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A reflection on the differences between incremental and breakthrough innovation

Of peeled carrots and 'the Fosbury Flop'

Insights from Kuhn's The Structures of Scientific Revolutions applied to corporate innovation

Some paradigm shifts of breakthrough innovation ...

Product concept	1962 products	2012 products
Personal music	LP record, pocket radio	iPod
Portable computation	Slide rule	Calculator, laptop
Voice communication	Wireline telephone	Cell phone
Digital news	Teletype	Twitter
Computer memory	Paper punch card	Memory stick
Map	Paper	GPS, Google Earth
Diaper	Cloth	Paper disposable
Reading material	Print book, newspaper	eReader, iPad
General information	Print encyclopedia	Wikipedia

With the 1962 publication of Thomas Kuhn's The Structure of Scientific Revolutions,[i] scientists, historians of science, and the general public witnessed a transformation in how we might think about scientific progress. Kuhn's work challenged the prevailing view of scientific progress – that it was cumulative, adding one insight on top of another, building increasing knowledge. In contrast, Kuhn's perspective was that science progressed in two ways:

1. Over longer time frames, one observes a series of rather disruptive revolutions, Kuhn's so-called ***paradigm shifts***, which are transitions from one frame of understanding to another. Each frame of understanding is a ***paradigm***.
2. Within each paradigm, however, we observe what Kuhn refers to as ***normal science***, the cumulative working out of details.

Kuhn illustrated these concepts by applying them variously, including to the transition from the Ptolemaic view of the solar system (earth-centric, with other planets traversing in circular orbits) to the Copernican view (sun-centric, with planets traversing in elliptical orbits). Each of the Ptolemaic and Copernican views is a ***paradigm***. The transition from one to the other is a ***paradigm shift***. That we can calculate orbital dynamics and plan the flight of trajectories of spacecraft suggests that ***normal science*** has, indeed, progressed steadily within the Copernican paradigm.

Application to innovation

While Kuhn specifically addressed the historical progression of science, generally speaking, his views also comfortably apply to a description of the progression of corporate innovation, with a paradigm shift corresponding to breakthrough innovation and normal science corresponding to incremental innovation.

The table at the top of this essay illustrates one aspect of this, identifying a number of paradigm shifts of breakthrough innovation experienced over the past fifty years. In each case the same product concept existed before and after the breakthrough while the products themselves were remarkably different before and after the breakthrough.

Some examples – applying these concepts to innovation

Example 1: Consider the development of peeling carrots for home use. One hundred or more years ago, this would have required using a simple, single-blade knife. As people cut their fingers peeling with knives and as manufacturing technology advanced, consumer safety rose in importance. Today, you can buy a simple safety blade peeler (with a pair of blades facing themselves, not outward) for about a dollar – a nice, incremental innovation improvement on the single-blade knife. The next incremental innovation was the ergonomic peeler, a safety blade peeler on a handle designed for extended periods of comfortable use. Ultimately, however, breakthrough innovation occurred with a paradigm shift from the consumer peeling carrots to the consumer buying pre-peeled carrots, and, with that, the manufactured baby carrot was born.[ii]

Kuhn's views also comfortably apply to a description of the progression of corporate innovation, with a paradigm shift corresponding to breakthrough innovation and normal science corresponding to incremental innovation.

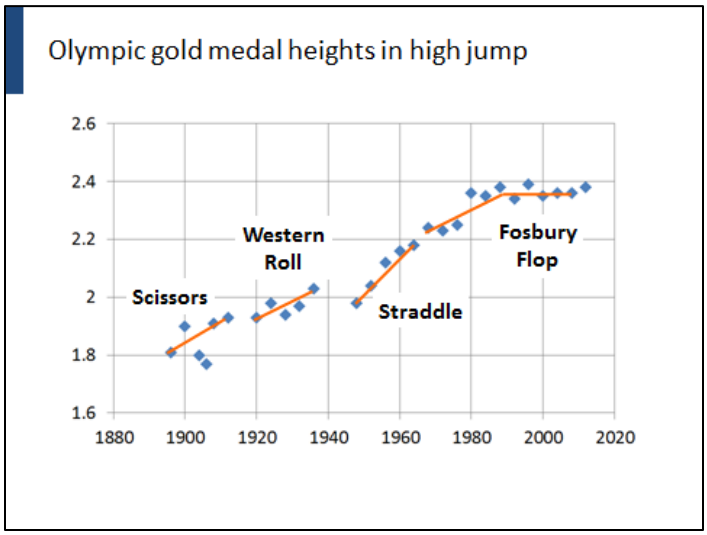
Example 2: As noted in the previous essay in this series, in our recent book,[iii] we tell the story of breakthrough innovation exemplar Tom Osborn of P&G. Here I re-tell the story with an emphasis on applying Kuhn's insights.

Working in the feminine hygiene products business, Tom recognized that many of his colleagues came from the diaper business and carried with them an unarticulated belief that a feminine hygiene pad could be understood as an extrapolation of a diaper – that is, they worked within a feminine-hygiene-pad-as-a-diaper paradigm. In many respects this was not an unreasonable paradigm for them to assume, as both feminine hygiene pads and diapers were employed to catch fluid. More importantly, products based on the diaper paradigm sold well in the marketplace and it also lent itself to opportunities for incremental ≫

innovation, improvements such as increased absorbancy. Tom, however, believed that the diaper paradigm could be improved upon in a more powerful way. After studying the problem in detail, Tom began to believe that an improved way of thinking about a feminine hygiene product was, instead, a garment paradigm.

However, management initially believed that it was best to remain in production with the diaper-paradigm products. Ultimately, Tom was able to successfully convince them to shift paradigms – not an easy task. P&G was rewarded in the marketplace for making this move that led to the 'billion-dollar brand', Always® Ultra.

Example 3: To illustrate that these complementary concepts of incremental and breakthrough innovation – defined in a manner consistent with Kuhn's insights – apply to innovation quite broadly, here is an example from athletics.[iv]



In the figure above, we observe the Olympic gold-medal-winning heights (in meters) in high jump for each of the Olympic games. Over this 100-plus year history, four distinct paradigms of high jumping were embraced by competitors, with the eras of dominance of each paradigm noted. What we can discern from this data is that incremental innovation occurred within each era while breakthrough innovation (paradigm shifts) occurred between eras.

Of interest is how one could not successfully implement 'the Fosbury Flop' without associated improvements in technology that had to take place in order for the paradigm shift to occur. In particular, a high jumper would have broken their neck had they attempted this move into a sawdust pit of the type used only a few years earlier. It was the advent of thick, foam landing pads that enabled Dick Fosbury to jump and land backwards, rather than forward – a move that, by lowering his center of mass during a jump, gave him a small, but clear competitive edge in attaining greater height.

Example 4: I'll conclude these reflections on paradigms, paradigm shifts, and the incremental innovations that occur within a paradigm with the link to a video[v] shared by Terry Grapentine,[vi] comparing two paradigms of banana peeling – that done by a monkey contrasted with that done by a human. Since hearing about this from Terry, I've been amused by just how easy it is to work within the monkey's paradigm! ■

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[i] Thomas S. Kuhn, The Structure of Scientific Revolutions (Chicago: University of Chicago Press, 1962).
[ii] See http://www.carrotmuseum.co.uk/babycarrot.html for a history of baby carrot innovation.
[iii] Abbie Griffin, Raymond L. Price and Bruce A. Vojak, Serial Innovators: How Individuals Create and Deliver Breakthrough Innovations in Mature Firms (Palo Alto: Stanford University Press, 2012).
[iv] This illustration was shared by Vijay Govindarajan in a presentation at the IRI 2012 Annual Meeting.
[v] http://www.youtube.com/watch?feature=player_embedded&v=nBJV56WUDng (how to peel a banana like a monkey).
[vi] Terry authored the recent book, Applying Scientific Reasoning to the Field of Marketing (New York: Business Expert Press, 2012).

'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.