

## **AN INNOVATIVE ROAD TO PARADIGM SHIFTS**

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### **ABSTRACT**

This paper aims to clarify the relationships and differences between incremental innovation, radical innovation, and a paradigm shift. A literature review was conducted of seminal articles and recent publications that addressed research with a focus on the definition of the different types of innovation and how they may impact each other in a business environment. Quantitative data was used to stress specific points. Analysis includes implications for the planning of product changes and new product introductions as well as how to recognize significant market shifts. This paper provides more substantial definition around paradigm shifts with attention given to symbiotic context.

**Keywords:** Radical innovation, incremental innovation, product life cycle, paradigm shift, symbiotic relationships

### **Introduction**

References are commonly made within every industry of the need for innovation. Given that customers are continually changing their minds and demanding more, competitors are always looking to grab market share, new entrants are looking to establish themselves with your customers, and suppliers are finding ways to differentiate themselves – it is no wonder this is an absorbing topic. The concept of innovation continues to be widely covered in a number of publications resulting in a wide variety of theoretical frameworks and empirical studies. The focus of this article is to examine the different types of innovation, their impact on the industry in which they compete, at what point is innovation required to occur, and at what point does the entire industry shift direction.

Innovation is often found whenever there are significant changes in the fundamental structures of an industry. These changes can be found in either shifts in market forces or technology (Afuah, 2003). An example of changes in industry structure occurred in the health industry as the decision-making process between the doctor and the patient was increasingly influenced by outside forces such as the company providing insurance, government mandates, and health maintenance organizations searching for cost-efficient solutions. In the early years, most Americans paid the doctor directly for their medical visits. However, during World War II, many people went to fight overseas and left a very tight labor market back at home. To prevent the inflationary rise of wages, goods, and services, the federal administration-imposed wage and price controls prevented employers from offering ever-increasing wages to lure workers to their factories and businesses. Ever vigilant, companies searched for ways to encourage the best workers to join them and hit upon the offering of fringe benefits such as health insurance. This dynamic began the evolution of the health care system in place in the modern world in many

countries. With this change came entrepreneurs searching for ways to take advantage of the shift – to include insurance companies, health maintenance organizations, and the government getting involved in its regulation. Eventually, changes in how health care should be provided were led by hospitals, pharmaceutical companies, and home providers all providing competing solutions.

Equally impactful, but happening in a much shorter period of time, was the impact that Amazon had upon booksellers. Internet technology-enabled Amazon to go direct to the end consumer, bypassing bookstores initially and eventually agents and publishers with the advent of self-publishing. Amazon is even being leaped over in the value system as famous authors such as Stephen King sell e-books directly to readers from their websites.

On the technology side of change, a good example is the digitization of music. For many years the best way to enjoy music was either through the radio waves or by listening at home with a record player. Digitization provided much more portability to this experience as music lovers listen to their favorites through digital music players of all sorts or through the use of streaming services that cater to their targeted preferences.

### **Methodology and Literature Review**

A systemic approach to analyzing technological change is not new. Innovation systems are defined in a variety of ways; to include physical dimensions, geographic focus, technological systems, and along industrial sectors. The concept of innovation continues to be widely covered in a number of publications resulting in a wide variety of theoretical frameworks and empirical studies. These concepts were identified and studied through a comprehensive literature search. In each case, the discussion surrounds the creation, use, and diffusion of knowledge. The focus of this article is on the relationship between the different types of innovation – from incremental to radical to a paradigm shift – and their implications for the innovative leader within a competitive business environment. More specifically, the objective of this article is to examine how to recognize shifts in the competitive business environment and be prepared to craft contingency plans to address those shifts.

### **Analysis and Discussion**

#### ***Types of Innovation***

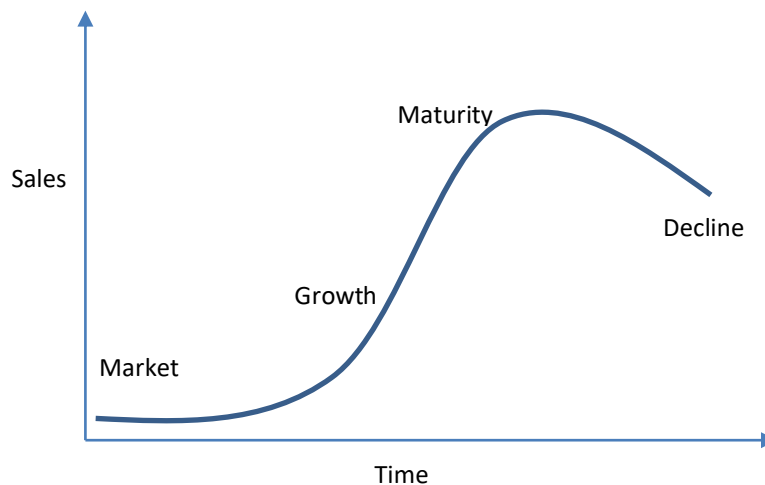
Two types of innovation are often referenced in the field of innovation: incremental and radical. But at what point does an innovation truly become a paradigm shift? To best answer this question, an examination of the definitions of these three terms needs to be conducted.

The definitions for all three terms vary across disciplines. The difference between incremental and radical innovation hinges on the degree of change (Baregheh, 2009). Generally, an incremental innovation engages a series of small improvements to the products, services, or processes of a given enterprise. These are typically conducted for the product or service to remain competitive within its ever-changing market. As customers demand more and competitors offer their competing enhancements, it is a necessary part of conducting business.

Radical innovation takes these changes to a much higher level. As far back as 1932, Joseph Schumpeter wrote of the need for “creative destruction” (Schubert, 2013). Essentially, this mandated the need to continually replace the products and services of the enterprise with dramatically improved versions – the consequence of not doing so would result in a competitor providing a significantly enhanced product that would replace the older versions with market share shifts occurring. Consumers create new wants as individual preferences change over time, and these unique wants may be hard to satisfy. This action mandates a need to remain one step ahead of consumer preferences and a willingness to make existing products obsolete.

***Jumping the Curve***

Corporate marketing executives have used the Product Development Cycle for many years. The model consists of four recognizable stages in the life of the average product as a corporation attempts to predict the sales and profitability of a new product entry into a market. The four stages are initial market introduction and development of the market, the growth of the sales of the product as more consumers seek to purchase, the maturity of the market as consumers slow their buying of the product (especially as competitors enter the market), and the decline of sales of the product as consumers look to other options. The predictability of the curve is not an exact science as there are many outside influencing variables such as uniqueness or cost of the product. The Product Development Cycle can be seen in graphic form below.

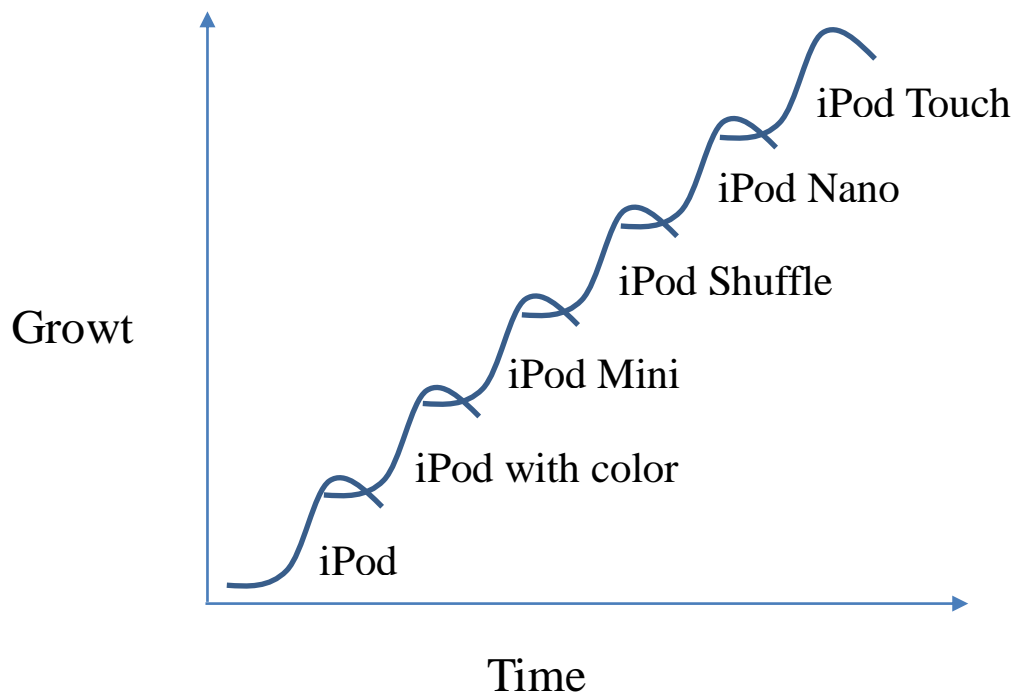


Source: Levitt, 1965

The real question for product innovators is when to introduce a new version of the product in the spirit of creative destruction? If a firm is not continually improving its products, a competitor will undoubtedly be glad to provide suitable alternatives to consumers who are always on the lookout for an improved version or a better value.

At one time, the most valuable company in the world, Apple Computer, did so by staying one step ahead with the advent of the iPod.

What is interesting is that Steven Jobs, then the transformational leader of Apple, managed to bring together three elements that already existed in the marketplace and bring them together in a unique way to produce the initial product that resulted in this string of hits. Did digital music already exist? Ask any college student at the time with a Napster account – the answer was yes. Did digital music players exist at the time? The answer was yes – with Rio being one of the leading brands. Could you get digital music onto a digital music player – the answer was yes, using file transfer protocols. What Jobs did that was innovative was to combine these three elements in a unique way such as to produce a breakthrough product. He combined a very attractive case for the iPod that provided social currency for those who were seen with it, provided an easy way to load songs onto the iPod through the iTunes app, and did deals with record companies to offer quality songs for download – at the time it often took several tries from the peer-to-peer service Napster to capture a high-quality digital recording. The rest was a matter of repackaging the iPod device into a variety of more convenient packages that remained aesthetically appealing and innovative.



Source: Apple Computer data with author graphic

In each successive product introduction, the fundamental architecture remained the same. That is, all of these versions of the iPod relied on the iTunes infrastructure and represented improved versions of the previous. In every version, the product produced music or the spoken word to an individual. The industry had come a long way since mom controlled the desktop radio that

boasted vacuum tubes, and teenagers were forced to listen to Lawrence Welk or Frank Sinatra rather than the Beatles. Eventually, the iPod was merged with a mobile phone, which could be considered their foray into a paradigm shift – more on that later.

When is the best time to jump to the next curve? Before you get too far down the downward sloping decline part of the curve, and preferably after the product has optimized its profit potential. This is creative destruction at its demonstrated best.

### ***Radical Innovation***

Radical innovation takes these changes to a much greater level. As far back as 1932, Joseph Schumpeter wrote of the need for “creative destruction” (Schubert, 2013). Essentially, this mandated the need to continually replace the products and services of the enterprise with dramatically improved versions – the consequence of not doing so would result in a competitor providing a significantly improved product that would replace the older versions with market share shifts occurring. Consumers create new wants as individual preferences change over time, and these unique wants may be hard to satisfy. This mandates a need to remain one step ahead of consumer preferences.

Utterback (1996) gives us some excellent examples of a series of radical innovations that fundamentally changed industries. The first was the ability to meet user needs to put words on paper. The first device that entered into the marketplace was the typewriter. The early versions were somewhat crude, but a dominant design emerged after several market-tested iterations was the Underwood Model 5 in 1899. This manual version had a standard visual front-striking type, a shift key, a tab key, QWERTY keyboard, and other evolved features. Satisfying that same need to put words on paper in the 1900s came the electric typewriter, with the IBM Selectric becoming the dominant design in 1961 with its spherical ball and ability to correct mistypes. Radical innovation occurred later in the 1960s when Xerox and Wang introduced word processors that could store documents in memory, making altering a few words on a page rather simple. Eventually, word processing applications were available on personal computers, with Microsoft ultimately achieving dominant status. What is most interesting about this evolution is that each stage destroyed earlier versions: electric typewriters killed the manual industry, word processors killed electric typewriters, and personal computers killed word processors. It happened slowly and over time, but try finding an Underwood Model 5, IBM Selectric, or WANG word processor these days. Today, online applications such as Google Docs represent the next wave as more goes to the cloud.

### ***Paradigm Shift***

The term “paradigm shift” was put forth conceptually by the American physicist Thomas S. Kuhn (Kuhn, 1962). In contrasting normal science to what would be considered a scientific revolution, Kuhn indicates that there will be a time in a scientific revolution when all of the values shared by the scientific community shift from long-standing techniques and patents being considered normal to a totally new way of looking at things. Kuhn provided several examples to

back up his observations to include in 1543 the transition in cosmology from a Ptolemaic cosmology to a Copernican one as well as the more recent transition between the worldview of Newtonian gravity and Einsteinian general relativity. The four recognizable stages outlined by Kuhn are: normal science, extraordinary research, adoption of a new paradigm, and the aftermath of the scientific revolution. The aftermath includes revising industry standards and even changing the curriculum in universities.

On a lesser scale, these are somewhat parallel to emergence of a dominant design for a single product (Christensen, Suarez, & Utterback, 1998) in which, as the design for a major product experiences an architectural shift, there is a window of opportunity for a firm to make choices to pursue those market and technological changes or face the possibility of failure. A dominant design wins the allegiance of the vast majority of customers and becomes the base features and functions which other firms - and future innovations - must build upon to remain competitive. Their prime example was rapid technological change in the rigid disk industry in which the Winchester architecture and intelligent interfaces fundamentally altered the industry and emerged as the standard dominant design along with two components: rotary voice coil actuators and direct drive pancake motors. Firms not keeping up with these changes failed. On a broad scale with paradigm shifts, or on the product level with the emergence of dominant designs, companies not recognizing change in both technology and market forces arenas provide themselves with substantial hurdles to future success.

So, the question becomes, at what point does a radical innovation, or a series of radical innovations, become a paradigm shift?

Henderson and Clark (1990) postulated that a radical innovation occurs in the form of an architectural reconfiguration of an existing system such that components are linked together in a new way. As an example, they cited the technology of a room air fan initially being mounted on the ceiling with improved blades and improved motor efficiency being incremental improvements. Radical improvement would come with the advent of central air conditioning with its compressors and refrigerants. Architectural innovation would come from the introduction of portable fans that would share the same components as the large fans (blades, motors, etc.) but would require changes in the interaction of those components.

Let's take this through the process one step further. For an example of a paradigm shift at the product level, an examination of the evolution of the automobile industry proves useful. The industry came about in the 1860s with the creation of a "horseless carriage" powered by a gasoline engine. Since that time, numerous incremental innovations continue to spur the industry forward. Providing that impetus was the parallel support of countless complementary innovators. For example, automobile travel became much more convenient as private and government-built roads improved beyond what was needed by horses and resulted in a smoother ride. In addition, gasoline vendors began to emerge along routes that enabled people to travel long distances. Radical innovation was introduced with the electric car. Gasoline vendors are now replaced by those who provide charging stations. Interestingly, electric cars were first

invented in Scotland in the 1830s by Robert Anderson but are just now enjoying more significant popularity as the gasoline engine eclipsed their value early on.

The future introduction of flying cars provides the probability of a real paradigm shift. In this case, most everything changes. New manufacturers would no doubt emerge with radical technologies for these types of automobiles. We can only use the word “automobile” as the name was derived from the Greek word for self (auto) and the Latin word for motion (motivus) – but there is no guarantee that this new way to provide the necessary service of transporting individuals from one place to another will retain that title. The complementary innovator gas station owners or electrical charging stations will be radically altered except to serve old technology. The concept of private and government-owned roads will be fundamentally altered as infinite possibilities become available. New rules for operating the vehicles will need to be established, standardized, and taught to flying car owners and users. Should flying cars evolve sufficiently to replace gasoline and electric-powered vehicles, a complete paradigm shift would have occurred.

### ***Components for a Paradigm Shift***

Following these examples, there would be several factors that would need to be present to declare a paradigm shift:

1. A radical innovation of the product itself – to include both architectural and component
2. Radical changes required by complementary innovators
3. Radical changes to the industry such that the industry, and in most cases society, are required to adopt new rules

Earlier in this article, we discuss the evolution of the iPod and its related infrastructure. The shift to the iOS format is proving to be another significant step forward for Apple. With the new operating system, iTunes is being cast aside with the ability to download and cross-reference digital material across multiple platforms done through direct access to internet technology. No need to connect to iTunes occasionally to update music and podcasts. Would this be a paradigm shift? Under our stated required factors above, it would not appear to be so as most complementary innovators (content providers, Internet Service Providers, etc.) are not undergoing a radical shift. Radical, perhaps, with the ability to cast off iTunes. Throw away wires and interact directly with the cloud – but not a paradigm shift.

### ***Accelerating the Shift***

Many factors determine how rapidly a new innovation may be adopted. Rogers (2003) postulates that there are four major elements that affect how an innovation gains momentum and spreads through a social system. First is the nature of the innovation itself - how complex the change is and how difficult it is to adopt. Second on the list is the communications channels – asking how do people find out about the innovation and inform each other. Third is time - how long it takes people to find out about the innovation and form an opinion as to whether to adopt.



Last is the social system - how close to established behavior patterns does the change adhere. These factors influence the adoption rate of different people who have different tolerances for adoption – that is, a person will do something different than they had typically done, such as purchase a different product or alter a behavior pattern. This is also impacted by the characteristics of the people considering the change – with innovators and early adopters jumping on the innovation early, the majority of the target population following them, and with laggards the last to adopt the innovation.

Perhaps equally important is the presence of other enabling innovations. Recent accelerated trends in technology and globalization are making the recognition of the ecosystem in which an innovation is spawned more critical than in earlier years. For example, Karl Benz is credited with creating the first gasoline-powered automobile in the late 1800s, but it was not until early in the next century that the Ford Motor Company started to make them more readily available through mass production. Two of the critical complements that accelerated the adoption of the automobile were the improvement of the roads (roads made for horse and buggy, along with the associated manure, did not make for a comfortable ride in the new automobile) as well as the introduction of gas stations whereby someone could find convenience in keeping their engine running, especially over greater distances. In these instances, large oil companies – not the automobile manufacturer – provide fuel for the automobile while programs such as the U. S. federal government enacting the Federal Highway Act of 1921 to construct a national grid. Without decent roads and the availability of gasoline, the automobile ecosystem would not have had the growth rate it realized. The ecosystem grew such that, by the administration of President Eisenhower, commerce and ease of travel between the different parts of the country enabled a “sunbelt shift” such that over 90% of the national growth in the 1980s was in the southern and western parts of the United States (source: fhwa.dot.gov).

Another important factor that serves to accelerate innovation is a screaming social need. In both India (Chhachhar, 2012) and Indonesia (Saville, et al, 2015) mobile telephony totally disrupted the social structure in the fishing industry. In both countries, small scale fishermen constitute a large population and one that provides a substantial amount of the total national catch – in Indonesia’s case, more than 80%. Over the years, the industry had been plagued with inefficiencies and a system of intermediaries that served to exploit both commercial fishermen and the consumer. Poverty was a severe problem in both of these countries, especially in the coastal areas as people tended to migrate to the larger population centers. The infrastructure of mobile telephony was implemented relatively quickly with the installation of wireless towers taking substantially less time to construct than the time it historically took to provide fiber optic or copper twisted pair wiring to different locations. Telecommunications companies stepped in with affordable plans that encouraged the purchase of handsets. In both instances, the fishing community was able to quickly share information that enabled them to both determine the best place to find a good catch and where they would get the best prices for their fish. At the same time, consumers were able to share information that enabled them to become more informed buyers. The overall result was the squeezing of the intermediaries such that the fishermen



enjoyed greater prosperity while their consumers experienced better value. Overall, the social structure shifted such that overall poverty decreased.

### ***Predicting a Paradigm Shift***

Given the interactive nature of the ecosystem of any product in modern times, the predictability of a paradigm shift is becoming ever more difficult. There are quite a few examples of prominent leaders in their field, indicating that a paradigm shift would not occur. To wit:

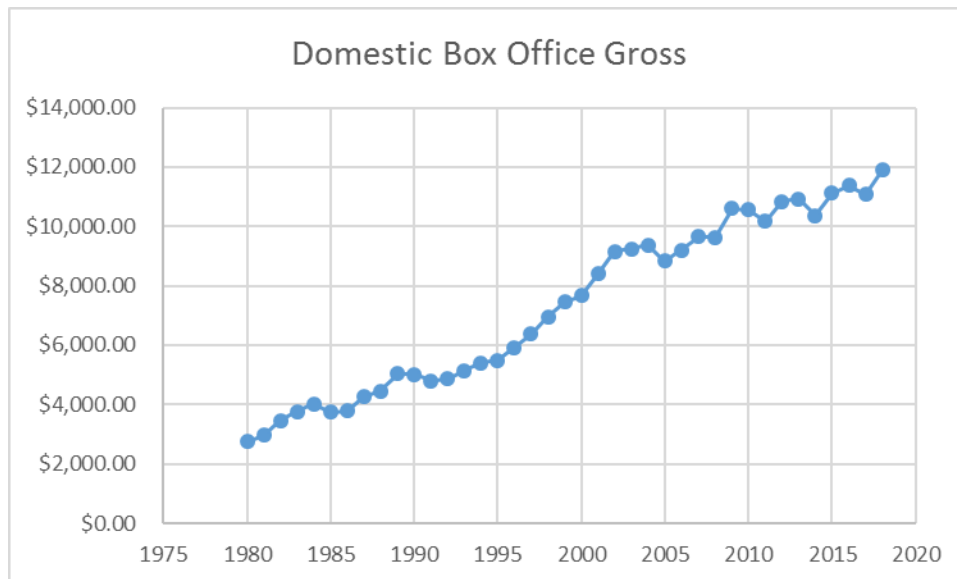
- Lee De Forest (invented the vacuum tube) indicated that space travel was impossible (Associated Press, February 25, 1957).
- In the January 1909 issue of Scientific American, the editor noted that the automobile had reached its limit of development.
- Microsoft CEO Steve Ballmer postulated that the iPhone would not get any significant market share (USA Today, April 30, 2007).
- After meeting with Adolph Hitler, Prime Minister Neville Chamberlain predicted a peaceful future for Europe (speech on September 30, 1938).
- John Langdon-Davis wrote in his book A Short History of the Future (1936) that democracy would be eliminated by 1950.

This is just a shortlist of the major predictions gone bad. It does not take a lot of research to find many more examples. There are many bold predictions made with great bravado that do not turn out to represent any semblance of reality. However, in the world of innovation, we find a lot of examples in which the world of technology and the world of consumer wants and needs had symbiotic relationships such that the entire industry shifted. This article referenced the fishing villages of India earlier in which the communications between fishermen and consumers enabled the whole social network to move away from poverty. More specifically, in recent years, the world has watched farming make greater and greater use of technology.

In our farming example, we will focus on the tractor - a simple product that hauls tillers, planters, and other equipment to prepare the land to produce crops. At one point, this product evolved into a smart product such that the tractor had a variety of accessories that enabled more efficient land production, such as air-conditioned cabins and GPS devices to guide more useful preparation. Eventually, tractor manufacturers made use of technology to make the tractor a smart connected product such that it was integrated into a more extensive system. As the farmers tilled the land, they could take soil samples to determine what nutrients the soil needed for optimal production of whatever crop was best suited. Once these samples were taken, the tractor became part of a product system that identified by square meter what nutrients were needed to prep the soil for planting and that data was entered into the tractor fleet of smart tillers, planters and chemical distribution systems that would optimize the land for the chosen crop to grow and raise yields. This all eventually became part of a network of systems in which farm equipment data interacted with irrigation systems and weather data to further optimize crop yields. Overall, combining the ever-changing world of available technologies with the ever-

changing needs of the farming community served to greatly improve the industry. It is essential to recognize that the innovator needs to focus on the changes on three different fronts: the world of emerging technology, the changing needs and wants of the end-user, and the interaction between the first two fronts that can be brought to useful commercial value. This is the evolution from a single product to be incorporated into a system of systems.

This symbiotic relationship can also lead to faulty predictions. For example, it was generally understood in the movie industry that once videos and DVDs of movies were readily available, that people would considerably slow their attendance at the local movie theatre. As it turns out, the data for the American moviegoer, as measured by gross revenue, can be found in the below graph.



Data Source: BoxOfficeMojo.com

As the graph indicates, people are still enjoying their time in movie theatres. In this case, the symbiotic relationship was mutualism – that is, both products benefited the movie studio producing the film as the studio benefited from sales of both movie tickets and DVDs. The small variations year-to-year are representative of the impact of major blockbuster movies being released. But what about videos and DVDs? This relationship would turn out to be symbiotic parasitism – meaning one product gains while the other suffers. In the chart below, we examine the change over several years in the preferences of consumers in the United States to purchase a DVD (physical media) or stream the movie over a connected device.

U. S. Consumer Spending	2014	2018
Physical Media	\$10.3 billion	\$5.8 billion
Digital media	\$7.6 billion	\$17.5 billion

Source: HIS Marketing and Digital Entertainment Group

As the data indicates, as the viewer chooses to view a movie in a more intimate setting such as at home or on their personal device, there is a decided shift away from DVDs to streaming the movie online.

In the VNI Report (2014), Cisco conducted a study that examined the consumption of online video with the increasing internet speed in several different countries – with both developed and developing nations included. The results were that there is a strong correlation between online video consumption and the speed of the internet available such that the higher the fixed broadband speed, the more a consumer is likely to view minutes of video. While this result appears to be common sense to those in the developing world, it was noteworthy that those in the developing world (such countries as Indonesia, India, Argentina, and Mexico were included) had the same trending lines as fixed broadband speeds increased. The parasitic relationship here is that as video broadband becomes faster, and access to internet viewing devices such as smartphones and tablets increases, DVD sales decrease.

Yin, Ansari and Aktar (2017) point to the inherent uncertainty in any perceived paradigm shift and note that major automakers have reacted to the increasing amount of technology embedded in their end product that they have set up offices in Silicon Valley to better anticipate technology development. This is the type of organizational flexibility needed within any ecosystem that is undergoing rapid change. At the same time, the manufacturer needs to be able to sufficiently differentiate itself to command premium pricing. Tesla currently has leadership in with the electric car concept while companies such as Bugatti or Lamborghini differentiate based on high performance and luxury. As the automobile industry continues to drive its innovation efforts, it will be interesting to see who will emerge as the new disruptors, who will have the strongest value network, and who will continue to strongly differentiate their product.

### **Conclusion**

In this article, we have served to add to the literature of innovation through the more specific identification of when a firm needs to consider jumping the curve to the next level of product or service attributes. In addition, a more precise definition of when a product or industry moves from being an incremental or radical innovation to becoming a true paradigm shift was introduced. This identification of a paradigm shift would require the thinking of a firm competing in that industry or market space to dramatically alter their thinking.

Inherent in the identification of significant innovative changes within an industry is the ability to identify the symbiotic context within which the change is occurring. In the case of movie watching used as an example, the choice between enjoying the theatre experience was only minimally hampered by the ability to watch a movie at a later date on a personal device. At the same time, the technology used to enjoy a film in a more intimate setting was greatly influenced by the ease of use and the instant gratification provided by streaming and downloading services. Indeed, the social environment dramatically affects the adaptation of an innovation. Researchers are encouraged to further test the theories presented in this paper.

**References**

- Afuah, A. (2003). **Innovation Management**. New York: Oxford University Press.
- Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management Decision*, 47(8), 1323-1339.
- Chhachhar, Abdul Razaque. (2012). Use of Mobile Phone among Fishermen for Marketing and Weather information. *Archives des Sciences -Geneve-*. 65. 1661-464.
- Christensen, C. M., Suarez, F. F., & Utterback, J. M. (1998). Strategies for survival in fast-changing industries. *Management Science*, 44(12), 207-S220.
- Henderson, R., & Clark, K. (1990) Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly*, 35(1).
- Kuhn, T. (1962). **The Structure of Scientific Revolutions**. Chicago: University of Chicago Press.
- Levitt, T. (1965). Exploit the Product Life Cycle. *Harvard Business Review*. Retrieved from: <https://hbr.org/1965/11/exploit-the-product-life-cycle>
- Rogers, E. (2003). **Diffusion of Innovations**, 5<sup>th</sup> Edition. New York: Free Press.
- Saville, R., Riani, E. & Hatanaka, K (2015). The role of mobile phone among small scale fishermen for life improvement and community support tool in Indonesian coastal area. *International Journal of Bioflux Society*, 8(6).
- Schubert, C. (2013). How to evaluate creative destruction: reconstructing Schumpeter's approach, *Cambridge Journal of Economics*, 37(2), 227–250.
- Utterback, J. (1996). **Mastering the Dynamics of Innovation**. Boston: Harvard Business School Press.
- Yin, E., Ansari, S., & Akhtar, N. (2017). Radical innovation, paradigm shift and incumbent's dilemma the case of the auto industry. *Future Studies Research Journal: Trends and Strategy*, 9(1), 138+.