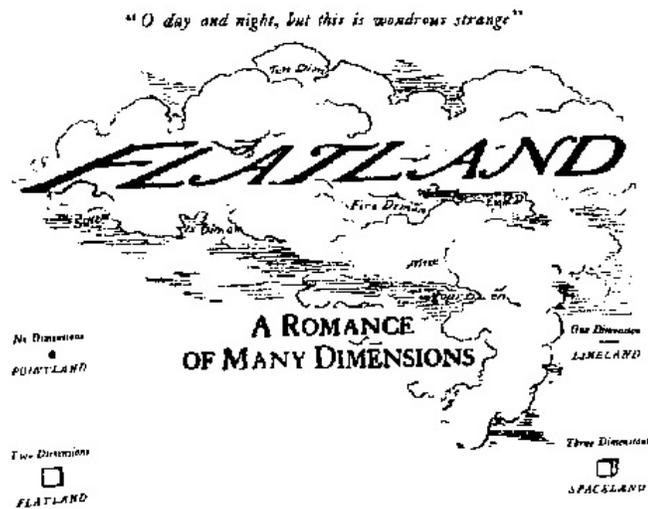


## A simple qualitative, yet mathematical model powerfully illustrates how breakthrough innovators come to know Flatland: A glimpse of things to come

How the orthogonality and non-linearity of discovery propel breakthrough innovators into new dimensions



Imagine the awe and wonder. What would you experience if – having lived your entire life to this moment confined to a two-dimensional plane – in an instant you were propelled into an entirely new and other world, one in which there were three dimensions? A world of spheres instead of circles. Transformation. Never again would things be the same.

This was the experience of the square, who, having lived its entire life in *Flatland*, encountered previously unimaginable other dimensions in Edwin Abbott's 1884 novella entitled, *Flatland: A Romance of Many Dimensions*.

The square's story should have a familiar sound and feel to us. It is the story of one who sees things previously unseen. It is the story of breakthrough innovation.

With this essay, we embark on a journey. A journey that propels us into new dimensions of insight. A journey that will consume the next several essays as we develop a simple conceptual framework, a model to guide our reflection on innovation. A framework that will help us gain new insight into the epistemology of breakthrough innovation.

### Before we embark

To prepare for our journey, let's recap where we've been.

First, we observed that Serial Innovators come to the process of innovation prepared with a wealth of factual information, as well as a strong memory and a highly active sense of curiosity which only serve to add over time to their broad and deep information base, the "know what" input of innovation. They are expert at *collecting and retaining the dots* of information from both proximate and disparate fields.

Second, we find that these same individuals come to the process of innovation with the "know how" of innovation, the tacit skill of systems thinking. They are expert at seeing subtle, hidden patterns in the existing data, *connecting the dots* of information from both proximate and disparate fields.

### The journey begins with a single step

Let's begin by taking these two insights and combining them into a very simple framework for innovation.

As depicted in Figure 1, when the "know what" base of factual information serves as the input to the "know how" of innovation skill of a Serial Innovator, the result can be the emergence of a breakthrough innovative insight, a new "know what" output.

In the next two essays, we will consider some of the salient characteristics of each of these epistemological elements: the initial "know what" input to innovation, the "know how" of innovation, and the new "know what" innovative output. Thereafter, we will consider how these features work together, seeking common themes and trends that yield additional insight into each, as well as into the whole.

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*If we suggest that two vectors represent two entirely different fields, such as industrial design and electronics, then multiplying (not adding) them propels one into an entirely new, third dimension – in this case a breakthrough new product concept such as the original iPod.*

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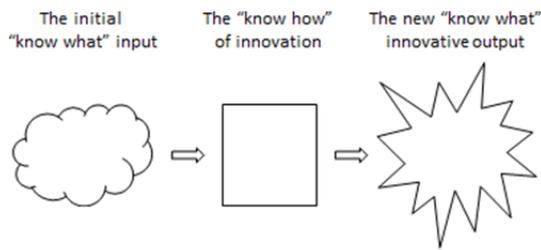
### A glimpse of things to come

We observe that breakthrough innovators gather and synthesize information and insights from many, disparate disciplines and sources in a way that they see a whole that is greater than the sum of its parts. Such transcending and creatively cross-fertilizing or mixing of disciplinary insight has been recognized, as well, by others in the literature.<sup>1</sup> Further, it has been recognized anecdotally by practitioners that "inventing is residing in the cross terms (the  $xy$  terms) of a polynomial" and that this illustrates where significant value is generated in the creation of new ideas. In this essay we take this understanding to a next level.

Perhaps the simplest illustration of this can be found in the multiplication of two orthogonal (i.e. perpendicular) vectors, A and B, as illustrated in Figure 2. ➤

## A very simple model of the epistemology of breakthrough innovation

1



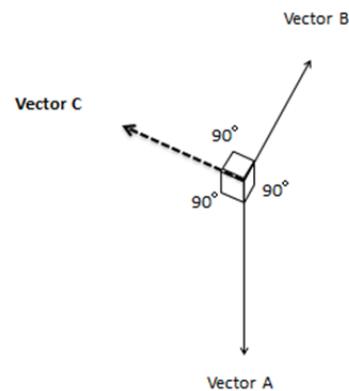
Taken alone, the vectors A and B define a plane; any point on this two-dimensional plane can be identified by an appropriately-weighted, linear combination of these two vectors. Multiplication of these two vectors, however, yields an entirely new vector, C, that is simultaneously orthogonal to (i.e. perpendicular to) each of the two original vectors. Further, it is critical to point out that there is no appropriately-weighted, linear combination of the original two vectors that will yield this new vector. If we, very loosely, suggest that the two original vectors represent initial factual knowledge (“know what”) in two entirely different fields, such as industrial design and electronics, then multiplying (non-linear “know how”) such initial factual knowledge with itself propels one into an entirely new, third dimension of “know what” – in this case, perhaps, a new product concept such as the original iPod. This is exactly what I suggest occurs during breakthrough innovation, and it is intriguingly similar to criteria applied in the non-obviousness test used to determine whether an idea is considered an invention in patent law – a simple combination (i.e. addition) of ideas (i.e. orthogonal vectors) is not sufficient to pass the test.

### A glance back to begin to develop what’s ahead

I find that it is increasingly important to help the reader see broader patterns and trends across these essays. “So, what’s the big idea?” (Essay 17) provides an example of taking step back so as to gain clarity. Of note in the present essay is just how closely related the metaphor illustrated in Figure 2 is to the Magic Eyes® of innovation metaphor

## Innovators are propelled into new dimensions

2



developed across Essays 4 through 9. With the Magic Eyes® metaphor, upon seeing the embedded image, the innovator comprehends the dots as a whole, not as distinct elements. Similarly, with the metaphor of Figure 2, upon multiplication, the innovator accepts vector C as a unique entity, not as the two distinct vectors (A and B) or as some appropriately-weighted linear combination of them.

There is a very good reason that these metaphors share such features, but more on this much later. ■

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<sup>1</sup> See, for example Frans Johansson, The Medici Effect: Breakthrough Insights at the Intersection of Ideas, Concepts, and Cultures (Cambridge, MA: Harvard Business Press, 2004) and Lee Fleming, Breakthroughs and the ‘Long Tail’ of Innovation. MIT Sloan Management Review 49: 69-74 (2007).

*“On the Epistemology of Innovation: How Breakthrough Innovators Connect the Dots” is a series of brief, occasional essays addressed to executives, managers, and technologists responsible for innovation in industry. Its purpose is to challenge readers to reflect broadly and deeply on the practice of innovation – in particular on how innovators come to know what to do today – in order to succeed commercially in the future. Essays are available without charge at the University of Illinois’ digital archive at <https://www.ideals.illinois.edu/handle/2142/27667>. The discussion group at <http://epistemology-of-innovation.com> is a place to provide feedback and dialog with the author and others regarding these essays, as well as to register to receive notice of new essays as they are issued.*