

# The Creative Process in Design Science Research: Identifying Patterns of Creativity

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## Abstract

Design science research (DSR) generates new knowledge in the processes of design, build, evaluation, and implementation for innovative IS artifacts. Recent literature describes the processes to be followed to conduct rigorous and relevant research in DSR projects. In this research in progress paper we posit that underlying all DSR processes there exists a fundamental creative process that is required for the IS artifact to be truly innovative. We argue that this process and the creative activities involved can and should be made explicit in the DSR process. We use example cases from two creative individuals from the fields of architecture and art who prospectively documented their creative process in the creation of innovative artifacts to understand how DSR researchers might more effectively identify and document their creative process and activities.

**Keywords:** Creative process, creative activities, design science research, action design research, innovative IS artifacts

## 1 Introduction and Motivation

The motivation for the research builds upon a series of articles by Hevner et al (2004), Peffers et al (2007), Sein et al (2011), and Mullarkey & Hevner (2015) that describe the design science process for diagnosing, designing, building, implementing, and evolving innovative IS artifacts. The later three articles, in particular, focus on the process of and frameworks for the conduct of DSR. Mullarkey & Hevner (2015), for example, provide a comprehensive approach to the iterative, emergent, evaluative, action design research (ADR) process with multiple points of entry and iteration.

In addition to these articles on processes and frameworks for the conduct of DSR, the literature is blessed with more and more articles that describe actual artifacts and the practice-inspired, research-ingrained projects that created the artifacts. In an analysis of twelve well documented published articles on ADR (or ADR-like) projects, the authors are able to elaborate on the IT solution class, the problem class, the intervention domain, and the artifact under construction and evaluation. (Mullarkey & Hevner, 2015) Each of these articles reviewed described an IS artifact or application of an artifact as a key contribution of the ADR. In each article, the authors describe the process followed to build and evaluate the artifact. In only two articles did the authors describe their means of evaluating how they knew the artifact was innovative. And, in none of

these ADR examples did we find a scholarly description of the nature and application of a creative process to inform research and practice of the “art” of designing the IS artifacts involved.

This lack of description of the creative process is not unique to the IS discipline. Across many disciplines, researchers find that the definition of a creative process is elusive. In a seminal analysis of creative development, Feinstein (2006) found, in large part, the challenge is that actors engaged in the creative process rarely document their approach. In his comprehensive investigation of thirty-one historically significant individuals (from Paul Cezanne to Ray Kroc to Virginia Woolf to Charles Darwin) having made “outstanding creative contributions,” he found that the most interesting source material came when actors prospectively produced materials at the time of artifact creation that gave insight to their “pattern of creative development.” This contemporaneously produced work that documents the creative process at the time of creation is the hardest to find but offers the clearest depiction of the creative process at work.

In DSR, artifacts include models, methods, constructs, design principles, features, and instantiations of software, hardware, and information systems. To be innovative, IS artifacts must possess a creative component. This creative component can either be an entirely new artifact or an entirely new way of applying an existing artifact. The IS artifact is always something “man-made” and, thus, is a creation of the artificial (versus natural) science. (Simon, 1996) Consequently, we suggest that DSR researchers should emphasize and work to rigorously describe the creative process at play in the creation of innovative artifacts that are then built, evaluated, implemented and evolved in the conduct of DSR. Doing so can aid the DSR researcher in their evaluation of the nature of the innovation in the subsequently produced artifact and may provide a roadmap to the creative process others may use when faced with a similar challenge in a DSR project.

The subsequent sections of this research in progress article discuss our understanding of the creative process and its application to DSR, explores two prospective, first-hand examples of patterns of creative development, and uses these case examples to suggest a method by which the DSR researcher and the DSR community might divine and document the creative process at work in their DSR. Finally, we argue that DSR benefits when the creative process is made explicit

## 2 Creativity

According to Burkus (2014, p. 15), “creativity is the starting point for all innovation” where creativity is defined as “the process of developing ideas that are both novel and useful” (Amabile 1996). We expect the role of human creativity to be especially salient in the DSR, where novel ideas are needed for an innovation process to begin. Creativity in the design process is informed by Amabile’s componential theory of creativity. Amabile (1983; 2012) posits that four components are necessary for a creative response:

- *Domain-relevant skills* include intelligence, expertise, knowledge, technical skills, and talent in the particular domain in which the innovator is working;
- *Creativity-relevant processes* include personality and cognitive characteristics that lend themselves to taking new perspectives on problems, such as independence, risk taking, self-discipline in generating ideas, and a tolerance for ambiguity.

- *Intrinsic task motivation* is seen as a central tenet. “People are most creative when they feel motivated primarily by the interest, enjoyment, satisfaction and challenge of the work itself – and not by extrinsic motivators.” (p. 3).
- *The social environment*, the only external component, addresses the working conditions that support creative activity. Negative organizational settings harshly criticize new ideas, emphasize political problems, stress the status quo, impose excessive time pressures, and support low-risk attitudes of top management. While positive organizational settings stimulate creativity with clear and compelling management visions, work teams with diverse skills working collaboratively, freedom to investigate ideas, and mechanisms for developing new ideas and norms of sharing ideas.

It is important to note that Amabile’s work is based on two important assumptions. First, there is a continuum from relatively low, everyday levels of adaptive creativity to the higher levels of creativity found in significant inventions and scientific discoveries. Second, there are degrees of creativity exhibited in the work of any single individual at different points of time and circumstances (Amabile 2012).

Further relevant insights on creativity can be drawn from the early work of Mednick (1962) who contributed the idea of ‘associative thinking.’ He states that creative thinking is simply “the forming of associative elements into new combinations which either meet specific requirements or are in some way useful” (p. 224). The more connections you can make to previous ideas in your mind, the more creative you are. Mednick’s work is supported by investigations into the composition of the brain by Takeuchi et al (2010a) who show using MRI methods that the physical structure of the human brain differs with levels of creativity – more creative individuals have more “white matter”, the connective tissue that transfers electrical signals between the areas of “gray matter” that house knowledge. Further experiments by Takeuchi et al (2010b) demonstrate that training can increase the white matter connections in the brain.

In conclusion, the creative perspective provides important insights on creative processes and interpersonal characteristics that ground the differences in the activity elements that are anticipated with design science research.

### 3 The Creative Process in DSR

Understanding and documenting creativity in the design process can be a difficult and elusive act. Feinstein (2006, p.31) finds: “the most widely described form of creativity is making a connection between or combining two elements that have not previously been connected or combined.”

Two important paradigms of creativity exist. The first, considers all creativity to be the consequence of random variation and selective attention where the creative individual “happens” upon the creative artifact. Feinstein argues that evidence from creative individuals themselves would suggest a second paradigm at play where creative individuals are “significantly more directed” in their creative process. He finds that they “guide themselves by forming creative interests, distinctive to them, defining distinctive, individualized domains they explore, leading them to build up distinctive conceptual structures in their interest domains which are in turn generative of their creativity.” (Feinstein, 2006, p, 32) At times in the creative process he suggests that seemingly random connections are made by the individual, as indicated in the first paradigm,

but that inevitably these occur because of how the individual has explicitly situated themselves in the domain and because of their creative process as they explore that domain.

We argue that this approach to understanding creativity can inform the DSR researcher as they take a pragmatic, practice-inspired approach to the design, build and evaluation of innovative artifacts. Consider the following points:

- We propose that the creation of innovative artifacts is a directed activity, consciously pursued by individuals and teams attempting to solve real problems.
- This approach recognizes the “art” in the IS artifact creation process in line with Simon’s (1996, p. 4) proposition that DSR is a human-made (as opposed to a natural science) process worthy of consideration and understanding.
- There is no one right creative process. In fact, the value is in explicitly highlighting the potentially unlimited number of creative activities at work as we conduct DSR. Different types of artifacts might necessarily rely on different creative processes. Different individuals and teams in different problem and different solution domains might utilize completely different creative processes. And, even individuals within the same domain are likely to pursue different creative processes as they generate innovative artifacts that might be designed to solve the same or similar problems.
- To the extent that IS researchers prospectively document their creative activities and patterns of creative development as a conscious act in their iterative design, build and evaluation of artifacts they will be able to inform themselves and the IS community of creative processes that lead to innovative artifacts.

The challenge for any DSR researcher is to thoughtfully identify the creative acts and the patterns of creative acts that occur in each iteration of the design, build, evaluation, implementation and evolution of any innovative artifact. As we analyzed the existing IS literature with exemplars of innovative artifacts we found it difficult to retrospectively identify and describe after the fact the creative process at work. (Mullarkey & Hevner 2015)

Feinstein (2006) argues that the ideal scenario for understanding an individual’s creative process is a situation where the individual is “compelled” to document the creative act, in situ, concurrently with the creation of the artifact. Nor should this be a one-time effort because, over time, patterns of creative development also occur that can be discussed as a part of the creative process.

Within a DSR project, the IS researcher is similarly compelled to document iterative cycles of artifact design, build, and evaluation where each iteration adds to the body of knowledge and influences the next evolution of that artifact or the creation of an entirely new artifact. If we can introduce a discipline into the iterative DSR cycles and between stages in the DSR process that identifies and records the activities in the creative process, then we are poised to add rigor and added relevance to the creation of innovative artifacts.

Importantly, we are not suggesting a “framework” for creative development or a new “method” for a creative process. Rather, we suggest that documenting the creative development that does occur, as it occurs, will inform researchers on the innovativeness and means of evaluation of innovative artifacts in DSR. Notably, patterns and processes of creative development may emerge that could generalize from one to many artifact designs or applications. Thus, our goal in this article is to share a means by which DSR

researchers can and should make explicit in their research the creative process at work as they generate innovative artifacts. We look to investigate,

1. The ways that the explicit discussion of the creative act in the planning for and design of each artifact influences the level of innovation in the artifact;
2. The ways that understanding the creative act is essential to the evaluation of the built artifact; and
3. The ways that the patterns of creative development can become manifest over multiple iterations of the ADR cycles and throughout the DSR process as artifacts evolve and are manifested.

In order to study these research questions, we looked for primary evidence of the creative process in actual innovative artifact creation examples. Lacking prospective evidence in the existing IS literature of creative processes, we identified two unique cases of prospective first-person recorded creative processes of two individuals with recognized outstanding contributions to the creation of innovative artifacts – architect Yann Weymouth and printmaker/artist Theo Wujcik.

## 4 An Initial Study of Creative Processes

This research initiative takes an action research (AR) approach to investigate in situ two cases of internationally recognized, creative individuals. Both cases involve decorated artists who were personally compelled to document their work involving the creation and manifestation of innovative artifacts.

The goal of this research effort is to contrast and compare the documented creative approaches of these two “artifact builders” to inform IS design science researchers on ways to make the creative process explicit in their projects. The contribution is in the discussion of these exemplars based upon their first-person, in situ, prospective documentation of their creative processes. We suggest that these cases will inform DSR researchers on how to conduct and communicate the creative process for future impact and dissemination.

Both case studies are just beginning at their initial curation of previously unpublished works. These cases are being explored using a robust action research process<sup>1</sup> (IRB authorization in place). We follow Feinstein’s (2006) approach to the extrapolation of creative interests, acts, processes and patterns that motivate the means to incorporate an explicit prospective discussion of the creative process in any to DSR project.

### 4.1 Weymouth to I.M. Pei

The first protagonist is Yann Weymouth who, among other notable achievements, is the architect of the Dali Museum in St. Petersburg, FL, USA. (<http://thedali.org/>) Mr. Weymouth is a graduate of MIT and Harvard and was notably the Project Manager for I.M. Pei’s Pyramid design for the entrance to the Louvre. Mr. Weymouth’s notebooks that document his creative process spanning a career of some fifty years are housed and displayed in the library at Harvard. The exception to which we have access are his still private notebooks on the process for the creation, design and construction of the award winning Dali Museum. Weymouth has shared these notebooks and an initial interview

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<sup>1</sup> IRB Letter 10017\_CR3\_1.25.16(0.01)

with the authors in preparation for the conduct of the research in question. His notebooks are of particular interest to Harvard and to this research because they have been shown to explicitly document both the scientific process and the artistic process he uses in the creative development and realization of his artifacts. And, his innovative artifacts include concepts, designs, models, and instantiations.

#### 4.2 Wujcik to Rosenquist

The second protagonist is Theo Wujcik (1936-2014). (<http://www.theowujcik.com/>) Theo was an internationally acclaimed printer and artist who started his career as a Tamarind Institute Master Printer to the avant-garde artists of New York and LA in the 1960s including James Rosenquist who became a personal friend. These artists valued Wujcik's printmaking in large part because of his documentation of his process used to produce every print proof. Wujcik became an artist in his own right in the 1970s and invented techniques in "chain link motifs" portraiture, printed plate chiseling, "modo dodo" found art, and polymer emulsion charcoal that are exceptional. Wujcik was trained as a master print maker to document his entire creative process for each work of art and provided a record curated by his partner Susan Johnson that describes a number of creative processes and patterns of creative development as he created the artifacts of his inventive breakthroughs. Through initial interviews, Wujcik's widow has also made his notebooks and original works of art available for the authors.

#### 4.3 Case Study Research Design

Our evaluation of the cases will take a within and between case approach to gain insights into the similarities and differences of the respective creative processes and the evolution of their patterns of creative development. We find these two individuals compelling surrogates for the DSR researcher because,

1. Each dedicated better than thirty years of their careers to the design, build, and evaluation of innovative artifacts;
2. Each exhibited patterns of creative development over time;
3. Their creative processes provide both similarities and differences;
4. Their artifacts inevitably incorporate multiple disciplines in an interdisciplinary approach;
5. Their creative processes evolved over time; and
6. They were both meticulously disciplined in the prospective documentation of their creative processes at the time of artifact creation.

### 5 Anticipated Findings and Contributions

Logically while every DSR effort may be capable of being creative and making creative contributions there is no guarantee that each iteration of a creative process will generate contributions that are valued outcomes or truly innovative IS artifacts. We pursue this line of investigation in order to inform DSR researchers and practitioners of the value and practice of creative processes to improve the probability of a DSR effort leading to one or more innovative artifacts valued by others.

In the DSR paradigm, innovative artifacts solve problems. Understanding how they solve those problems is a meaningful contribution of DSR. Using the example cases we anticipate the development of a prospective approach that encourages IS practitioners and researchers to make creative activities explicit and infuse the creative process

in IS artifact creation in ways that improve the probability of the development of innovative artifact. We anticipate that understanding the way the individuals or teams use a creative process to get to the “how” will inform researchers and practitioners alike in their quest for more innovative artifacts.

Consequently, we suggest that this study will provide evidence that DSR researchers can and should emphasize and work to rigorously describe the creative process at play in the creation of innovative artifacts. These cases can provide additional evidence that prospective documentation of the creative process can also aid the DSR researcher in the evaluation of the nature of the innovation in the subsequently produced artifact. We anticipate the identification of and need for DSR researchers to communicate a “creative domain” in any IS solution domain that purports to lead to innovative artifacts. We anticipate that the creative domain will communicate the elements of the creative process that lead to the guided emergence of the innovative artifact(s) generated in that IS DSR process. And, given that communicating the creative process at work may provide a roadmap that others may use when faced with a similar challenge in a DSR project, we anticipate this study culminating in an approach for prospective, explicit description of the creative process in DSR.

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