



Entrepreneurship at the interface of design and science: Toward an inclusive framework[☆]

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A B S T R A C T

Entrepreneurship scholars are increasingly interested in conducting work at the interface of design and science. However, a consistent methodological framework for this type of work is missing. In this paper, we therefore develop such a framework. First, three examples of entrepreneurship scholarship at the design-science interface are outlined. From these examples, we infer two key characteristics of design science (DS). For one, research outputs not only include theoretical constructs and models, but also values, principles and practices. In addition, creative design and scientific validation are complementary and equivalent research activities in DS. Whereas design and validation are legitimate research approaches in their own right, we conclude that the interaction between the two can drive the continual renewal of the entrepreneurship field and unlock the potential of an inclusive body of knowledge that is both rigorous and relevant.

1. Introduction

Scholarship in the field of entrepreneurship and management has long been characterized by an intellectual stasis, resulting in a limited capacity to inform practice (Davidsson, 2002; Hughes et al., 2011; Khurana and Spender, 2012). This intellectual stasis also explains why the field of entrepreneurship is rather fragmented (cf. Shane, 2012; Venkataraman et al., 2012) and why academic and experiential knowledge on entrepreneurship are, at best, loosely connected (Romme, 2016).

Therefore, entrepreneurship scholars are increasingly becoming interested in doing work at the interface of design and science (e.g. Berglund et al., 2018; Dimov, 2016; Osterwalder, 2004; Sarasvathy et al., 2008). In *The Sciences of the Artificial*, Simon (1969) identified two properties of key phenomena studied by scholars in fields like business, education and architecture: human intentionality and environmental contingency. Simon argued that these two properties make an exclusively 'scientific' approach inadequate for studying these phenomena. Evidently, human intentionality and environmental contingency are at the heart of entrepreneurship practice and scholarship. Entrepreneurial artifacts such as value propositions and business models are inextricably linked to the entrepreneurial intentions driving them, and moreover, cannot be decoupled from the environmental settings in which they were created and the environmental conditions expected in the future. Furthermore, entrepreneurship scholarship also arises from personal intentions and academic values that inform and frame how, for example, one collects and interprets data, interacts with entrepreneurs and entrepreneurship students, and responds to unexpected events and setbacks in academic life. As such, the

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properties of human intentionality and environmental contingency imply that entrepreneurship research is a science of the artificial, that is, it involves both creative design and scientific validation.

More recently, Simon's initial set of ideas were re-introduced in the discourse on the purpose and nature of management and entrepreneurship studies (e.g. Hatchuel, 2001; Romme, 2003; Sarasvathy, 2003; Sarasvathy and Venkataraman, 2011), which in turn may serve to develop a more inclusive 'design science' perspective on the field of entrepreneurship, also inspired by similar perspectives in adjacent fields (e.g. March and Smith, 1995). However, a consistent methodological framework for entrepreneurship research as design science is still missing (cf. Dimov, 2016; Sarasvathy, 2003; Venkataraman et al., 2012). In this paper, we intend to develop such a framework. This design science (DS) framework explicitly acknowledges the key contributions of scientific or design work in their own right, but also calls for scholarship at the interface between science and design.

As such, entrepreneurial phenomena lend themselves to a scientific as well as a design approach. Their processes unfold over time and one inevitably has to choose a time reference point (e.g. now, or somewhere in the past) in studying them (McMullen and Dimov, 2013). This reference point creates an arbitrary separation between what has already happened and what is yet to happen, both of which can serve as objects of research. A specific outcome, such as (a failed effort in) a new venture, can be described and explained retrospectively, as an object of science (cf. March and Smith, 1995). By contrast, the open-ended prospective process that lies ahead offers few dimensions that can be taken for granted. Thus, most scholars with social science backgrounds are only interested in the acting entrepreneur when patterns and/or outcomes have surfaced which can become the object of description and explanation. Here, a DS perspective can help connect retrospective and prospective approaches.

An inclusive classification of key notions and terms is an essential prerequisite for developing this perspective. Without an inclusive taxonomy, a more comprehensive understanding of the entrepreneurship (research) landscape cannot be developed. This paper involves an attempt to create such a framework, in order to facilitate collaboration and dialogue between entrepreneurship scholars across existing paradigmatic boundaries as well as, in the longer run, prospectively enable entrepreneurs and their stakeholders to effectively address their most pertinent challenges.

The argument is organized as follows. First, we explore three examples of DS research in the entrepreneurship domain. These examples set the stage for developing a comprehensive framework of how, why and when various research outputs are created, assessed, theorized and justified in DS. Finally, we discuss how this framework may serve to better connect theory and practice by systemically connecting rigor and relevance.

2. Examples of work at the design-science interface

This section serves to outline several examples of entrepreneurship research at the interface between science and design. In particular, we refer to DS scholarship in the area of business modeling, entrepreneurial effectuation, and university spinoffs.

2.1. Business modeling

A prominent example of DS is Osterwalder and Pigneur's (2010) *business model canvas*, arising from Osterwalder (2004) doctoral work. Informed by the DS framework developed by March and Smith (1995) for the field of information systems, Osterwalder (2004) explored how business models can be described and represented, to create a foundation for subsequent tool development. He conducted interviews with entrepreneurs, investors and other experts, which revealed that "business models were perceived as a tool to create a commonly understood language to improve communication and understanding of the fundamental questions of a business" (Osterwalder, 2004, p. 159). Thus, a more rigid conceptual approach to business models appeared to be necessary. Osterwalder therefore systematically reviewed and synthesized the literature to develop a so-called 'business model ontology' involving four key dimensions (e.g. product, customer interface) and nine key constructs (e.g. value proposition, target customer, distribution channel) and their relationships. Osterwalder implemented this initial framework in a computer-based tool, and tested the resulting prototype in a case study.

After completing his doctoral dissertation, Osterwalder set out to further develop the business modeling framework, via prototyping processes that involved the active contributions of more than 450 practitioners, resulting in the 'business model canvas' (Osterwalder and Pigneur, 2010). This large-scale effort to co-create and iteratively develop prototypes of the canvas provides a good example of how academic knowledge on entrepreneurship is successfully developed into practical tools.

2.2. Effectuation

Another interesting example of design science work in the entrepreneurship field is Sarasvathy's (2001; 2003) work on *effectuation*. In her doctoral thesis, Sarasvathy raised hypothetical scenarios to 27 successful entrepreneurs, by asking them to 'think aloud' about how they would approach a particular start-up proposition. From these data, she then (off-line) extracted design principles for entrepreneurial effectuation: for example, the 'bird in hand' and 'affordable loss' principles (Sarasvathy, 2001). These design principles have been informing the redesign and transformation of entrepreneurship education and training programs at many schools and universities throughout the world (e.g. Honig, 2004; Read et al., 2010). The original empirical work of Sarasvathy has also been extended toward knowledge and tools for novice managers and executives (Read et al., 2009). Other studies have focused on the performance consequences of the set of effectuation principles (e.g. Fischer and Reuber, 2011) and connecting the effectuation principles to other theoretical frameworks regarding opportunity, action, cognition, finance, operations, and strategy (e.g. Read and Dolmans, 2012; Sarasvathy et al., 2008).

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