

Industrial Design and Innovation Theory

A Basis for Describing the Experience of Innovation

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Abstract

Much of the current literature on innovation tends to cover methods of generating new ideas or the listing of the steps required to develop and implement new product or service ideas. This paper seeks to examine a more general experience of innovation beginning with a simple definition of the term itself. The idea at the heart of an innovation is then be examined using Scruton's description of the aesthetic experience of architecture as a model. With this, distinct elements of the idea event can be identified. Insights drawn from innovation and creativity literature can then be seen to illustrate the way these elements of the idea experience are manipulated. Ultimately the new idea must be introduced and the process of industrial design provides an insightful model for exploring this experience of introducing new ideas to achieve innovation.

Biography

Barry Wylant is an Assistant Professor in the Industrial Design Program, the Faculty of Environmental Design at the University of Calgary in the province of Alberta, Canada. He holds an MEdes in Industrial Design from the University of Calgary and a BES in Architecture from the University of Manitoba. Although in the first year of his position at the U of C, he has ten years of professional product design experience working on several projects in a variety of product areas including infant care, universal access, medical products, electronics and sports products.

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Introduction

Much of the current literature regarding innovation tends to cover either methods of generating new ideas or identifying the steps required to develop and implement new ideas. However there seems to be little discussion of what actually occurs as an idea happens and is then developed. What is the exact nature of the event where an idea occurs? What is the nature of manipulation that happens as this idea is developed? Are there universal aspects to the creation and development of ideas? A clear description of the experience of innovation would aid in grounding the procedural investigations pursued by many writers on this topic.

The activity of industrial design provides a unique reference point for a discussion on innovation. Industrial designers are often charged with the task of creating innovative solutions in the design of new products. They must learn of and resolve many issues that will have a strong impact on a proposed new product. Such issues are raised by various stakeholders in the development process, many of whom come from disparate backgrounds complete with differing and often competing points of views. As industrial designers must eventually arrive at a solution in this, the process of industrial design can serve as an excellent model for an examination of the experience of innovation.

Initiating such a discussion though first requires a definition for the term innovation and this can be simply defined as “the act of introducing something new.” (*Canadian Dictionary*, 1998, p.702). There are various other definitions available however most of these try to introduce some level of qualification such as *the introduction of a new product or service to generate profitable economic activity*. The use of a qualifier in this instance represents an effort to assign value to the notion of innovation. The qualifier dilutes the definition by imposing a value standard on the term innovation that exists outside of the precise definition of the word. In other words, the phrase *to generate profitable economic activity* defines the extent of *success* in a given innovation rather than the nature of the innovation itself. As the focus here is on the essence of innovation, the simplest definition must prevail.

From the definition above, two things are required to accomplish innovation: the existence of something new and a method for introducing it. The question then arises as to what exactly constitutes something new and what constitutes its introduction. In new product development, an executive might view the introduction of something new as the market introduction of a fully designed and developed product. To someone more technically minded innovation might refer to the act of developing the initial product idea, ‘introducing it’ to its own existence. Or it could refer to the need to redesign a prototyped idea so that it can be easily manufactured. Often, the point where an individual might draw this delineation is a reflection of their own background and experience. Indeed one may find a variety of potential points of delineation between the generation of a new idea and its eventual, widespread introduction.

To breach this impasse, the simplest delineation of the new thing and its introduction must again be sought. In the examination of any innovation there is, at its heart a new idea. Within the innovation there is a point where this new conception can be seen to exist only as an idea alone, where nothing has been done with it, no activity pursued due to its existence. To proceed with the introduction of the idea requires that one act on it. There is thus a natural delineation between having an idea and initiating any action required to introduce it. For the purposes of this paper then, the 'something new' aspect of innovation will be considered as the new idea exclusively. Introducing the new idea encompasses any activity necessary to develop and eventually introduce it.

The Idea Experience

The new idea at the heart of an innovation can be difficult to analyze. There is an almost magical quality to any new idea, as if it appears out of nowhere. Yet ideas do not just appear, they are a product of human experience and can be examined in this light. A useful reference for such human experience lies in Scruton's discussion of the aesthetic experience of architecture. This discussion provides a model of a certain type of experience that can inform our understanding on the generation of ideas.

From Scruton, the experience of architecture is described as a potentially pleasurable one that is based upon an act of imagination in the appreciation of a given piece of architecture. Through our senses we may perceive that a building is literally built of red brick, but it is our imagination that allows us to see and understand the overriding forms in their assembly, such as the semi-circular arrangement for the array of stones in an arch. It is the same type of experience that allows someone to see the shape of animals in the clouds or a face in the moon. Exercising our imagination allows us to experience something in a manner beyond what we perceive it to be at a basic or literal level. We know that clouds are made up of water vapour and can never be an animal, but our imagination allows us to experience the clouds in the form of an animal. Similarly, the ability to see beyond the mere assemblage of bricks or concrete and to fully experience the formal composition in architecture requires the exercise of our own imagination. Scruton refers to this experience as an act of imaginative perception (Scruton, 1979, p.74).

An interesting aspect of Scruton's discussion is the ability of architecture to command our attention for this imaginative perception. As it exists in public space, an arresting piece of architecture can easily hijack our thoughts. Simply standing within eyeshot of such architecture gives us the agenda of its consideration. Whatever our thoughts or immediate goals at any given moment, architecture has the ability to insert the consideration of its design into them. The need to consider the architecture can be quite subtle or quite pressing in nature. We may, as a casual passerby, linger on the beauty of a given building, or as a hurried traveler seek to quickly make sense of the interior space of a train station to arrive at the right track on schedule. Whatever the personal agenda a potential viewer may have, a building can, merely through its presence, trigger the question of its consideration.

Another aspect to Scruton's discussion is the malleability of the experience. One can choose, at will, different ways of seeing or experiencing the architecture. As with his example of the upper floor row of columns of the Palazzo Pisani-Moretta in Venice, one can choose to see either neighbouring columns ending in an aedicule (a pointed arch) or the circular arch that joins every third column (Scruton, 1979, p.85). We can flip back and forth

from seeing one or the other geometric arrangement and thus pause on the ambiguity within the design. This malleability can be further affected by the effect that others may have upon our experience of the architecture. If we do not immediately pick up on the ambiguity of the columns of Palazzo Pisani-Moretta, another may point this out giving us the prompt to see and experience this design ambiguity.

An idea is defined as the “conception existing in the mind as a result of mental understanding, awareness or activity.” (*Webster’s Encyclopedic Unabridged Dictionary*, 1989, p.706). The imaginative perception that constitutes the aesthetic experience of architecture would seem to meet the requirements of this definition and so this imaginative perception can also be referred to as the genesis of an idea. In considering the building the viewer can arrive at a sense of its order, its beauty and/or its design. In effect the viewer arrives at an idea about the building. In this context Scruton’s description of the aesthetic experience of architecture is useful because constituent elements of the architectural experience can be readily identified and in turn provide a model for a discussion on the generation of ideas. Within the aesthetic experience of architecture there is, of course, the building itself and the individual or viewer who comes into its presence. Encompassing both is the building’s site. The building’s site provides the context of where and when the experience is stimulated; it is the environment of the experience. The building stands before the viewer as a subject or a topic for interpretation and reflection. To this scenario the viewer brings their own individual background or context: experiences, education, state of mind, goals and desires, ways and models of thinking, etc. any of which might influence their imaginative consideration of the building. Within this scenario of the building, its site and the individual viewer, there is (as noted above) the inherent ability of the building to raise the question of its consideration for the viewer. From this discussion of the aesthetic experience of architecture then, four constituent elements that contribute to the genesis of a new idea can be identified: the environment where the idea is generated (building site), the individual who generates the idea (the viewer), a topic that is considered (the building itself) and the question that raises the need for such consideration within the viewer (the very presence of the building).

Speaking analogously, these four elements of the idea experience can be seen in many examples. In her discussion on creativity, the psychologist Margaret Boden describes the scenario where the chemist Kekule hits upon an idea for the molecular structure of benzene (Boden, 1994, p.82). Until this discovery, Kekule had previously developed the theory that organic molecules were made up of strings of carbon atoms, yet for benzene the observed valencies of the constituent atoms did not match the properties his theory would have predicted. One day, Kekule turned his chair to the fire and began to doze. In his relaxed state the flames appeared as moving atoms, then as longer string-like structures moving like intertwined snakes. Suddenly he saw that one snake had grabbed its tail and he awoke with a start. In this vision he realized that the strings of carbon atoms in benzene were likely arranged in rings. A fact he would prove in his later research.

In this example, Kekule’s study provides the physical environment for where the idea experience occurs. Within this environment the fire acts as a topic of consideration, much as buildings do in the discussion above. Kekule, the individual who generates the idea, already has the agenda or question of determining the molecular structure of benzene deeply embedded within his consciousness. As he is dozing, Kekule’s state of mind can be seen to

be highly relaxed, yet in this state he imaginatively contemplates the fire and in turn sees the dancing atoms become snakes moving within the flames. Upon his reveille, the possible ring-like structure for benzene exists in his thoughts and an idea can be said to have been generated.

Another classic example of the idea experience involves Archimedes and the insight that leads to his theory for water displacement, now known as Archimedes principle (O'Connor, 1999). In this example, Archimedes notices the water level rising as he lowers himself into the bath. It was his imaginative consideration of the rising water that led to the epiphany where he understood how the displacement of water works. Here again the idea experience elements can be seen: the bathing space is the environment, the water within that environment can be seen as the topic for consideration, the need to consider the displacement of water rests within the curiosity of Archimedes and he indeed is the individual who generates the idea.

It is important to note at this point that the examples above do not specifically address the quality, originality or value that can be associated with the generation of ideas. Rather they serve merely to exemplify the mechanistic interaction and role of the elements within the idea experience. Psychologists and other investigators often examine the role of such issues as environment, the individual's state of mind, background, the personal or historical originality of ideas and the ways that quality might be manipulated in the creation of ideas.

The Considered Idea

The question of value within the innovation process merits a dedicated paper; however with the elements of the idea experience identified above it is possible to see how the quality of these elements and their interaction can affect the quality of a resultant idea. For instance the background, knowledge and experience of the individual will impact on his or her ability to imaginatively consider a given topic. In order to see the shape of a horse in the clouds one must be equipped with the knowledge of what a horse actually looks like. A large personal library of experience and knowledge can be used to great effect in the imaginative consideration of any given topic which in turn can influence the eventual quality of an idea. The potential ability and indeed willingness to contemplate a subject in a variety of ways is an asset in the creation of new ideas.

One's willingness to openly consider a given topic is indicative of another issue in the way ideas are created. One's imaginative consideration of any topic is tempered to some degree by what psychologists refer to as conceptual space. This refers to the overriding theories, rules, paradigms and grammars that govern how an individual might consider a given concept. As Margaret Boden describes it, "The dimensions of a conceptual space are the organizing principles that unify and give structure to a given domain of thinking." (Boden, 1994, p.79). Such principles are useful in terms of communication in that they allow for a common currency in the exchange of information, such as the way English grammar gives rules to the way we use and combine words. However such principles can be problematic in the generation of ideas by limiting the way someone may imaginatively consider a given topic and by controlling the way a given problem or query is defined. Prior to achieving the insight of the ringed molecular structure for benzene, Kekule was caught in the conceptual space of his own theory which dictated that organic molecules were structurally arranged in linear strings.

The issue of conceptual space is interesting in that it can, through a creative act, be either radically altered or slightly tweaked. The development of perspective drawing during the early part of the Renaissance can be considered a radical departure from the way artists had previously approached painting and drawing. Once established though it served as the basis of future explorations and tweaks for at least two subsequent generations. Conceptual space can provide a framework for the exploration of new ideas which can lead to modifications and tweaks to the limits of that conceptual space, or through its negation it can lead to the generation of a completely new conceptual space.

As with conceptual space, it is interesting to explore other issues that can affect the way topics are considered and ideas created. Within the literature on innovation, a variety of ways for creating and generating new ideas are covered. These techniques often appear to address the manipulation of elements in the idea experience. For example, in an exercise to develop new types of surgical drapes (material used to isolate sterile fields in surgery), 3M implemented a program of “lead users” (von Hippel, 1999, p. 35). In this instance people who have experience in doing similar things and using similar technologies but at an advanced level in far fields are assembled in brainstorming sessions to explore the potentialities of the proposed 3M technology. This is very much an effort to enhance the generation of ideas by the targeted assembly of individuals with very specific types of experience and knowledge.

Indeed brainstorming as an ideation technique involves the manipulation of the idea experience elements. The brainstorming session is fundamentally about collecting ideas and the manipulation of the idea experience elements can be seen to work in two ways. First off there are the up-front manipulations which includes the management of the session’s environment and the casting of the individuals who will take part. The specific meeting environment includes the people that have gathered for the session, the methods used for capturing the results of the session and the way a given session is chaired. In inviting someone to take part, one is inviting that person, their experience and knowledge, their state of mind and their ways of thinking. As noted above the people who are assembled for the session can bring a breadth of knowledge and experience to it.

The second way of manipulating the elements involves the way the brainstorming session is executed, that is the way that problems are presented and topics considered. Tom Kelley in his book, *The Art of Innovation* describes how crucial it is to succinctly table the problem for the brainstorming session (Kelley, 2001, p.56). This tabled problem in effect becomes the agenda or question that is internalized by all of the session’s attendees. As the session proceeds and discussion is engaged on the problem, a flow of ideas can result. The dynamic that occurs here is that as one individual grapples with the problem and then makes a statement about their thoughts to the rest of the attendees, his or her statement becomes a topic of consideration for the others. Another person who considers this statement within the context of the tabled problem may then arrive at a new idea. That idea in turn can become a new topic of consideration for another person in the group, who after their consideration of this new topic may then generate yet another new idea. And so on. As Kelley points out, a successful 60 minute brainstorming session can generate upwards of 100 ideas (Kelley, 2001, p.58).

Another interesting manipulation of topics that can occur is the use of various media to capture ideas and topics. The use of markers, brown butcher paper, sticky notes and other visual material augments the oral discussion of brainstorming sessions (Kelley, 2001, p.59). Topics are not exclusively presented orally or captured via written notes. The use of various media can complement the ways various people think. Someone may hit upon a new idea only after examining a sketch, even if the information captured in that sketch had previously been presented orally. Visual stimuli work, after all Kekule considered the flames of a fire and Archimedes the change in water level. Thus not only are the number of topics generated in a given brainstorming session important, but also the ways that ideas and topics are presented is important in providing effective and multiple stimuli for the consideration of the session members. If a greater number of topics are considered in a variety of ways, then a greater number of ideas will be generated. Wild ideas in brainstorming sessions can be seen to be useful within this context. The wild, nonsensical idea may eventually be discarded but open-minded consideration of the wild idea as a topic can lead to a potentially useful idea.

Introducing the New Idea

The discussion of brainstorming illustrates the way that ideas can be worked, manipulated and in effect stacked to generate still more ideas. From the initial discussion above though, innovation is only achieved if the new idea can be introduced. With a new idea in hand some way or method is therefore required to introduce it.

The process of industrial design provides a reference for understanding how such a method might work. The activity of industrial design is intended for developing product ideas for their eventual introduction into production and the marketplace. The impetus for the process is any new product idea. The industrial designer is not necessarily (or often) the one who has the new product idea, thus making the industrial design process an interesting example for an examination of a given idea's introduction. The basic process in industrial design typically requires the execution of a number of phases. These can include an initial defining phase, any additional research, design concept generation, design concept refinement, an initial design specification, prototyping, and eventually a design specification for manufacturing. Others have written extensively and in a more detailed manner about the phases of developing the design and preparing for the launch of a new product. At issue here are not the specific phases of development; rather it is the exploration of experience and thought process as a given product design is created.

It is interesting to note at this point that as the effort to design something is initiated, the end result of the intended effort is unknown. The design process is therefore a process of discovery to determine how the eventual design will take shape. The thing to be designed may be initially understood at a very nominal level, but the actual dimensions of its exact usage, size, shape, and materials, etc. are typically resolved as a result of the design process.

The first phase in the design process is one of definition: establishing the parameters of the project to be undertaken. Here constraints and criteria for the intended design are defined and summarized, typically in a design brief. The design brief formalizes the line of inquiry for the design effort. One aspect of the brief is a statement regarding the nature of the design problem; that is raising the question of what ultimately is to be designed. The manner in which the design problem is defined is quite important. If, for example, the design

problem is defined as the *design of a new paper clip*, then the problem remains at an effectively nominal level. If this definition is modified to the *design of a device that temporarily binds loose sheets of paper together*, a better understanding is achieved of what the end design must do to actually be a paperclip. A driving criterion is established for the final design.

This initial defining phase, as summarized in the design brief, accomplishes a number of things: first off, in redefining the new product idea as a line of inquiry for the industrial designer, the new product idea is made into a question. Given the elements of the idea experience noted above, it thus forms part of the groundwork for the generation of new ideas. Secondly, as the design brief typically summarizes all that is known about the design problem at the time, it outlines the boundaries of the conceptual space for that line of inquiry. Thirdly, with the establishment of criteria in the design brief, a strong aspect of an introductory method is revealed: that of evaluation.

In order to execute any kind of evaluation, some 'thing' must exist to be evaluated. The subsequent phases of the industrial design process concern the creation of such things (deliverables): sketches, renderings, models, CAD models and prototypes. Although the richest evaluation might be achieved with the final production version of the product this is typically quite expensive, if not utterly impractical, to achieve outright. Thus, throughout the design process, the designer's deliverables stand in as facsimiles for the final product for any given evaluation.

To create any of these interim facsimiles requires the generation of ideas on the part of the designer. Given the line of inquiry defined in the brief, the designer may consider a variety of stimuli or topics that will lead to the generation of design ideas. These are captured and communicated in the form of the design deliverables noted above. Once into the process, the consideration and evaluation of any deliverable (such as a sketch) can then lead to the creation of subsequent ideas and new deliverables. The initial product idea thus sets the course for the generation of many new ideas as the design process is executed.

Yet the design process is not simply about generating new ideas. A further, interesting capability of these deliverables is to not only serve as a topic of evaluation for design features, as matched against the criteria in the design brief. The consideration of any aspect of a design deliverable can potentially lead to an evaluation of the conceptual space for the design project. Given that a conceptual space can be modified, refined or even negated (as with Kekule and his discovery of the ringed molecular structure of benzene) the design process also becomes one of refinement and manipulation of the conceptual space for that design inquiry. In completing the design of a new product, the actual dimensions for its existence are defined. This represents the culmination of ideas, applied to resolve design issues derived from an ultimate definition of the conceptual space for the design project. Effectively, resolving the design problem requires the resolution of both the design itself and its attendant conceptual space.

This exploration of the design process illustrates that achieving innovation is not an obvious task. Success in introducing any new idea requires clear thinking and a disciplined effort to arrive at an understanding of both the problem and the conceptual space that the new idea raises.

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