, UK: Sage.

Hanson, N. R. 1958. Patterns of Discovery: An Inquiry into the Conceptual Foundations of Science. Cambridge, UK.: Cambridge University Press.

Hevner, A. R., S. T. March, J. Park and S. Ram. 2004. "Design Science in Information Systems Research." Mis Quarterly 28(1):75-105.

Iivari, J. 2007. "A Paradigmatic Analysis of Information Systems As a Design Science." Scandinavian Journal of Information Systems 19(2):39-64.

Klimoski, R. 1991. "Theory Presentation in Human Resource Management." Human Resource Management Review 1(4):253–271.

Lynham, S. A. 2000. "Theory Building in the Human Resource Development Profession." Human Resource Development Quarterly 11(2):159–178

Magee, B. 1973. Popper London, UK: Fontana Press.

Mahoney, J. T. and R. Sanchez. 2004. "Building New Management Theory by Integrating Processes and Products of Thought." Journal of Management Inquiry 13(1):34-47.

March, S. T. and G. F. Smith. 1995. "Design and Natural Science Research on Information Technology." Decision Support Systems 15(4):251-266.

Markus, M. L. and D. Robey. 1988. "Information Technology and Organizational Change: Causal Structure in Theory and Research." Management Science 34(5):583–598.

Metcalfe, M. 2004. "Theory: Seeking a Plain English Explanation." Journal of Information Technology Theory and Applications 6(2):13-21

Niehaves, B. 2007. "On Epistemological Diversity in Design Science: New Vistas for a Design-Oriented IS Research?" In The 28th International Conference on Information Systems (ICIS). Montreal, Canada

O'Raghallaigh, P., D. Sammon and C. Murphy. 2010. "Map-Making and Theory-Building: Principles for Achieving Presentation and Content Effectiveness." In International Conference on Information Systems (ICIS) Saint Louis, MI., USA.

Peffers, K., T. Tuunanen, M. A. Rothenberger and S. Chatterjee. 2007. "A Design Science Research Methodology for Information Systems Research." Journal of Management Information Systems 24(3):45-77.

Popper, K. 1959. The Logic of Scientific Discovery. New York, NY., USA: Basic Books.

Popper, K. 1965. "Three Views Concerning Human nowledge." In Conjectures and Refutations: The Growth of Scientific Knowledge, ed. K. Popper. London, UK: Routledge.

Popper, K. 1978. "Three Worlds." The Tanner lectures on human values:143-167.

Popper, K. R. 1962. Conjectures and Refutations: The Growth of Scientific Knowledge. New York, NY., USA: Basic Books.

Quine, W. V. and J. S. Ullian. 1980. "Hypothesis." In In: Klempe, E.D., Hollinger, R., David Kline, A. Eds.., Introductory Readings in the Philosophy of Science.: Prometheus Books, Buffalo, New York.

Rittel, H. W. J. and M. M. Webber. 1973. "Dilemmas in a General Theory of Planning." Policy sciences 4(2):155-169.

Sarker, S. and A. S. Lee. 2002. "Using a Positivist Case Research Methodology to Test Three Competing Theories-in-Use of Business Process Redesign." Journal of the Association for Information Systems 2(1):7.

Schilpp, P. A. 1974. The Philosophy of Karl Popper. La Salle, IL., USA: Open Court Publishing Company.

Shapiro, D. L., B. L. Kirkman and H. G. Courtney. 2007. "Perceived Causes and Solutions of the Translation Problem in Management Research." Academy of management journal 50(2):249–266

Simon, H. A. 1967. "The Business School a Problem in Organizational Design." Journal of Management Studies 4(1):1–16.

Simon, H. A. 1996. The Sciences of the Artificial. Cambridge, MA., USA: MIT Press Books.

TenHouten, W. D. and C. D. Kaplan. 1973. Science and its Mirror Image: A Theory of Inquiry. New York., NY., USA: Harper and Row.

Wacker, J. G. 1998. "A Definition of Theory: Research Guidelines for Different Theory-Building Research Methods in Operations Management." Journal of Operations Management 16(4):361–385

Walls, J. G., G. R. Widmeyer and O. A. El Sawy. 1992. "Building an Information System Design Theory for Vigilant EIS." Information Systems Research 3(1):36-59.

Weick, K. E. 1989. "Theory Construction as Disciplined Imagination." Academy of Management Review 14(4):516–531.

Weick, K. E. 1999. "Conclusion: Theory Construction as Disciplined Reflexivity: Tradeoffs in the 90s." Academy of Management Review 24(4):797–806.

Weick, K. E. 2005. "The Experience of Theorizing: Sensemaking as a Topic and Resource." In Great Minds in Management: The Process of Theory Development, eds. K. G. Smith and M. A. Hitt. Oxford, UK.: Oxford University Press.

About the Authors

Paidi O'Raghallaigh is a researcher in BIS at UCC, Ireland. Paidi holds a PhD from UCC. His current research interests include systems of innovation and theory-building. He has over 15 years of experience as an Information Systems (IS) consultant and trainer.

David Sammon is a researcher in BIS at UCC, Ireland. David holds a PhD from UCC. His current research interests include conceptual data modelling, collective mindfulness, sense-making, and IS implementation. He is an Associate Editor of the Journal of Decision Systems.

Ciaran Murphy is Professor of BIS at UCC, Ireland. His current research interests include decision support systems, knowledge management, the role of information in organisations, and services innovation. He is the founder of the Financial Services Innovation Centre (FSIC) at UCC.