



Diffusion of Innovations



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1. INTRODUCTION

New product innovation can be a highly effective means for modern corporations to create competitive advantage. However it also comes with significant risks. It is often assumed that good innovations will thrive by virtue of their inherent worth, but in reality many will fail. In fact, less than ten percent of the new products launched each year succeed (Cheng et al, 2007), and of those that do, most diffuse at a surprisingly slow rate (Rogers, 2005).

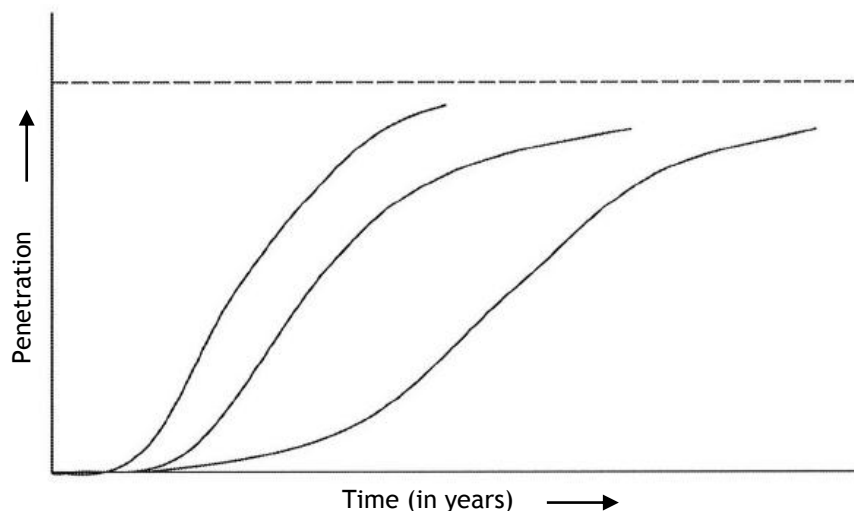
A key measure of a new product's success is its penetration of target markets. Penetration occurs by a process of diffusion, whereby the new product is gradually adopted by increasing numbers of people within a segment or within a society. By developing an understanding of why some innovations diffuse easily and rapidly, while others diffuse slowly, or fail to meet penetration objectives, innovators can maximise the likelihood that the new products they launch will succeed.

The objective of this paper is to understand how benchmark examples of relevant technology diffusion have succeeded, while also investigating the reasons many fail, even when the technology is sound.

2. INNOVATION DIFFUSION OVERVIEW

The diffusion of an innovation is often expressed as an S-shaped curve, depicting the percentage of a population that adopts a new product over a period of time.

Figure 2.1 Examples of S-shaped diffusion curves



The rate of adoption is indicated by the gradient of the diffusion curve and the size of the potential market is reflected in the curve's maximum height. Critical mass occurs at the point at which enough individuals have adopted an innovation to make its continued adoption self-sustaining.

A study by Ortt et al (2004) found that the diffusion curves for breakthrough communication technologies have historically taken a decade or more to accelerate after the first introduction. The same study also found that most breakthrough communication technologies are used initially in small-scale, niche applications that are nothing like the wide-scale, well known applications that they become associated with in the longer term. While not definitive, these small-scale applications have an important role in stimulating wide-scale diffusion of the technology.

Typically, breakthrough technologies that require new infrastructure, procedures and organisations to thrive will take longer to diffuse than those that can be applied within existing infrastructure and that can profit from de facto procedures and organisations. This is further

substantiated by the fact that in the 21st century, increasing connectivity is driving acceleration in the diffusion rates of new technologies, as the following table illustrates:

Technology / Application	Years to Reach 50 Million Users
Electricity	50
Telephone	50
Radio	38
Personal computers	16
Televisions	13
Mobile phones	11
Sony walkmans	10
Video cassette recorders	10
Digital cameras	9
eBay	6
DVD players	5
iPods	5
Internet	4
iTunes	3
AOL chat	2.5
Skype	2
Napster	1.5
MySpace	1

Source: Collier (2006)

2.1 DETERMINANTS OF THE RATE OF DIFFUSION

Widely regarded as the leading authority on innovation diffusion, Everett Rogers proposes that differences in the rate of diffusion can be attributed to a combination of “product differences” and “people differences”.

2.1.1 Product Differences

Research suggests that up to 87 percent of the variance in an innovation’s rate of diffusion can be attributed to the following five product characteristics, known as Roger’s Five Factors:

1. Relative advantage;
2. Compatibility;
3. Complexity;
4. Trialability; and
5. Observability.

Relative advantage refers to the degree to which a product is perceived to be better than the product it replaces.

Compatibility refers to the extent to which an innovation is perceived as being consistent with the values, past experiences and needs of potential adopters.

Complexity is the degree to which an innovation is perceived as being difficult to understand or use.

Trialability refers to the degree to which an innovation can be experimented with on a limited basis.

Observability is the degree to which the results of an innovation are visible to others.

A focus on product differences allows companies to understand and maximise the appeal of a new product. Firms should aim to increase the product’s perceived relative advantage, increase

its perceived compatibility with the values and norms of the target market, decrease its perceived complexity, increase its trialability and increase its observability.

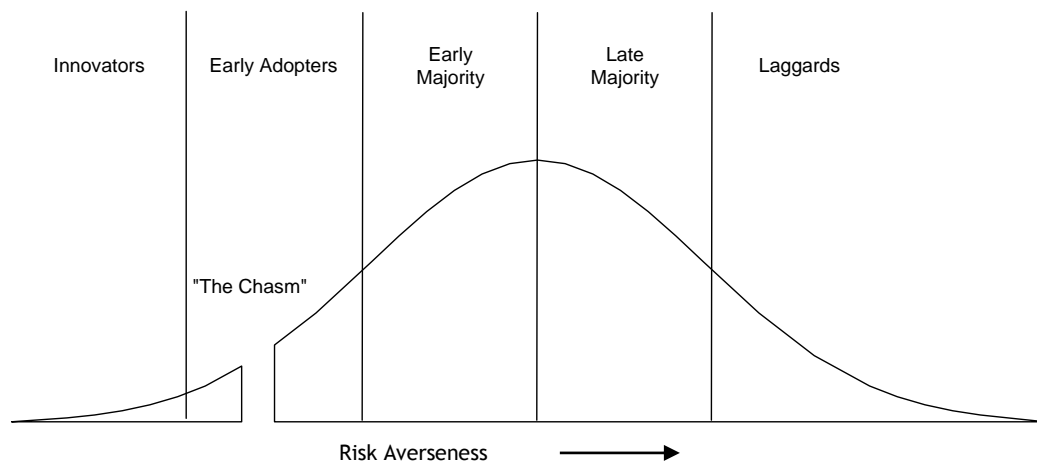
2.1.2 People Differences

Once a product's position in relation to Roger's Five Factors is known, the diffusion process is best managed by focusing on people differences. In his well-known book *Diffusion of Innovations*, Rogers divides potential adopters of a new product into five categories:

1. Innovators;
2. Early Adopters;
3. Early Majority;
4. Late Majority; and
5. Laggards.

The distribution of a population across these categories is described by a bell curve, with the propensity to adopt a new innovation being highest amongst the innovators and lowest amongst the laggards. This corresponds to an increasing risk averseness in each successive segment.

Figure 2.2 Technology diffusion model



Moore (1999) elaborates on this by proposing that the diffusion of a new technology is most likely to falter in the transition from the early adopters to the early majority, and expresses this visually as a “chasm” on the bell curve.

Through a deep understanding of the available market for a new product, and a knowledge of which segments are likely to adopt early and which are likely lag at the tail end of the bell curve, a firm can focus its limited resources on the customers that are likely to provide the greatest return on investment. Finding early adopters accelerates the rate of innovation diffusion and provides firms with valuable information that helps them refine their marketing program including segmentation, targeting, positioning and the four Ps.

2.1.3 Innovation Adoption Process

The innovation adoption process is described across five distinct phases:

1. Awareness
2. Persuasion
3. Decision
4. Implementation
5. Confirmation

Awareness refers to a consumer's acknowledgement of the presence of an innovation and is often driven by the intersection of need recognition with marketing communications.

Persuasion occurs when a consumer processes the available information associated with an innovation and considers the product's appeal based on this. Roger's Five Factors are the main drivers of persuasion.

Having considered the persuasion factors, the consumer will come to a *Decision* about whether to adopt or reject the innovation.

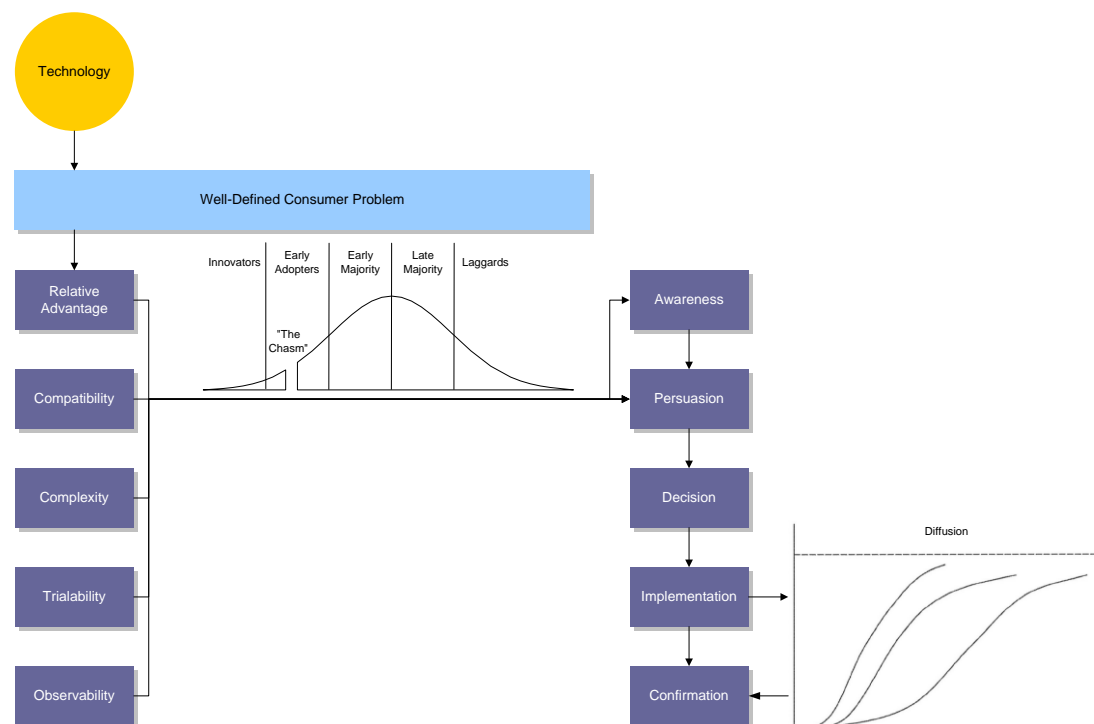
Implementation refers to activities undertaken by a consumer to engage with an innovation having made the decision to adopt it.

Confirmation is concerned with post-adoption behaviour exhibited by the adopter and is reinforced by the innovation's actual delivery against relative advantage, compatibility and complexity.

2.2 TECHNOLOGY ADOPTION AND DIFFUSION MODEL

By considering the way that product factors, people factors and the adoption process interact, we can begin to develop a model for technology adoption and diffusion. A technological breakthrough is only meaningful to consumers if it is linked to an application that solves a well-defined consumer problem. This application needs to perform well against Roger's Five Factors, and be positioned strategically to appeal to the categories of potential adopters, if it is to succeed. If the product factors and people factors are managed dexterously, the product will be more likely to fare well in the awareness and persuasion stages of the adoption process, leading to greater consumer acceptance and, ultimately, greater diffusion.

Figure 2.3 Technology adoption and diffusion model



3. INTERVIEWS

Interviews were conducted with the following international experts in innovation diffusion. Each interviewee has broad personal experience in high-tech industries and the rapid diffusion of new technologies.

Jim Plamondon is CEO of Thumtronic, a company he formed after making a breakthrough innovation in music theory and technology. Previously, Jim spent eight years as a Marketing Manager with Microsoft Corporation, where he was responsible for accelerating the diffusion of Microsoft's proprietary technologies by establishing them as de facto standards.

Andy Tarczon is a Founding Partner of The Diffusion Group, an analytics firm that has provided innovation diffusion advice to companies such as Hewlett Packard, Dell, Apple, TiVo, Intel, Motorola and Microsoft.

Martin Wells is CEO of Tangler, an Internet based discussion network that offers the next generation of web forums. Tangler is experiencing growth of over 30% per month and aims to host a quarter of a million forums by the end of 2009.

Bob Frankston, along with co-creator Dan Bricklin, developed Visicalc, the first electronic spreadsheet program, preceding Lotus 1-2-3 and Microsoft Excel. Bob also spent five years with Microsoft focusing on home networking.

4. INTERVIEW FINDINGS

4.1 CRITICAL SUCCESS FACTORS

Without exception, the interviewees identified having an outstanding customer value proposition as the number one critical success factor impacting the diffusion of innovations. Getting the offer right is more important than being first to market. The best value propositions are created when the new technology can be used to enhance an experience that the target market is already familiar with. For example, the DVD player, one of the most successful innovations of the last few decades, was an enhancement of the VCR.

In 2002, Accenture surveyed 3,500 consumers in five countries on the subject of business innovation. The study found that companies aiming to achieve competitive advantage through new product innovation needed to refocus their efforts on targeting actual customer needs. When asked "What benefits of innovative products and services are most valuable to you?", survey respondents answered as follows:

Benefit	Percentage
Improve my physical health/sense of well-being	52.2%
Help me learn, or provide intellectual stimulation	46.4%
Give me more free time	38.1%
Help me connect with friends and family	37.9%
Help me make the most of free time	37.2%
Help me make more money	34.9%
Help me pursue my interests/hobbies	33.6%
Provide me entertainment	32.2%
Promote my up-to-date image	6.3%

By ensuring that the innovation's value proposition stems from a real customer need, companies can maximise diffusion speed.

Another factor identified as critical is the ability to engage the innovator and early adopter segments. These two groups play an important role in the socialisation of an innovation through word of mouth communications, and failure to target them can lead to slow, or no diffusion.

To further accelerate the diffusion of an innovation, companies should try to ground their innovation in terms of something else which is familiar to the target market. For example, in the case of Tangler, potential users may not be familiar with the term "group discussion technology" but they do understand the meaning of a forum. Using language that is meaningful to target markets increases the likelihood of rapid diffusion.

According to Jim Plamondon, for an innovation to diffuse rapidly it must be simple, cheap, powerful and unique. Simplicity increases the likelihood that the target market can engage with an innovation successfully. Affordability makes the innovation available to a greater cross-section of people. Power refers to the degree to which an innovation meets people's needs. And if an innovation is unique, publicity and word-of-mouth communication will be maximised, contributing to market growth. Further, patent protection of a unique innovation allows a company to aggregate demand driving economies of scale, leading to reduced costs and the creation of additional value.

A final critical success factor is ensuring that the target market has a great experience when trialling and ultimately using the innovation. Apple has mastered this ability and used it over time to build a strong brand. Similarly, TiVo (a new brand in digital set-top recording devices) has focused on delivering fantastic customer experiences and is now beginning to see a return on this investment in brand.

4.2 THE TROJAN HORSE STRATEGY

There are many examples of high tech products that have used a Trojan horse strategy to achieve penetration into a market, by creating a compelling use through an anchor or linked application. For example, the Xbox can also be used as a set top box to channel digital movie downloads. Similarly, the PS3 doubles as a Blu-ray disk player. Social bookmarks manager del.icio.us started out as a way of storing bookmarks for people who use more than one computer. From there, by sharing all the bookmarks, it evolved into the world's largest bookmarked directory of the Internet. Similarly MySpace originally approached LA Indie bands offering to create them a free website. In return, the bands were simply required to put the MySpace link on the bottom of their promotional posters. Fans wanting to find out what their favourite bands were up to were channelled to the MySpace environment and the social networking business grew exponentially from there. The Java programming language is another example. Originally it was promoted as a language that would run on every platform and be completely secure. As it was adopted it became a "litmus test" for understanding the Internet. Programmers encouraged their employers to adopt Java because it was better for them as individuals and diffusion was maximised.

4.3 DIFFUSION TIMEFRAMES

What timeframe constitutes rapid diffusion? The Visicalc spreadsheet diffused to a critical level of penetration within three years, but that was considered extremely fast for a disruptive innovation and Bob Frankston emphasised that such rapid diffusion was an exception rather than a rule. Home networking was more representative of a typical diffusion timeframe, taking between five and ten years.

At Microsoft, Jim Plamondon's team would be given 18 months to achieve critical mass with a new technology, and two years was considered a long time.

According to Martin Wells of Tangler, in the delivery of virtual products such as web forums, it can take around 18 months from the inception of a new technology to the correct identification of an appropriate value proposition. Once a clear need has been identified and the message has been framed in language people can instantly understand, diffusion will increase dramatically.

Andy Tarczon of The Diffusion Group adds that new technologies that are essentially evolutions of existing technologies will diffuse much more rapidly than technologies that require whole new frames of reference and behaviours. For example, Apple's iPod did not take long to diffuse because people already understood the concept of mobile music thanks to groundwork done by the Sony Walkman and Diskman.

4.4 MINIMISING RESISTANCE TO INNOVATION ADOPTION

Resistance to innovation adoption usually occurs because the relative advantage of the innovation is not perceived or the learning gap is too great. Grounding innovations in the familiar is one of the best ways of avoiding this. For example, digital movie distribution is far more likely to succeed if it is television rather than PC-centric.

Resistance can be classified as presale or post-sale. Presale resistance is best combated with a well-designed value proposition and post-sale resistance can be managed with continuous education programs that help ensure the customer experience.

Another way to minimise resistance to an innovation is by having independent experts validate claims regarding the innovation's relative advantage. Equally effective is increasing the trialability and observability of the innovation so that potential adopters can experience or witness the innovation's performance for themselves.

4.5 WHY DIFFUSION FAILS TO OCCUR

When good innovations fail, the most likely reason is a lack of customer focus resulting in a poor value proposition. Other barriers to innovation diffusion are as follows:

- Customer expectations not met;
- No innovative advantage perceived;
- Information about product is scarce, unclear, or difficult;
- Need for product is not seen;
- Unique attributes not seen;
- Poor selection of target market;
- Poor communication of product benefits;
- Poor distribution channel selection; and
- Pricing problems.

4.6 BRIDGING THE LEARNING GAP

The best way to avoid creating an insurmountable learning gap for an innovation is by reducing complexity. Keeping things simple and transparent is a great way of maximising diffusion. Where complexity cannot be reduced, it is important to provide comprehensive and easily accessible training. It is also important to speak in terms of the target market's perceptual models and build from there.

Microsoft's strategy to bridge the learning gap was to produce support materials that aided the decision-maker and that complimented each stage of the technology adoption process. Microsoft would also train independent consultants in new technology free of charge to leverage this group's influence and capacity to generate positive word of mouth communications.

4.7 IMPORTANCE OF TECHNICAL SUPPORT

On one level, it is important to provide technical support to customers as a component of service delivery and to maximise the customer experience. On the other hand, the need to involve complex technical support can be an indicator that the innovation has already failed. Ideally, using the product should be intuitive to the point that technical support is not required. One way of managing this is to invest in the "out of box" experience, which companies like Apple do very well.

4.8 IMPORTANCE OF PROMOTION

In recent years there has been a tendency for technological innovations to utilise non-traditional means of promotion, particularly those that are Internet-based. Above the line advertising has become less prevalent as companies turn to cheaper alternatives such as PR and word of mouth, and more subversive forms, such as viral advertising.

4.9 PRICING STRUCTURE

The strategy of giving away a new technology for free or below cost to maximise diffusion is valid but can be risky. While it is often excellent business to give away one product in order to sell more of its high-margin peripherals, companies engaging in this kind of strategy must always be entirely clear on how they will drive ongoing revenue.

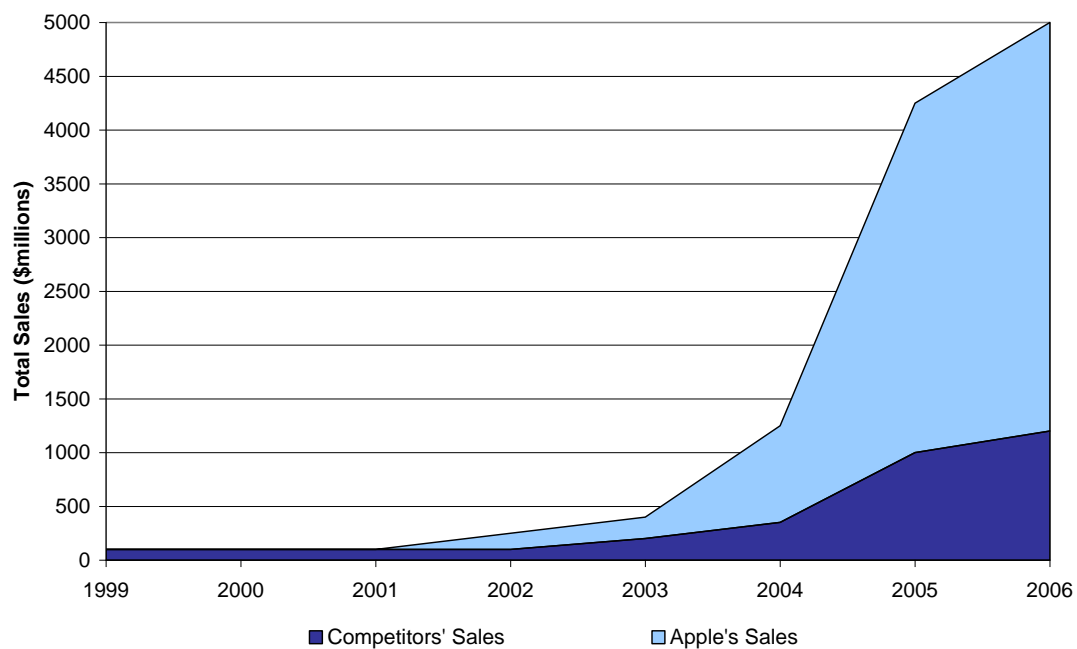
5. CASE STUDIES

5.1 EXAMPLES OF SUCCESSFUL DIFFUSION

5.1.1 Apple iPod

The first digital music players became available in the U.S. in 1998. In 2001, when Apple released the iPod, total digital music player sales had been plateauing at approximately \$100 million for three years. By 2006 iPod sales had grown exponentially and Apple controlled more than 75% of a \$5 billion market.

Figure 5.1 U.S. digital music player sales 1999 to 2006



Source: Peterson (2007)

There were several factors that contributed to the enormous success of the iPod. Despite entering some three years later than its competitors, Apple was able to quickly gain traction in the emerging digital music player market by leveraging its considerable design and manufacturing expertise, as well as the strong brand recognition already associated with its name.

But perhaps more importantly, Apple benefited from the previous product releases. By observing the behaviour of the innovators and early adopters who understood the technology and could articulate what they wanted from a digital music player, Apple was able to clearly define the consumer need for the first time - as "the ability to easily purchase, store, access and enjoy music". By framing the technology within a compelling value proposition, and providing customers with a fantastic usage experience, Apple set the imaginations of the early and late majorities alight and sales exploded.

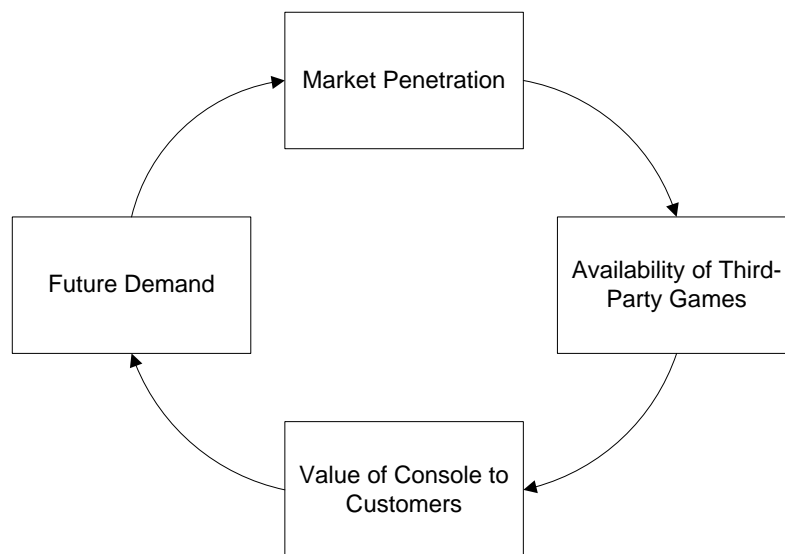
5.1.2 Nintendo Wii

For the past two decades, competition in the video game console industry has centred on providing better quality graphics, more sophisticated game play and a wider array of games. Nintendo have turned this on its head with their Wii console and an innovative strategy to reach the non-gamer market by making game play simpler and more intuitive, and to offer the experience at a more affordable price point. The primary enabler for this strategy has been the development of a chip embedded in the Nintendo Wii controller that can sense movement in three dimensions.

Nintendo's competitors Microsoft (with the Xbox 360) and Sony (with Playstation3) typically incur a loss on each console they sell with the aim of saturating the market and reaping the benefits of subsequent software sales. By contrast, Nintendo makes a profit of around US\$50 on every unit, despite selling its console for less than half the price of a PS3 and under two thirds the price of an Xbox. In the U.S. in June 2007, the Wii console was selling at twice the rate of the Xbox, and four times the rate of the PS3.

Meanwhile, the attractiveness of the platform to third-party game developers is increasing as a result of the Nintendo Wii console outselling its competitors. This creates a virtuous circle of demand for the Wii.

Figure 5.2 Virtuous cycle of demand for the Nintendo Wii



5.2 EXAMPLES OF UNSUCCESSFUL DIFFUSION

5.2.1 Sony Betamax

When the video cassette player market emerged in the 70s, the Betamax format was introduced a full year before the VHS format, and to this day is reputed to have been the better of the two in terms of quality. Despite this, it did not prosper. One likely reason for this is that a lack of any market research before introducing the format meant that Sony failed to identify that consumers required a two hour minimum tape capacity before they would even consider making a purchase. Beta's one hour capacity fell well short of this. Also, at the time of launch, Betamax video recorders were bundled with colour TVs and advertised at a high-end price point. This led to the perception that Betamax was targeted at the luxury market. Compounding this, Sony formed a joint venture with Paramount Home Video to sell Paramount's feature films on video cassette and priced them at \$79.95. Meanwhile VHS tapes were being sold profitably at \$29.95. And finally, Sony failed to target the Betamax at the innovator and early adopter segments. Betamax was the only VCR on the market for the first year after launch. Despite having first-mover advantage, the Betamax format failed, due in large part for a complete disregard for consumer preferences.

5.2.2 Philips CD-I

The Philips Compact Disk Interactive entertainment system (CD-I) combined television and audio compact disk technology in an interactive system and was expected to carry Philips' performance into the 21st century. However, diffusion of the CD-I was much slower than anticipated. A key reason for this was that Philips failed to engage the innovator and early adopter segments, instead focusing their market strategy from the outset on the profile of the targeted customer - married with school aged children, technologically advanced and relatively affluent. Additionally, at the time of launch in 1991, the product was missing some of the

features that had been planned for inclusion, meaning that there were some inconsistencies between the advertising campaign and the product experience. The distribution channels selected for the launch did not include any stores associated with an image of high tech sophistication and therefore did not substantiate the product's leading edge positioning. And finally, the price dropped several times following the product's launch, undermining the image of quality. In summary, a failure to target innovators and early adopters at the beginning of the campaign, combined with confusing signals from the marketing mix led to slower than expected diffusion and low penetration.

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