A System Dynamics Analysis for the Complementary Integration of Online Contents Distribution Businesses and Electronic Payment Businesses

by

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ABSTRACT

Problems are occurring in the digital business economy as companies try to realize a tangible profit. As network infrastructures improve, the value of information becomes less and less since marginal costs for digital goods is practically zero and searching the cost of goods is also extremely low. How, then, can the media industry remain profitable in the digital business economy? One way to retain the value of digital goods is through the use of firm governmental regulations, but this is still insufficient because of the ever-expanding network infrastructure and the growing threat of piracy.

This thesis discusses potential strategies to be used in today's digital business economy based on current difficulties. It proposes an integrated business model for an on-line contents distribution business and an electronic payment business which complement each other.

It is well-known that content distribution businesses are facing severe threats from piracy. By providing content for free as a complementary service for profitable businesses, it will be shown that media distribution companies can maximize the value of their contents library, which would otherwise be worthless in face of growing piracy.

The thesis also discusses the migration process in an integrated business model by utilizing a System Dynamics approach to the analysis. The electronic payments business is regarded as a profit driver that can be complemented by the attractive value proposition of free online contents distribution businesses. For an infrastructure-oriented business like electronic payments, broad acceptance of such a service is critical to reducing customers' perceived risk. By introducing free content downloads, a business strategy is proposed that accelerates customer penetration and rapid migration to a profitable and integrated business of online contents distribution and electronic payment. By combining these two potentially successful two business models, a profitable business integration is proposed in which each business supplements the other in the digital business economy.

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Chapter 1

Problem Scope and Statement of Objective

1.1 Introduction

The digital business economy is experiencing difficulties realizing a profitable business in the contents distribution business. As network infrastructures improve, information on the network is becoming more commoditized because of low exchange costs and potential piracy which disrupts the profitable digital business value chain (Shapiro, 1998). Facing commoditization of the information, then, how can the media industry continue to earn a profit in the digital business economy? Is there a successful business model that would help counter the epidemic piracy problem?

I will discuss the ongoing difficulties of the online contents distribution industry, which is facing severe threats of piracy, and then propose a business scheme for the contents distribution industry, focusing on potential business integration with complementary businesses (Brynjolfsson et al., 1992) such as the electronic payment business.

I begin by surveying the background of the online content industry (Chapter 1 and Chapter 2). Then I discuss examples of new business tools, business strategies, or new technologies, which I could leverage or refer to as having successfully fostered new business strategies (Chapter 3). After discussing potential business tools for implementing new business strategies, in Chapter 4 I construct System Dynamics models (Sterman, 2000) for an Online Contents Distribution business as the target business and an Electronic Payment business as the complementary business. I have characterized and run the proposed model to simulate the decline in profits suffered by the U.S. music industry due to piracy. I have designed the model as feasibly precise as possible. In implementing the Electronic

Payment business into a System Dynamics model, I base the European market case on that market's use of the advanced Smart Card. In Chapter 5, I propose a business model that integrates the Online Contents Distribution business and Electronic Payment business, followed by System Dynamics models for those businesses. I also process scenario projections under a variety of conditions, including governmental initiative, industrial initiative, managerial actions, and business model propositions, revealing dominant influences and outcomes. Chapter 6 summarizes my findings and conclusions.

1.2 Music Industry Overview

Exhibit 1.1 highlights the diminishing sales revenue currently occurring in the U.S. music industry. As shown, the number of CDs sold grew from 1992 to 1999, with the growth rate of around 15%, but then dropped precipitously to 0.4% in 2000 and declined even further to -6.4% in 2001. Worse than CD album sales were revenues for single CD sales. Those numbers declined 44.4% in 2001 and 75.3% in 2002. On the other hand, the number of DVDs sold increased from 1999 to 2002, reflecting the ongoing motivation of customers to purchase entertainment.

Table 1.1 Sales Revenues in the U.S. Music Industry

		93	94	95	96	97	98	99	2000	2001
CD Sales	Units	495.4	662.1	722.9	778.9	753.1	847.0	938.9	942.5	881.9
	Dollar	6,511.4	8,464.5	9,377.4	9,934.7	9,915.1	11,416.0	12,816.3	13,214.5	12,909.4
%Change	Units	21.6%	33.6%	9.2%	7.7%	-3.3%	12.5%	10.9%	0.4%	-6.4%
	Dollar	22.2%	30.0%	10.8%	5.9%	-0.2%	15.1%	12.3%	3.1%	-2.3%
CD Sales	Units	7.8	9.3	21.5	43.2	66.7	56.0	55.9	34.2	17.3
Single	Dollar	45.8	56.1	110.9	184.1	272.7	213.2	222.4	142.7	79.4
%Change	Units	6.8%	19.2%	131.2%	100.9%	54.4%	-16.0%	-0.2%	-38.8%	-49.4%
	Dollar	1.6%	22.5%	97.7%	66.0%	48.1%	-21.8%	4.3%	-35.8%	-44.4%
DVD Sales	Units	-	-	-	-	-	0.5	2.5	3.3	7.9
	Dollar	-	-	-	-	-	12.2	66.3	80.3	190.7
%Change	Units	-	-	-	-	-	-	400.0%	32.0%	139.4%
	Dollar	-	-	-	-	-	-	443.4%	21.1%	137.5%

Source: RIAA, 2003.

What was behind diminishing CD sales beginning in 1999? Some say the economy was slow and that the tragic events of September 11, 2001 interrupted fourth-quarter plans. But a large factor contributing to the decrease in overall shipments in 1999 is online piracy and individual CD-burning. Just as in the late 1980s the newly introduced 3.5-inch disk-drive technology overwhelmed the 5-inch disk drive in the hard disk drive market, so have today's new peer-to-peer, free file-sharing programs disrupted the music distribution industry, even as the industry continues to focus solely on the traditional CD retailing value chain. While the music industry began to discuss client/server-type online music distribution with strict copyright management, free "underground" file-sharing programs appeared and quickly attracted a huge customer base, causing the traditional music distribution industry to suffer, as Exhibit 1.1 showed. Some consumers no longer buy music because they download or copy music for free. According to a recent survey of 2,225 music consumers between the ages of 12 and 54, commissioned by the RIAA (L'Ecuyer, 2002), 23% said they bought little or no music in 2001 because they instead downloaded or copied most of their music for free. Such actions are causing the music distribution supply chain to shift from a traditional CD-retailing supply chain to a file-sharing supply chain. File-sharing technology is becoming a dominant technology in the music distribution value chain because file sharing technology is so prevalent that financial deficits due to file-sharing are almost negligible. The need is to acquire a profound understanding of innovative technology, either as business driver or threat, and to counter undesirable business dynamics with business dynamics innovations that utilize new technologies or a new business scheme.

According to Utterback (1994), the innovation cycle is roughly divided into three phases: Fluid, Transition, and Specific. Controversial free file-sharing programs such as Napster or Gnutella, are becoming the dominant technology in the Fluid stage. Even though government regulations somewhat affect the spread of file-sharing programs, the fact is that when is quashed, similar programs will follow, reinforcing the piracy problem. (I will discuss this factor in greater detail utilizing System Dynamics Analysis in Chapter 5.)

My questions are:

- Can we prevent piracy which is largely reinforced by the epidemic of file-sharing programs?
- What is the appropriate strategy for the Online Content Distribution industry in order to properly control the file-sharing problem and turn the unprofitable content distribution business into one that is profitable?

It was 1999 when Napster first appeared on the market and quickly obtained 65 million users worldwide within one year—the same year revenues from single-CD sales turned negative. By 2000, those same sales had dropped off 36%. The negative impact of free file-sharing programs cannot be ignored by the music industry or by the content distribution industry in areas such as movie or game software distribution.

1.3 Economic Impact of Piracy on the Music Industry

Let's suppose that there had been constant growth in 1999-2000, with a growth rate of 12%. Then expected CD sales, in both number and dollars, without a piracy problem would look something like the following:

Table 1.2 Expected CD Sales Revenue without Piracy

		(in Millions, net after returns)		
		99	2000	2001
CD Sales	Units	938.9	1051.6	1177.8
	Dollar	12,816.3	14,743.7	17,240.2
%Change	Units	10.9%	12.0%	12.0%
	Dollar	12.3%	15.0%	16.9%
CD Sales Single	Units	55.9	62.6	70.1
	Dollar	222.4	261.2	321.8
%Change	Units	-0.2%	12.0%	12.0%
	Dollar	4.3%	17.5%	23.2%

Source: RIAA, 2003.

Based on the projections in Exhibit 1.2, the economic impact of piracy on the music industry can be roughly calculated as follows:

Year 2000: $(14,743.7+261.2) — $(13,214.5+142.7) = $1,647.7 million = **$1.65 billion**

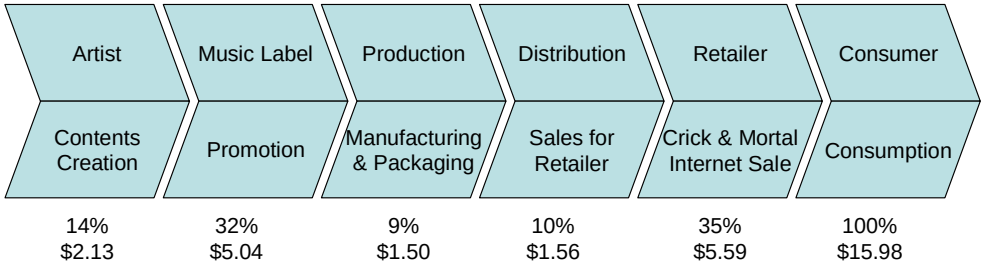
Year 2001: $(17,240.2+321.8) — $(12,909.4+ 79.4) = $4,573.2 million = **$4.57 billion**

While only a rough estimate, these calculations illustrate the music industry's loss each year due to piracy.

Fine (1998) explains the importance of an appropriate design for the value chain. Along with the industry's accelerated clock speed, especially in the digital business economy, firms are under pressure to put in place appropriate value chain designs with three-dimensional concurrent engineering and taking into account horizontal and vertical integration of the supply chain. Without proper value chain design, a firm would easily lose competitiveness by upstream or downstream integration. The key findings I took from Fine are how to maintain the competitive dynamics between suppliers and buyers. Once collapsed, the chain would lose its mutual link, thus diminishing expected profit.

In the content distribution industry, digitized content and a lack of digital rights management (Lyon, 2001) have had a huge affect on the collapse of the music distribution industry. A successful engagement that eases copyright management leading to profitability in the CD retailing value chain (see Figure 1.1) is that the digital contents are delivered via CD media, in conjunction with copyright protection in the CD-retailing value chain. As shown in Figure 1.1, a designated amount of revenue, represented by the percentage below each stage, is distributed to each value stage.

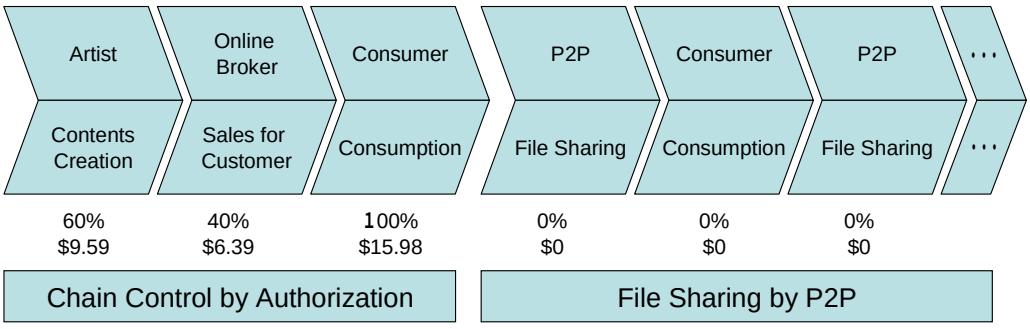
Figure 1.1 CD-retailing Value Chain



Source: RIAA, 2003.

On the other hand, a file-sharing program turns a CD-retailing value chain into a file-sharing value chain, as shown in Figure 1.2.

Figure 1.2 File-sharing value chain



Source: Author, 2003.

In the file-sharing value chain, identity authorization is becoming the key technology to properly manage copy protection (Shapiro, 1998). Once downloaded, digital contents are easily exchanged for free, and there is no effective identity authorization control scheme to protect illegal, repeat file-sharing of downloaded digital contents. In Figure 1.2, once digital contents are downloaded to consumers, illegal file-sharing is continually repeated among digital contents holders. File-sharing programs encourage such illegal file-sharing by providing an information exchange

platform for peer-to-peer connection without allowing a central server to censor illegal file-sharing activity. Some might say, “A file-sharing program is simply enabling personal file exchanges,” but the negative impact of free file-sharing, which has led to huge deficits in the music industry, cannot be ignored. It is urgent that concrete strategies for countering piracy, and protecting eligible copyright, and building a profitable music distribution business, be defined.

1.4 A System Dynamics Model of Business Diffusion

Understanding that the threat posed by piracy might easily explode into an even larger problem, I have developed a business model strategy to counter or at least contain the epidemic piracy problem. To devise a feasible business model, a profound understanding of the issuing industry and of consumer preferences must first be elaborated, while allowing successful scenarios to emerge.

In earlier studies, James M. Lyneis (1993) utilized a system dynamics model to understand the activity of an R&D organization and to devise a strategic decision-making scheme for an R&D organization. Masahisa Kawashima (2002) applied system dynamics to prove consumer preferences in various phases of business diffusion. Karin L. Knoll (1995) utilized system dynamics to elaborate successful scenarios of technology diffusion into newly evolved markets. System dynamics models are quite useful for analyzing and forecasting industry dynamics, especially in situations where factors such as consumer preferences as willingness or risk perception strongly affect the diffusion of the business.

In this thesis, I utilize system dynamics analysis to understand business diffusion, consumer preference, and technology diffusion, and to develop forecasts for the industry under different scenarios of governmental initiative, industrial initiative, and managerial actions. In addition, I also developed scenarios for profitability and the feasibility of a newly proposed integrated business model for an Online Contents Distribution business and an Electronic Payment business.

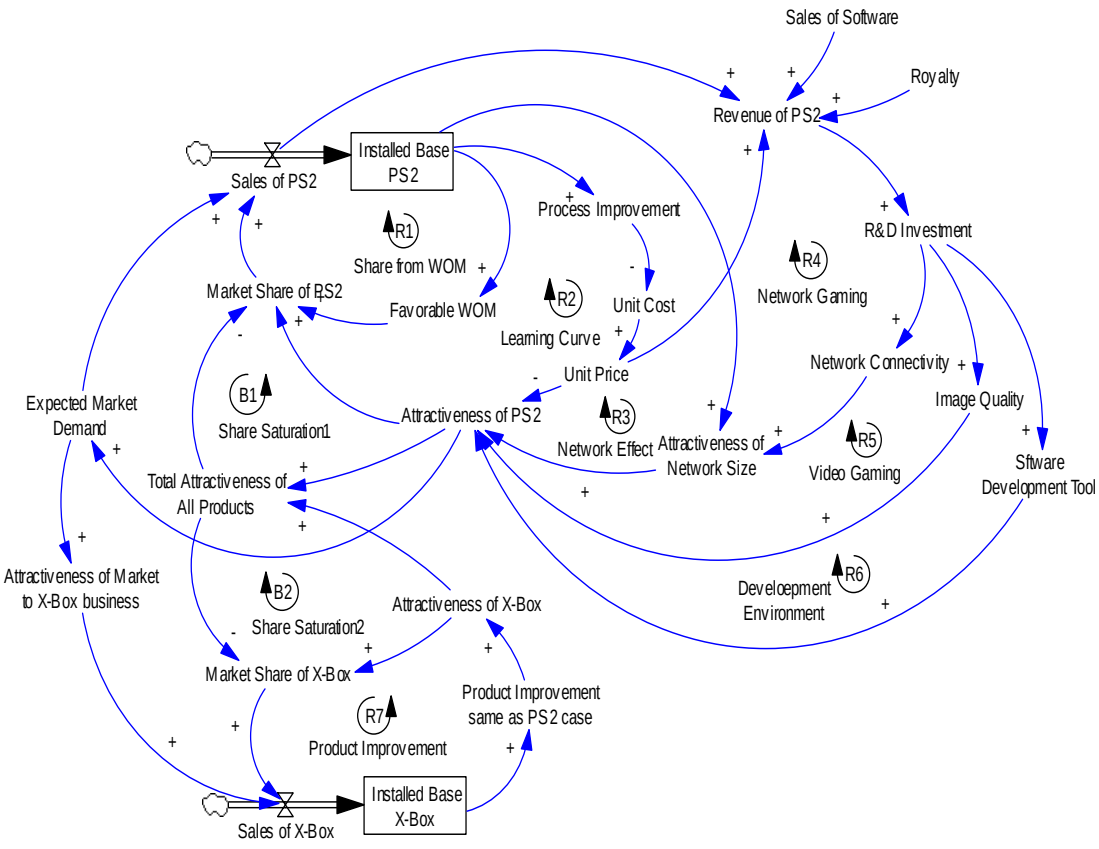
1.4.1 Understanding System Dynamics Analysis

To properly understand the capability of system dynamics analysis, I devised a sample system dynamics model describing the competitive business diffusion of PlayStation 2 (PS2) business and the X-Box business in the video game business. I will explain how the system dynamics model works using this sample model.

In the case of PlayStation2, effective new technology development by Sony and a large number of software developers are two major advantages compared to the X-Box business, which led PS2 to success. I believe Sony's strategy for its PS2 business is the following, based on the sample model I constructed, which is in Figure 1.3.

- PS2's critical strategies of high imaging quality and networking connectivity are highlighted. Both contribute to the growing attractiveness of PS2 (R4 and R5 in the model diagram).
- Continual development of the Software Development Kit (SDK) enables PS2 to maintain close relationships with software suppliers, thus encouraging development leading to higher-priced software in the market as well as PS2's attractiveness (R6).
- Networking is a critical issue for PS2 to resolve as it faces the powerful network connectivity of X-Box, which has strong ability to provide various network-related games which significantly improves the attractiveness of X-Box.

Figure 1.3 System Dynamics Model for PS2 and X-Box



Source: Author, 2003.

The networking capability of X-Box threatened PS2's R&D leadership in the gaming market which forced PS2 to add this new value. As shown in the diagram, this is one beauty of system dynamics modeling—to reveal critical industrial factors by directly describing relationships in a proposed business. Each connection represents both qualitative and quantitative relationships, and shows the relative respect among the factors. We are able to learn this by modeling the competitive business situation between PS2 and X-Box. I will utilize system dynamics analysis in both qualitative and quantitative analyses in Chapters 4 and 5.

1.4.2 A Conceptual Model for Complementary Business Integration

I am proposing an integrated business model of the Electronic Payment business, with Free Content Distribution as a complementary business, as shown in Figure 1.4. This model explains how the integration of these two business models supplements each other to absorb and counteract the piracy problem. Clearly, an Online Content Distribution business would suffer huge negative impacts due to piracy. The idea is that giving up profitability from a legal Content Distribution service and providing such service for free as a complementary service of an Electronic Payment business that is already profitable would reinforce a service like Content Distribution. Apparently, content distribution lacks a profitable business structure even though it provides concrete value by distributing content to users. At the same time, the Electronic Payment business appears to lack sufficient value for users even though it represents a huge business opportunity with the potential to replace all payment transactions as well as bring in commission revenues once adopted.

The idea of integrating the two businesses is to motivate user adoption of the Electronic Payment business by freely offering added value via the Contents Distribution service which is otherwise unprofitable in its current market situation. One possible implementation for an integrated business model is to utilize Free Download Player, with the Electronic Payment business competing against an MP3 Player. Free Download Player is capable of legally receiving free content distribution service rather than just playing back MP3 music. This concrete value proposition of free content download should result in wide adoption of Free Download Player in the market, thus beating out MP3 player. Once widely adopted, Free Download Player would provide the additional value of Electronic Payment to users who might not otherwise have an opportunity to deal with the Electronic Payment scheme. Hopefully, wide adoption of Free Download Player would accelerate wide adoption of Electronic Payment, thus reinforcing the proposed value of both features via one device.

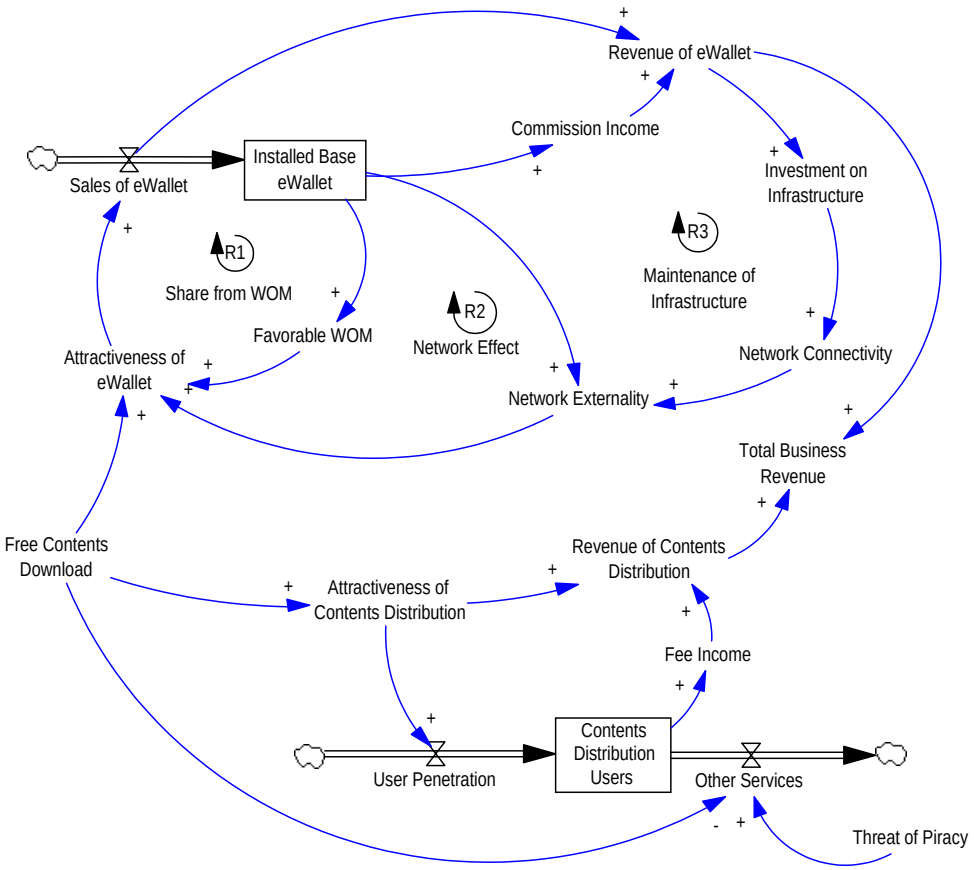
By providing complementary services {Parker, 2000; Brynjolfsson et al, 1992), I expect an additional reinforcing feedback loop, Word of Mouth, to lead to improved attractiveness of Electronic Payment, as shown in Figure 1.4. Furthermore, the increased number of customers

reinforces network externality as well (Shapiro, 1998), thereby creating additional attractiveness of the Electronic Payment business.

In this model, the Electronic Payment business is expected to be the profit driver for entire integrated business model. It is widely believed that customer penetrations coupled with a killer application are the keys to the explosive growth of such Electronic Payment applications as Wireless Mobile Electronic Payment (Balsan, 2002).

In this thesis, I will discuss the profitability and feasibility of an integrated business model of Electronic Payment businesses and Free Contents Distribution businesses as the killer business model in the unprofitable Online Contents Distribution industry.

Figure 1.4 Conceptual Model of Complementary Business Model



Source: Author, 2003.

1.5 Summary

In this chapter, I have discussed the ongoing difficulties encountered by the online content distribution industry by showing diminishing financial data. It is assumed that the diminishing music distribution industry comes primarily from an epidemic of file-sharing activities that pirate the contents of profitable content distribution businesses. The evidence provided correlates diminishing music industry revenue and emerging file-sharing program to reveal the importance of countering piracy in order to maintain a profitable music distribution industry.

I also confirmed that newly emerging file-sharing programs disrupt a profitable content distribution value chain by eliminating the profit-withdrawing stages of the CD-retaining value chain due to illegal file exchange activities among digital content holders. This value chain projection also shows that the threat of piracy disrupts the profitable content distribution value chain and highlights the need to implement a counter-strategy against piracy. To develop a feasible solution for countering these ongoing difficulties, a strong understanding of the issuing industry is necessary, allowing successful scenarios to emerge.

I will utilize system dynamics analysis as the primary tool for investigating the ongoing and would-be industry. I developed a sample system dynamics model of the game industry to help the reader understand the capability and methodology of system dynamics analysis along with heuristic findings. Furthermore, I proposed a conceptual model that integrates an Online Contents Distribution business and an Electronic Payment business as one solution for countering piracy. I discussed the concept of complementary integration of two businesses that resonate and supplement the benefits and shortcomings of each business. I also discussed the causal effects of the proposed model and revealed the possibility of such a business integration.

To answer the opening question: “How can the content distribution industry maintain profitability in a digital business economy?,” I will use the integrated business model as a possible answer and then prove its feasibility in the following chapters.

Chapter 2

Industry Background and Required Technology

2.1 Introduction

In this chapter, I will discuss the ongoing situation facing both the online content distribution industry and the electronic payment industry. Both industries have similar difficulties in migrating to next-generation infrastructure even though their respective ongoing business schemes are facing cumulative troubles. For instance, the content distribution industry faces serious problems with piracy and is further threatened by widespread file-sharing programs. The electronic payment industry's newly proposed Smart Card payment scheme is lagging even though their new payment scheme offers additional security to customers. In each case, both the industry and government are trying to take initiatives to accelerate migration to a new business scheme, somehow hoping to encourage migration into the next scheme.

In this Chapter, I explore the current situation of the industry as well as supplemental business enforcements, such as legal punishment by the government or an industry standard upheld and pursued by the industry itself which will somehow affect business dynamics. I also discuss the impact of supplemental factors on business model migration.

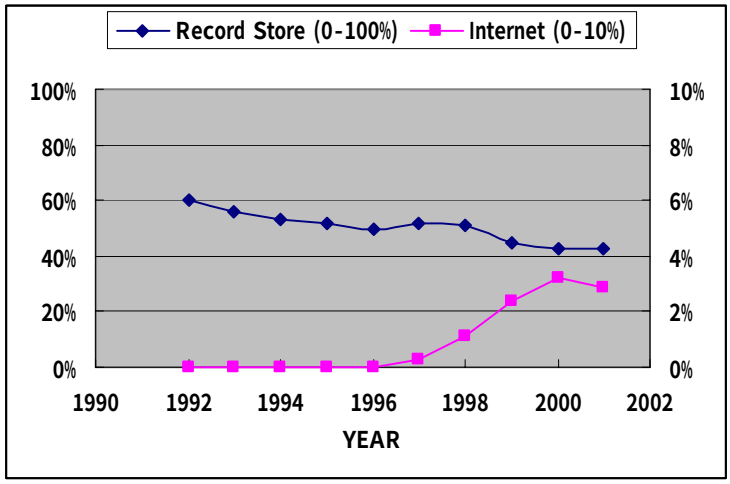
2.2 The Online Content Distribution Industry

2.2.1 Downward Trend of the Music Industry

As discussed in Chapter 1.2 and illustrated in Exhibit 1.1, the U.S. music industry has spiraled downward since the beginning of 2000. This can be explained by a general malaise in the world's economic condition as well as fierce competition from other leisure products such as mobile communication products and computer games. However, another, more likely, explanation is widespread illegal file-sharing and copying to CD-Rs which continues to adversely affect overall CD sales, which were down 6.7 % to $12,044 million in 2002. Figure 2.1 shows consumer preferences over time regarding where to buy music content.

The figure shows obtaining music on the Internet became a major factor in the late 1990s, along with solicit Internet penetration into the market. As CD purchases on the Internet grew over time, CD purchases at record stores declined, reflecting the consumer's growing preference toward online CD purchasing. With the mood of consumers continuing to shift toward online CD purchasing, illegal file-sharing schemes further motivated consumers to share illegal file content online, which further reduced CD revenues from online CD sales in 2001, as shown in Figure 2.1.

Figure 2.1 Consumer preferences for buying music content

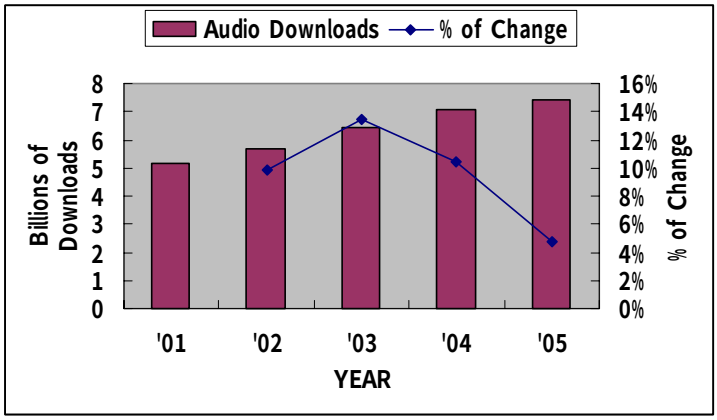


Source: RIAA, 2003.

2.2.2 The Number of Illegal File-Sharing Programs and Users

Even after the controversial Napster scheme was declared illegal and shut down, illegal file-sharing users continued to grow, largely in the form of 140 million KaZaA users by the end of 2002, twice as many as Napster held at its peak (Snyder, 2003). Weekly downloads of current P2P applications from KaZaA occurred 3,145,095 times during the week of Jan 6-12, 2003. Another second-tier P2P application, iMesh, allowed 440,887 downloads during the same period. These extraordinary numbers reveal concrete demand by consumers for free file-sharing applications no matter whether it is illegal or not. According to a Yankee Group estimation (Goodman, 2002a), consumers age 14 and older in the United States downloaded an estimated 5.67 billion audio files via unlicensed file-sharing services in 2002. In 2003, the same consumer base will download 6.43 billion files—a growth rate of 13.4%, revealing enormous demand by consumers for file-sharing, as shown in Figure 2.2. Even with supreme effort on the part of content owners to protect their existing business, users will continue to use unlicensed file-sharing programs such as KaZaA, Morpheus, and LimeWire, as shown in Figure 2.2. Government and industry are being forced to take action against illegal file-sharing in order to protect profitable business models.

Figure 2.2 Audio Downloads via Unlicensed File-Sharing Service



Source: The Yankee Group, 2002.

2.2.3 Industry and Government Initiatives Against Piracy

2.2.3.1 Government Initiatives

Today the problem of piracy is occurring everywhere. For instance, one user in Europe can easily download music from the file-sharing server of another user in the U.S. via an Internet connection. Although there is no international copyright law to prevent such illegal pirating, many treaties among countries have been signed, demonstrating the intent to respect each country's copyright laws. In the U.S., many states have their own laws that support federal law and provide government penalties for music piracy.

The No Electronic Theft (NET) Act was enacted to more directly regulate legislative penalties against piracy of digital contents. The NET Act censors illegal use of digital content by downloading, e-mailing, chat services, or reproducing in any manner. The NET Act sets penalties of up to three years in prison and $250,000 in fines, even if there no financial gain was achieved or sought. The NET Act regards receipt or expectation of any value as an exchange of value that should be penalized regardless of whether the activity is for profit. Repeat offenders can be imprisoned for up to six years (RIAA, 2003).

Following the NET Act, the Digital Millennium Copyright Act (DMCA), a more comprehensive reform of copyright law, was enacted in 1998. The DMCA includes key issues such as the circumvention of copyright systems, fair use in a digital environment, and online service provider liability (U.S. Copyright Office, 1998).

Ending the threat posed by Napster via legislative enforcement in 2000 seemed, at first glance, to point to successful legal efforts against piracy. But in reality, the impact of legal efforts against unlicensed file-sharing is still low. Furthermore, the more strictly legal efforts are enforced, the more unlicensed file-sharing services are motivated to go offshore where no copyright law exists (e.g., Sharman Networks in Vanuatu) or copyright low are far looser (e.g., Listen4ever.com in China) (Goodman, 2002c).

As more piracy problems crop up, content providers are turning to the U.S. Congress to provide feasible solutions, even though the piracy seems to continue at least for now. Recent legislations introduced in Congress are the following:

- **Senator Hollings' bill** regulates government-approved standard security technologies that are applied to hardware and software.
- **Representative Berman's bill** approves the right of contents providers, such as record labels or movie studios faced with piracy threats, to take technical countermeasures to repel illegal file-sharing networks.
- **Broadcast flags (FCC)** regulate the recording environment on digital television receivers. Uses are only allowed to record "flagged" content in lower-quality analog form or encrypted digital form that is playable only on the digital television receiver that recorded the contents.

2.2.3.2 Industry Initiatives

The most significant industry-wide initiative to establish a secure digital content exchange is the Secure Digital Music Initiative (SDMI) forum, which consists of more than 160 companies of such wide variety as information technology, consumer electronics, Internet service providers, security technology, and recording industries—all working to develop open standards to combat piracy (SDMI, 1999).

SDMI's main scheme against piracy is regulating the use of digital content by utilizing so-called "digital watermarks" that are put into the content. However putting digital watermarks on content also has a negative impact on consumers for using digital contents in the market. It involves a complicated procedure of playing or reproducing copyright-protected digital content, and a higher price for a music player with additional digital watermark management hardware, resulting in limited

use by consumers claiming copyright protection technology. Beyond that, a lack of widely accepted open standards also hinders a digital rights management scheme such as SDMI.

There is also another concern about music downloads among industry-wide conglomerates like AOL Time Warner, which owns the content distribution service of Warner Bros. Records as well as AOL, the world's largest Internet connection service. Even though AOL is very concerned with illegal file-sharing which threatens the content distribution business, it is also true that AOL expects a great deal of money from its Internet connection service which contributes to illegal file sharing.

It is clear that as file-sharing becomes more civilized in the market, other industries beyond the music distribution industry would also affect the dynamics of file-sharing activities even though it is illegal. An interesting comment from Steve Blumenthal, the former CTO of ISP Genuity, appeals that network traffic dropped 50% from its peak after the Napster activity was declared illegal, causing second thoughts about the impact of illegal file-sharing activities as perhaps a necessary evil as a market driver that accelerates extended use of the network.

The increasing complexity of the digital business industry is one major issue behind the slow adoption of an industry-wide standard that would enhance secure digital music distribution, since all stakeholders' interest are entwined. Clearly, a concrete initiative is required to support strict control, but the industry has yet to devise an industry-wide win/win scenario.

2.2.4 Summary

The content distribution industry is apparently losing profitability due to piracy. It is not unlikely that the entire music distribution industry will lose profitability due to an apparently inexhaustible supply of piracy schemes, one after the other. Technology innovation within such schemes is apparently accelerating, as Section 2.2.2 outlined, while both government and industry struggle to identify strategies against piracy. They have imposed relatively soft legislation, including the NET Act or the seemingly unconsolidated SDMI effort. Apparently the entire music industry is

now losing control of copyright management, allowing ever-growing piracy technology to spread epidemically. A huge user base in the music distribution industry threatens industry profitability. It is urgent that an industry-wide strategy be developed to counter the problem of piracy.

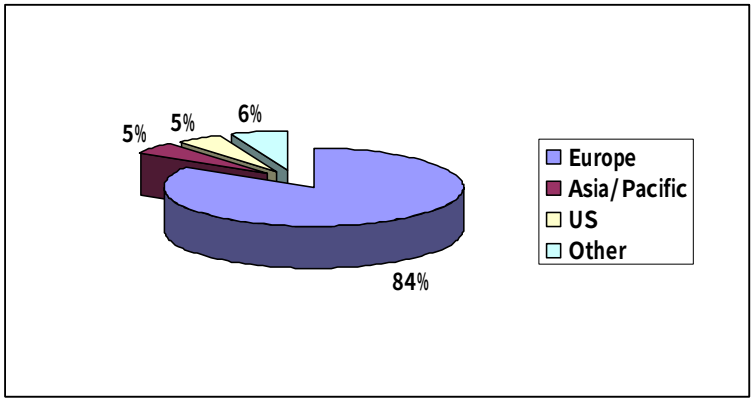
2.3 The Electronic Payment Industry

2.3.1 Regional Trends in the Electronic Payment Business

The world's most accepted electronic payment scheme is payment via magnetic strip electronic payment (MSEP), which is used by roughly 1.8 billion cardholders worldwide as of 2002, with an estimated payment volume of $4.5 trillion. In terms of payment volume by region, the U.S. accounts for 45%, Europe for 27%, Asia for 17%, Latin America for 6%, and Others for 5%.

Following MSEP is Smart Card Electronic Payment (SCEP), which is enjoying widespread growth worldwide over the last few years. The broad use of the Smart Card in the huge U.S. electronic payment market has been anticipated since the mid-1990s, but growth in US Smart Card payments has not emerged due to the lack of a definitive business case for industry participants (Smart Card Alliance, 2003). Figure 2.3 shows the regional distribution of Smart Card circulation worldwide, showing how rapidly the European market accepted the Smart Card infrastructure but not

Figure 2.3 Percentage of Bank Smart Cards Worldwide (by region)



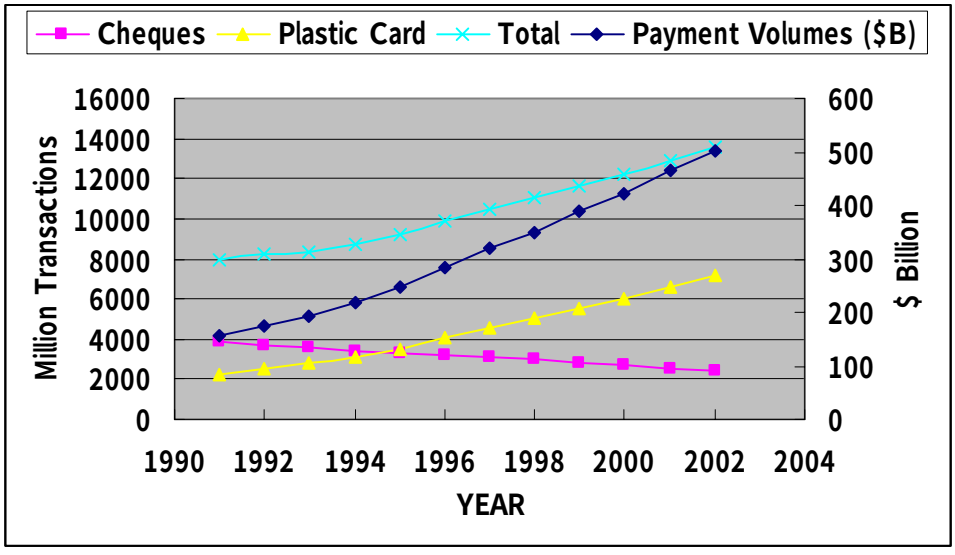
Source: Celent Communications, 2001.

in the U.S. France had already achieved complete diffusion into the Smart Card infrastructure in banking use by the mid-1990s (Scutti, 2000).

In this thesis, I deal primarily with the diffusion process of payment schemes, including Smart Card. Considering the excellent accessibility of market data regarding the diffusion process of electronic payment schemes, I will utilize the European card payment infrastructure as a good example.

Figure 2.4 shows the transaction volume in the UK by payment schemes. Replacement of check payment with plastic card electronic payments by MSEP can be seen as plastic card electronic payment grows. Also shown in Figure 2.4 is the estimated payment volume of plastic card electronic payment in the UK. Accounting for roughly 11% of the worldwide payment volume of $4.5 trillion, the UK's payment volume amounted to $500 billion in 2002, enough market volume to use the electronic payment industry as a reference in this thesis.

Figure 2.4 UK Check and Plastic Card Transaction and Payment Volumes



Source: APACS, 2002.

On the other hand, U.S. payment volume amounted to $2 trillion, roughly 45% of worldwide payment volume. Compared to total music industry sales volume in the U.S. of $13 billion in 2002, total card payment volume of $2 trillion in 2002 (roughly 154 times greater) is large enough to expect huge financial effects for the card payment industry as a complementary business for the relatively small-size music industry, even with slight changes in the card payment structure that adds to the impact on the online content distribution business.

2.3.2 Lagging Migration to Smart Card in the U.S.

Figure 2.3 showed that Smart Cards have not been well accepted in the U.S. as they have in other regions (Celent, 2001). While Europe leads the world in Smart Card infrastructure, Asia Pacific is just becoming mobilized, while Latin America is establishing a Smart Card infrastructure to help combat fraud. Why is it taking so long for the U.S. to adopt the Smart Card infrastructure, lagging nearly ten years behind Europe? One explanation may be the huge momentum of the current and ongoing magnetic card payment scheme used in the U.S., which is sustained by a well-developed ongoing infrastructure with over ten million point-of-sale devices and strong reliance on ongoing consumer use of the magnetic card payment scheme.

Another explanation is that both consumer and merchant awareness of the benefits of Smart Card payment is low, leading to less demand for the Smart Card payment infrastructure. Merchants believe there is no financial incentive to move into that infrastructure, which hampers their investment in the infrastructure. Lacking widespread U.S. issuance and acceptance, it will take years for merchants to upgrade the physical checkout devices needed to accommodate Smart Card features. And with so little Smart Card circulation, merchants hesitate to speed up their adoption pace.

The best benefit of Smart Card for issuers is its fraud protection linked to strong brand perception. Facing increasing fraud problems, the electronic payment industry is eager to move into a new payment scheme, and the Smart Card infrastructure is committed to fighting against fraud.

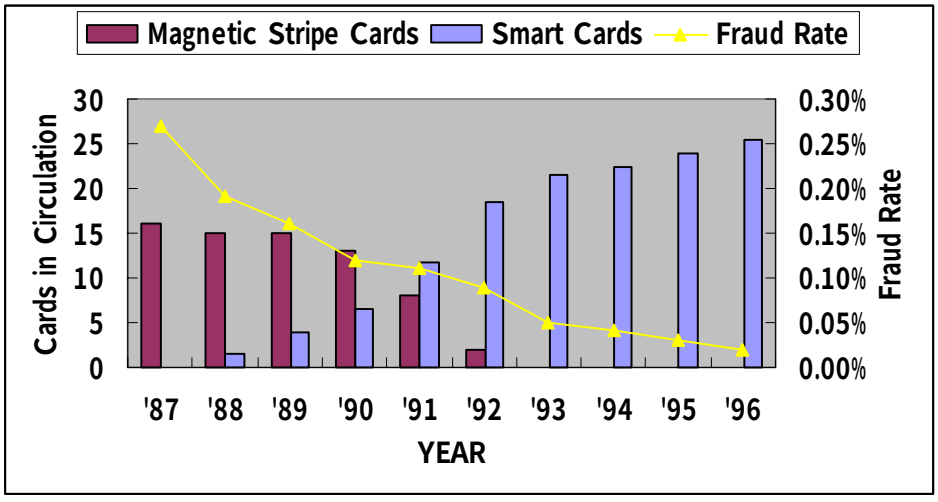
Although the security payoff against fraud was proven by dramatically reduced fraud in France a decade ago (see Sec. 2.3.3.1), the lack of both infrastructure and demand in the U.S. have so far damped the value of Smart Card in the U.S. market. It can be concluded that strong leadership by government or industry to introduce a new payment infrastructure, such as Smart Card, is required before further acceleration of Smart Card adoption occurs in the U.S.

2.3.3 Industry and Government Initiatives for New Payment Schemes

2.3.3.1 Government Initiatives

While the electronic Payment industry struggles with migration to the new Smart Card payment scheme, France provided an excellent example of such a migration when it was initiated by strong government initiative. Figure 2.5 illustrates the rapidly decreasing number of magnetic stripe cards circulating in France, and the steady increase of Smart Cards circulating since their introduction in the late 1980s. In 1993, the French government passed a strict initiative banning all magnetic cards in circulation as well as government financing for a new Smart Card infrastructure (Scutti, 2000).

Figure 2.5 Smart Card adoptions in France and relating Fraud Reduction



Source: Prudential Securities, 2000.

As Figure 2.5 shows, migration from magnet strip card payments to Smart Card payments occurred smoothly, with fraud losses dropping dramatically, from 0.16% in 1989 to 0.02% in 1996, proving the impact of Smart Card technology on fraud reduction as well as the feasibility of smooth migration to Smart Card infrastructure, when given strong governmental support.

In the UK, migration to Smart Card is now ongoing in the bank card infrastructure. The UK Department of Interior, along with various merchant associations, confirmed that the migration to Smart Card will be complete by 2004 (NR Research Center 2002), with an investment of £1.1 billion, split into £300–350 million for merchants and £750-800 million for banks. According to the UK Department of Interior, Smart Card adoption has enabled them to reduce fraud losses by 80%, saving $300 million to date and $400 Million by 2005.

2.3.3.2 Industrial Initiative

Visa launched its so-called "smart Visa" as a comprehensive brand and technology initiative for Smart Card migration in 2000 (SCA, 2002). The smart Visa incorporates EMV (Europay MasterCard Visa), a payment application established to enhance Smart Card payments for secured internet payments. The smart Visa aims to create credible technology for secured payment transaction technology by allying with such major issuers as First USA, Fleet, Providian, and Target. The smart Visa is setting *de facto* standards for a U.S. Smart Card payment scheme by requiring issuers to use global platform technology, which provides a common payment platform and allows issuers to expand their payment application on a standardized common platform. Visa also announced its "smart Rewards" platform in April 2002, which helps both merchants and issuers to provide rewards programs, such as electronic coupons or punch card rewards, by providing managing tools to facilitate interactions among rewards applications by reducing technical and time-to-market burdens.

MasterCard launched its Smart Card initiative, called "OneSMART" in (SCA, 2002). OneSMART facilitates the wide use of Smart Card by providing various packaged solutions that

include chip-based credit and debit cards, Internet payments, security, loyalty, e-ticketing, e-coupling, and value-stored wallets. MasterCard has established partnerships with such large issuers as Citibank, First Data, and Welcome Real-time to build a Smart Card service infrastructure.

It is also trying to differentiate the multi-application open environment by leveraging the MULTOS technology. MasterCard is trying to provide common application programming interface (API) by offering MasterCard Open Data Storage (MODS) specifications that enable member financial institutions to provide more control of cardholders; personal information as well as highly secured privacy.

2.3.4 Summary

Even with its clear security value, customers seem reluctant to migrate to the Smart Card payment scheme. The main reason that hinders consumer is the lack of Smart Card infrastructure stemming from a lack of initiative from both government and industry. Given the successful migration to Smart Card in France during the early 1990s, it is clearly feasible for the market to accept a new payment infrastructure within five years if allied with government regulations and required government funding to encourage the correct installment of this new business scheme. Considering the slow migration to the Smart Card scheme in the U.S., it is clear that a strong initiative or some other device that motivates the consumer must be installed before there will be a smooth transition to Smart Card.

On the other hand, the online contents distribution industry also needs definitive instructions from government and industry to encounter piracy. Although there have been some recent successful seizures of pirated materials, and more reports of improving piracy reduction are coming forward, I believe the entire industry still needs another round of profound technology development. In the online contents distribution industry, governmental initiatives seem effective for countering piracy, as can be seen in the case of legal directives shutting down Napster. However, the fact is that there are

numerous similar kinds of trials in courts today. Even though government punishment seems effective against piracy, new and clever piracy programs continue to pop up, leading to further judicial trials in the months and years to come. While I have no doubt that government punishment inhibits piracy somewhat, unless piracy becomes easy to pursue, another piracy problem will undoubtedly evolve. To counter piracy at a fundamental level, the development of copy protection technology is requisite for finally eradicating all piracy activity.

2.4 Technology Trends

2.4.1 File-Sharing Technology

In this section, I survey the various file-sharing technologies that are used in peer-to-peer applications like Napster or Gnutella (Olson, 2001), which already do or have the potential to disrupt the profitable online contents distribution business. The obvious threat of file-sharing applications is the uncontrollable file exchange activity among digital content holders based on the anonymity of peer-to-peer connections with no central server involved to censor illegal file copying. In this section, I survey the file exchange schemes of peer-to-peer technology and provide insight into the file-sharing activities, which I hope will lead to a potential solution for countering piracy from a technology point of view.

2.4.1.1 What is peer-to-peer?

A peer-to-peer file exchange scheme differs from traditional client-and-server models in that each peer acts as both client and server, whereas the peer role is predefined in traditional the client-and-server model. In other words, while each peer is able to request specific information from other available peer servers on the Internet without being interfered by central servers, each peer is also able to respond, as a server, to requests from other peers for information that may be available for free distribution. The peer-to-peer scheme increases the value that each peer on the network can add

for other peers, because each peer is able not only to take information from the Internet but also can share the information with other peers. The peer-to-peer scheme also increases the difficulty of controlling copyright-managed content distribution, since peer-to-peer schemes do not require a central server, which eventually results in illegal copying among some users.

2.4.1.2 Pure peer-to-peer

Figure 2.6 describes the relationship of each peer on a pure peer-to-peer network that does not require a central server. Each peer locates other peers on the network and they interact with each other as both clients and servers. The advantage of this type of network is the irrelevance of a central server. Without a central server new peers can freely join the Internet to share information. At the same time, the lack of a central server poses the disadvantage of limited discovery. Because limited numbers of clients are without a central server, the information available is also limited compared to the amount available with a central server that fully manages the available information on the Internet.

2.4.1.3 Peer-to-Peer with Simple Discovery Server

Figure 2.7 shows another network structure, similar to pure peer-to-peer, but with a central server to discover other peers. This type of network mitigates the limited reach of a pure peer-to-peer network by providing a network-wide discovery range of centrally managed discovery servers. In this type of network, an application from each peer first notifies the central server of its existence. The server then provides each requesting peer of a list of other peers participating on the Internet that can be accessed as content-sharing servers. Based on provided list of contents from available servers, each peer can contact a target server individually to request specific information for sharing.

Figure 2.6 Pure P2P

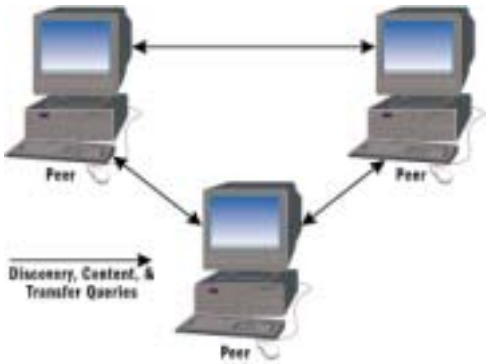


Figure 2.7 Hybrid P2P

Source: MSDN, 2001.

2.4.1.4 Peer-to-peer content distribution

The recent widespread use of peer-to-peer programs such as SETI illustrates the positive potential of peer-to-peer use for huge volumes of scientific calculations by effectively pulling together a computing grid comprised of peers on a huge peer-to-peer network. At the same time, widespread use of a file-sharing program like Napster or Gnutella also indicates the negative potential of peer-to-peer use for illegal copying of commercial digital content, which results in serious economic damage to the content distribution industry. Since the potential impact of peer-to-peer is so great, both the pros and cons of the peer-to-peer effect are emerging simultaneously in today's market. I would hope to see peer-to-peer used in a positive way, but unfortunately some degree of economic damage from peer-to-peer file sharing is widely observed these days. On the other hand, research by others also discusses improvements in the performance of peer-to-peer content distribution. Some can be seen in the use of scalable and high-performance content

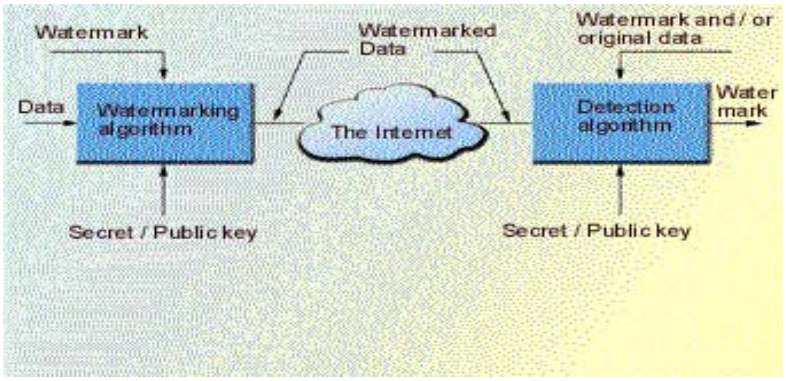
lookups in peer-to-peer systems (Sripanidkulchai, et al, 2003). Others go to the selective use of pure peer-to-peer networks to enhance existing client and server systems (Padmanabhan, et al, 2002).

2.4.2 Copy Protection Technology

2.4.2.1 Digital Watermarking

Digital watermarking is a process of embedding secret and robust identifiers inside digital contents in order to protect copyrights, similar to a watermark on currencies or stock certificates. Watermarked content can prove its originality, thereby protecting copyright. Figure 2.8 describes how digital watermarking works.

Figure 2.8 Digital Watermarking



Source: EWATERMARK.com, 2003.

First, a neutral registration authority allots a unique registration number to a digital content depending on the nature of the content, then archives the content and unique registration number for future reference. The content owner then generates a suitable watermark that is carried within the data. The watermark is relatively small (one percent) so as to be imperceptible. Then the watermark, a public/private key, and host data are processed using a watermarking algorithm to generate the watermarked data. To detect it, special watermark and/or original host data, a secure/public key, and test data are required. All these inputs are processed by a watermarking algorithm to extract the

watermark and any additional data, called a ‘label,’ a public notice informing a user about the Intellectual Property Rights (IPR) of the content.

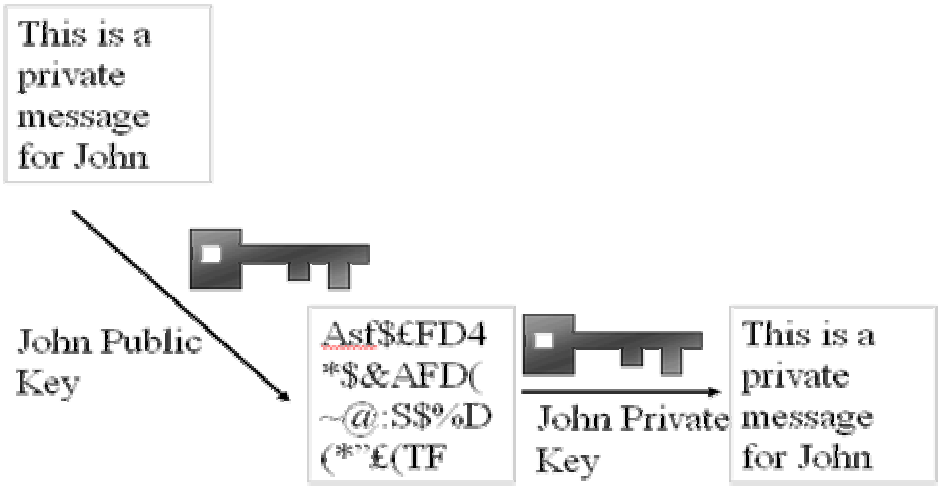
Using a watermarking to establish genuineness enables one to trace a path followed by the contents in a distribution chain, which also enables locating the path taken by illegally copied content. The authenticity of watermarked content also easily pinpoints any attempt to modify the content-regulating circulation of illegal contents. Digital watermarking is still at the infant stage, although many benefits have already been proved. This slow adoption of watermarking technology arises primarily from its complex procedure and algorithm, and further simplifications will be needed before widespread acceptance takes place.

2.4.3 Secure Transaction Technology

2.4.3.1 Public Key Infrastructure

Public Key Infrastructure (PKI) has gained momentum in recent years. It utilizes two keys—one public and one private—to encrypt or decrypt contents that are being exchanged. If one content is encrypted with the private key, only the public key can decrypt it and vice versa. Figure 2.9 explains the basic concept of PKI. The private key is known only to the owner and should never be disclosed, while publicly trusted Certificate Authorities maintain distribution of public keys. This relationship enables users with recipients’ public keys to encrypt the message and send it privately to owner of the private key, the only person who can decrypt it. The PKI security scheme is a powerful way to counter piracy in both the content distribution and electronic payments businesses, and has been gaining momentum in the wired network infrastructure. However, in the wireless network infrastructure, wide adoption of so-called wireless PKI is far from reality due to its complex operation and lack of a cost-effective solution.

Figure 2.9 Public Key Infrastructure



Source: Entrust Inc., 2003.

2.4.4 Summary

In this section, I listed the core technologies that might affect the online contents distribution and electronic payment businesses. Even from a technology point of view, I found there were tremendous opportunities for developing file-sharing technology, while anti-piracy technology schemes suffer from slow adoption due to the complexity of their operation and lack of cheap technology solutions. Further development of user-friendly anti-piracy technology is inevitable, as well as necessary, in order to fight piracy through widespread use of anti-piracy schemes. Add to that, further cost reductions in anti-piracy technology are also necessary to encourage rapid migration to the use of anti-piracy technology which will further accelerate cost reductions as the technology matures. Clearly there is a need for anti-piracy technology, but the entire industry is having problems identifying a balanced solution that both deters piracy yet is relatively easy to use.

Chapter 3

Payment Solutions Without Infrastructure Investment

3.1 Introduction

In this chapter, I will explore possible mobile payment solutions that do not require huge infrastructure investment, as well as emerging new infrastructure services such as Mobile Virtual Network Operators (MVNO). It is generally expected that huge infrastructure investment is inevitable for platform operators such as mobile phone operators or mobile payment operators. One well-known exception to investing in mobile operations without infrastructure investment is Virgin Mobile's business which emerged in the late 1990s, which demonstrated that it was possible to build a successful platform business without huge infrastructure investment. In addition, mobile operators themselves are reluctant to make huge investments in untried or unknown new network infrastructures like 3G or 4G which can be affected by a mobile market that matures early or the lack of a killer application except voice communications and SMS services.

In November 2002, Tele2, a Norwegian mobile operator, announced it would hand back its 3G license to the Norwegian government, and thereafter the company planned to offer 3G services via an MVNO agreement with Telenor, a Swedish mobile operator and MVNO service provider (Hughes, 2002).

Furthermore, third-party mobile payment vendors, such as PayPal in US or Paybox in Germany, provide potential mobile payment solutions that effectively utilize incumbent infrastructures like SMS messaging or bank transfer infrastructures, without requiring huge infrastructure investment. Such aggregation service providers as Microsoft or Sun are attempting to

provide payment solutions by forming “customer communities” as one way to improve the attractiveness of information aggregation services.

During my exploration of business models that do not require huge infrastructure investment, I will also consider the impact of each business model on business factors in a variety of scenarios, and then propose a new business model which will be discussed in detail in Chapter 5.

3.2 Mobile Virtual Network Operators (MVNO)

Mobile operators are currently experiencing some difficulty in trying to expand their market volumes in a global wireless marketplace that is rapidly moving toward saturation. In fact, mobile penetration rates now exceed 50% in the U.S. wireless market. Therefore, mobile operators are hoping to expand consumer demand by providing extended services, such as voicemail or short messaging services (SMS).

Beginning in the late 1990s, some mobile operators began to allow second parties known as Mobile Virtual Network Operators (MVNO) to partially accommodate the operators’ network infrastructure and to provide their own network-related services to enhance their businesses. One highly successful example is the MVNO implementation of Virgin Mobile in the UK. Virgin Mobile offers music-related services on their handsets. For instance, customers can listen to sample music clips from Virgin artists for free and then proceed to a simple one-click purchase of that CD on their handsets if they so choose. Virgin Group saw an opportunity to propose additional value to its customers by incorporating its traditional Virgin Record value chain into its MVNO services, at the same time providing wireless customers with additional value and expanding demand among wireless customers.

MVNOs first appeared in Europe in the late 1990s and soon began crowding into the U.S. market. Many MVNOs emerged from non-communication businesses that had superior customer relationships as part of their core businesses, such as Virgin Records. From the perspective of

establishing customer relationships without a major investment in network infrastructure, this MVNO model is one of the best candidates for rapidly expanding a proprietary customer channel while maintaining customer benefits, by making use of the partial network infrastructure from wireless operators.

MVNO enables businesses to leverage significant advantages while maintaining the required network infrastructure at dramatically reduced cost. Some of these advantages are:

- Widely known brand names that resonate with a specific target audience, many of whose members may not currently subscribe to wireless services;
- Large and loyal customer bases that expect a certain level of product value, customer service, and organizational efficiency for their non-communications services;
- Core businesses outside of traditional communications services such as retail, packaged goods manufacturing, and media and entertainment, all of which have a specific tie to their end customers; and
- Domain expertise in certain industries and a strong understanding of the needs and requirements of current and future service expectations from their existing customer base. (Source: Hughes, 2002)

3.2.1 Market Overview of MVNO

There are a number of MVNO service providers that have come to the market in the last few years. Among these, Virgin Mobile (a subsidiary of Virgin Atlantic Airway) offers wireless service using One 2 One's network infrastructure. Virgin Mobile is also launching MVNO service in Australia using Cable & Wireless Optus's network infrastructure. In the UK, Sainsbury's One (a subsidiary of retail giant J Sainsbury) is offering wireless services using the BT Cellnet network infrastructure. In Hong Kong, the government is requiring that 30% of its 3G capacity be dedicated to resale use, thereby broadly supporting MVNO activity. In North America, many MVNOs are

emerging from the retail industry (see Table 3.1), even though MVNO activity itself is still in its infancy in North America. With 50% wireless penetration in the U.S., the point at which growth begins to decelerate, the U.S. wireless market is now focused on other market segments such as youth, minorities, and seniors. MVNOs would also be appropriate for expanding market segments by bridging a variety of incumbent market segment into the rapidly saturating wireless market.

Table 3.1 MVNOs and reseller examples

MVNO/Reseller	Established Brand	Strong Distribution	Product Differentiation	Financial Resources
TracFone (US)	Product is marketed through a variety of retail outlets including Wal-Mart, Target, JC Penny, Staples, Office Depot, Lowe's and Radio Shack.	Phones and cards are avairable at 650,000 retail outlets.	Focus is on traditional prepaid market - not limiting to alternative segments.	Affiliate of America Movil.
Virgin Mobile (US)	Limited in United States. Resources to build brand are strong.	Limited - Virgin Record Stores number less than 50.	Yes. Company plans to offer product specifically catering to Youth / Teen Market.	Virgin Group, though experiencing difficulties, does hove ready access to cash.
Boost Wireless (US)	Limited brand appeal in United States - hoping to develop completely new brand that will resonate with fickle teen market.	Would need a partner to rapidly expand distribution network.	Company has differentiated offering and experience in wireless services.	Strong.

Source: The Yankee Group, 2002.

3.2.2 Forecasted Cost Savings on MVNO Infrastructure

I have attempted to forecast the impact of MVNO deals on the amount of infrastructure investment required to develop wireless infrastructures. As an example, I refer to an MVNO deal with Nordic mobile operators.

In November 2002, Tele2 (a Norwegian operator) announced that it would turn its third-generation (3G) license back to the Norwegian government. Instead, the company would offer 3G services through an MVNO agreement with Telenor (a Swedish operation) which would significantly reduce costs for Tele2. The company said the estimated cost of building a 3G network from scratch would be €500 million (€ = euro). As shown in Table 3.2, the agreement covers both Norway and Sweden. Telenor becomes the MVNO for a Universal Mobile Telecommunications System (UMTS) service that utilizes Tele2's UMTS infrastructure; Tele2 becomes MVNO for 3G service utilizing Telenor's 3G infrastructure; therefore, each complements the other.

Table 3.2 Tele2 and Telenor MVNO Agreement

	Sweden	**Norway**
Tele2	Svenska UMTS (JV Telia and Tele2)	MVNO with Telenor (Returned 3G License)
Telenor	MVNO with Svenska UMTS	3G License holder

Source: Gartner Dataquest, 2002

According to CMP Media research (Kuchinskas, 2002), it is estimated that it could cost more than €100 million for an MVNO to own and operate everything except the network, including call centers, customer care, and the mobile portal. Furthermore, it is estimated that at least €5 million would be required in order to outsource operations and pay content and service providers. Based on estimated expenditures for building a wireless network and paying an MVNO service provider, the estimated amount of cost reduction would be:

MVNO impacts on cost reduction

= Payment for MVNO service / Investment on building wireless network

= €100 million / €500 million

= 1 / 5 (based on historical data)

3.2.3 Potential MVNOs in the Non-Wireless Arena

There are many potential contenders that could come from outside the communication industry, such as Wal-Mart, Target, Costco, Nike, and Disney—all of whom already have strong channels of communication with large customer bases representing many people who have no wireless service. These contenders may very well be willing to expand their market volume and sales channels by using additional wireless channel MVNO services. Furthermore, MVNO would be a good way to increase existing sales channels for companies with digital content distribution channels that may be struggling (because of piracy) to find a profitable and secure model for distributing digital content. Additional wireless channels could lead to greater opportunities for digital content distribution players such as AOL Time Warner, Disney, and Sony to grow their markets.

3.2.4 Summary

MVNO is a wireless service provider that emerged from the non-communications industry to enhance its core business by providing wireless communication service by partially borrowing another carrier's network infrastructure. MVNO leverages popular brand names to deepen relationships with loyal customers by adding wireless services to its products and services mix. MVNO enables traditional business providers that do not have network services to resell and utilize network services as part of a larger value-added offering to loyal customers. In this thesis, I treat MVNO as an excellent strategy for quickly obtaining network infrastructure and providing loyal customers with network-based services.

The impact and key success factors of MVNOs are the following:

1. ***dramatically reduces initial infrastructure investment by up to one-fifth;***
2. ***business plans and rules are already in place;***

3. ***customers are aware of the services that can be rendered;***
4. ***customers are interested in the brand and see it as a viable alternative to a traditional wireless network service provider; and***
5. ***results in a win/win situation with both parties to an agreement.***

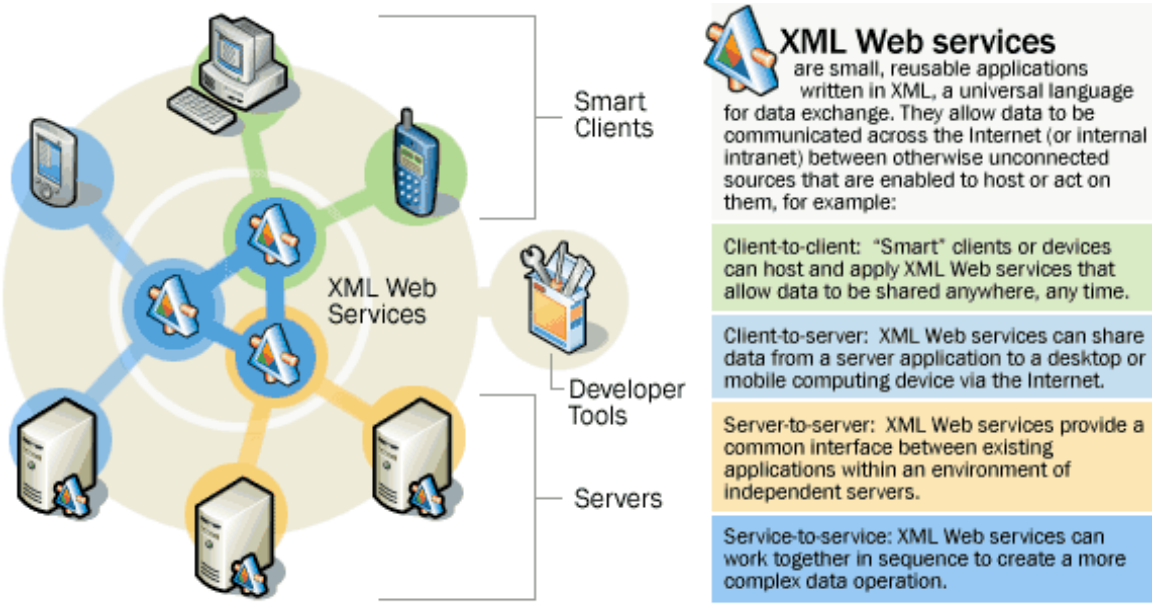
3.3 Identity Aggregators

3.3.1 Microsoft Dot Net Initiative

The electronic payment business is finding itself confronted with various security problems and complex payment procedures that end up discouraging consumers from migrating to new payment schemes such as Smart Card. The Microsoft Dot Net Initiative is an identity aggregation service that helps consumers ease into sometimes complex payment procedures; it also mitigates the risk of piracy by collecting in advance security-sensitive personal data such as personal information, payment instruments, financial accounts, or interests, and then storing the information in a secure aggregation server. This allows consumers to process electronic payments with a simple one-user ID called a Passport (Microsoft.net, 2003).

Figure 3.1 describes the basic concept of Microsoft Dot Net. As shown, each consumer device or system is connected via XML Web service, and user ID information is shared within the Dot-NET infrastructure. Each user ID is unique within the Dot-NET infrastructure no matter which software technology the user ID is dealing with, as long as it deals with Dot-NET technology such as Java.NET or Visual Studio.NET. Within the Dot-NET infrastructure, no matter which device a user uses, each user ID is uniquely identified and the user can enjoy information services or electronic payments easily with their own individual “Passport.”

Figure 3.1 Microsoft Dot Net Initiative



Source: Microsoft Corp., 2003.

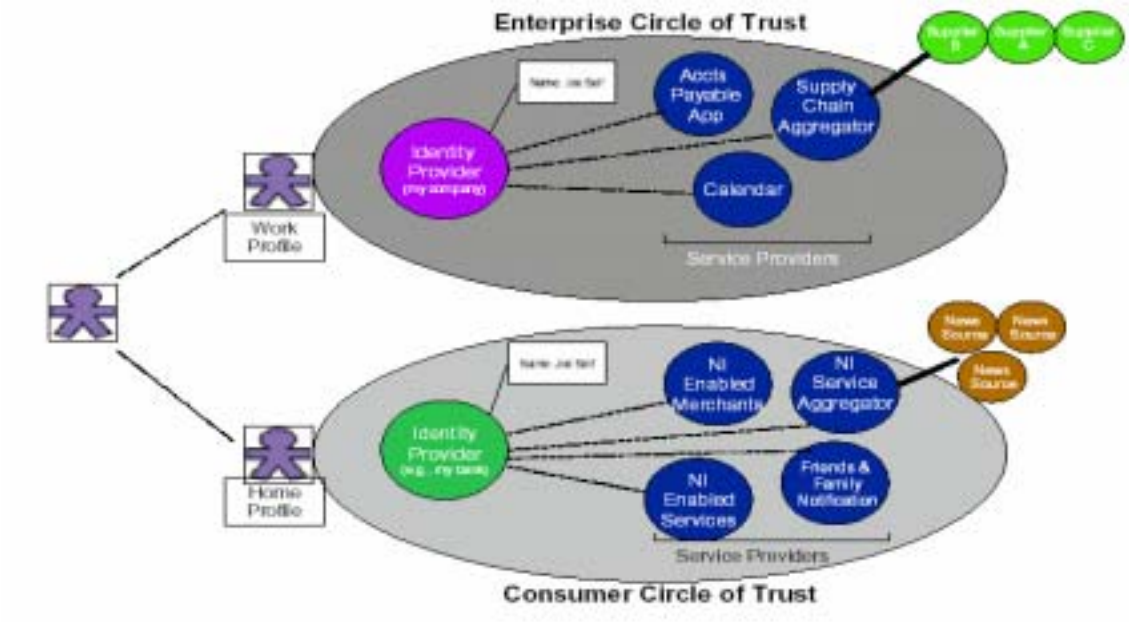
Microsoft is working at becoming the dominant digital business platform by enforcing widely adoptable common platform standards like the Dot-NET technology not only in user application service platforms but also in software development platforms. In that way, the company hopes to have already acquired platform dominance, just as they currently enjoy with the dominant Windows families.

By introducing an identity aggregation service, users can enjoy simplified payment procedures with reduced perceived risk due to secured account information, which leads to greater use and reduced security problems. These two value propositions may be the main values that drive more users toward identity aggregation services.

3.3.2 Sun Liberty Alliance

Sun leads the industry with its identity aggregation service called Liberty Alliance (2003), which provides an industry-wide, single sign-on infrastructure similar to that of Microsoft Dot NET's Passport. Liberty Alliance already has over 150 participants from different industries, including Fidelity, Bank of America, Sony, United Airlines, VeriSign, and General Motors. Even companies from payment industries such as MasterCard and American Express also have memberships. Figure 3.2 explains the structural concept of Liberty Alliance. The "Enterprise Circle of Trust" represents the committed relationship between business units, such as Internet services or merchants using Liberty-enabled technology. Each participant enters into an operational agreement within the Liberty-enabled digital society. The "Consumer Circle of Trust" represents the aggregation of otherwise isolated user private information, such as account information or personal information needed to transact business. Each circle represents a federation of service and operational agreements.

Figure 3.2 Sun Liberty Alliance – Federated Network Identity



Source: Liberty Alliance, 2003.

3.3.3 Summary

Identity aggregation services are clearly becoming a value proposition with greater usability due to simplified payment schemes and perceptions of less risk due to secured account information. Although the value proposition is concrete, however, adoption of identity aggregation services is far from widespread. Lagging development of the electronic payment infrastructure may be one explanation for the slow adoption, if the electronic payment market itself is too small to be recognized yet as a new payment method. Another explanation is the lack of users of this new service, which causes potential users to refrain from using a new service that is unknown to them. Customers often hesitate to migrate to a new service until they see that other people already use it.

The potential value of identity aggregation is powerful enough to eventually create a dominant platform in the digital business market just as Windows already holds in the software market. Accelerated migration into identity aggregation services will obviously require strong industry initiatives, just as Microsoft has done, to further hasten the widespread adoption of this new scheme until it hits a critical mass of satisfied users which will further reinforce adoption of these identity aggregation schemes.

3.4 Third-Party Solution Providers

3.4.1 PayPal

PayPal is a money transfer system that can be utilized by anyone with an e-mail address. It does not require a merchant account or a payment gateway. In 1999, PayPal began providing its service for customer-to-customer money transfers for those who purchased items at eBay auctions. Today it is currently the most popular online payment system of its kind (Wilson, 2001).

In order to verify a customer, PayPal introduced a unique methodology. Verification first requires the customer to provide account information. X.com, the company behind the PayPal service, makes two random deposits to a customer's proposed account using a customer-specific ID

number. If the account-holder can identify the specific number, then PayPal considers this account verified, since holding a financial account requires the account holder to provide proof of identification beforehand. In other words, PayPal relies totally on verification of financial services when customers set up an account, thereby enabling almost no required payment gateway.

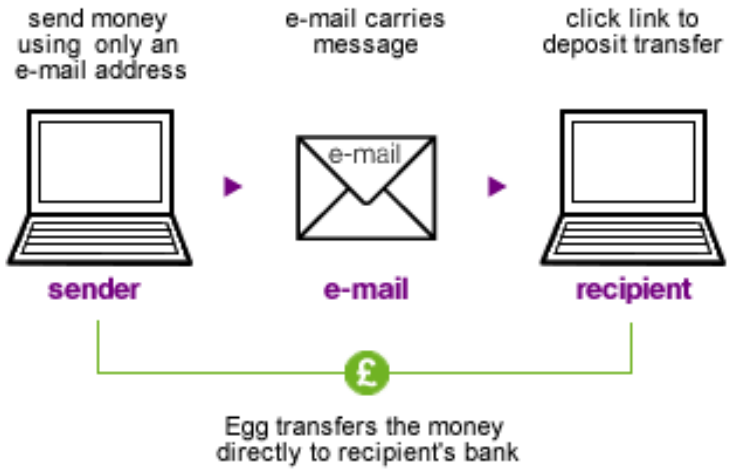
A lower fee is another reason for the broad adoption in online payment schemes. PayPal earns money on the float, not as a commission fee from customers. Superior consumer credit card protection against fraud has also led to high adoption of PayPal for on-line payments. X.com provides a high level of reimbursement. The combination has made significant inroads into the Visa/MasterCard monopoly also used in the electronic payment business.

3.4.2 EGG

Egg is a UK-based, on-line bank providing an Internet-based cash system. Egg's payment system enables small payment transfers between anyone with an e-mail address and a bank account. Security checks of the participant are processed on-line by Experian, a credit rating business. To send money, signed-up users enter the e-mail address of the person who will receive the money, and indicate the debit account, such as Egg or some other, which the user prefers (see Figure 3.3). The recipient who receives the e-mail is then required to key-in a predetermined code from the sender as well as their bank details so the payment can be credited. To discourage piracy, there is a payment ceiling of £200, which generally covers most transactions. Egg is planning to expand the person-to-person payment service to a fee-based service for companies, thus expanding the potential market.

In terms of business development, Egg plans to cooperate strategically with stakeholder Microsoft. In February 2002, Egg announced it would allow Microsoft's Hotmail to participate in Egg's micro-payment service (ePaynews.com, 2002). Egg and Microsoft are introducing a Hotmail-based micro payment solution, as well as an identity aggregation service, to complement

Figure 3.3 EGG payment scheme



Source: Microsoft Email Money, 2003.

widely accepted credit card payments. Furthermore, Egg is allying with Microsoft in software development by applying MS Dot-NET technology, switching away from the traditional UNIX-based software, which is expected to produce additional business synergies (Glick, 2003). The underlying motivation for Egg's move toward allying with Microsoft seems to be both expected business synergies as well as a desire to avoid conflict with the big players, which it will accomplish by forming this alliance beforehand.

3.4.4 Summary

Many third-party solution vendors are trying to gain market position in the electronic payment business. Overall, the efficient use of established infrastructure, such as Internet connections, e-mail infrastructures, and credit card accounts seems to be the key strategies for third party vendors, leading to reduced requirements for developing infrastructure while proposing seemingly unique solutions. But a lack of specific advantages such as an overwhelming infrastructure or few technology difficulties, always results in low entry barriers for such payment

giants as MasterCard or Visa. Third-party solution providers always have to be aware of entrants who threaten to take over the leading position in with a successful micro-payment solution.

Wireless carriers are also working to provide potential solutions, as can be seen in NTT DoCoMo's micro-payment solution in Japan. To retain their strength in the micro-payment arena, third parties have to devise concrete advantages or ally cooperatively with large stakeholders in the digital business value chain, as we saw with Egg's cooperative venture with Microsoft.

Chapter 4

Business Model Scenario and Analysis

4.1 Introduction

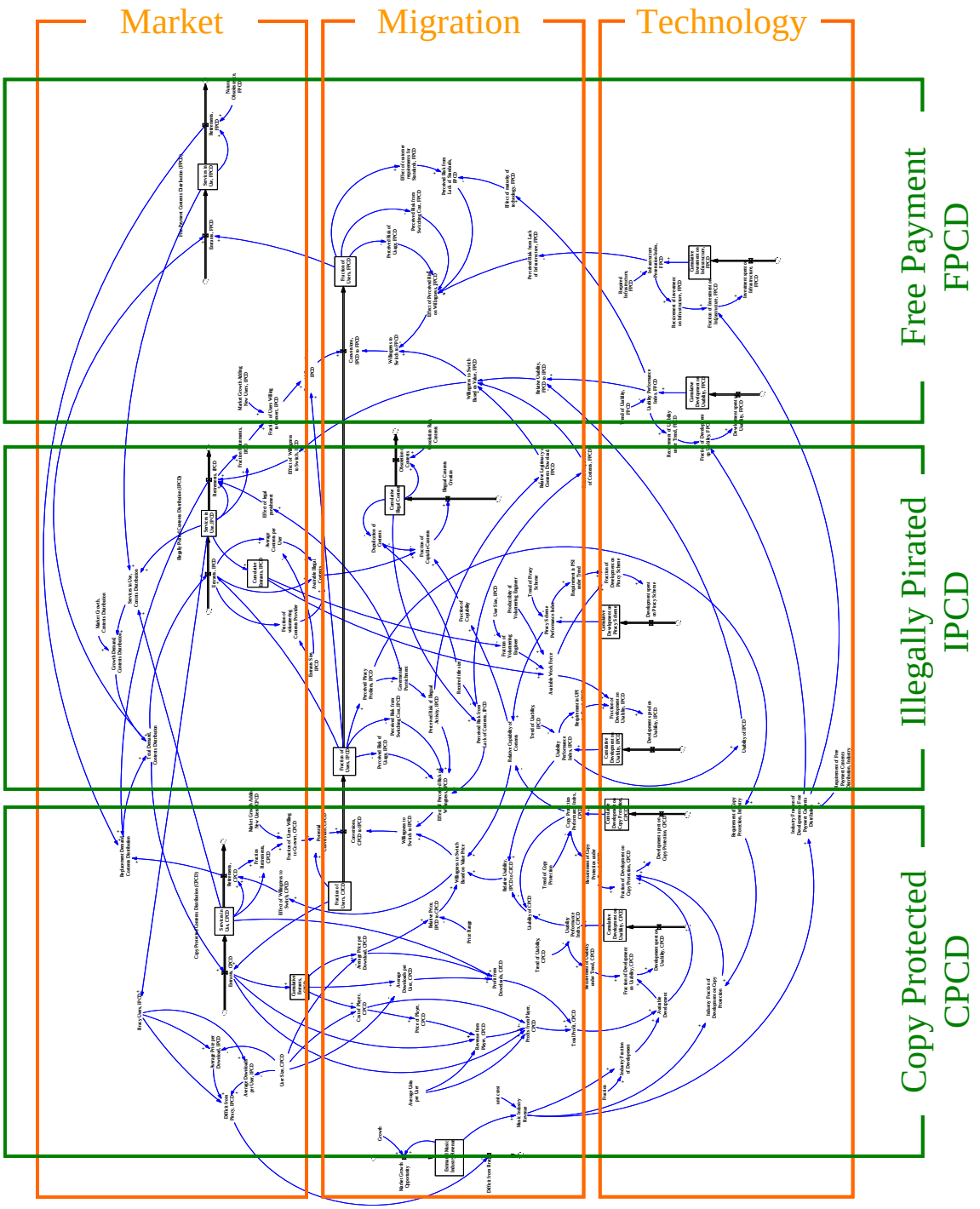
In this chapter, I will discuss how the online music distribution business has suffered as a result of illegal file-sharing. I will begin by modeling this situation using System Dynamics feedback loop analysis. Second, I will analyze current business conditions in the electronic payment industry, also using System Dynamics models. The purpose of this chapter is to clarify the business factors or other events that have the most impact on the success of each business.

4.2 Online Contents Distribution Model

4.2.1 Description of the Model

Figure 4.1 shows a System Dynamics model for the online contents distribution industry. The model consists of the market, technology, managerial actions regarding investment and pricing, and regulatory action such as industrial regulation. There are three generations of business models used in this model. The first generation is Copy Protected Contents Distribution (CPCD), in which all the downloaded contents are protected by a strict copy protection scheme to manage the digital right of contents distribution. The second generation is Illegally Pirated Contents Distribution (IPCD), in which users can copy or share illegally pirated contents available on a file-sharing server. For customers who want convenience with pirated file sharing for free, they can convert easily from CPCD to IPCD, as represented in the model. Today's digital business industry

Figure 4.1 Model of the Online Contents Distribution Business



Source: Author, 2003.

has suffered as a result of many shifts from CPCD to IPCD, which has disrupted the digital business value chain. The third generation is Free Payment Contents Distribution (FPCD) in which content providers offer downloadable content for free specifically to regain customer base to their own management, hoping to build a profitable business model that is allied with a complementary business such as electronic payment. In this model, “Fraction of Users” represents the proportion of users who use download models CPCD, IPCD, or FPCD.

The critical area of the model determines conversions between generations of business. The number of users who enter a certain service is represented by “Entrants”. Entrants for each business model depend on total demand and fraction of users by business model. Total demand consists of growth demand and replacement demand. Total demand is distributed to a stock of “Services in Use” which represents the actual users in each business type.

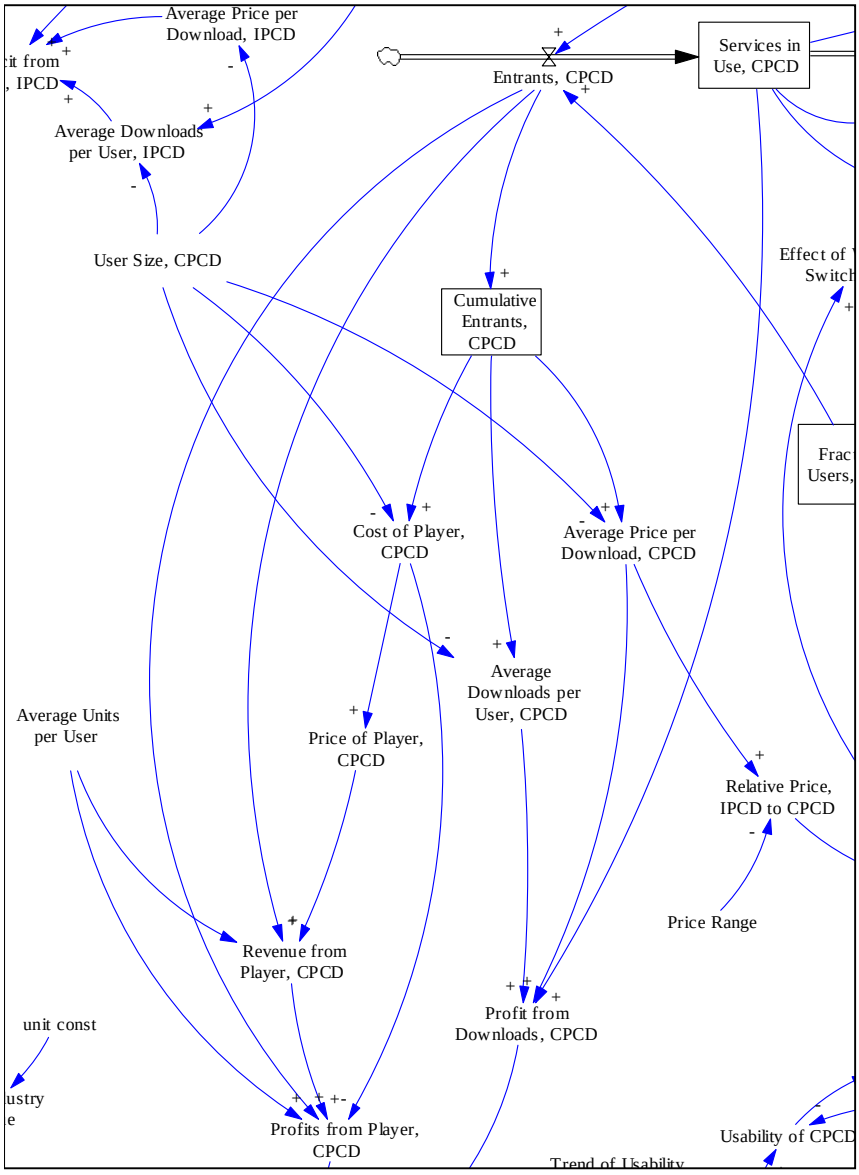
4.2.1.1 Revenue Generation from Contents Distribution

This model shows two key concepts for revenue estimation: (1) direct revenue from Copyright Protected Contents Distribution (CPCD), and (2) deficits suffered as a result of piracy.

Direct revenue from CPCD is estimated by adding download revenue plus copy protected hardware revenue. Download revenue is comprised of the number of users who use CPCD (users), Average Price per download ($/download) which reflects competitive pricing of downloadable contents, and Average Downloads per User (downloads/user) which reflects customers’ purchasing behavior. Hardware revenue consists of number of users and cost of the player which reflects learning effect.

Deficits suffered as a result of piracy is estimated based on the number of users who use IPCD (users), Average Price per retail CD which represents the price of legal CD sales the pirating users would have purchased in retail store if they had not used illegal file sharing, and Average Purchase per User which represents the number of retail purchases the pirating users would have made if they had not used illegal file sharing.

Figure 4.2 Direct revenues from CPCD business



Source: Author, 2003.

Music industry revenue, which includes both CD retail sales and online distribution sales, is estimated by assuming annual growth minus pirated deficit represented as the deficit suffered from piracy.

Average Price per Download: Record labels are making music download services cheaper and simpler to reach customers who continue to flock to free file-sharing services while ignoring paid content distribution services, according to Yankee Group Research (Goodman, 2002b). Universal Music Group (UMG) and Sony Music Entertainment plan to cut prices for digital music downloads. UMG plans to charge $0.99 for singles and $9.99 for albums and include both new releases and older titles. In addition, UMG will allow consumers to copy songs to MP3 players. Sony, which has offered *a la carte* digital music downloads for two years via its RioPort partnership, is lowering the price of downloads from $1.99 to $1.49 and will allow CD burning. These moves reflect a new strategy by content providers to regain customers from free file-sharing services (Pogue, 2003). Table 4.1 represents the various features of ongoing online contents distribution services.

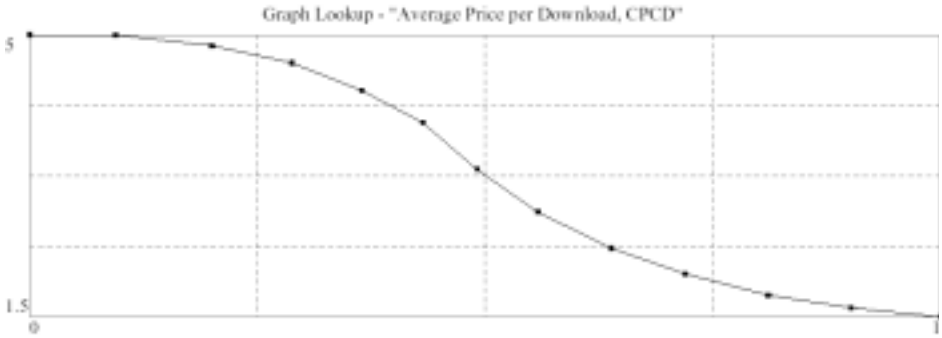
Table 4.1 Ongoing Online Contents Distribution

	Download Fee	Subscription Fee	Burnable Songs
Pressplay	$0.49/song	-	-
AOL	Browsing Free	$18/month	10 songs
Rhapsody	$1/song $0.49/song	$5/mont $10/month	No Limit No Limit
MusicNow	$1/song	$5/month	No Limit
UMG	$0.99/song	-	No Limit
Sony Music	$1.49/song	-	No Limit

Source: New York Times, 2003.

I estimated the price levels of download services assuming $5 per download as the average price for initial new users, and $1.50 per download as the ultimate price in a mature market with severe competition, as shown in Table 4.1. In Figure 4.3, the horizontal axis represents cumulative customers normalized by an assumed 10 million maximum customers in the U.S. market and vertical axis represents the average price per download with assumed diminishing manner along with customer accumulation.

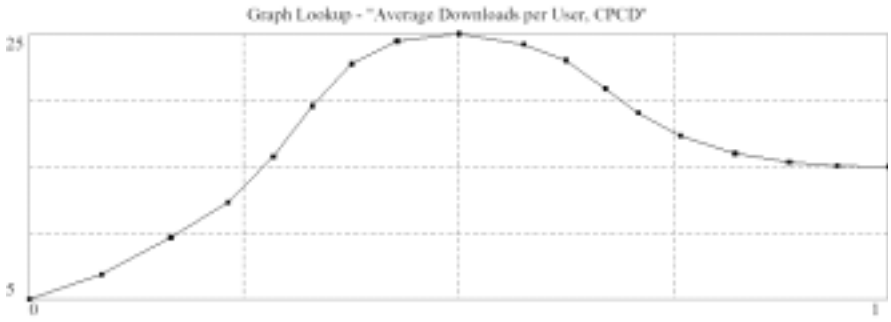
Figure 4.3 Average Price per Download ($ / Download)



Source: Author, 2003.

Average Downloads per User: Assuming customers purchase music online, I forecast average downloads per user as shown in Figure 4.4. In the figure, the horizontal axis represents cumulative customers normalized by an assumed maximum of 10 million customers in the U.S. market. As number of customers grows in the service and use of download services becomes popular, the number of downloads per user also increases along with the popularity of the service. But once the cumulative number of customers exceeds critical numbers, the number of downloads per user decreases, reflecting declining interest in new services. Generalization of the service drives average downloads per user to a stagnant level of 10 downloads per user.

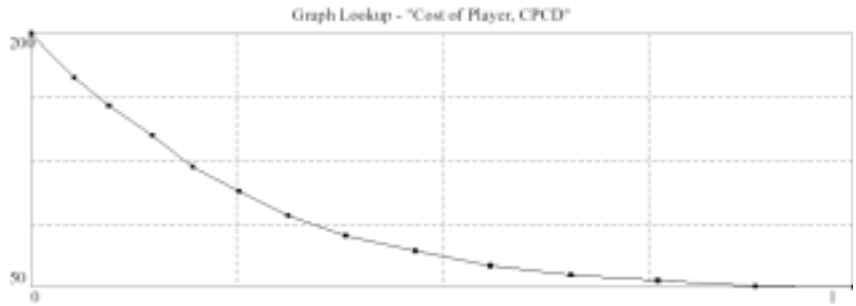
Figure 4.4 Average Downloads per User (Downloads / User)



Source: Author, 2003.

Cost of Player: Reflecting the learning effects of the production line, I assume Cost of Music Player with copy protection scheme as shown in Figure 4.5. The horizontal axis represents cumulative customers normalized by 10 Million customers. I assume an initial cost of $200 per unit and an ultimate cost of $50 in a mature market. In terms of unit price of the music player, I assume a price of 1.2 times Cost of Player, very competitive pricing against MP3 players, and well discounted in the market for illegally copied MP3 music clips.

Figure 4.5 Cost of Player ($ / Unit)

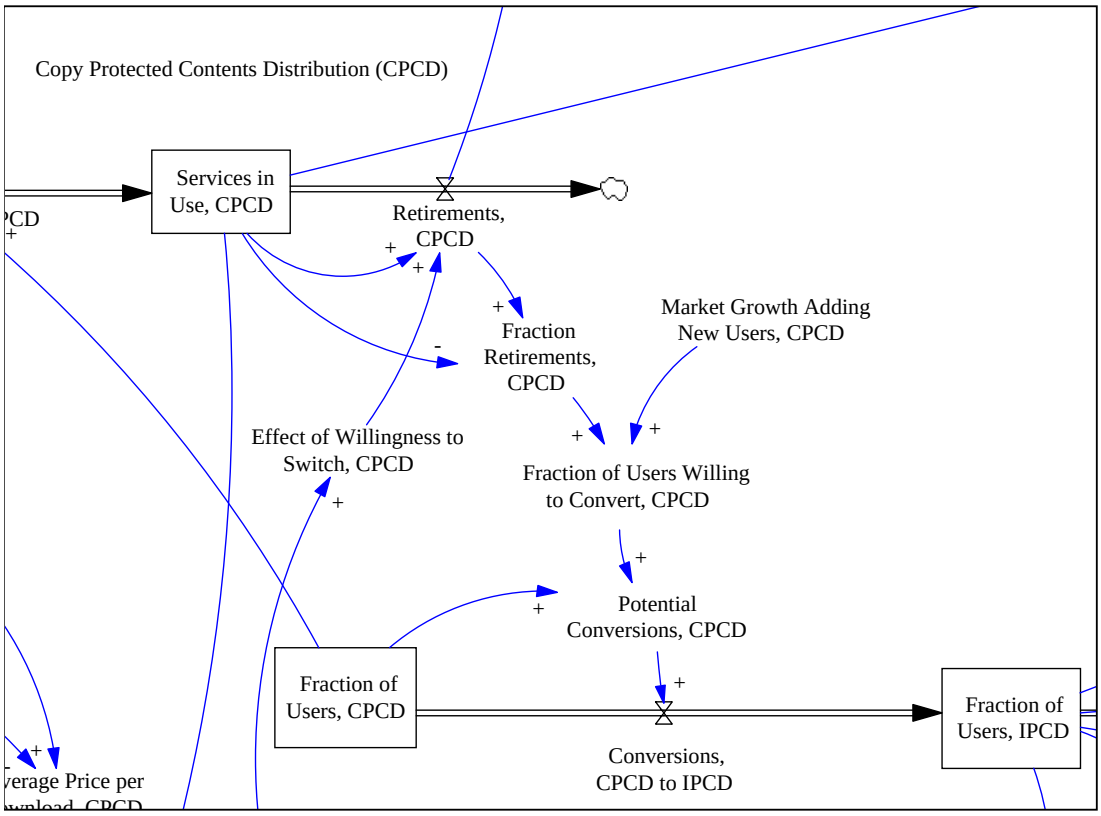


Source: Author, 2003.

4.2.1.2 *Potential Conversions*

Potential Conversions determines the amount of customers ready to convert from one business to another, as shown in Figure 4.6. Potential Conversions occurs when the market itself grows or when customers feel ready to shift to another service. The factors that drive customers to switch, consist of obsolescence of current technology, price competitiveness of new business models, and customers' willingness to switch.

Figure 4.6. Potential Conversions



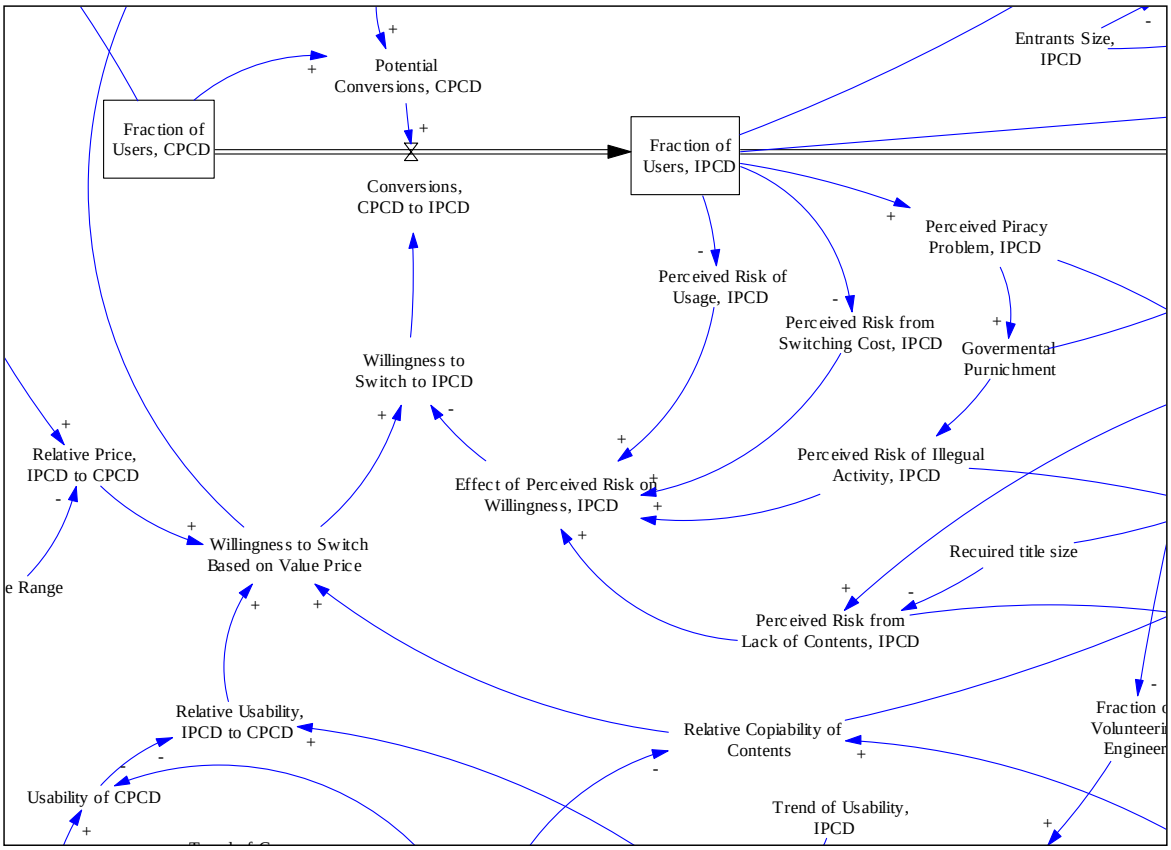
Source: Author, 2003.

4.2.1.3 *Willingness to Switch*

While Potential Conversions generates users who wish to convert to the next generation, Willingness to Switch manipulates the actual conversion from one business model to another as sketched in Figure 4.7.

Willingness to Switch consists of Willingness to Switch Based on Value Price and Effect of Perceived Risk of Willingness. Willingness to Switch Based on Value Price reinforces the switch from one business to another, representing users' motivation to switch based on the relative price and relative value of the business: the higher the relative value of a new business and/or the lower the relative price (in this case the price of IPCD is always zero), the more willing are potential users to switch to a new business. Relative value consists of Convenience of Relative

Figure 4.7 Willingness to Switch



Source: Author, 2003.

Usability and Relative Copiability of Contents between CPCD and IPCD business. The more usability of new business and/or the more Relative Copiability of Contents, the easier it is to pirate, and the more willing are potential customers to switch to a new IPCD business.

The Willingness to Switch is balanced by the Effect of Perceived Risk on Willingness: the higher risk the customers recognize, the less willing are potential customers to switch. The Effect of Perceived Risk on Willingness consists of Risk of Usage, Switching Cost, Risk of Illegal Activity, and Lack of Contents. Risk of Usage reflects the hesitation of users to use new services until the new services become popular. They are unsure that the new service will become a *de facto* standard and do not want to deal with services that never gain popularity. The more users of new

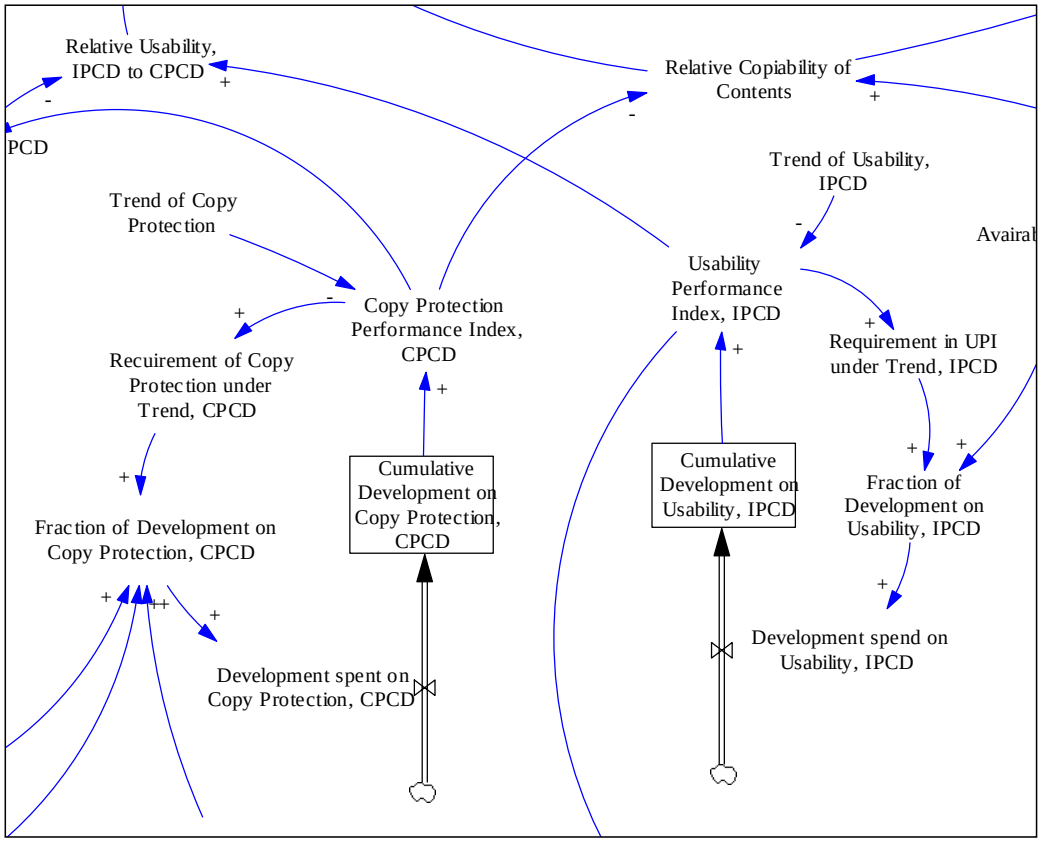
service, the lower the Risk of Usage. Switching cost also leads to high risk. If customers are required to pay additional fees or change operating procedures from what the customer is accustomed to, they will hesitate to switch to a new service. As a new service gains popularity along with supporting technology and developed procedures, switching costs will fall as well. Risk of Illegal Activity comes from the perception by customers of committing an illegal activity, i.e., pirating digital content. Perceived Piracy Problem of the industry, reinforced by the increased number of users in IPCD business, leads to increased Governmental Punishment and increasing Perceived Risk of Illegal Activity. Risk from Lack of Contents is the perceived risk of customers who hesitate to shift to a new pirated-content business until they recognize some satisfactory level of content. Perceived Risk from Lack of Contents is based on cumulative illegal content that is fed from illegal content distribution users. The more illegal content is on the market, the less risk customers feel for shifting to a pirated-content IPCD business.

4.2.1.4 Technology Development

Figure 4.8 represents the development of given technologies. Usability performance of each business model depends on cumulative development of useable technology, such as user interface or collaborative operations between user software and content servers. Relative Usability is the difference between Usability Indices, revealing relative operability of the download software of each business models.

Relative Copiability of Contents is the difference between Copy Protection Performance Index and Piracy Scheme Performance Index revealing the ease of stealing content. The more Piracy Scheme and the less Copy Protection Performance, the easier it is for copy users to switch to IPCD business. Like Usability, Copy Protection Performance and Piracy Scheme Performance depend on cumulative development of a given technology.

Figure 4.8 Cumulative development



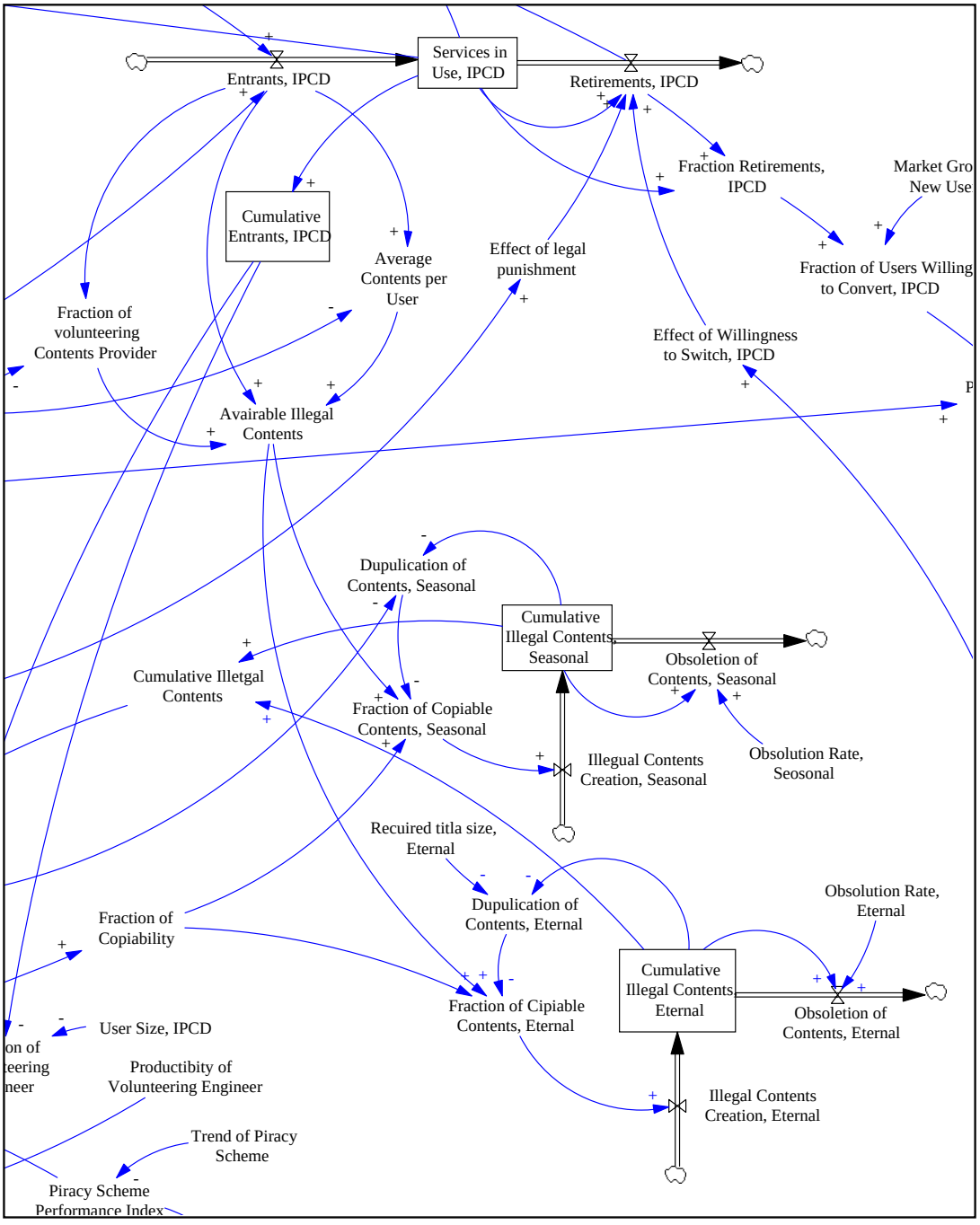
Source: Author, 2003.

4.2.1.5 Cumulative Illegal Contents

Figure 4.9 shows illegal content creation fed by illegal content distribution users. Cumulative Illegal Contents consists of two parts: (1) seasonal contents, and (2) permanent content. Seasonal content is content with limited life, such as hit songs or songs for the younger generation. Permanent content is content with a permanent lifetime such as classic orchestral music or operas. Therefore, Seasonal contents have much higher rate of obsolescence than Permanent contents. Available illegal content provided by illegal content distribution users is determined by Numbers of Entrants, Number of Contents that entrant users carry in, and Fraction of Volunteer content providers among entrant users. Duplication of Contents determines what portion of newly entered contents is effectively added to the contents database without duplication. The more contents

accumulate in the database, the more often duplication of the contents occurs. Fraction of Copiability is derived from the difference between Copy Protection Index and Piracy Protection Index which determines the ease of pirating digital products.

Figure 4.9 Cumulative Illegal Contents



Source: Author, 2003.

4.2.1.6 Managerial Actions

Managerial actions determine the behavior of the model ting the parts of the system together. The key managerial considerations are determining the amount and allocation of development spending which depends on revenues, profits, and technical performance. A certain fraction of industry revenues is spent on development; therefore, industry initiative to determine the amount of development is also a key concern of the industry. Especially for an unprofitable industry like online music distribution, either industry initiative or governmental initiative to encourage spending on future development could be key drivers for fostering technology such as copy protection or database management. New technology to prevent piracy will only come when there re sufficient engineers willing to tackle the problem. However, for the time being, strong industry encouragement or strict government enforcement and punishment seems to be the most effective tools for countering piracy.

4.2.2 Characterizing the model

In this section, I will characterize the proposed Online Music Distribution Model. I start by defining a "Base Case" that imitates today's music distribution industry as closely as possible. To define the model, I have characterized market and technology characteristics in the following sections.

4.2.2.1 Copyright Protected Contents Distribution (CPCD)

Market Characteristics

Initial CPCD users: 2 million users (1998)

1.3% (online revenue) * $10B (total music revenue) = $0.13B

$0.13B / 15 (average downloads/user) / $4 (average price / download) = 2 M users

Maximum CPCD users: 10 million users

Retirement from CPCD:	5% + Effect of Obsolescence (0-10%)
Market Growth (Online Contents Distribution):	3%
Market Growth (Music Industry):	1%

Pricing Characteristics

Average price / download:	$5 - $1.5 (see Figure 4.3)
Average downloads / user:	5 - 25 - 15 (see Figure 4.4)
Cost of Player:	$200 - $50 (see Figure 4.5)
Price of Player:	1.2 * (Cost of Player)

Technology Characteristics

Fraction of Industry to Development:	0.1%
Required Development for Usability:	$1 billion
Initial Development for Usability:	$500 million
Development spent for Usability:	(0 - 0.5) * (0.1% * Industry Profit + Total Profit)
Required Development for Copy Protection:	$3 billion
Initial Development for Copy Protection:	$ 0
Development spent for Copy Protection:	(0 - 0.5) * (Perceived Risk of Piracy (0 - 0.1) * (Total Music Industry Revenue))

4.2.2.2 Illegally Pirated Contents Distribution (IPCD)

Market Characteristics

Initial IPCD users:	0 (1998)
Maximum IPCD users:	10 million users
Retirement from IPCD:	5% + Effect of Obsolescence (0-10%)

Volunteer Workforce

Available workforce: Cumulative entrants * Fraction of volunteers * Productivity of volunteers

Fraction of volunteer engineer:	5% - 0%
Productivity of volunteer engineer:	$10,000 / engineer

Technology Characteristics

Required Development for Usability:	$1 billion
Initial Development for Usability:	$500 million
Development spent for Usability:	(0 - 0.5) * Available volunteer workforce
Required Development for Piracy Scheme:	$1 billion
Initial Development for Piracy Scheme:	$500 million
Development spent for Piracy Scheme:	(0 - 0.5) * Available volunteer workforce

4.2.2.3 Free Payment Contents Distribution (FPCD)

Market Characteristics

Initial FPCD users:	0 (1998)
Maximum FPCD users:	10 million users
Retirement FPCD:	5% + Effect of Obsolescence (0-10%)

Technology Characteristics

Fraction of Industry to Development:	0.1%
Required Development for Usability:	$1 billion
Initial Development for Usability:	$800 million
Development spent for Usability:	(0 - 0.5) * (0.1%*Industry Profit)
Required Investment for Infrastructure:	$6 million
Initial Investment for Infrastructure:	$0 (1998)

Investment spent for Infrastructure: (0 - 0.5) * (0.1%*Industry Profit)

4.2.2.4 Conversion from CPCD to IPCD

Weighted Risk explains the combined feelings of consumers, and each weight represents the assumed importance of consumers toward the willingness to take risk.

Effect of Perceived Risk on Willingness

= 0.15 * Perceived Risk of Usage + 0.15 * Perceived Risk from Switching Cost

+ 0.35 * Perceived Risk of Illegal Activity + 0.35* Perceived Risk from Lack of Contents

Willingness to Switch Based on Value Price

= 0.6 * Relative Price, IPCD to CPCD + 0.2 * Relative Usability, IPCD to CPCD

+ 0.2 * Relative Copiability of Contents

Willingness to Switch to IPCD

= Willingness to Switch Based on Value Price - 0.5* Effect of Perceived Risk on Willingness

4.2.2.5 Conversion from IPCD to FPCD

Effect of Perceived Risk on Willingness

= 0.15 * Perceived Risk of Usage + 0.15 * Perceived Risk from Switching Cost

+ 0.35* Perceived Risk from Lack of Standards + 0.35* Perceived Risk from Lack of Infrastructure

Willingness to Switch Based on Value

= 0.5 * Relative Availability of Contents + 0.3 * Relative Legitimacy of Contents Download

+ 0.2 * Relative Usability, FPCD to IPCD

Willingness to Switch to FPCD

= Willingness to Switch Based on Value - 0.5 * Effect of Perceived Risk on Willingness

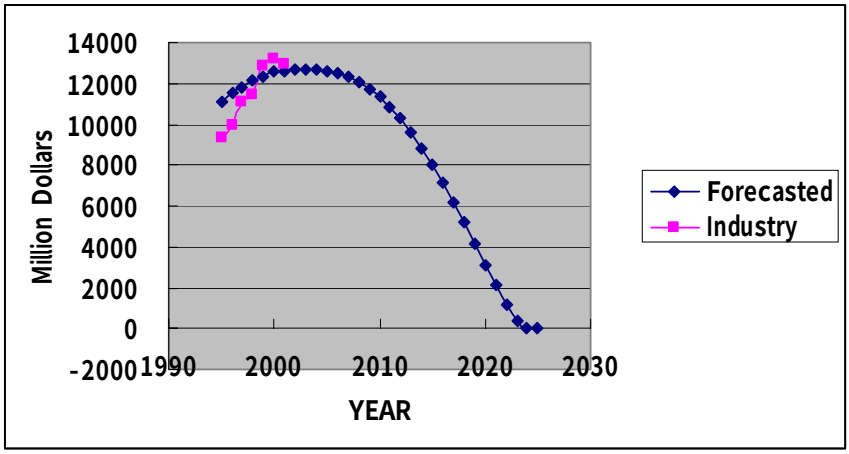
4.2.3 Behavior of the Base Model

In this section, I will discuss the behavior of the proposed model in light of the current situation in the online contents distribution model. The biggest problem facing the online contents distribution industry is the lack of piracy prevention. Even though the industry has tried to invent feasible solutions to regulate piracy, another piracy scheme comes along. Considering this vicious circle, I assumed the required development for Copy Protection Technology to be three times that of Piracy Scheme. Further, responding to loose governmental regulations against piracy, I assumed low sensitivity to risk of government punishment. With this condition in mind, I will discuss key characteristics and reveal both drivers and prohibitors of each characteristic.

4.2.3.1 Music Industry Sales Revenue

Figure 4.10 depicts historic music industry sales revenue and forecasted music industry sales revenue. Year 2001 was the year when music industry sales revenues experienced a -6.4% revenue growth rate. Some would blame a slow economy or after-effects from September 11 which interrupted fourth quarter plans. But a large contributor to the decline in overall shipments beginning in 1999 is piracy of digital content. Newly introduced file-sharing programs are invading

Figure 4.10 Music Industry Sales Revenue



Source: RIAA, 2003.

the music industry. While the industry discusses client-server type online music distribution with strict copyright management, free file-sharing programs appeared and gained such a huge customer base that the traditional music distribution industry suffered amazing damage. Some consumers no longer buy music because they can download or copy music for free. According to recent surveys among 2,225 music consumers ages 12 to 54, commissioned by the RIAA and conducted by Peter Hart Research Associates (L'Ecuyer, 2002), 23% of music consumers surveyed said they did not buy music in 2001 because they downloaded or copied most of their music for free. The music distribution supply chain is shifting from traditional CD-retailing supply chain to a file-exchanging supply chain.

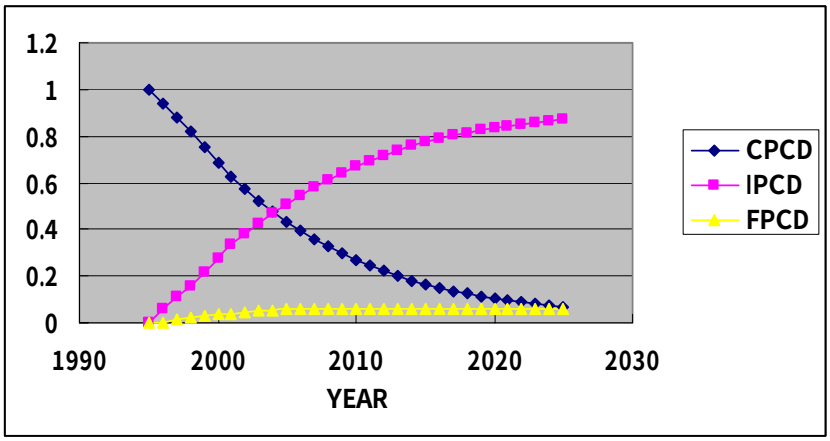
Figure 4.10 also depicted the forecasted music industry sales revenue that assumes the piracy problem will continue to exist and hurt the music industry value chain. The figure confirms that beginning in early 2000, music industry revenues continue to drop year by year. By the mid-2020s, the industry will have lost all revenue, according to my forecast model. Interestingly enough, the decrease ratio of sales revenue beginning from early 2000 accelerates reflecting the network effect of the piracy platform. It is always difficult to change the direction of the dominant platform once the platform forms a growth loop reinforced by network externality. Today, in 2003, the industry faces a distinct possibility that it will lose its profitability unless serious steps are taken to counter the piracy problem.

4.2.3.2 Users by Business Type (Fraction)

Figure 4.11 shows the diffusion of the CPCD, IPCD, and FPCD businesses over time. Because of the attractiveness of file-sharing, users begin to moving to IPCD immediately. This diffusion is explained in Figure 4.12, along with a technological index. As with the digital business industry today, the figure illustrates that Piracy Scheme always exceeds Copy Protection Scheme.

Another interesting finding is that even though the music industry tries to develop better protection technology through technology development, piracy technology always goes beyond

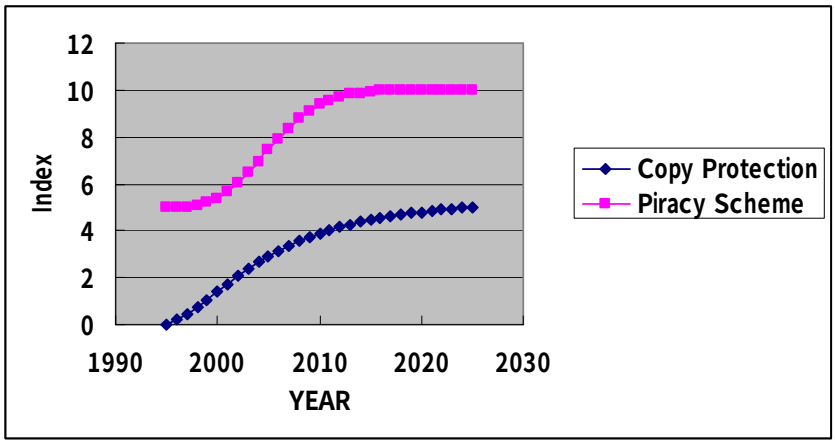
Figure 4.11 Users by Business Type (Fraction)



Source: Author, 2003.

copy protection schemes based on an inexhaustible supply of volunteer technology developers, reflecting the current vicious circle in the online music distribution industry. In this situation, online music distribution users would easily shift to piracy schemes as Figure 4.11 indicates. I also found that there is almost no conversion to FPCD. This could be explained because customers are satisfied with pirated contents without requiring official download services even though it is free. I will discuss this further in following section.

Figure 4.12 Technological Index

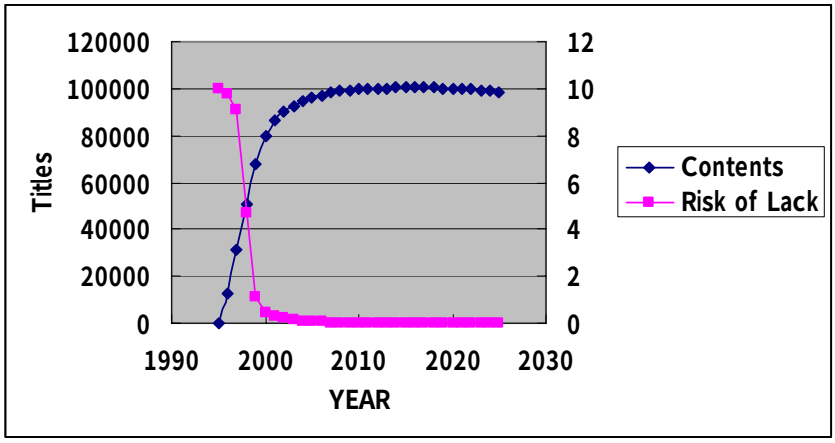


Source: Author, 2003.

4.2.3.3 Cumulative Illegal Contents

Figure 4.13 shows the illegal contents accumulated illegally. In a situation where the piracy scheme always exceeds the copy protection scheme—an ongoing situation—there is no scheme to prevent illegal copying. As the Figure shows, illegal contents have accumulated rapidly since the late 1990s into the early 2000s, totaling a huge number of titles. At the same time, users' risk from lack of content has rapidly diminished since the late 1990s, reflecting a market mood of "online music for free" that became prevalent at that time. Even with a high obsolescence rate of 50% among seasonal illegal contents, the inexhaustible source seems to replenish the supply of contents as quickly as it becomes obsolete, as shown.

Figure 4.13 Cumulative Illegal Contents (Risk from Lack of Contents)



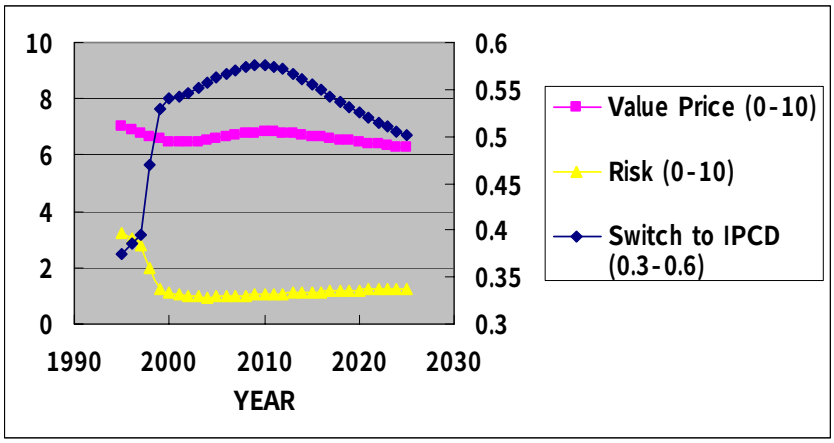
Source: Author, 2003.

4.2.3.4 Willingness to Switch from CPCD to IPCD

Figure 4.14 shows the Willingness to Switch and its components. As shown, Willingness to Switch rose rapidly, from 0.35 to 0.55 on scale of 1.0 in the late 1990s, apparently reflecting the mitigating risk to users which rapidly decreased from 3 to 1 on a scale of 10 during the same period, thus revealing a general distribution of piracy content reinforced by mass customer acquisition and satisfactory number of contents, which echoes the content distribution market of the late 1990s. (I

will discuss risk in more detail in the following section.) Willingness to Switch based on Value Price, constant at the level of 7 on a scale of 10, is relatively high, revealing users' motivation to switch to IPCD due to price advantage (IPCD is free service) and copiability of the piracy scheme (the piracy technology index always exceeds the copy protection index, reflecting similar actions in the online music distribution industry; see Section 4.2.3.2).

Figure 4.14 Willingness to Switch from CPCD to IPCD



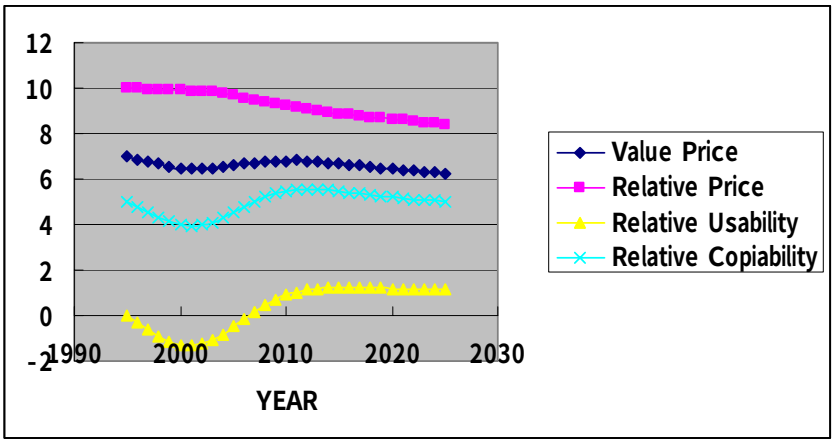
Source: Author, 2003.

4.2.3.5 Willingness to Switch based on Value Price, CPCD to IPCD

Figure 4.15 shows how Willingness to Switch forms based on its components. Willingness to Switch based on Value Price consists of Relative Price of IPCD to CPCD, Relative Usability of UPCD to CPCD, and Relative Copiability of Contents, virtually measuring the relative performance of the IPCD to CPCD. Willingness to Switch based on Value Price is roughly outlined by the dominant ingredients with the coefficient of 0.6, Relative Price as shown. Relative Price reflects the price advantage of IPCD against CPCD and gradually decreases along with reducing price of CPCD due to cost reduction caused by learning effect. Relative Copiability decreases, reflecting required delay to accumulate enough workforces to dedicate for development of piracy schemes. But overall Relative Copiability remains positive, meaning the piracy scheme index will

always exceed the copy protection index. The same is true of Relative Usability. Usability may turn negative once, but overall Usability does not explain any major differences along the time line.

Figure 4.15 Willingness to Switch based on Value Price, CPCD to IPCD

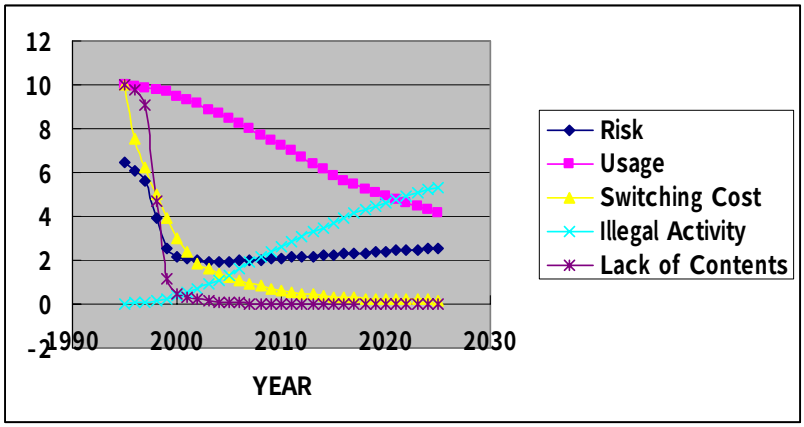


Source: Author, 2003.

4.2.3.6 Effect of Perceived Risk on Willingness, CPCD to IPCD

Figure 4.16 shows the components of Perceived Risk, which consists of Risk from Usage, Risk of Switching Cost, Risk of Illegal Activity, and Risk from Lack of Contents. Each Risk contributes relatively evenly to total risk formation. Perceived Risk suddenly falls in the late 1990s, echoing the proliferation of file-sharing software in the market, and a sudden drop in major risk components that comprise total risk. Risk of Switching Cost dropped suddenly, right after the introduction of file-sharing software, since there is no additional funding required for user-friendly, freely downloadable, file-sharing software. Risk from Lack of Contents also dropped suddenly because volunteer content providers reinforce the explosion of illegally copied content. As the number of IPCD users grows, the perceived risk of Illegal Activity increases as well. But due to limited government punishment, the level of perceived risk from Illegal Activity is not high enough to have a dramatic effect on total perceived risk. Perceived Risk of Usage gradually falls as the number of IPCD users grows, just at the level to cancel the effects of Risk of Illegal Activity.

Figure 4.16 Perceived Risk on Willingness, CPCD to IPCD

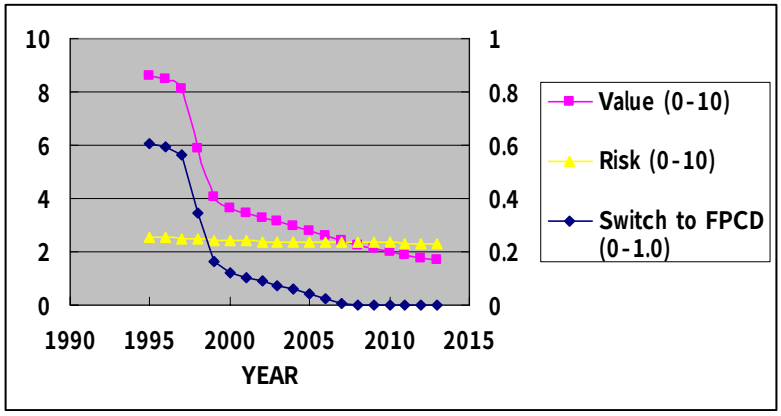


Source: Author, 2003.

4.2.3.7 Willingness to Switch from IPCD to FPCD

Figure 4.17 shows Willingness to Switch and its components. Willingness to Switch dropped suddenly in the late 1990s along with Willingness of Switch, based on the relative value provided by FPCD. Again, this seems to relate to the fact that a satisfactory amount of content was circulating in the late 1990s, thus eliminating the need for the FPCD business to provide a variety of contents for free. Perceived Risk stays constant at the level of 2.5 revealing no major diffusion to FPCD service, since almost all of the risk parameter depends on cumulative users of FPCD service.

Figure 4.17 Willingness to Switch from IPCD to FPCD

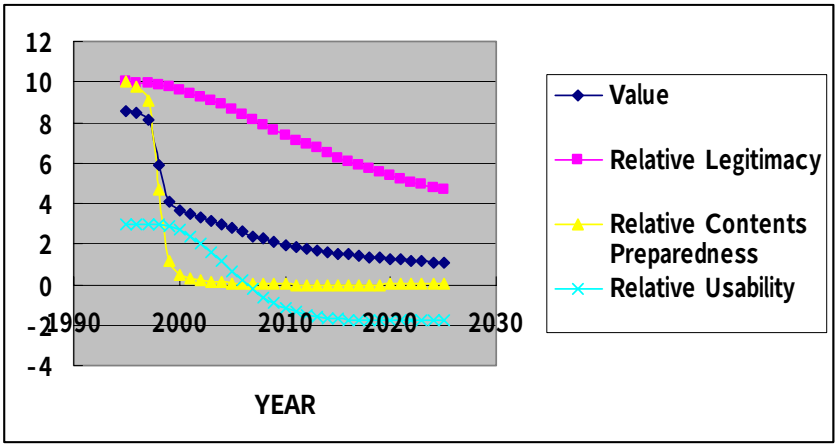


Source: Author, 2003.

4.2.3.8 Willingness to Switch based on Value, IPCD to FPCD

Figure 4.18 shows Willingness to Switch to FPCD based on Value. As shown, Willingness to Switch based on Value rapidly decreased in the late 1990s. This could be explained as the effect of a sudden decline in the ingredients of Relative Availability of Contents, a dominant factor in Willingness to Switch, with a coefficient of 0.5. Availability of Contents is the opposite of cumulative illegal contents, expressing the relative competency of the FPCD service in terms of numbers of contents. In the mid-1990s, with a much smaller amount of illegal contents, availability of contents of FPCD far exceeded that of illegal contents. But as cumulative contents grew rapidly in the late 1990s, availability of illegal contents equaled or exceeded that of FPCD service, thereby driving Relative Availability of Contents to drop suddenly in the late 1990s. Relative Usability gradually decreases as the number of cumulative volunteer engineers improves the usability of IPCD service over time. Relative Legitimacy is the opposite effect of Perceived Risk of Illegal Activity. The more Risk of Illegal Activity, the less Relative Legitimacy, expressing the degree of legitimacy of FPCD service.

Figure 4.18 Willingness to Switch based on Value Price, IPCD to FPCD

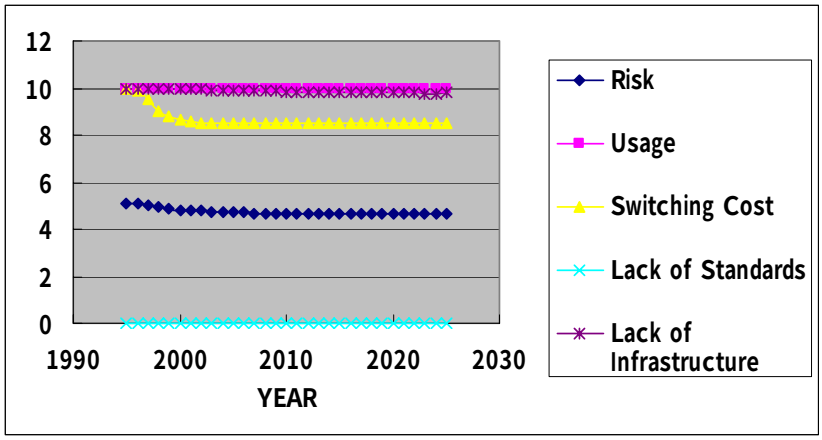


Source: Author, 2003.

4.2.3.9 Effect of Perceived Risk on Willingness, IPCD to FPCD

Figure 4.19 depicts Perceived Risk and the ingredients of total risk. As shown, with less diffusion to FPCD service due to less willingness to switch inhibited by rapid accumulation of illegal contents, major change in risk is not observed because almost all risk factors are highly dependent on cumulative users of FPCD services. Even though initial user-sensitive switching cost decreased a bit, other risk factors remained the same over time. Risk from Usage and Risk from Lack of Infrastructure remain around 10, revealing the highest level of risk since there are almost no users and almost no infrastructure. Risk from Lack of Standards stays at zero, revealing no risk because Risk from Lack of Standards depends on users' requirements for standards under the condition that both service and technology are mature. With lack of users, there is no Risk from Lack of Standards.

Figure 4.19 Perceived Risk on Willingness, IPCD to FPCD



Source: Author, 2003.

4.2.4 Summary

In this section, I explored the current situation of the online contents distribution industry utilizing System Dynamics analysis. As observed, the biggest problem facing the online contents

distribution industry now is the lack of piracy prevention. Even though the industry has developed some solutions to regulate piracy, just as quickly another piracy scheme crops up.

According to the analysis, it is not too much to say that the music distribution industry today (in 2003) is facing a critical turning point—whether to totally lose profitability or to pursue some strategy to counter the piracy problem.

Key findings in this section are:

1. ***In a situation of unsatisfactory copy protection technology, it is obvious that the industry is unable to prevent illegal copying, especially since there appears to be an inexhaustible source of volunteer engineers willing to develop piracy schemes.***
2. ***It is possible that the entire music industry will lose all profitability by the mid-2020s.***
3. ***It has taken only a few years for a sufficient amount of illegal contents to accumulate due to a seeming inexhaustible supply of volunteer content providers.***
4. ***Satisfactory levels of accumulated illegal content have prevented migration to FPCD schemes.***
5. ***A growing accumulation of illegal content plays a dominant role in determining risk, both for accelerating the migration to IPCD and preventing migration to FPCD.***

4.3 Electronic Payment Business Model

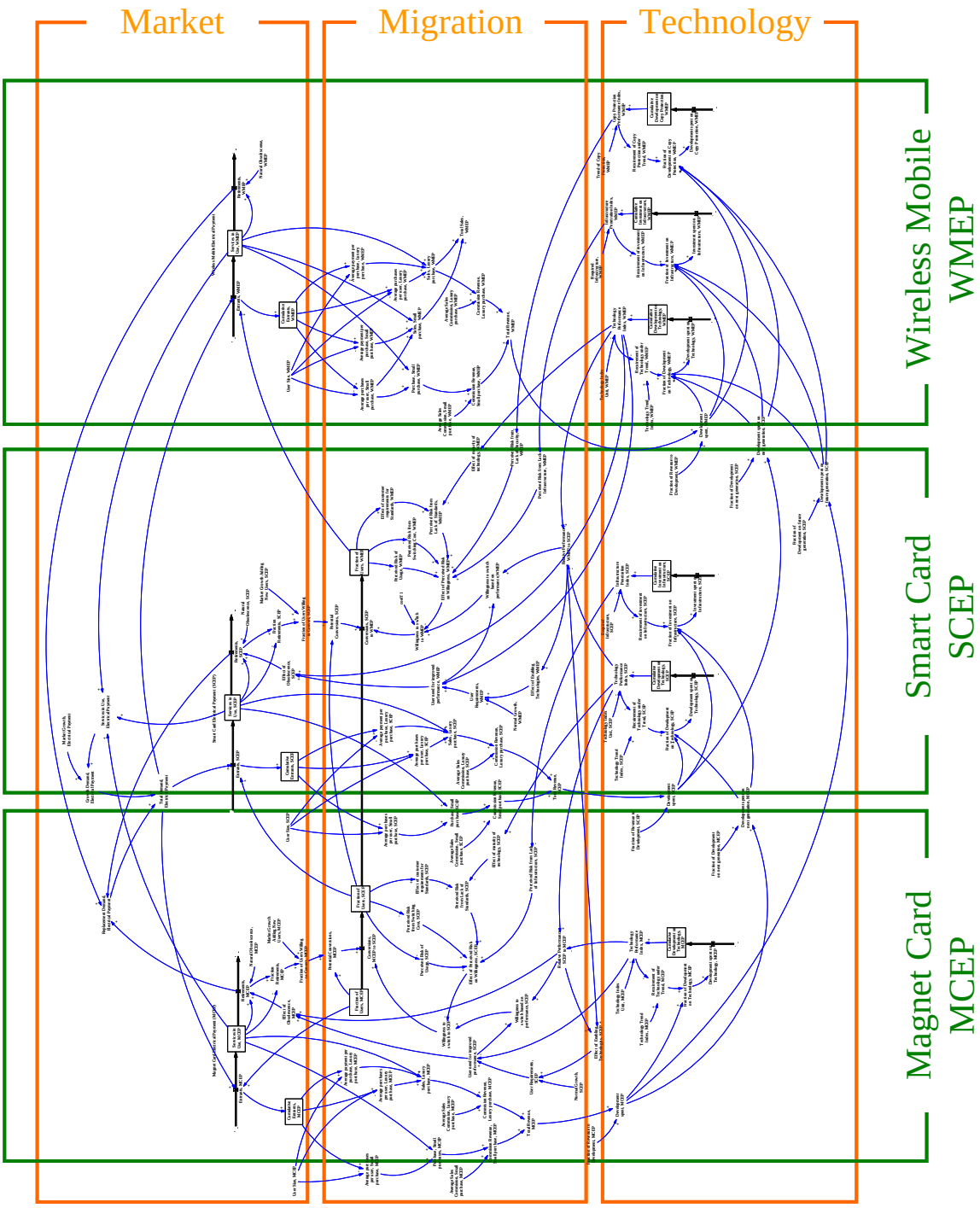
4.3.1 Description of the Model

Figure 4.20 represents an Electronic Payment Business model using System Dynamics methodology. The model consists of the market, technology, managerial actions regarding investment and pricing, and regulatory actions such as industrial initiatives. In this Electronic Payment model, I assume three different payment methods that are migrated over time. Payment users begin electronic payments using the Magnetic Card Electronic Payment (MCEP) scheme, where a traditional plastic card with a magnetic stripe is the media for electronic payment. Users then migrate to Smart Card Electronic Payment (SCEP), where a plastic card with an integrated circuit (IC) inside enables secure payment transactions as the payment media. France has already converted all bank cards from MCEP to SCEP with a corresponding 90% reduction in bank card fraud (Scutti, 2000). Other European and Asian countries are following France's lead, but the U.S. is far behind due to widespread use of traditional MCEP credit and debit cards (SCA, 2000).

The third payment method is Wireless Mobile Electronic Payment (WMEP), where electronic payment is issued via a user's handheld device, such as a mobile phone or PDA. Many WMEP schemes are emerging worldwide, but broad acceptance of WMEP in the payment market is far from reality—a major problem I will explore further in this thesis.

"Fraction of Users" represents the proportion of users who utilize each payment model—MCEP, SCEP, or WMEP. The critical area of the model determines the conversions between each payment schemes. The number of users who enter a certain service is represented by Entrants, which is dependent on total demand and fraction of users by each payment scheme. Total demand consists of growth demand and replacement demand. Total demand is distributed to a stock of "Services in Use" which represents the actual users in each payment type.

Figure 4.20 Electronic Payment Model



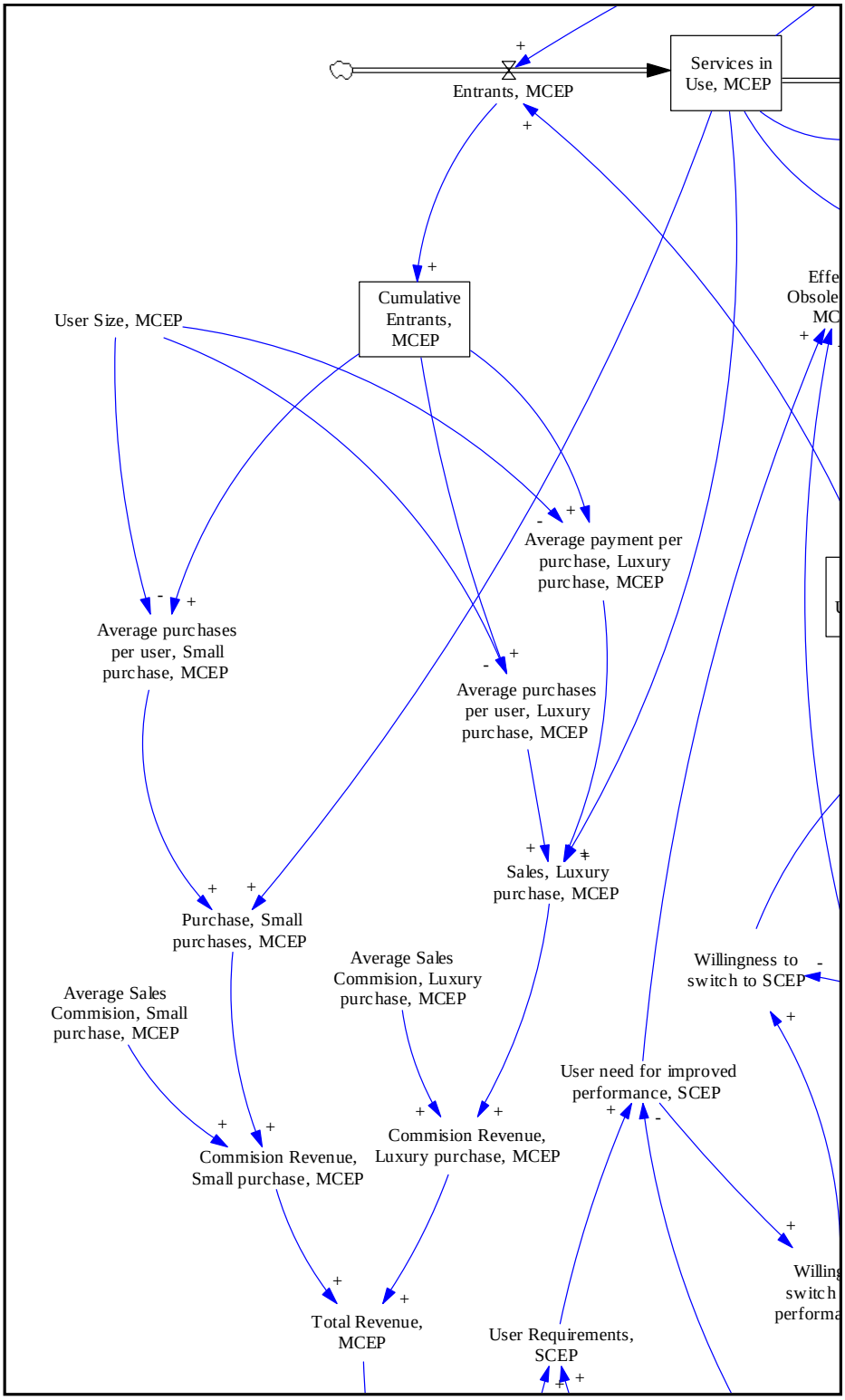
Source: Author, 2003.

4.3.1.1 Revenue Generation of Electronic Payment

In the Electronic Payment model, I assume a revenue generation model as shown in Figure 4.21. For payment methodology in general, there are two ways of payment: Small Payment and Luxury Payment. In MCEP, these payments are categorized into Debit Card Payment and Credit Card Payment (APCS, 2002), and, in WMEP into Micro Payment and Trusted Payment (Balsan, 2002). Commonly, Small Payment scheme collects a commission from each merchant at the time of purchase; Luxury Payment scheme collects a commission fee from both merchant and user based on the purchase price. Therefore, I assumed two ways of revenue generation for Electronic Payment model as shown.

Average Purchase per User: Average Purchase depends heavily on who uses which payment method and where. For instance, Debit Card Payment, roughly categorized as Small Payment, requires less float time than Credit Card since it directly accesses the user's bank account. Therefore, it can be estimated that there are more young users of Debit Card Payment despite a lower purchase limit than those who use Credit Card Payment. According to the Credit Card Research Group, Average Purchase per User is around $40 in Debit Card Payment and $100 in Credit Card Payment (NRI, 2001). One- third of debit card use goes to food and drink purchases, according to research. A debit card is often used for car-related purchases (such as gas refueling). On a purchase execution basis, two-thirds of debit card use goes to purchases at supermarkets, department stores, and gas stations. On the other hand, credit card use is widely dispersed to service, car-related use, commodities, and leisure, with no eminent use observed. In considering these findings, there seems to be a separation of use in Electronic Payments: debit card payment for cheaper purchases such as food and drink, and credit card payment for higher purchases and more dispersed use.

Figure 4.21 Revenue Generation of Electronic Payment model



Source: Author, 2003.

Commission Revenue: While a signature is required for credit card payments, the use of debit cards requires a Personal Identification Number (PIN), which is some predefined combination of numbers. Another difference is the merchant's commission for each payment. With credit cards, each merchant must pay 2-3% of the purchase total as a commission to the credit card issuer. In contrast, with debit cards, the merchant pays the issuer approximately $0.25 per purchase regardless of the total purchase price—clearly, much cheaper than a credit card payment. The higher fee to merchants for use of credit cards is controversial in the retail industry, and some merchants are refusing to accept some credit cards (e.g., American Express) in order to avoid paying the high fee. I have assumed a definition of commission as follows:

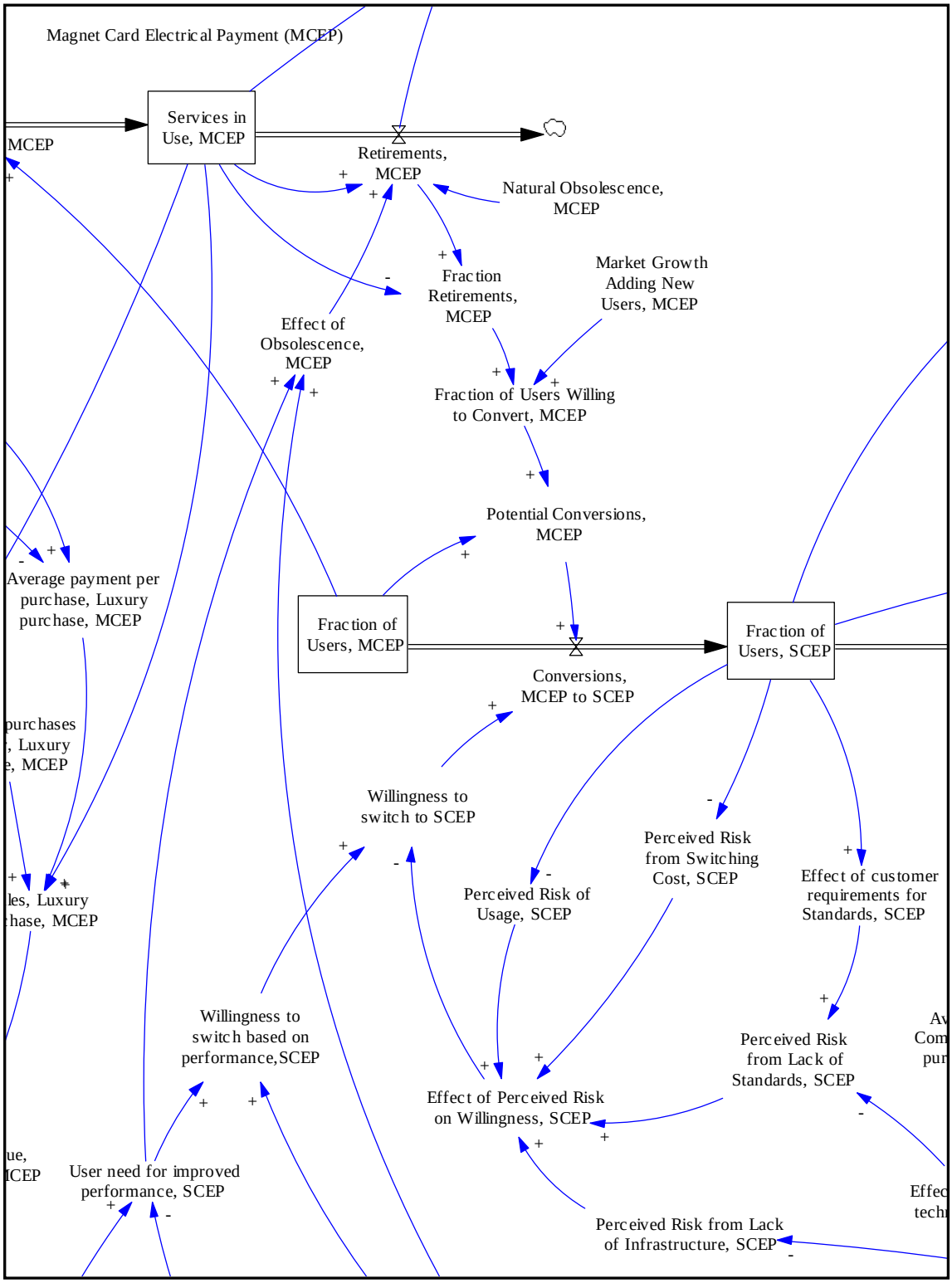
Average Commission for Luxury purchase (Credit Card):	2.5% of purchase price
Average Commission for Small purchase (Debit Card):	$0.25 per purchase

4.3.1.2 Potential Conversions and Willingness to Switch

Figure 4.22 represents Potential Conversions and Willingness to Switch. While Potential Conversions determines the amount of customers ready to convert from one payment scheme to another, Willingness to Switch manipulates the actual conversion from one payment scheme to another. Potential Conversions occurs when the market itself grows or when customers feel ready to shift to another scheme. The Effects of Obsolescence which motivates users to leave the current scheme, is driven by users' acknowledgement of a new technology and the maturity of the old technology. The more acknowledged new technology is available, the more users wish to move to the new technology.

Willingness to Switch based on performance reinforces Willingness to Switch, and Effect of Perceived Risk balances Willingness to Switch. The more attractive technology becomes available and users recognize the new technology, the more Willingness to Switch grows. In this case, the relative performance of a new technology could be the higher security of SCEP compared

Figure 4.22 Potential Conversions and Willingness to Switch



Source: Author, 2003.

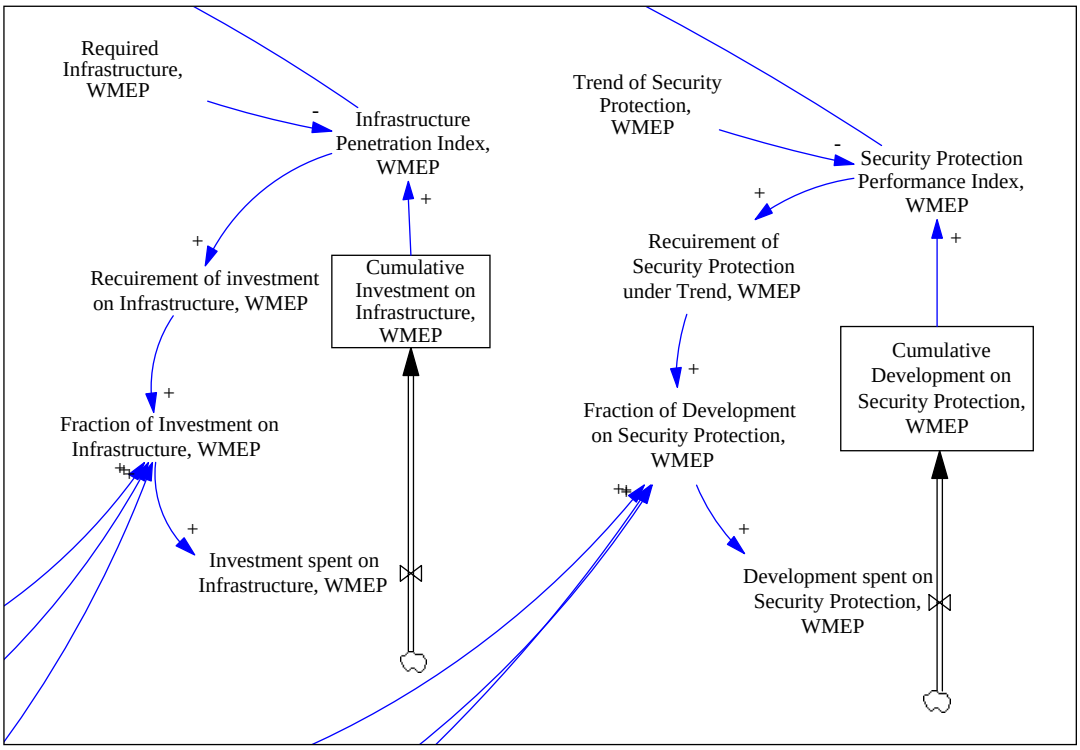
to that of MCTP, or the higher mobility of WMEP compared to that of SCEP. These performances are all represented as Performance Indices described in following section.

The Effect of Perceived Risk on Willingness consists of Risk of Usage, Switching Cost, Lack of Standards, and Lack of Infrastructure. Risk of Usage reflects users' hesitation to use new services until the new service becomes popular. Switching Cost also leads to high risk. As a new service gains popularity along with supporting technology and procedures developed, Switching Cost falls. Risk from Lack of Standards reflects users' requirement for regimented industry standards with a wide adoption of a payment scheme and mature technology. The more prevalent the technology, the more users need industry standards to regulate the payment system. Risk from Lack of Infrastructure reveals the availability of required payment infrastructure, such as an IC card reader in SCEP or a wireless ID reader in WMEP.

4.3.1.3 Representation of Technology Development

Figure 4.23 represents the development of given technologies or infrastructures. The Technology Performance Index of each payment model represents required technology development for a given payment scheme, such as the cost reduction of IC cards in SCEP or development of payment protocols in WMEP. The Infrastructure Penetration Index represents the readiness of required infrastructure for each payment scheme, such as IC reader in SCEP or wireless ID reader in WMEP by physical merchants. Without penetration of the payment infrastructure, there is no widespread adoption of a new payment scheme. Perceived Risk from Lack of Infrastructure reflects the scarcity of payment infrastructure. Copy Protection Performance Index reveals the security of each payment scheme. Perceived Risk from Lack of Security negatively correlates to Copy Protection Performance Index: the securer the payment scheme, the less risk from lack of security.

Figure 4.23 Cumulative development



Source: Author, 2003.

4.3.2 Characterizing the Model

In this section, I characterize the proposed Electronic Payment Model by defining a Base Case which has been designed to replicate the incumbent Electronic Payment industry as closely as possible. I assumed market and technology characteristics as follows.

4.3.2.1 *Magnetic Card Electronic Payment (MCEP)*

Market Characteristics

Initial MCEP users:	18 million users (1995, UK case)
Maximum MCEP users:	40 million users
Market Growth:	5%

Pricing Characteristics (Luxury Purchase)

Average payment / purchase:	$100 (UK case)
Average purchases / user:	40 – 50 - 60 (UK case)
Average sales commission:	2.5% (UK case)

Pricing Characteristics (Small Purchase)

Average payment / purchase:	$40 - $40 - $30 (UK case)
Average purchases / user:	80 – 100 - 120 (UK case)
Commission / purchase:	$0.25 (UK case)

Technology Characteristics

Fraction of Revenue to Development:	33 %
Required Development for MCEP Technology:	$1 billion
Initial Development for MCEP Technology:	$500 million
Development spent for MCEP Technology:	(0 - 0.5) * Available Development for MCEP

4.3.2.2 Smart Card Electronic Payment (SCEP)

Market Characteristics

Initial SCEP users:	0 (Year 1995)
Maximum SCEP users:	40 million users
Market Growth:	5%

Pricing Characteristics (Luxury Purchase)

Average payment / purchase:	$100 (UK case)
Average purchases / user:	40 – 50 - 60 (Based on UK case)
Average sales commission:	2.5% (UK case)

Pricing Characteristics (Small Purchase)

Average payment / purchase:	$40 - $40 - $30 (UK case)
Average purchases / user:	80 – 100 - 120 (UK case)
Commission / purchase:	$0.25 (UK case)

Technology Characteristics

Relative Fraction of Revenue to Development from previous generation:	33%
Fraction of Revenue to Development from current generation:	33%
Required Development for SCEP Technology:	$2 billion
Initial Development for SCEP Technology:	$500 million
Development spent for SCEP Technology:	(0 - 0.5) * Available Development for SCEP
Required Investment for SCEP infrastructure:	$4 billion
Initial Investment for SCEP Infrastructure:	$0
Investment spent for SCEP Infrastructure:	(0 - 0.5) * Available Development for SCEP

4.3.2.3 Wireless Mobile Electronic Payment (WMEP)

Market Characteristics

Initial WMEP users:	0 (1995)
Maximum WMEP users:	40 million users
Market Growth:	5%

Pricing Characteristics (Luxury Purchase)

Average payment / purchase:	$100 (UK case)
Average purchases / user:	40 – 50 - 60 (Based on UK case)
Average sales commission:	2.5% (UK case)

Pricing Characteristics (Small Purchase)

Average payment / purchase:	$40 - $40 - $30 (UK case)
Average purchases / user:	80 – 100 - 120 (UK case)
Commission / purchase:	$0.25 (UK case)

Technology Characteristics

Relative Fraction of Revenue to Development from first generation:	10%
Relative Fraction of Revenue to Development from previous generation:	10%
Fraction of Revenue to Development from current generation:	33%
Required Development for WMEP Technology:	$3 billion
Initial Development for WMEP Technology:	$0
Development spent for WMEP Technology:	(0 - 0.5) * Available Development for WMEP
Required Investment for WMEP infrastructure:	$6 billion
Initial Investment for WMEP Infrastructure:	$0
Investment spent for WMEP Infrastructure:	(0 - 0.5) * Available Development for WMEP
Required Development for Security Protection:	$6 billion
Initial Development for Security Protection:	$0
Development spent for Security Protection:	(0 - 0.5) * Available Development for WMEP

4.3.2.4 Conversion from MCEP to SCEP

Each weight represents the importance of each component on formulating combined risk.

Effect of Perceived Risk on Willingness

= 0.1 * Perceived Risk from Usage + 0.1 * Perceived Risk from Switching cost

+ 0.4 * Perceived Risk from Lack of Standards + 0.4 * Perceived Risk from Lack of Infrastructure

Willingness to switch based on performance

= 0.5 * Relative performance, SCEP to MCEP + 0.5 * User need for improved performance

Willingness to switch to SCEP

= Willingness to switch based on performance - 0.5 * Effect of Perceived Risk on Willingness

Effect of Obsolescence

= Relative Performance, SCEP to MCEP + User need for improved performance

4.3.2.5 Conversion from SCEP to WMEP

Effect of Perceived Risk on Willingness

= 0.05 * Perceived Risk from Usage + 0.05 * Perceived Risk from Switching Cost

+ 0.3 * Perceived Risk from Lack of Standards + 0.3 * Perceived Risk from Lack of Security

+ 0.3 * Perceived Risk from Lack of Infrastructure

Willingness to switch based on performance

= 0.5 * Relative performance, WMEP to SCEP + 0.5 * User need for improved performance

Willingness to switch to WMEP

= Willingness to switch based on performance - 0.5 * Effect of Perceived Risk on Willingness

Effect of Obsolescence

= Technology Performance, WMEP + User need for improved performance

4.3.3 Behavior of the Base Model

In this section, I attempt to simulate the proposed Electronic Payment model in accordance with ongoing market conditions in the electronic payment industry. The profound problem facing the electronic payment industry at this time is the sluggish diffusion of new payment schemes such as SCEP or WMEP. According to Damien Balsan, (2002), creating industry-wide trust is absolutely required for rapid diffusion and widespread acceptance of new payment schemes. In this

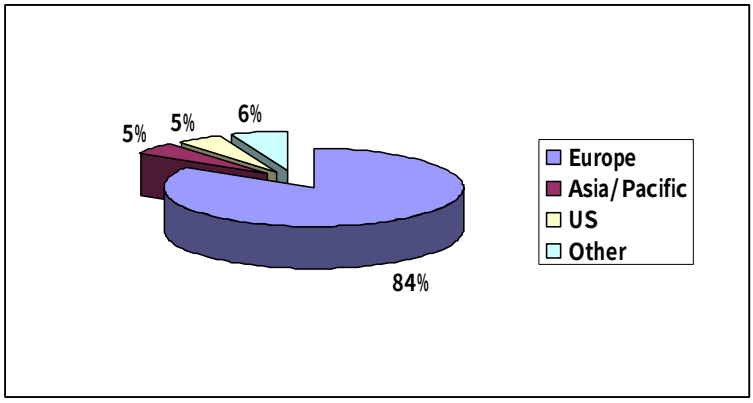
sense, penetration of the infrastructure and/or a perception of security seem to impact the diffusion process. With these factors in mind, I can reveal both drivers and prohibitors of each characteristic.

4.3.3.1 Current Condition of the Smart Card Payment Infrastructure

Smart Card technology has enjoyed widespread growth worldwide over the last few years, and proliferation of the technology in the U.S. has been anticipated since the mid-1990s. In fact, the three major card associations (American Express, MasterCard, and Visa) have established Smart Card programs with significant issuer participation and over 17 million cards in circulation by the end of 2001 (Card Marketing, 2002).

The next step is for Smart Cards to achieve wider acceptance across the merchant population, thereby enabling consumers to realize the benefits of the technology. However, in the U.S., the growth of Smart Card use for payments has not yet occurred due to a lack of a definitive business case for all industry participants (SCA, 2003). Figure 4.24 shows how rapidly the European market accepted the Smart Card infrastructure, but not in the U.S. (Celent, 2001). In fact, has France already achieved complete diffusion into a Smart Card infrastructure for banking use by the mid-1990s (Scutti, 2000).

Figure 4.24 Percentages of Bank Smart Cards Worldwide, by Region, 2001



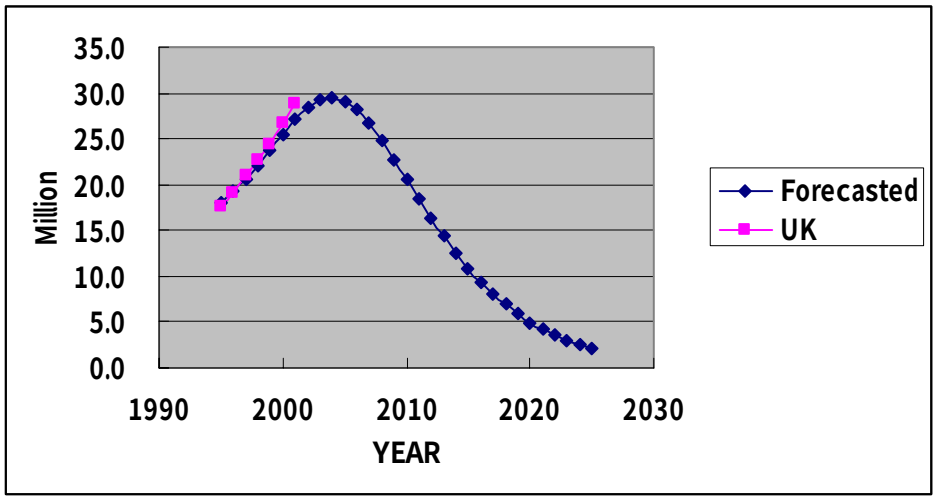
Source: Celent Communications, 2001.

In this section, one focus is to analyze the diffusion process of payment schemes, from MCEP through SCEP to WMEP, in light of current and historical market data for each payment scheme. When considering a higher adoption rate for a new payment infrastructure, I use the European card payment infrastructure as my reference point. I will use market data from both the UK and France as references for validating the proposed System Dynamics model.

4.3.3.2 Magnetic Card Holders in UK

Figure 4.25 depicts current magnetic card users in the UK and forecasted card users in proposed System Dynamics model. As shown in Figure 4.25, current card users and model-generated card users prove the legitimacy of the proposed model. Peaking in 2004, magnetic card users begin turning to a mitigating phase that allows card users to migrate to other payment services such as SCEP or WMEP. Under current conditions, and lacking a definitive business case for the entire card payment industry, it is acceptable that magnetic card users will retain their magnetic cards for more than ten years in the MCEP payment scheme, while it took less than five years for magnetic card users in France to replace all their banking card with Smart Cards,

Figure 4.25 Magnetic Card Users in UK



Source: APACS, 2002.

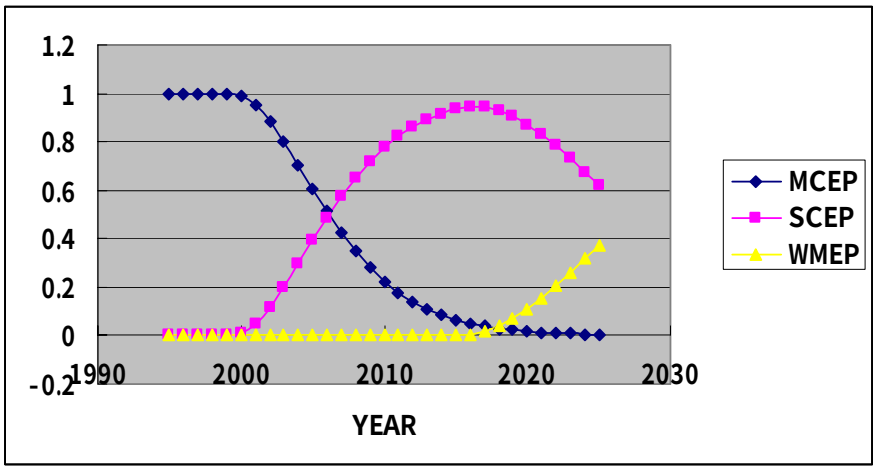
prompted by strong government support and regulations for adopting SCEP scheme in the banking infrastructure to avoid card fraud (Scutti, 2000).

The UK banking industry recently announced that it estimates the migration of banking cards from MCEP to SCEP will be achieved during 2004 to prevent bank card fraud (NR Research Center, 2002), while adoption of MCEP for card payments is still sluggish due to the lack of a definitive business case.

4.3.3.3 Users by Payment Type (Fraction)

Figure 4.26 shows the simulated diffusion process of each payment type—MCEP, SCEP, and WMEP. Beginning in 2000, migration from MCEP to SCEP occurs and is completed in the mid-2010s—a long time due to lack of a definitive business case sustained by wire adoption of payment infrastructure (refer back to Section 4.3.3.1). Migration from SCEP to WMEP is even further away, according to the simulation, occurring in early 2020, which shows the difficulties of creating a proper business model based on industry-wide trust sustained by a prevailing infrastructure (Balsan, 2002). These migration processes are explained by the level of willingness to switch to each payment scheme, and will be discussed later.

Figure 4.26 Users by Payment Type (Fraction)



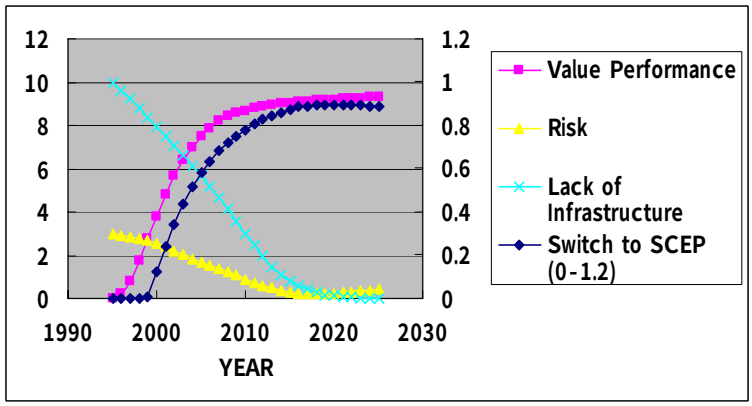
Source: Author, 2003.

4.3.3.4 Perceived Risk and Willingness to Switch to SCEP

Figure 4.27 shows the Willingness to Switch from MCEP to SCEP and each component. It is important to note that migration from MCEP to ECEP occurs at Year 2000 (Figure 4.26), the same year that Willingness to Switch based on Value Performance exceeds Perceived Risk on Willingness in Figure 4.27. It is also important to understand the major components of each factor, Willingness to Switch and Risk on Willingness. As shown in Figure 4.27, the major component of Willingness to Switch is Willingness Based on Value Performance, which measures the relative technology performance of SCEP against MCEP. As technology development accumulates in the MCEP technology index, attractiveness of the MCEP scheme also increases, reflecting a higher number for Willingness on Value Performance. To accelerate migration into a new SCEP scheme, managers can accelerate technology development to make SCEP service attractive.

Another concern is the perceived risk that balances Willingness of Switch to SCEP. A major factor for perceived risk at an early stage, where there is no other risk on a cumulative user basis, is Risk from Lack of Infrastructure. As shown in Figure 4.27 sluggish adoption of infrastructure in the market hinders the adoption of the SCEP scheme in the market, balancing Willingness to Switch to SCEP. Another managerial concern is how to accelerate infrastructure adoption for an SCEP scheme for rapid and wide adoption of SCEP.

Figure 4.27 Willingness to Switch from MCEP to SCEP



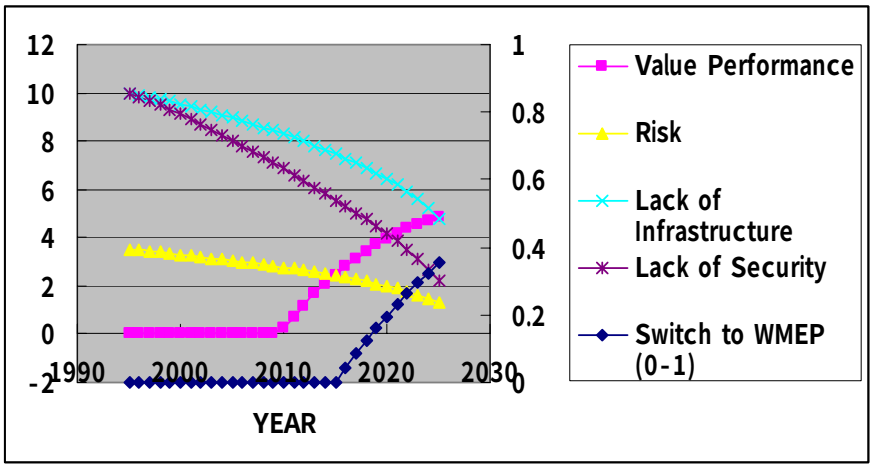
Source: Author, 2003.

4.3.3.5 Perceived Risk and Willingness to Switch to WMEP

Figure 4.28 shows Willingness to Switch from SCEP to WMEP and each component. Again, it is important to notice that migration from SCEP to WMEP occurs at Year 2016 (Figure 4.26), the same year that Willingness to Switch based on Value Performance exceeds Perceived Risk on Willingness in Figure 4.28. Due to a severe lack of infrastructure for WMEP, it takes a long time for migration from SCEP to WMEP to occur.

It is also important to understand the major components that make migration happen. The dominant player in Willingness to Switch is, again, the relative technology performance of WMEP against SCEP, which drives Willingness to Switch based on Value Performance. Effective development to improve the attractiveness of WMEP would dramatically accelerate migration to WMEP. On the risk side, Lack of Security and Infrastructure plays a dominant role in forming Perceived Risk on Willingness, as shown in Figure 4.28. Especially in WMEP, security is the highest concern among users when migrating to WMEP. Further, wide adoption of infrastructure is inevitable for forming industry-wide trust leading to wide adoption of WMEP. To accelerate the migration process, rapid security technology accumulation and effective investment for infrastructure are the highest concerns.

Figure 4.28 Willingness to Switch from SCEP to WMEP



Source: Author, 2003.

4.3.3.6 Revenue of Electronic Payment Model

Figure 4.29 depicts the estimated revenue from each electronic payment model. As shown, revenue from MCEP dominates the electronic payment industry, with a growth rate of 8-9%. As the SCEP scheme replaces MCEP, so too does revenue from SCEP become a dominant revenue generator for the entire electronic payment industry, with a growth rate of 4-5%. By the mid-2020s, as WMEP replaces SCEP, so does revenue from WMEP. Because of slow migration from SCEP to WMEP due to lack of trusted infrastructure, SCEP will become the dominant revenue generator in the 2010s and 2020s, according to the forecast.

Based on the fact that total card sales in the UK were $268B in 2001 (NR Research Center, 2002), total revenues from the electronic payment industry in the UK in 2001 can be estimated as follows.

Estimated revenues from electronic payments in the UK in 2001

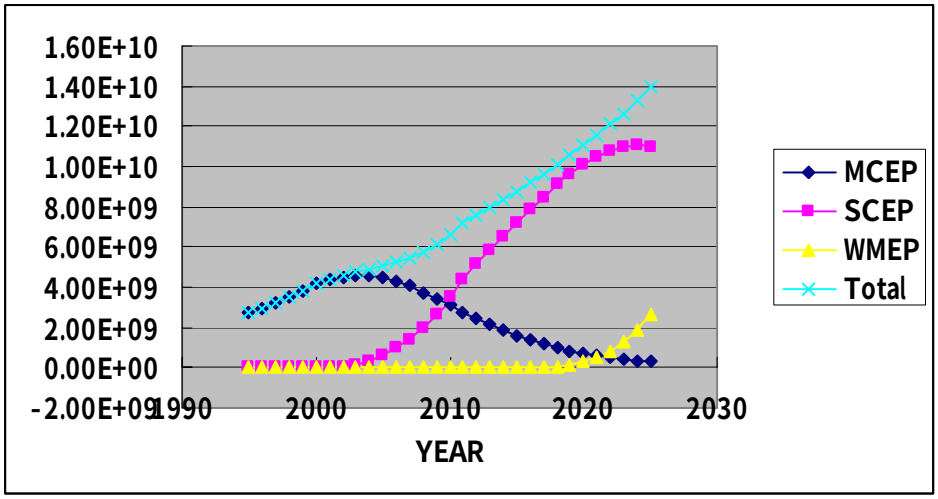
= (Credit Portion) * (Sales) * (2.5%) + (Debit Portion) * (Sales) / (Avg Purchase) * $0.25

= 55.7% * $268B*2.5% + 44.3% * $268B / $40 * $0.25

= $3.73B + $0.74B = **$4.47B (Market-based) vs. $4.36B (Simulation-based)**

With simulation-based estimated revenues of $4.36B, this proves that calculations for estimated revenues from the electronic payment industry for both market and simulated data support the validity of the model.

Figure 4.29 Revenue of Electronic Payment Model



Source: Author, 2003.

4.3.4 Summary

In this section, I explored the current situation of the electronic payment industry using System Dynamics analysis. As discussed, it is essential for technology to be developed for an attractive payment service, which will drive the migration of potential users to a new payment scheme. In addition, maintaining infrastructure and dealing with security issues are equally important. This means that huge investments will be required in order to have a well-coordinated scheme that creates user trust and leads to widespread adoption of the new payment scheme.

Key findings in this section are:

1. ***The lack of infrastructure for a new payment scheme is a major obstacle for both SCEP and WMEP, offsetting the migration of potential users to a new payment scheme.***

2. ***Improved security protection technology is essential for accelerating migration from SCEP to WMEP, in order to persuade potential users and create trust for a WMEP scheme.***
3. ***Lack of industry or government initiatives in support of a new payment scheme slows the migration process toward any new payment scheme, in contrast to the case of government initiative taken in France.***
4. ***SCEP will become the dominant revenue generator in the 2010s and 2020s owing to the sluggish adoption of WMEP, which has been delayed by a lack of trusted infrastructure.***

Chapter 5

System Dynamics Analysis of Integrated Business Model

5.1 Introduction

Having discussed two separate business models for the online music distribution industry and the electronic payment industry, I will now try to integrate the two industries by exploring possible business strategies for both businesses, to complement each other and to forecast the future of such a joint business. The beauty of System Dynamics analysis is the ability to forecast the future under different business scenarios. I began by analyzing current business conditions and applying different scenarios. Then I forecast the future of the online music distribution industry applying other possible business scenarios.

The purpose of this thesis is to try integrating the online music distribution industry and electronic payment industry as complementary businesses for each other. This chapter analyzes the feasibility of such a joint business and clarifies the business factors or events that would most likely impact the success of the new joint business.

5.2 An Integrated Business Model

5.2.1 Description of the Model

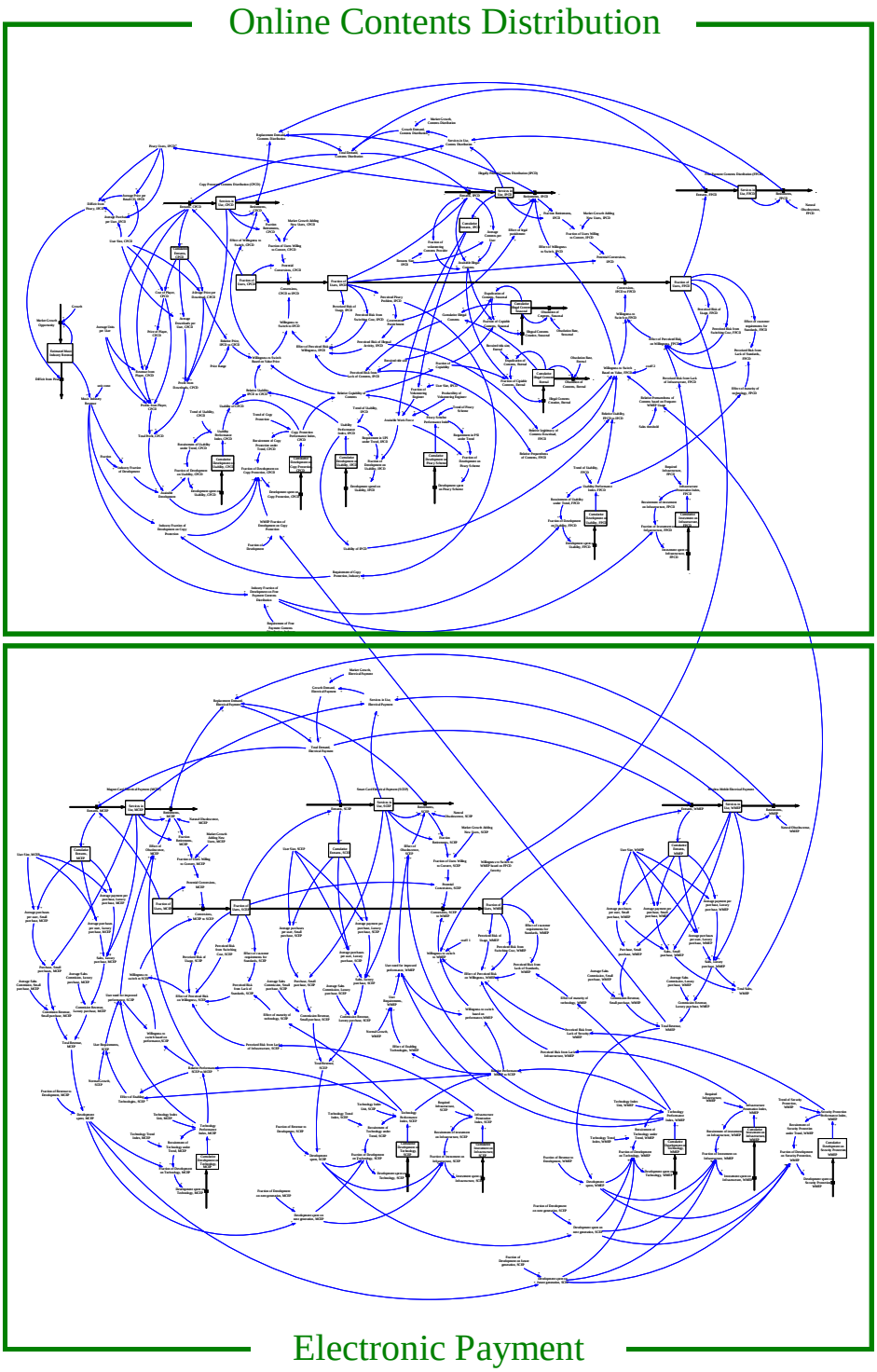
Figure 5.1 represents a joint business model of the online contents distribution business combined with the electronic payment business. As discussed in previous sections, there are three stages in business models: CPCD, IPCD, and FPCD in the online contents distribution business,

and MCEP, SCEP, and WMEP in the electronic payment business. An interesting commonality in both business models is the delayed diffusion of wireless-related businesses, FPCD and WMEP, due to a lack of infrastructure and an insufficient level of security assurance that creates trust.

The purpose of such an integrated business model is to maximize the value of each business model by supplementing each other's business, especially in the sluggish wireless-related FPCD and WMEP businesses. As discussed in previous sections, migration from one business to another occurs when Willingness to Switch exceeds Perceived Risk. The major problem we saw in migration to wireless-related FPCD and WMEP is low Willingness to Switch due to lack of attractive services and high Perceived Risk due to lack of infrastructure and security scheme. FPCD has definite attractiveness for distributing contents for free. However, it is facing financial difficulties caused by the need to improve copy protection, the need to maintain a satisfactory infrastructure network, and because of piracy problems that have hampered their profitable business.

On the other hand, WMEP is clearly lacking attractiveness of service that initially motivates users to migrate to WMEP service, as well as the financial difficulties that prevent improved security protection and maintaining the infrastructure, due to sluggish migration to WMEP. So the integrated business model will try to mitigate such individual difficulties by complementing the values and shortcomings of each business.

Figure 5.1 Integrated Business Model



Source: Author, 2003.

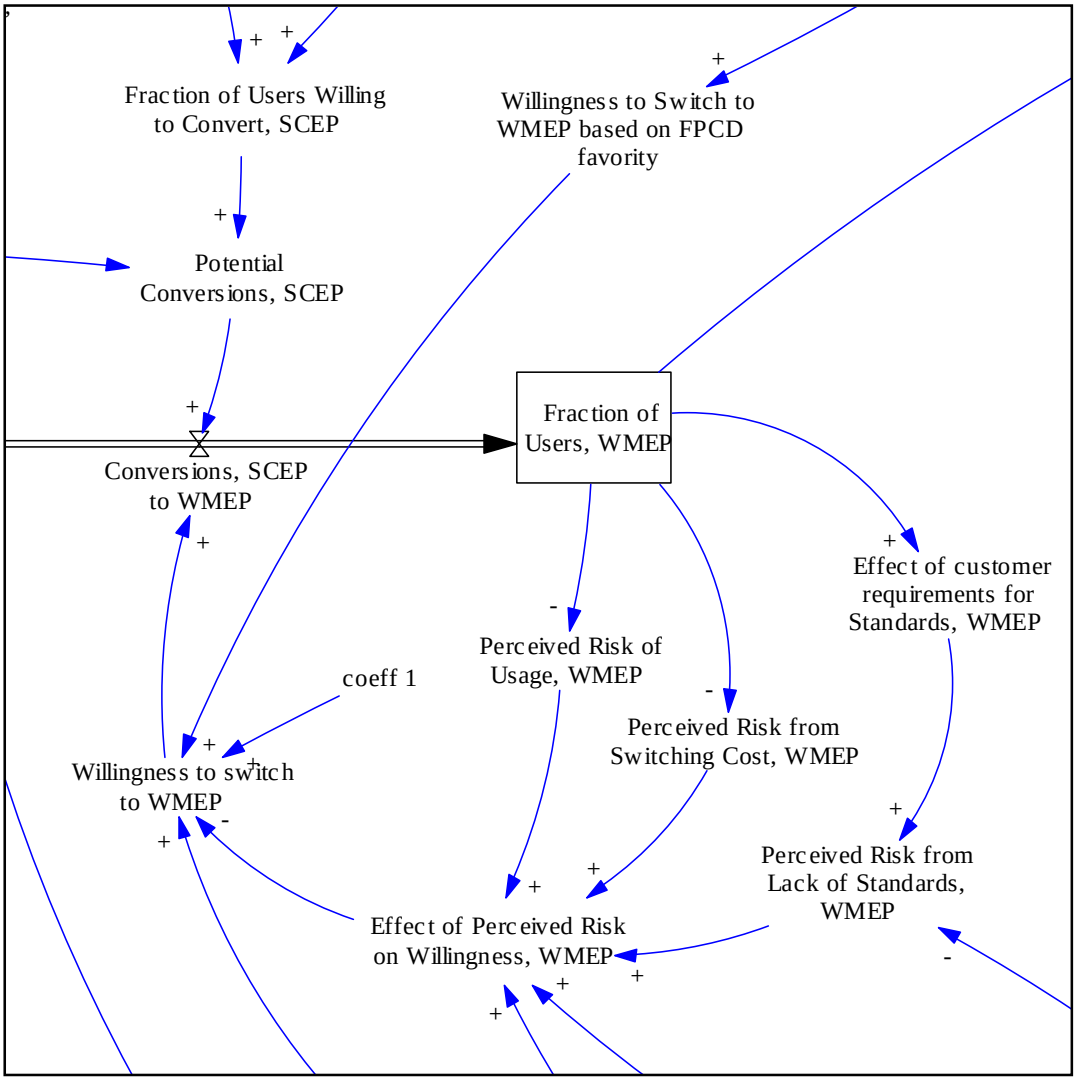
The attractiveness of a free download service would supplement WMEP by introducing a joint service business that included both FPCD and WMEP. As the number of FPCD user increases, positive word-of-mouth about the attractive FPCD service will reinforce WMEP use as well because FPCD and WMEP are tied together, thus driving migration to WMEP. Rapid migration to WMEP leads to improved WMEP revenues, with the added complementarities of supplementing copy protection technology development against piracy and also contributing to improved profitability for the whole industry by accelerating migration to a profitable business model. Figure 5.1 represents two models, online contents distribution model in the upper half and electronic payment model in the lower half, with the interconnection between the two models also shown.

5.2.1.1 Sharing the Value of a Free Content Download Service

Figure 5.2 explains the inter-relationship between FPCD and WMEP in sharing the value of a Free Content Download Service using FPCD for both business models. Apparently, free content download is a definitive value proposition for customers but it is not sufficiently attractive in the FPCD business which faces the attractiveness of illegal piracy with IPCD. The idea is to provide free content distribution to WMEP as a complementary service in order to motivate potential WMEP users to quickly migrate to WMEP. Rapid migration to WMEP further supplements the FPCD business by funding copy protection development as a complementary development.

Willingness to Switch to WMEP based on FPCD favorability represents the users' positive word-of-mouth also driving Willingness to Switch to WMEP. Willingness to Switch based on FPCD favorability derives from User Fraction of FPCD Business. The more users use an FPCD service favoring free downloads, the more potential users are willing to migrate to a WMCD service because of FPCD favorability.

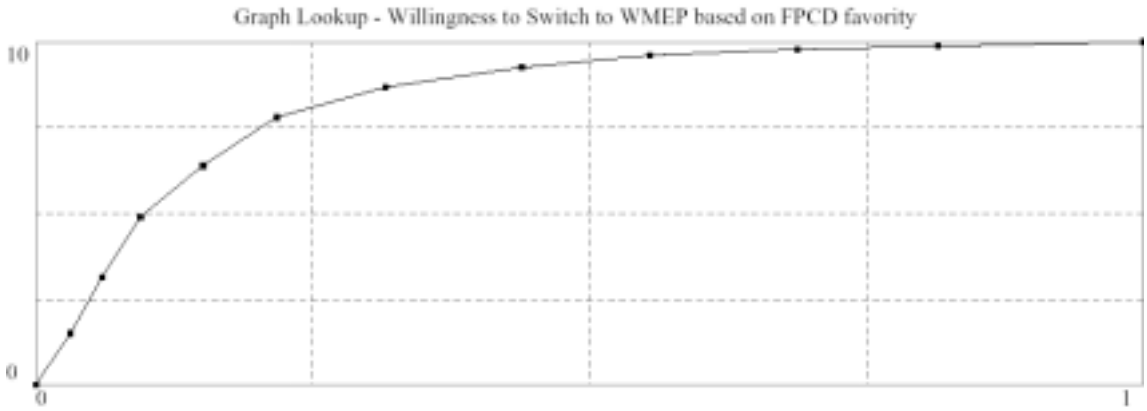
Figure 5.2 Sharing the Value of Free Content Download Service



Source: Author, 2003.

Figure 5.3 depicts the assumed sensitivity of WMEP users on FPCD service. Considering the novelty of the complementary FPCD business with WMEP, I assumed a high sensitivity among WMEP users on Willingness to Switch based on FPCD favorability as shown.

Figure 5.3 Willingness to Switch to WMEP based on FPCD favorability



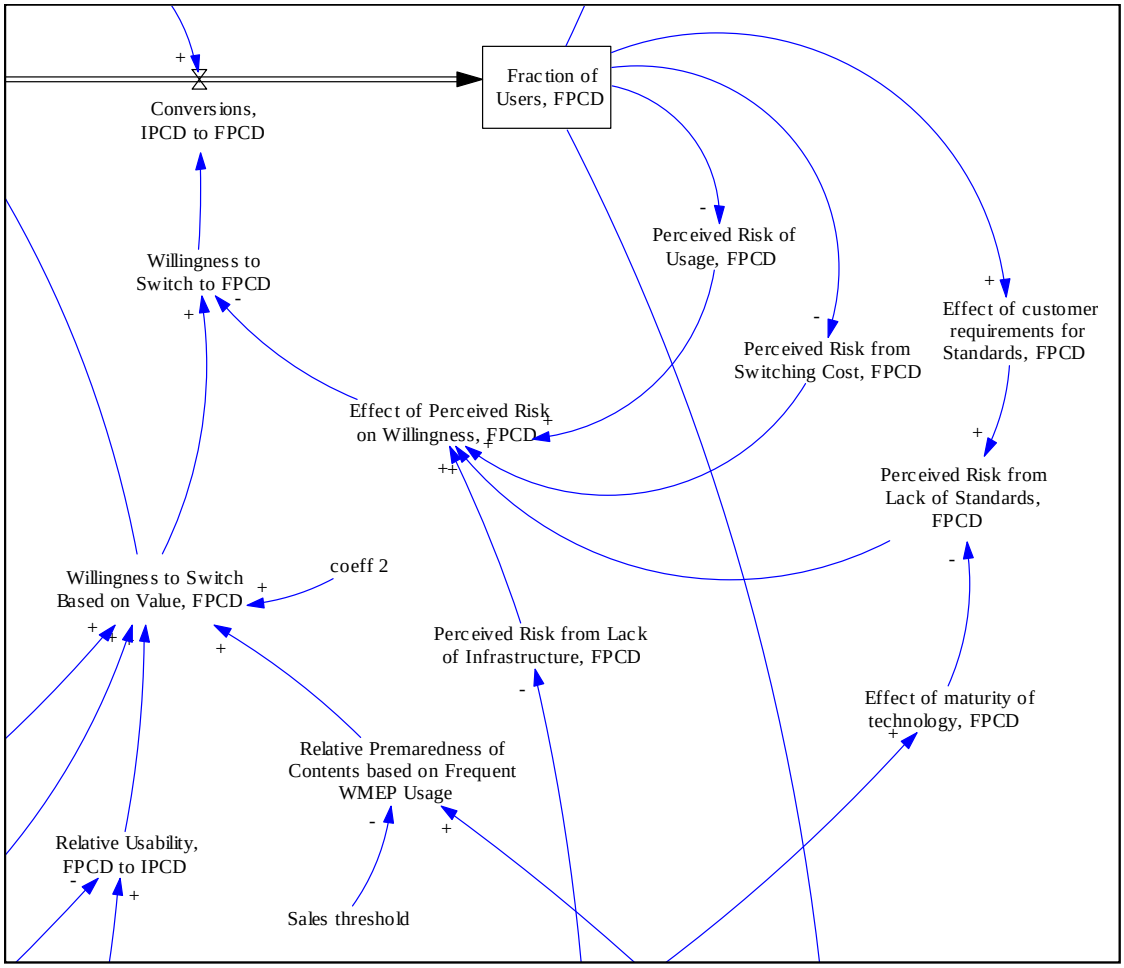
Source: Author, 2003.

5.2.1.2 Frequent WMEP users rewarding program

A frequent WMEP user reward program is one idea to encourage more frequent use of the WMEP scheme by offering a wide variety of free content in the FPCD service based on the amount WMEP users spend in the WMEP infrastructure. In short, the more they use WMEP, the more FPCD contents they get. This scheme also utilizes the value of free content distribution but the degree of service relies on how much WMEP users spend, thus motivating WMEP users to spend more on WMEP infrastructure. Figure 5.4 explains the mechanism of this scheme.

Relative Preparedness of Content based on Frequent Usage increases as cumulative sales of WMEP users increases, reinforcing migration to FPCD service and WMEP service since these two are tied together. Another perspective is that an expanding number of FPCD users will further stimulate FPCD favorability, further driving WMEP use.

Figure 5.4 Frequent WMEP users rewarding program



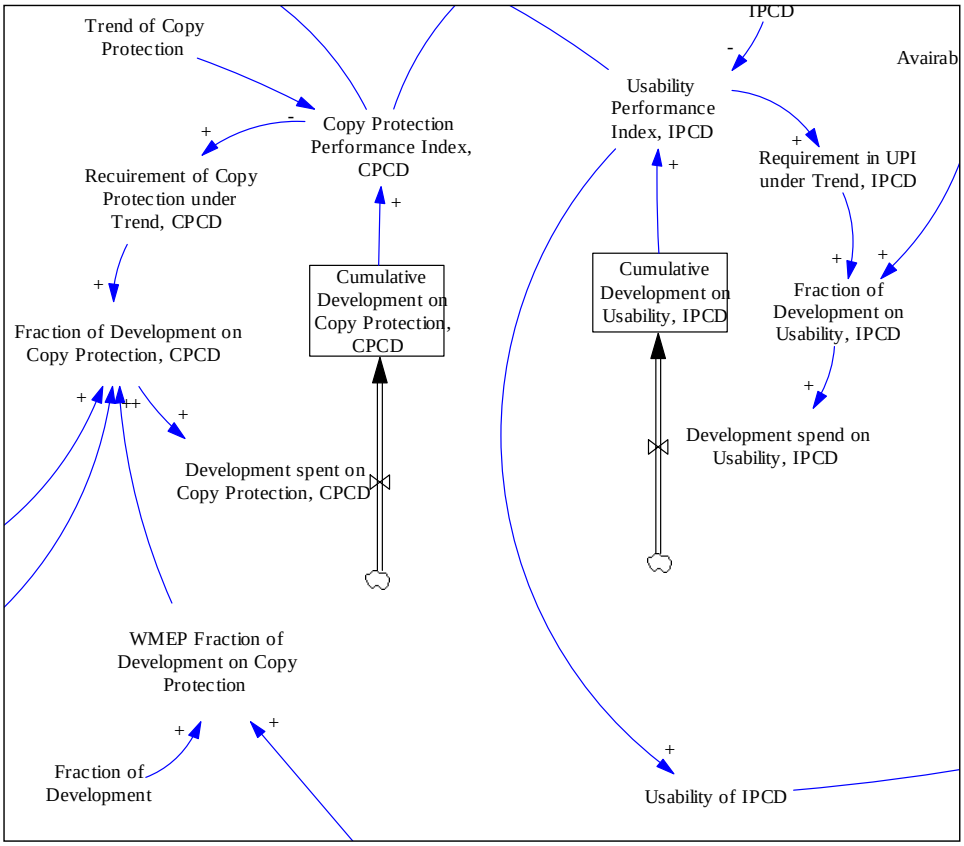
Source: Author, 2003.

5.2.1.3 Complementary FPCD development fed by WMEP revenue

The integrated business will also enable revenue sharing between the two complementary businesses, mainly gained by WMEP, thus enabling additional development of copy protection technology for FPCD. The unprofitable FPCD business is suffering financial difficulties that are hindering its ability to invest in further technology development required to battle piracy problems. Without a revenue source it seems difficult for the online distribution industry to underwrite further investment in copy protection technology. But development fueled by a complementary WMEP business would accelerate prevention of piracy leading to a more profitable online content

distribution business. Figure 5.5 explains the additional development of Copy Protection technology development fed by a profitable WMEP business. WMEP Fraction of Development on Copy Protection, derived from WMEP Revenue, enables the acceleration of copy protection development, hopefully restoring profitability to the online content distribution business.

Figure 5.5 Complementary Copy Protection development fed by WMEP revenue



Source: Author, 2003.

5.2.2 Characterizing the Model

In this section, I explain the characteristics that are assumed for the proposed integrated business Model. Adding to the implementation of structural strategy in integrating the two business models discussed in previous sections, I also imposed managerial initiatives and industrial initiatives to accelerate the success of the proposed integrated business model. As a managerial

initiative, I expect to utilize MVNO to aggressively accelerate infrastructure penetration. As an industrial initiative, I expect the entire music distribution industry to aggressively invest in FPCD development for accelerating the proposed integrated business model. I assume 5% of music distribution industry spending on FPCD development. Furthermore, reflecting an overall perception of the piracy problem, I expect the entire music industry to spend 2.5% of industry revenue on the development of copy protection technology.

5.2.2.1 Characterizing the MVNO enforcement

In the wireless-related FPCD and WMEP business, rapid creation of satisfactory levels of infrastructure is requisite for reducing risk caused by Risk from Lack of Infrastructure, which will enable smooth migration to a wireless-related business. In addition, infrastructure rental services from a Mobile Virtual Network Operator (MVNO) service is rapidly emerging today. There have been reports of several successful business cases, including Virgin Mobile and One-2-One, which have witnessed a significant reduction of required infrastructure investment. According to a recently announced MVNO deal between Norwegian Tele2 and Swedish Telenor, Tele2 could reduced its required infrastructure investment by more than 90% by utilizing Telenor's 3G MVNO service instead of building its own 3G network (Randall, 2002).

In my proposed integrated business model, I have assumed $6 billion as required investment on infrastructure for wireless communication. Considering MVNO as an appropriate managerial strategy, I dropped required infrastructure for wireless communication down to $1 billion based on the forecasted reduction of required infrastructure with the rate of one-fifth, as discussed in Chapter 3.2.2.

5.2.2.2 Characterizing the model

Copy Protection Technology Characteristics

Fraction of Industry to Development: 2.5% (0.1% in Base Model)

Required Development for Usability:	$1 billion
Initial Development for Usability:	$500 million
Development spent for Usability:	(0 - 0.5) * (2.5% * Industry Profit + Total Profit)
Required Development for Copy Protection:	$3 billion
Initial Development for Copy Protection:	$ 0
Development spent for Copy Protection:	(0 - 0.5) * (Perceived Risk of Piracy (0 - 0.1) * (2.5% * Industry Profit + Total Profit + 33% * WMEP revenue)

FPCD Technology Characteristics

Fraction of Industry to Development:	5% (0.1% in Base Model)
Required Development for Usability:	$1 billion
Initial Development for Usability:	$800 million
Development spent for Usability:	(0 - 0.5) * (5%*Industry Profit)
Required Investment for Infrastructure:	$1 billion ($6 billion in Base Model)
Initial Investment for Infrastructure:	$0 (1998)
Investment spent for Infrastructure:	(0 - 0.5) * (5%*Industry Profit)

WMEP Technology Characteristics

Fraction of WMEP Revenue spent on Copy Protection Development:	33%
Required Development for WMEP Technology:	$3 billion
Initial Development for WMEP Technology:	$0
Development spent for WMEP Technology:	(0 - 0.5) * Available Development for WMEP
Required Investment for WMEP infrastructure:	$1 billion ($6 billion in Base Model)
Initial Investment for WMEP Infrastructure:	$0
Investment spent for WMEP Infrastructure:	(0 - 0.5) * Available Development for WMEP

Conversion from IPCD to FPCD

Effect of Perceived Risk on Willingness

= 0.15 * Perceived Risk of Usage + 0.15 * Perceived Risk from Switching Cost

+ 0.35* Perceived Risk from Lack of Standards + 0.35* Perceived Risk from Lack of Infrastructure

Willingness to Switch Based on Value

= 0.5 * Relative Preparedness of Contents + 0.3 * Relative Legitimacy of Contents Download

+ 0.2 * Relative Usability, FPCD to IPCD

+ 0.33 * Relative Preparedness of Contents based on Frequent WMEP Usage

Willingness to Switch to FPCD

= Willingness to Switch Based on Value - 0.5 * Effect of Perceived Risk on Willingness

Conversion from SCEP to WMEP

Effect of Perceived Risk on Willingness

= 0.05 * Perceived Risk from Usage + 0.05 * Perceived Risk from Switching Cost

+ 0.3 * Perceived Risk from Lack of Standards + 0.3 * Perceived Risk from Lack of Security

+ 0.3 * Perceived Risk from Lack of Infrastructure

Willingness to switch based on performance

= 0.5 * Relative performance, WMEP to SCEP + 0.5 * User need for improved performance

Willingness to switch to WMEP

= Willingness to switch based on performance - 0.5 * Effect of Perceived Risk on Willingness

+ 0.33 * Willingness to Switch to WMEP based on FPCD favorability

5.2.3 Behavior of the Integrated Business Model

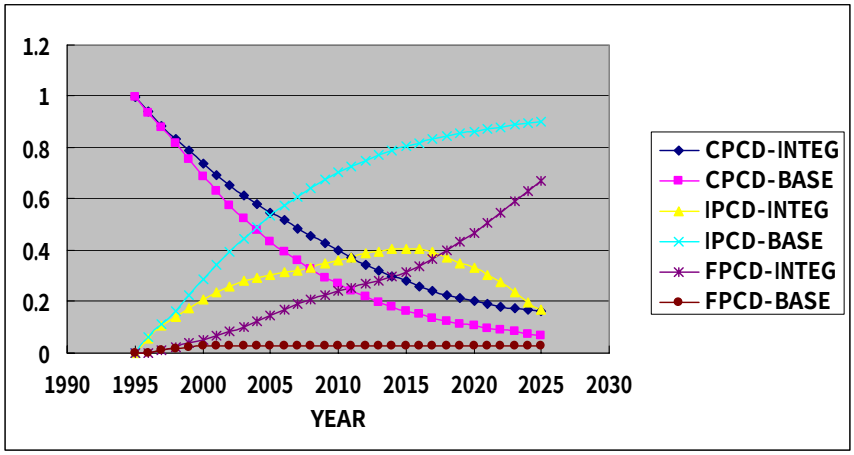
In this section, I reveal the impact of integrating the two businesses and highlight the benefits and shortcomings for each industry using System Dynamics diffusion models.

5.2.3.1 Users by business Type (Fraction)

Figure 5.6 and Figure 5.7 show the impact of the integrated business model on the diffusion process for each online music distribution type (CPCD, IPCD, and FPCD) and those of each payment type (MCEP, SCEP, and WMEP).

As shown in both businesses, the impact of integration on the diffusion process apparently accelerates the process, especially in the wireless-related businesses of FPCD and WMEP. For FPCD, significant improvement is observed, from almost no diffusion in the Base Case to a level of 0.7 in 2025 in the Integrated Business Case. For WMEP, business diffusion occurs roughly five years earlier in the Integrated Business Case than in the Base Case, proving the acceleration effect of the integration.

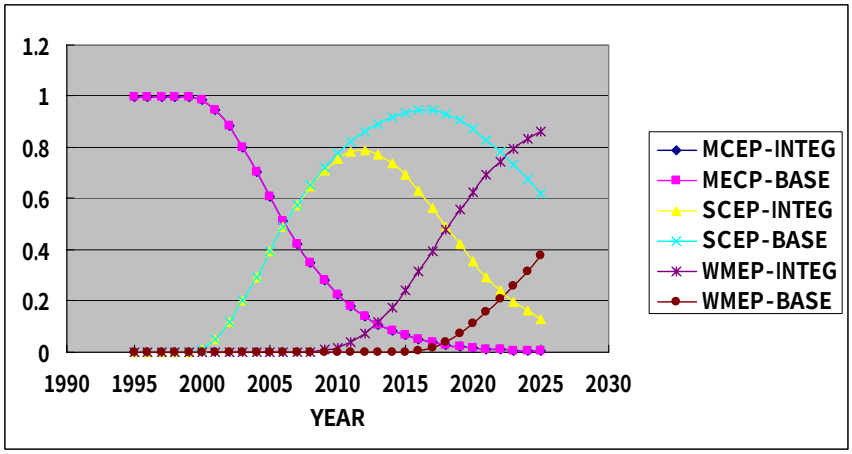
Figure 5.6 Online Contents Distribution



Source: Author, 2003.

Also observed is the sudden drop in the number of IPCD users beginning in the mid-2010s. This could be explained by the reduced copiability of illegal contents balanced by improved copy protection development and fed by additional WMEP revenues rapidly growing in the mid-2010, sustained by rapid growth of WMEP users.

Figure 5.7 Electronic Payment

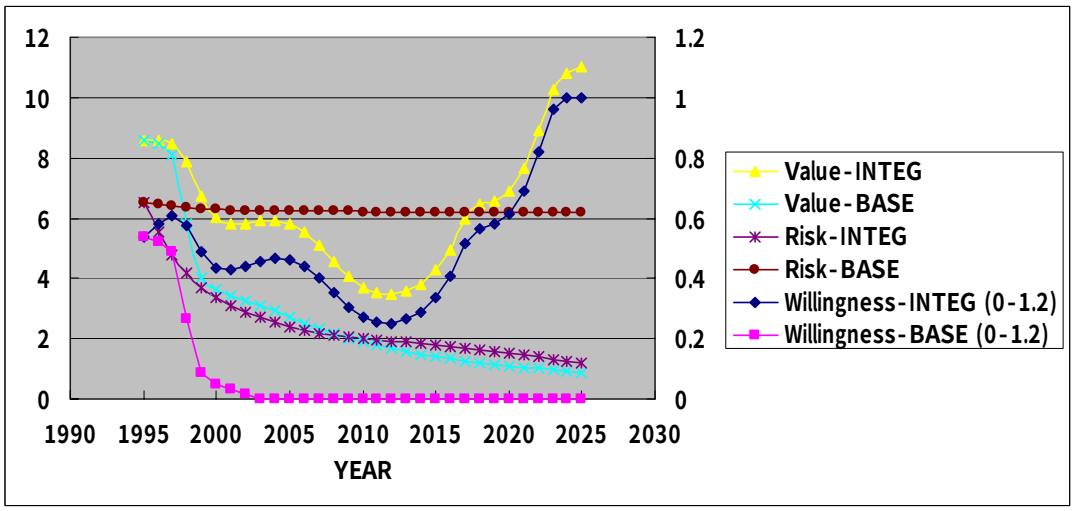


Source: Author, 2003.

5.2.3.2 *Perceived Risk and Willingness to Switch to FPCD*

Figure 5.8 depicts Willingness to Switch to FPCD and its components, depicting the impact of integration on both willingness and risk. In the Integrated Business Case, Willingness to Switch decreased once and then regained high levels beginning in the mid-2010s. This could be

Figure 5.8 Willingness and Risk

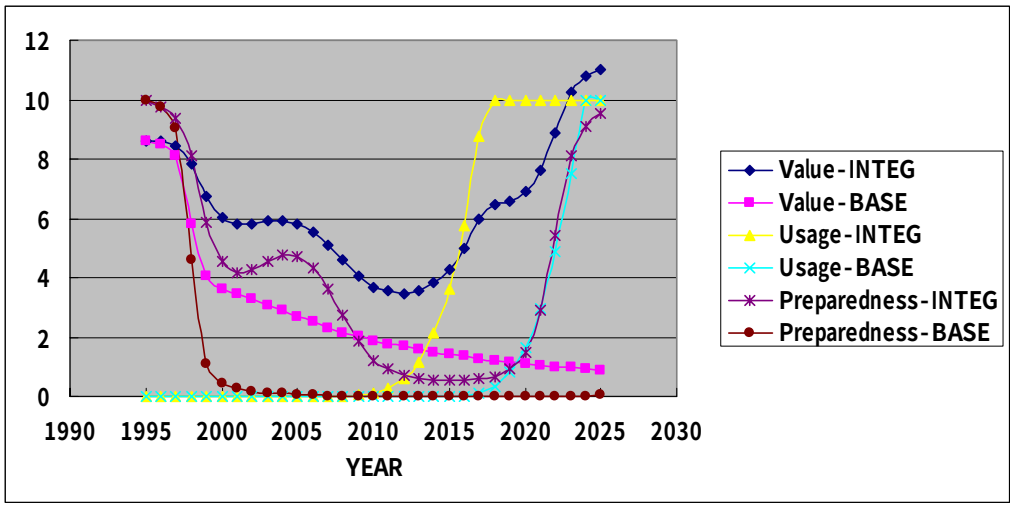


Source: Author, 2003.

explained by the reinforcement of the same-shaped Willingness to Switch based on Value and a mitigating balance effect by rapidly reducing Perceived Risk due to downsized investment requirement on infrastructure reduced by introducing MVNO.

Figure 5.9 explains the formation of Willingness to Switch based on Value and its dominant players, Relative Preparedness of Contents and newly-added Preparedness of Contents based on Frequent WMEP Usage. Preparedness of Contents negatively reflects the accumulation of illegal contents, showing that illegal contents accumulated in the late 1990s and late 2010s began to grow scarce in the early 2020s. The scarcity of illegal contents beginning in the early 2020s may well be explained be reinforced by copy protection developments supplemented by additional WMEP revenue in the early 2010s (refer to Section 5.2.3.1 for diffusion to WMEP). Also reinforcing Willingness to Switch based on Value is the Relative Preparedness of Contents based on WMEP use (refer to Section 5.2.1.2). As WMEP users rapidly grow in numbers in the early 2010s, Frequent Use of WMEP increases as well, imposing additional value to FPCD.

Figure 5.9 Willingness to Switch based on value

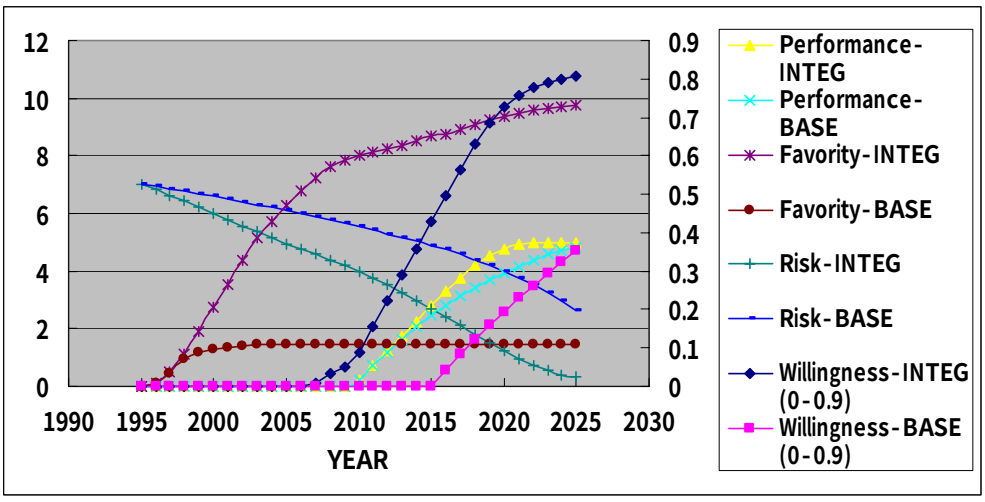


Source: Author, 2003.

5.2.3.3 Perceived Risk and Willingness to Switch to WMEP

Figure 5.10 shows Willingness to Switch to WMEP and its major components, Willingness to Switch Based on Performance, Effect of Perceived Risk on Willingness and newly added Willingness to Switch to WMEP Based on FPCD Favorability. As shown, Willingness to Switch to WMEP begin to increase roughly five years earlier in the Integrated Business Case than in the Base Case, leading to rapid migration to WMEP in the Integrated Business Case. The main driver of this acceleration is the reinforcing effect of newly added Willingness to Switch Based on FPCD Favorability. Because of the novelty of a combined business model, I assumed a high sensitivity of user perception toward Free Payment Contents Distribution leading to a high level of Willingness to Switch Based on FPCD Favorability over time. I expect this newly added factor will accelerate WMEP migration. Also reinforcing the migration to WMEP is reduced Risk from Lack of Infrastructure due to reduced investment for satisfactory infrastructure, thanks to MVNO.

Figure 5.10 Willingness to Switch to WMEP

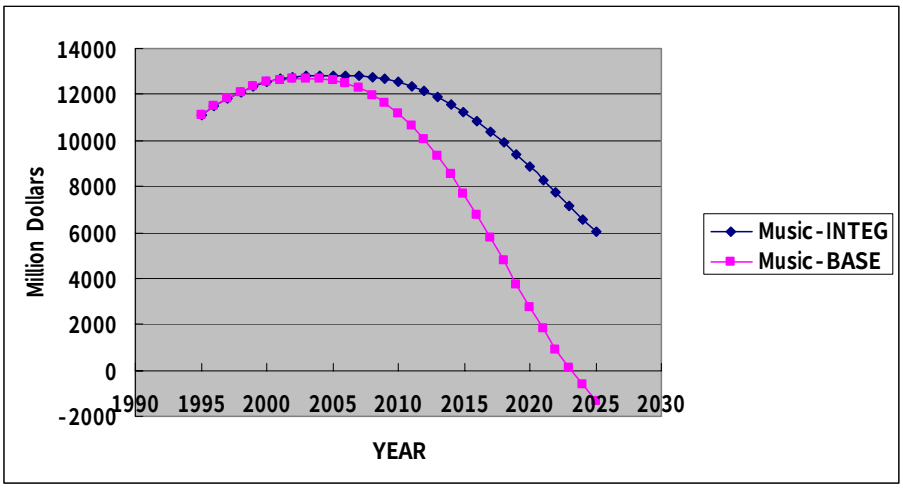


Source: Author, 2003.

5.2.3.4 Revenue of Integrated Business Model

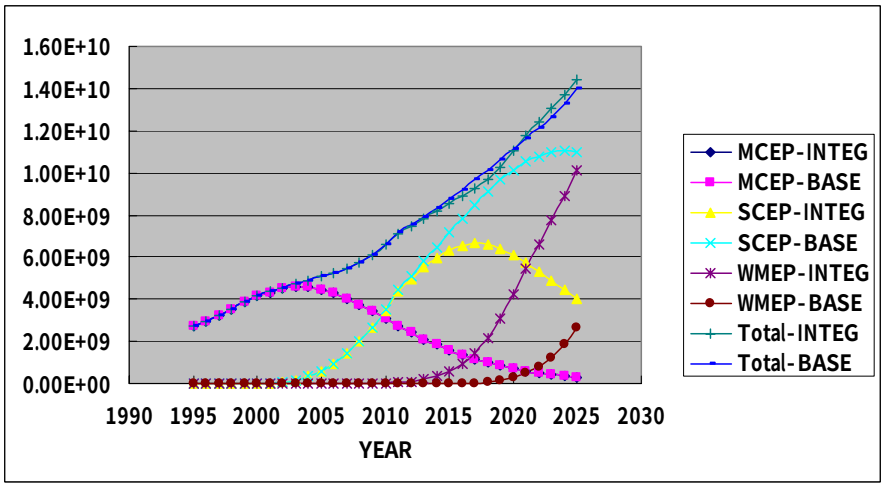
Figure 5.11 depicts the impact of the business integration on estimated music industry sales revenues. As shown, the integration leads to improved profitability for the music industry. This can be explained by improved copy protection technology, which reduced migration to the unprofitable

Figure 5.11 Music Industry Revenue



Source: Author, 2003.

Figure 5.12 Electronic Payment Revenue



Source: Author, 2003.

IPCD business, initiated by increased industrial development of copy protection technology and additional development fed by complementary WMEP revenue.

Figure 5.12 shows the impact of the business integration on electronic payment business revenues. One obvious finding is the rapid revenue creation of WMEP business replacing SCEP revenue. Rapid migration to WMEP enables rapid WMEP revenue creation, leading to quicker development of copy protection technology, which supplements FPCD technology development.

5.2.4 Summary

In this section I proposed an Integrated Business Model that integrated the online contents distribution business and the electronic payment business as a means of supplementing each business. Through the use of System Dynamics analysis, I also sought to identify the key drivers and inhibitors of a successful business. As discussed, FPCD and WMEP each have benefits and shortcomings, and the effective use of complementary integration could generate the successful business model as we observed.

Considering the process of business dynamics, acceleration of diffusion is the one dominant factor for successful business. In this case, accelerating sluggish business migration to WMEP by effectively utilizing the value of FPCD, leads to further acceleration of the reinforcing loop that motivates users to migrate to WMEP. In a successful business scheme, one simple trigger sometimes leads to bigger success, which is what we see in this case.

It is important to notice how to prepare the business mechanism in a way that realizes the most successful scenario, thus fully utilizing the reinforcing effects of the successful scheme.

Key findings in this section are as follows.

1. ***Integration of online contents distribution and electronic payment businesses accelerates WMEP migration for at least five years, based on System Dynamics analysis.***

2. ***Profitability of complementary WMEP reinforces additional development of copy protection technology, leading to fewer illegal contents by the mid-2020s.***
3. ***MVNO plays a supplement role in accelerating a successful integrated business, easing required infrastructure development which is inevitable for trust creation.***
4. ***Value sharing by each business model is the key for successful complementary business models. Successful value sharing leads to reinforcement of value utilization.***

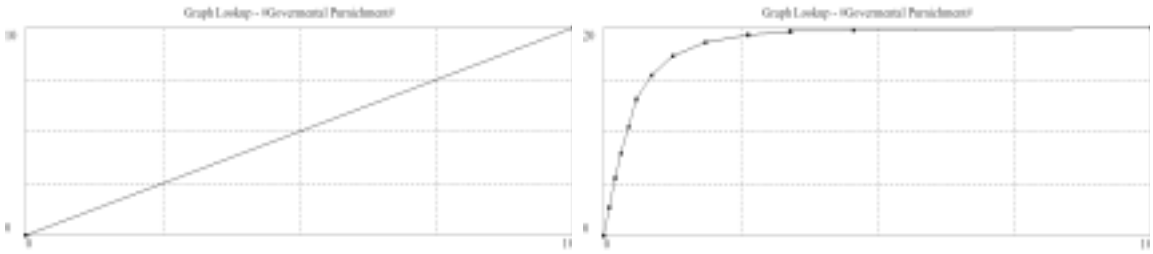
5.3 Case 1: Extreme Government Punishment of Piracy

One reason why the legitimate online contents distribution industry suffers is a lack of government regulations against piracy. In this section, I assume a possibly rigid and rapid government legal action against piracy, and apply it to the online contents distribution industry, revealing possible outcomes as a result of government regulation.

5.3.1 Government punishment

Figure 5.13 explains the differences of assumed government action toward piracy between (a) the Base Model (with moderate punishment), and (b) the Case 1 Model (extreme punishment). In the Base Model, the government imposes moderate punishment on a scale of 10 linear response to perceived piracy (X axis). On the other hand, with extreme government punishment as shown in the Case 1 Model, the government imposes rigid punishment on a scale of 20 exponential response to perceived piracy (X-axis).

Figure 5.13 Governmental Punishment

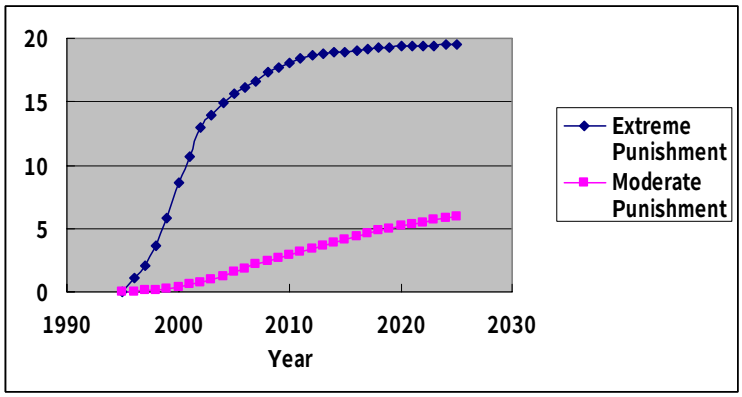


(a) Moderate Punishment (b) Extreme Punishment

Source: Author, 2003.

Figure 5.14 illustrates imposed government punishment based on each government policy described above. Interestingly, even with an extreme punishment policy as described in Figure 5.13 (b), imposed punishment only grows moderately as shown in Figure 5.14 (Case 1), reflecting a sluggish perception of piracy, especially in the early stage.

Figure 5.14 Case 1: Imposed Government Punishment



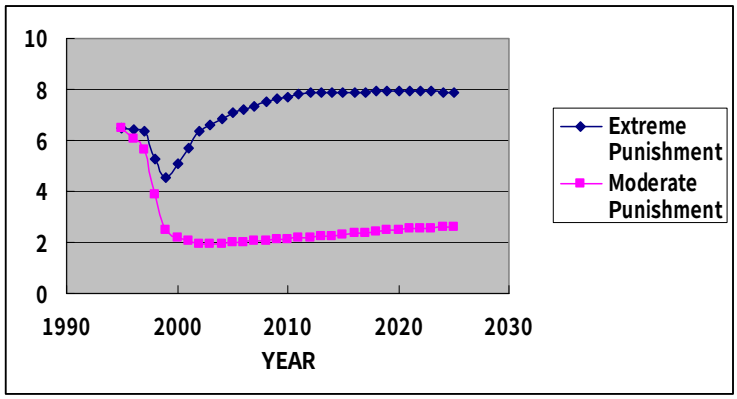
Source: Author, 2003.

5.3.2 Perceived Risk and Willingness to Switch to IPCD

Figure 5.15 reveals perceived risk under different punishment policies. Figure 5.16 reveals the willingness to switch to IPCD, reflecting different perceived risk under different government

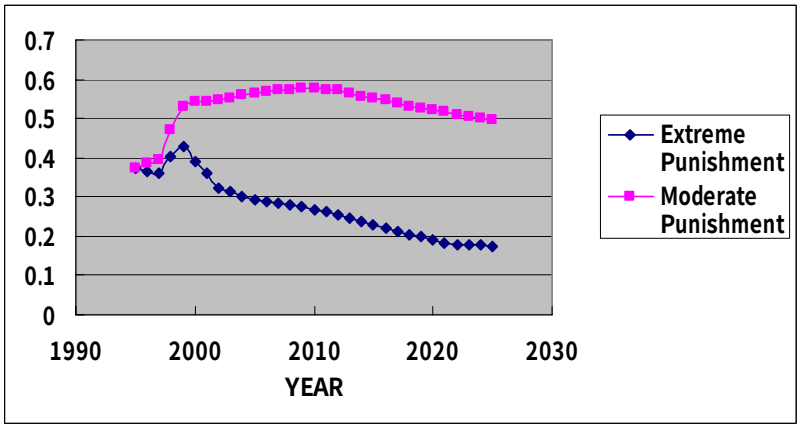
punishment scenarios. As shown in Figure 5.16, perceived risk of extreme punishment decreases once and then suddenly bounces up due to a rapid increase in perceived risk of illegal activity as the result of strict government policy. This is offset by a diminished perceived risk of lack of content. Reflecting increased risk due to a policy of extreme punishment, the willingness to switch diminishes proportionally, as shown in Figure 5.17. Willingness to switch dropped from 0.6 to 0.3, with a constant decline reflecting increased perceived risk due to extreme punishment by government policy.

Figure 5.15 Case1: Perceived Risk on Willingness, CPCD to IPCD



Source: Author, 2003.

Figure 5.16 Case1: Willingness to Switch from CPCD to IPCD

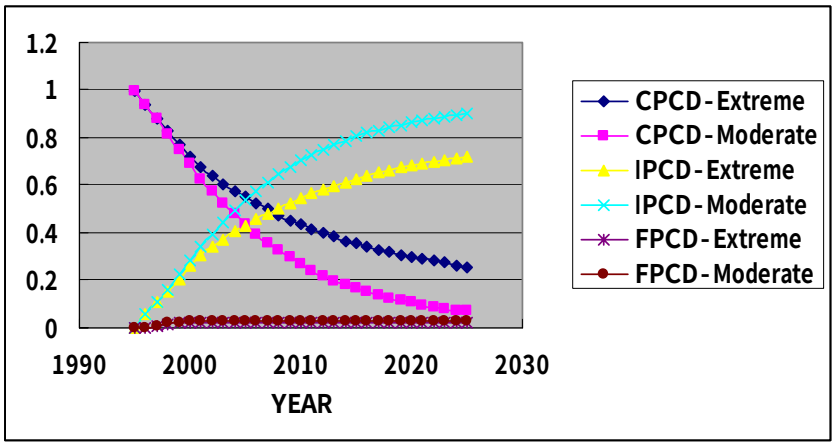


Source: Author, 2003.

5.3.3 Users by Business Type (Fraction)

Figure 5.17 depicts the effect of extreme punishment on business migration. As shown in Figure 5.17, even though some delay is observed, the CPCD business is still migrating to the unprofitable IPCD business, despite increased risk perception caused by extreme punishment. Possible explanations for this inevitable migration are: (1) even with diminished levels, Willingness to Switch to IPCD is still positive, thus encouraging migration to IPCD (refer to Section 5.3.2); and (2) Perceived Risk from Lack of Contents still diminishes rapidly even with extreme punishment imposed, as described in the following section.

Figure 5.17 Case1: Users by Business Type (Fraction)



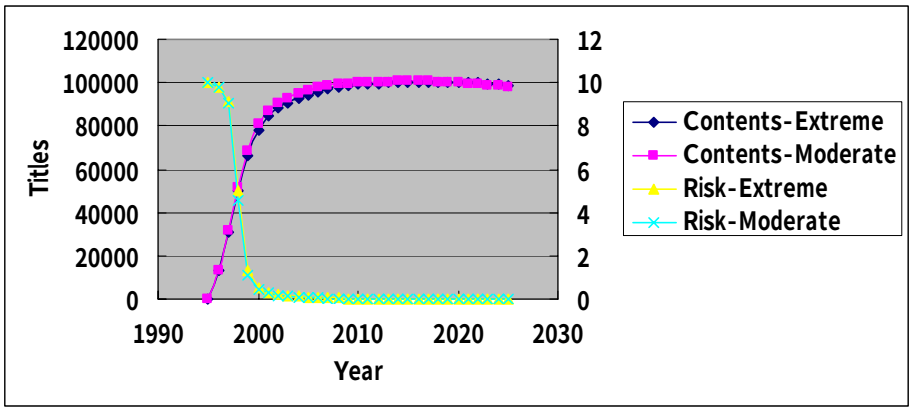
Source: Author, 2003.

5.3.4 Cumulative Illegal Contents

Figure 5.18 shows the effect of extreme punishment on Cumulative Illegal Contents. As shown, illegal contents accumulation seems not to be affected by increased risk caused by extreme punishment. This interesting phenomenon could be explained by the following figure revealing available illegal contents provided by illegal content providers. As shown in Figure 5.19, available illegal contents in different punishment scheme show no major differences in the early stage until the late 1990s. However, the early stage until the late 1990s is the critical time for illegal content

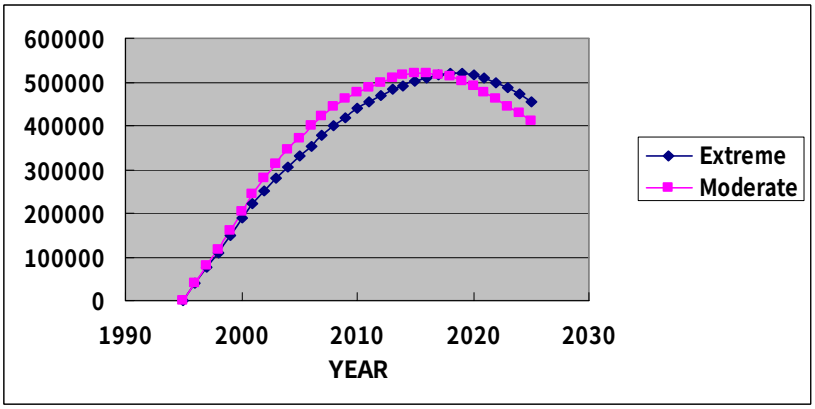
accumulation for rapidly accumulating large numbers of illegal contents and for rapidly decreasing perceived risk from lack of contents. In fact, in the late 1990s, perceived risk from lack of contents is already low enough to encourage migration from CPCD to IPCD. Even perceived risk of illegal activity gradually increases in early 2000 (refer to Section 5.3.2), trying to balance migration to IPCD, and reducing risk from lack of contents due to accumulated illegal contents seems to drive back migration to IPCD, thus canceling the balancing effect of imposed risk of extreme punishment.

Figure 5.18 Case 1: Cumulative Illegal Contents (Risk from Lack of Contents)



Source: Author, 2003.

Figure 5.19 Case 1: Available Illegal Contents

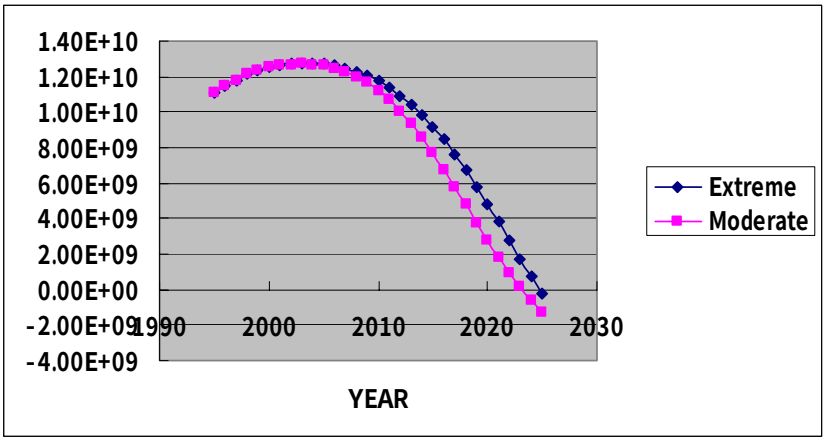


Source: Author, 2003.

5.3.5 Music Industry Revenue

Figure 5.20 depicts the impact of extreme government punishment on music industry revenues. As shown, even some delay (i.e., 2-3 years) is observed, but the overall diminishing nature remains the same as before. As evident in earlier sections, Figure 5.20 also shows that moderate or late imposition of government punishment has only a delaying effect on the migration process to unprofitable IPCD.

Figure 5.20 Case 1: Music Industry Revenue



Source: Author, 2003.

5.3.6 Summary

In this section, I explored the impact of extreme government punishment on the migration process from CPCD to IPCD utilizing System Dynamics analysis. As observed, even though some delay in migration is observed, migration from CPCD to unprofitable IPCD is inevitable, even under imposition of government punishment. The main findings in this scenario are as follows:

1. ***Second-hand government action against piracy has only a delaying effect on migrating CPCD to the unprofitable IPCD business.***

2. ***It is important to impose strict government punishment, especially at the early stage, in order to restrict the formation of a reinforcing effect caused by illegal content accumulation.***
3. ***Moderate government punishment against piracy also has only a delaying effect on migration from CPCD to IPCD.***

5.4 Case 2: Music Industry Initiative on Copy Protection Development

As it continues to suffer from the piracy problem, the music industry is now at a turning point: whether to totally losing profitability or strategically counter piracy (refer to Chapter 4.2.3.1). The diminishing profitability of the CPCD business seems insufficient to feed required development of copy protection technology, which always follows a piracy scheme development (refer to Chapter 4.2.3.2).

In this section, I assume that the entire music industry has become nervous about piracy such that it decides to invest huge portions of industry revenue into the development of copy protection technologies. I will discuss potential outcomes under the situation that the music industry takes the initiative to develop copy protection technology.

5.4.1 Characterizing the Model

Reflecting aggressive investment by the entire music industry on copy protection technology, I assume a fraction of 5% for determining the portion of industry revenues that will be spent on copy protection technology development. I also assume the required development for copy protection technology to be three times that of piracy, reflecting the relative ease of piracy scheme development.

Copy Protection Technology Characteristics

Fraction of Industry to Development:	5% (0.1% in Base Model)
Required Development for Usability:	$1 billion
Initial Development for Usability:	$500 million
Development spent for Usability:	(0 - 0.5) * (5% * Industry Profit + Total Profit)
Required Development for Copy Protection:	$3 billion
Initial Development for Copy Protection:	$ 0
Development spent for Copy Protection:	(0 - 0.5) * (Perceived Risk of Piracy (0 - 0.1) * (5% * Industry Profit + Total Profit))

Piracy Technology Characteristics

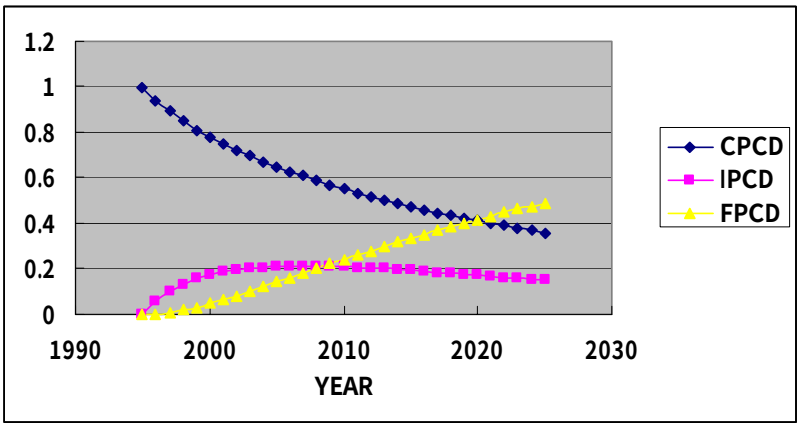
Required Development for Usability:	$1 billion
Initial Development for Usability:	$500 million
Development spent for Usability:	(0 - 0.5) * Available volunteer workforce
Required Development for Piracy Scheme:	$1 billion
Initial Development for Piracy Scheme:	$500 million
Development spent for Piracy Scheme:	(0 - 0.5) * Available volunteer workforce

5.4.2 Users by Business Type (Fraction)

Figure 5.21 depicts the diffusion of each business—CPCD, IPCD, and FPCD—over time. In contrast to the Base case, where almost all business migrates into the IPCD business until 2020 (refer to Chapter 4.2.3.2), Case 2 reveals that migration from CPCD to IPCD slowed and migration to FPCD accelerates. This obvious change in the diffusion process occurs mostly because of enforced copy protection technology development accelerated by industry initiative. Figure 5.22 shows the technology index of Copy Protection Scheme and Piracy Scheme. While the Copy

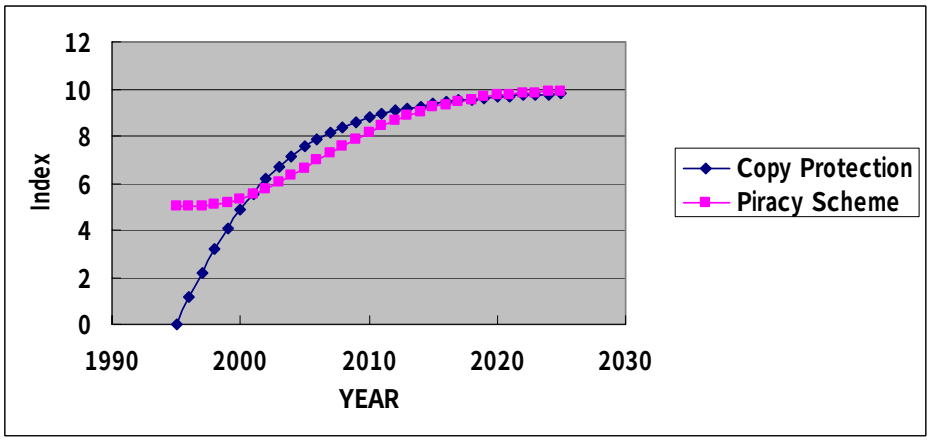
Protection Index never exceeded the Piracy Scheme Index in the Base Case, copy protection technology development accelerated by industry initiative grows rapidly and soon exceeds Piracy Scheme development in early 2000, as shown in Figure 5.21. In this scenario, online music distribution users would hesitate to migrate to IPCD due to difficulties of illegal copying and lack of contents caused by copy protection, as we discuss in a later section. Furthermore, IPCD users prefer migrate to the FPCD service due to increased attractiveness of preparedness of contents of FPCD service, as we also discuss in a later section.

Figure 5.21 Case 2: Users by Business Type (Fraction)



Source: Author, 2003.

Figure 5.22 Case 2: Technology Index

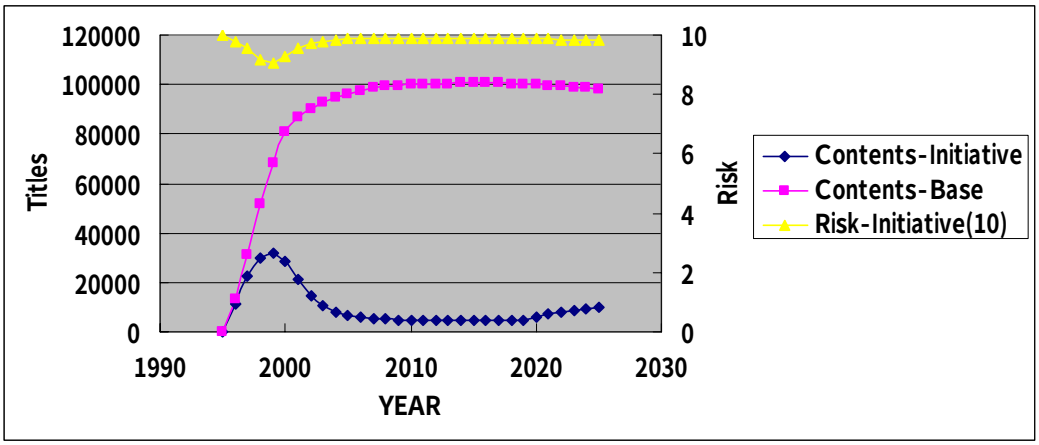


Source: Author, 2003.

5.4.3 Cumulative Illegal Contents

Figure 5.23 depicts the accumulation of illegal contents under different scenarios. As shown, while cumulative contents saturate to a satisfactory level of 100,000 titles, even with a high obsolescent rate of 50% for Seasonal contents in the Base Case, cumulative contents in Case 2 reveals a lack of illegal content due to the highly regulated Copy Protection Scheme. An interesting finding in the cumulative illegal contents in Case 2 is that even with highly regulated copy protection, some portion of illegal contents remain in illegal contents accumulation without obsolescence. I regard these remaining illegal contents as permanent content, such as classical music or opera, which are not affected by Seasonality. Straightforwardly, while risk from lack of content in the Base Case rapidly diminishes in the late 1990s reflecting rapidly cumulating illegal contents, that in Case 2 stays high reflecting a scarcity of illegal contents caused by highly regulated copy protection management.

Figure 5.23 Case 2: Cumulative Illegal Contents (Risk from Lack of Contents)

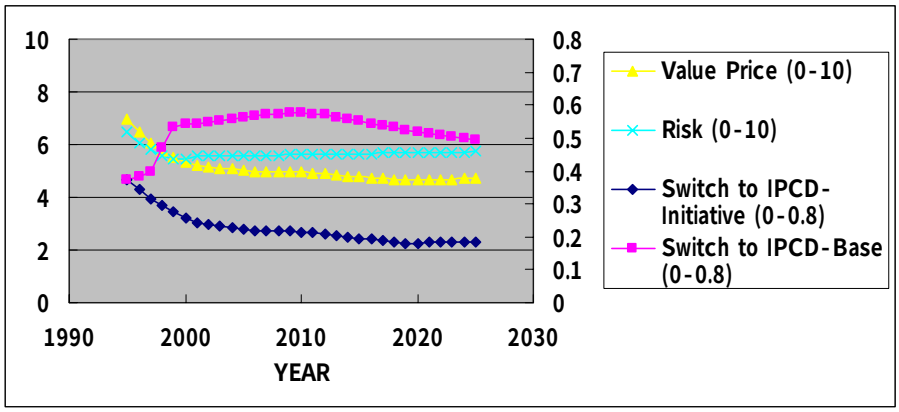


Source: Author, 2003.

5.4.4 Perceived Risk and Willingness to Switch to IPCD

Figure 5.24 shows the Willingness to Switch from CPCD to IPCD in different scenarios and the components Willingness to Switch Based on Value Price and Risk on Willingness. As shown, Willingness to Switch from CPCD to IPCD becomes sluggish in Case 2 at the level of 0.2, revealing customers' diminished motivation to migrate to IPCD mainly due to strict copy protection management. Eminent copy protection development affects both Willingness Based on Value Price and Risk on Willingness. Willingness Based on Value Price diminishes rapidly, from level 7 to level 5, while in the Base Case it remains at level 7. This reduction comes from consumers' devaluation of IPCD service, reflecting growing difficulties with copying illegal content due to strict copy protection technology. Risk on Willingness remains high at level 6-7, balancing Willingness to Switch to IPCD. Risk on Willingness diminishes quickly down to level 2 due to rapid accumulation of illegal content in the Base Case. This also stems from strict copy protection technology leading to lack of accumulated illegal contents.

Figure 5.24 Case2: Willingness to Switch from CPCD to IPCD

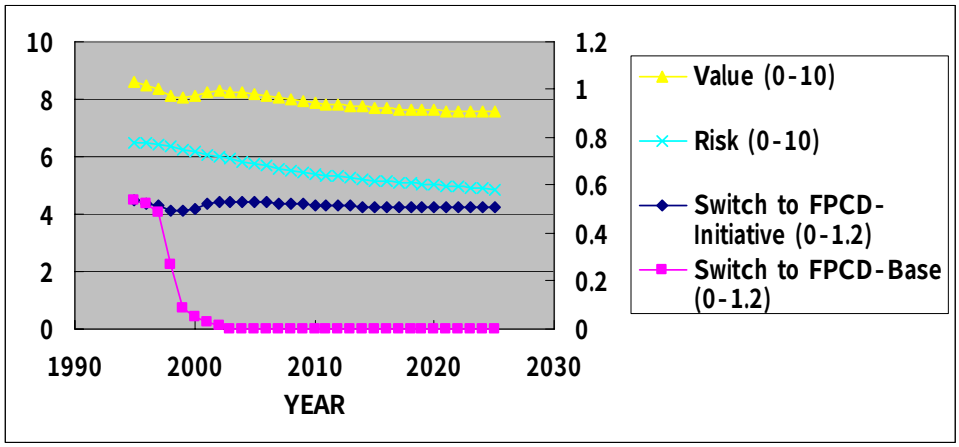


Source: Author, 2003.

5.4.5 Perceived Risk and Willingness to Switch to FPCD

Figure 5.25 reveals the Willingness to Switch to FPCD and its components, Willingness Based on Value and Risk on Willingness. Willingness to Switch to FPCD in the Base case declined rapidly from level 0.6 to almost zero in early 2000s, mainly because of the rapid decline of customers' perception of preparedness of free download contents of FPCD service degraded by rapid accumulation of illegal contents in IPCD service in the late 1990s to early 2000s, as shown in Chapter 4.2.3.3. However, Willingness to Switch to FPCD remains at the higher level of 0.5-0.6, sustained by a higher level of Willingness to Switch Based on Value at the level 7-8 on a scale of 10. Dominant player, Willingness to Switch Based on Value is the preparedness of free download contents against illegally accumulated contents. With scarce illegal content accumulation, as we see in Section 5.4.3, preparedness of free download contents of FPCD service would remain at a higher level, thus leading to higher value proposition of FCD service, resulting in a higher level 7-8 on a scale of 10 of Willingness to Switch to FPCD Based on Value. In addition, Risk on Willingness declines slightly from level 6 to level 5 on a scale of 10 as the fraction of FPCD users increases. The high level of Willingness to Switch Based on Value and slightly declining risk perception produce the high level (0.5-0.6 on a scale of 1.0) of Willingness to Switch to FPCD.

Figure 5.25 Case2: Willingness to Switch from IPCD to FPCD

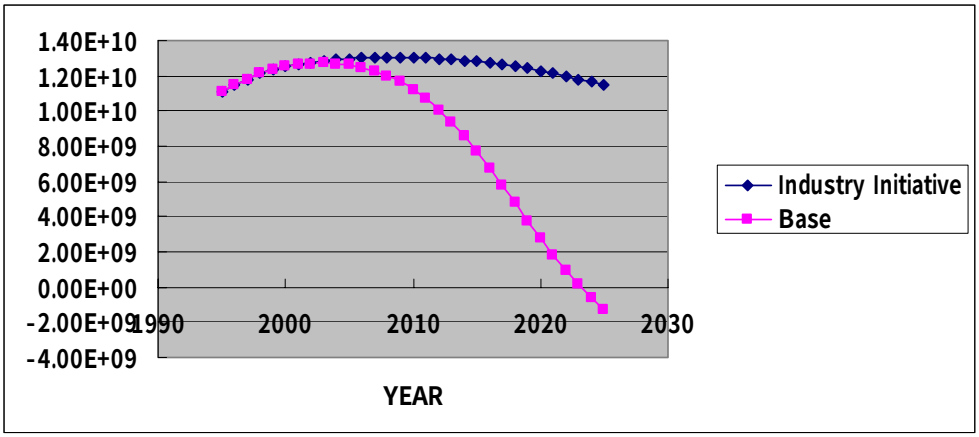


Source: Author, 2003.

5.4.6 Music Industry Revenue

Figure 5.26 shows the possible outcome of music industry revenue in a scenario of aggressive investment by the entire music industry on copy protection technology. As shown, the whole music industry revenue is widely improved by strictly imposing copy protection management through improved technology. As discussed earlier, the music industry is now at a turning point, whether to lose profitability or to impose strategies against piracy to remain profitable. In current market conditions, the entire music industry seems reluctant to invest in copy protection technology development due to the lack of a successful business model for digital content distribution. But it is obvious that without industrial initiative for investing in technology development, the whole music industry might lose profitability, as shown in Figure 5.26.

Figure 5.26 Case 2: Music Industry Revenue



Source: Author, 2003.

5.4.7 Summary

In this section, I explored the impact of a music industry initiative on developing copy protection technology against piracy utilizing System Dynamics analysis. As observed, a strict initiative by the whole music industry aimed at developing copy protection technology is quite effective for retaining the profitability of music industry revenue. This is mainly due to limited

migration to unprofitable IPCD service, thereby reducing the deficit caused by illegal piracy. No single factor is dominant in this scenario, but multiple causal effect, triggered by increased amounts of copy protection technology development initiated by the music industry, leads to improved profitability of industry revenues as a whole.

The main findings in this scenario are as follows.

1. ***Industry initiative for developing copy protection technology is effective for maintaining profitability in the entire music industry.***
2. ***Improved copy protection technology not only prevents users from migrating to unprofitable IPCD, but also encourages migration from IPCD to controllable FPCD.***
3. ***Even with strict copy protection control, there are some permanent contents remaining in illegal contents accumulation.***

5.5 Case 3: Music Industry Initiative for Copy Protection Development with Sacrificed Usability

In Case 2, I dealt with the situation where the whole music industry accelerated the amount of investment on copy protection technology, thus successfully leading to reduced piracy while maintaining the profitability of the music content distribution industry. Discussing the copy protection scheme successfully developed by the music industry, another question arises: “Is it possible to implement extreme copy protection technology while retaining appropriate usability?”

In Case 3, I consider the interesting condition of extreme copy protection achievement fostered by industrial initiatives with unexpected difficulties in usability that are not acceptable to customers. The conditions are easily seen in the market, especially in tech-oriented technology development.

5.5.1 Characterizing the Model

As in Case 2, I assume the entire music industry will spend a huge portion of industrial revenue (5%) on developing copy protection technology. I also assume the same difficulty of copy protection technology as in Case 2, requiring three times as much required development as that needed for piracy schemes. I implement a relative relationship between copy protection technology and usability of a copy-protected contents distribution program, so as the Copy Protection Technology Index improves, the Usability Index decreases, in turn reflecting the fact that Copy Protection Scheme sometimes suffers from the usability of the copy protected program, even with improved copy protection.

Considering these conditions, I characterize the model as follows.

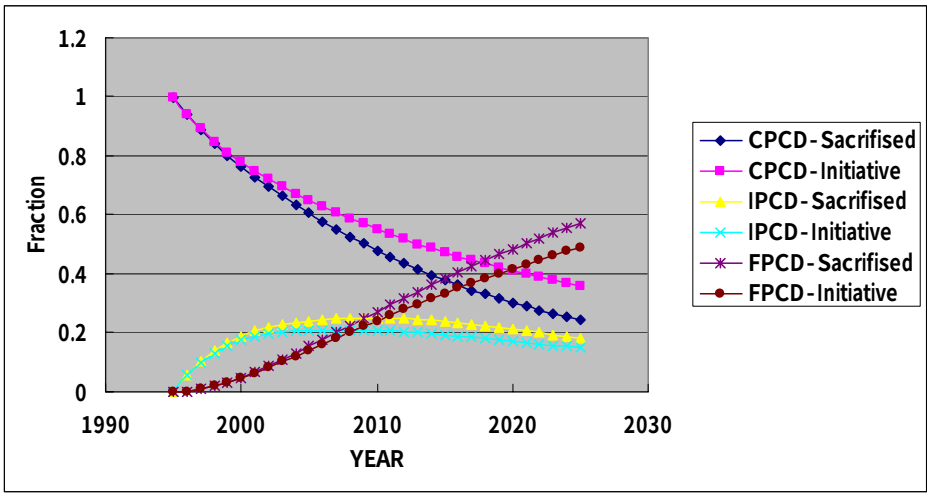
<u>Copy Protection Technology Characteristics</u>	
Fraction of Industry to Development:	5% (0.1% in Base Model)
Required Development for Usability:	$1 billion
Initial Development for Usability:	$500 million
Development spent for Usability:	(0 - 0.5) * (5% * Industry Profit + Total Profit)
Required Development for Copy Protection:	$3 billion
Initial Development for Copy Protection:	$ 0
Development spent for Copy Protection:	(0 - 0.5) * (Perceived Risk of Piracy (0 - 0.1) * (5% * Industry Profit + Total Profit))
Usability Performance Index:	Usability Performance Index – 0.5 * Copy Protection Performance Index
<u>Piracy Technology Characteristics</u>	
Required Development for Usability:	$1 billion
Initial Development for Usability:	$500 million

Development spent for Usability:	(0 - 0.5) * available volunteer workforce
Required Development for Piracy Scheme:	$1 billion
Initial Development for Piracy Scheme:	$500 million
Development spent for Piracy Scheme:	(0 - 0.5) * Available volunteer workforce

5.5.2 Users by Business Type (Fraction)

Figure 5.27 depicts the migration process of each business type of CPCD, IPCD and FPCD, revealing the impact of reduced usability sacrificed by improved copy protection. Since improved copy protection and reduced usability have opposite impacts on business diffusion, such that reduced usability of copy protected program encourages the migration to IPCD while improved copy protection hinders migration to IPCD, it seems worthwhile to observe the possible forecast generated by System Dynamics analysis. Looking at Figure 5.27, it seems obvious that business migration from CPCD to IPCD is somewhat accelerated, revealing reduced usability of copy protected programs that apparently encourages users to migrate to IPCD rather than improved copy protection hindering the migration.

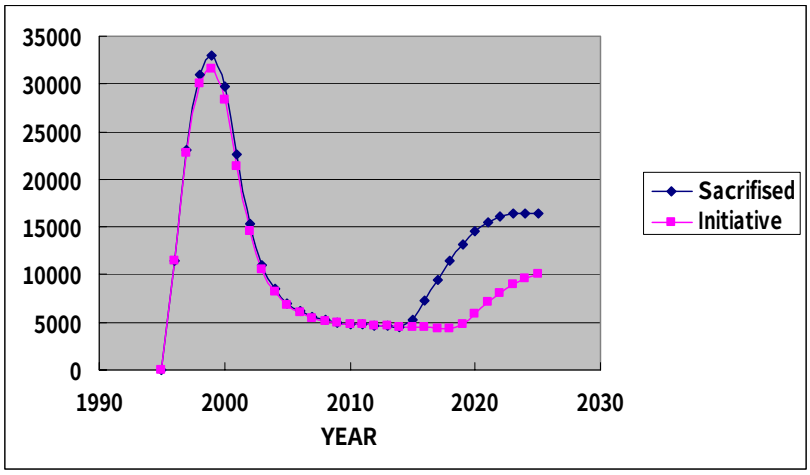
Figure 5.27 Case 3: Users by Business Type



Source: Author, 2003.

Figure 5.28 depicts cumulative illegal content, showing the impact of reduced usability on cumulative illegal content. As shown in the figure, cumulative illegal contents remain the same even though reduced usability encourages migration to IPCD a bit. It is obvious that even though some portion of customers are encouraged to move into IPCE, allowing more volunteer piracy scheme development, the circulation of illegal contents still seems to be highly regulated by superior copy protection technology fed by industry- initiated development.

Figure 5.28 Case 3: Cumulative Illegal Contents



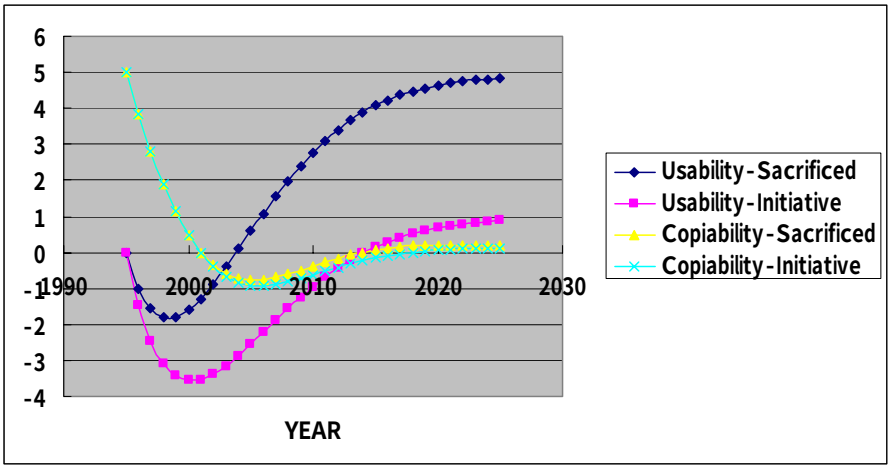
Source: Author, 2003.

5.5.3 Perceived Risk and Willingness to Switch to IPCD

Figure 5.29 shows the relative usability and relative copiability of piracy programs against a copy protected contents distribution program. Figure 5.29 reveals that improvement of copy protection technology greatly increases the relative usability of piracy programs due to reduced usability of copy protected programs, while maintaining a high level of copy protection. This condition represents well the possible market condition of implementing excellent copy protection technology but with extremely poor user interface.

Figure 5.30 shows the Willingness and the Risk to Switch from CPCD to IPCD. Based on observations of relative usability in Figure 5.29, it is understandable that Willingness to Switch

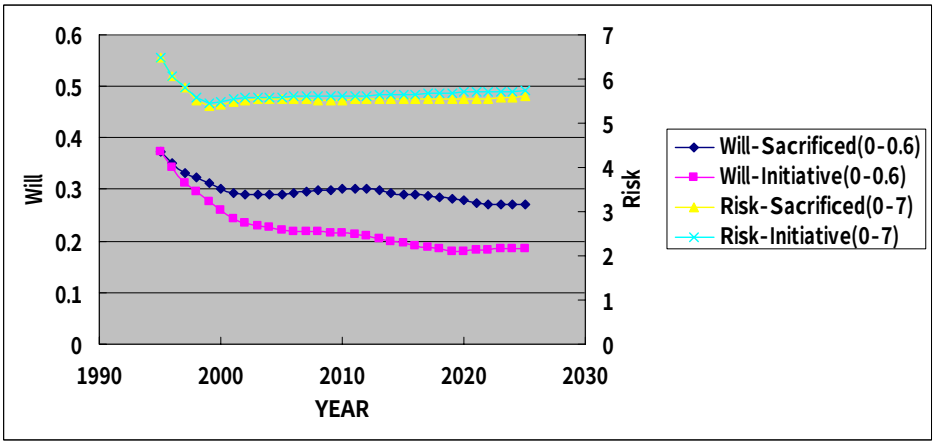
Figure 5.29 Case 3: Relative Usability and Copiability



Source: Author, 2003.

improved by the amount of increased usability of IPCD, while risk- related factors stay the same because there are almost none of the gained risk factors usually discussed with widespread adoption of certain factors. It is also obvious that as far as copy protection is firmly assured, migration to IPCD is highly regulated due to perceived risk of scarcity of available contents prohibited by copy protection technology no matte how difficult it is. Developing strong copy protection technology seems to be essential to refrain from unprofitable IPCD.

Figure 5.30 Case 3: Willingness to Switch to IPCD



Source: Author, 2003.

5.5.4 Summary

In this section, I surveyed the possible impact of reduced usability along with the achievement of high levels of copy protection often seen in the market, especially in the case of technology-oriented solution implementations. Based on System Dynamics analysis, as far as a high level of copy protection being achieved, there seems to be no danger to allowing illegal contents to spread, even with the hard-to-use user interface of copy protected programs. But it is also true that with a user-friendly interface, we could expect higher levels of copy protection, thus avoiding illegal piracy. It is important to develop better user interface in conjunction with secure anti-piracy schemes.

The main findings in this scenario are as follows.

1. ***It is more essential to develop more secure copy protection technology than to develop less-secure, user-friendly copy protection technology in order to beat piracy.***
2. ***The circulation of illegal contents is less sensitive to usability of the program than to the relative level of copy protection technology against piracy.***

5.6 Case 4: Sensitivity Analysis for required infrastructure of WMEP

The virtue of an integrated business model is to accelerate business migration of sluggish wireless-related FPCD and WMEP businesses, thus effectively supplementing the advantages and shortcomings of each business. One challenge needing resolution in the integrated business model is acceleration of wireless-related infrastructure development by effectively utilizing MVNO service, eventually leading to extra copy protection technology development and enabling reinforced migration into wireless-related FPCD and WMEP businesses.

Earlier examples of an integrated business model discussed in this chapter assumed that wireless communication infrastructure, such as 3G infrastructure, can handle all electronic payment settlements, including luxury payments and/or small payments. But in reality, the availability of wireless payment schemes is currently somewhat restricted, and the industry is struggling to find a payment solution that will provide both feasibility and trust (Balsan, 2002). According to Balsan, the only solution that enables wireless devices to handle both luxury payments and small payments is the bank-industry-initiated "Dual SIM card Payment (DSP)" which installs both bank account information and user ID information in two SIM cards on a wireless device. But the more availability on the mobile device, the more that users have to be careful of theft. This is one major reason hindering the adoption of the DSP solution, as well as its complex operability. In one sense, a micro payment scheme on a wireless device appears to be a good solution since it limits the maximum amount that can be spent using the wireless device. But the flip side of the problem is the limitation itself, which regulates the amount that can be spent by the user and hampers the user's flexible purchasing ability.

A solution that enables both luxury-type payments and secured transactions seems to be a wireless payment scheme that is allied with Point Of Sales (POS) terminals that are responsible for user verification by the merchant. This solution is an expansion of the proof-of-payment scheme that is part of the magnetic card payment infrastructure and applies it to the wireless payment infrastructure. A wireless POS solution seems like it could be the ultimate solution, but the problem is that additional investment for wireless POS infrastructure is required, which poses a problem given the lack of infrastructure.

In this section, I will conduct a sensitivity analysis of forecasted business migration in light of a variety of required infrastructures and feeding mechanisms to discuss the degree of impact of recurring infrastructure on business migration.

5.6.1 Characterizing the Model

As in Case 2, I assume the entire music industry will spend a huge portion of its industry revenue (5%) on developing copy protection technology. I also assume the same difficulty of copy protection technology as that in Case 2, requiring three times as much required development as that of piracy schemes. I implement a relative relationship between copy protection technology and usability of copy protected contents distribution program such that as the Copy Protection Technology Index improves, the Usability Index decreases in turn, reflecting the situation where a copy protection scheme sometimes suffers from the usability of a copy protected program even with improved copy protection.

As with the Basic Integrated Model (refer to Section 5.2.2); I assume the aggressive involvement of the whole music industry to develop both FPCD and Copy Protection technology. I assume 5% of the industry fraction of the music distribution industry will go to FPCD development for encouraging industrial motivation toward FPCD development. I also expect 2.5% of the industry fraction of the music distribution industry will go to Copy Protection Development, reflecting high industry concern toward the piracy problem.

5.6.1.1 Characterizing required investment

In determining required infrastructure, I assume utilization of an MVNO service that reduces required investment for wireless communication, from $6B down to $1B, thereby enabling accelerating infrastructure development, as in the previous case. Sensitivity analysis is conducted by following two extreme cases of wireless micro payment (WMP) and wireless POS payment (WPP). In the WMP scenario, only the WMEP business includes small payments in its payment scheme, so no additional investment on infrastructure is required except investment for MVNO. At the same time, WMP also regulates the degree of complementary development for copy protection technology fed by WMEP earnings (refer to Section 5.2.1.3) since WMEP is fed only by WMP. On the other hand, while WPP requires of additional investment in wireless POS infrastructure, WPP

enables full funding to develop copy protection technology fed by both Luxury Payment and Small Payment.

It is exciting to see the sensitivity of the integrated business model. In the WPP scenario, I assume a required investment on POS infrastructure based on required investment on Smart Card-based bank card infrastructure ongoing in the UK (NR Research Center, 2002). In the UK, all bank cards are now migrating to the Smart Card infrastructure under a government initiative that will be completed in 2004. A required investment of $2.2 billion for Smart Card infrastructure is being shared by banks and merchants in a 70/30 ratio, respectively. In the WPP scenario, I assume a required portion of 70% as the amount for required investment on infrastructure. I also adjusted the required investment in the UK to one appropriate for the US, proportional to demographics as follows.

Required investment on POS infrastructure

= 70% * $ 2.2B * 277M (US Population) / 59M (UK Population) = **$7.2B**

Required investment on WMEP in WPP scenario

= investment on wireless POS + investment on MVNO = $7.2B + $1B = **$8.2B**

5.6.1.2 Characterizing the model

Copy Protection Technology Characteristics

Fraction of Industry to Development:	2.5% (0.1% in Base Model)
Required Development for Usability:	$1 billion
Initial Development for Usability:	$500 million
Development spent for Usability:	(0 - 0.5) * (2.5% * Industry Profit + Total Profit)
Required Development for Copy Protection:	$3 billion
Initial Development for Copy Protection:	$ 0
Development spent for Copy Protection:	(0 - 0.5) * (Perceived Risk of Piracy (0 - 0.1)

	* (2.5% * Industry Profit + Total Profit + 33% * WMEP revenue)	
WMEP Revenue:	Small Payment	(WMP: Wireless Micro Payment)
	Luxury + Small Payment	(WPP: Wireless POS Payment)
	Luxury + Small Payment	(DSP: Dual SIM card Payment)

FPCD Technology Characteristics

Fraction of Industry to Development:	5% (0.1% in Base Model)
Required Development for Usability:	$1 billion
Initial Development for Usability:	$800 million
Development spent for Usability:	(0 - 0.5) * (5%*Industry Profit)
Required Investment for Infrastructure:	$1 billion ($6 billion in Base Model)
Initial Investment for Infrastructure:	$0 (1998)
Investment spent for Infrastructure:	(0 - 0.5) * (5%*Industry Profit)

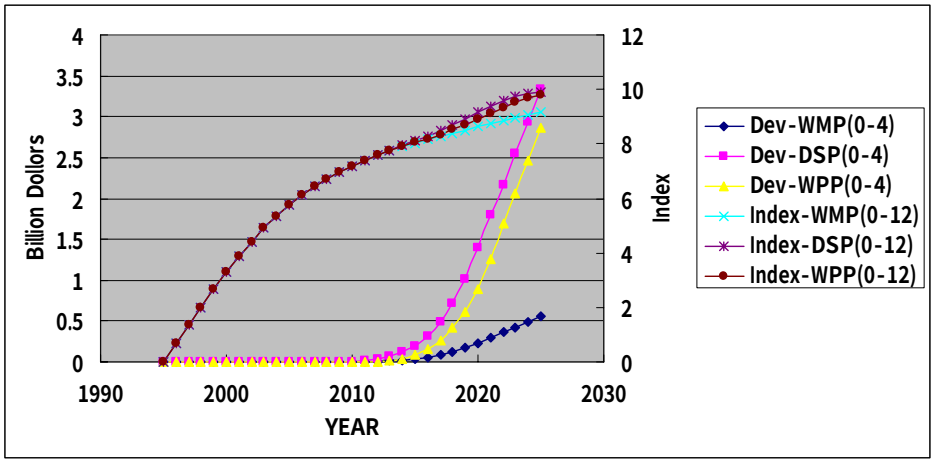
WMEP Technology Characteristics

Fraction of WMEP Revenue spent on Copy Protection Development:	33%
Required Development for WMEP Technology:	$3 billion
Initial Development for WMEP Technology:	$0
Development spent for WMEP Technology:	(0 - 0.5) * Available Development for WMEP
Required Investment for WMEP infrastructure:	$1 billion (WMP: Wireless Micro Payment)
	$8.2 billion (WPP: Wireless POS Payment)
	$1 billion (DSP: Dual SIM card Payment)
Initial Investment for WMEP Infrastructure:	$0
Investment spent for WMEP Infrastructure:	(0 - 0.5) * Available Development for WMEP

5.6.2 Cumulative Illegal Contents

Figure 5.31 depicts complementary available development for copy protection technology fed by a variety of wireless payment scheme, Dual SIM Payment (DSP), Wireless Micro Payment (WMP), and Wireless POS Payment, as well as the realized Copy Protection Index with each feed. As shown in Figure 5.31, WMEP-initiated complementary developments start feeding in the mid-2010s, reflecting late adoption of WMEP in the electronic payment business. An observed one-year delay between the DSP and WPP feed is supposed to originate from lagged migration of WPP to the WMEP business one year later than that of DSP, mainly due to much heavier required investment of $8.2B in WPP instead of $1B in DSP. A less steep slope of WMP feeding for development represents the limited revenue fed only by a small payment scheme. The realized copy protection technology index represents the additional development fed by each payment scheme, revealing the degree of impact of complementary feeds for development on copy protection technology development.

Figure 5.31 Case 4: Available development and Index

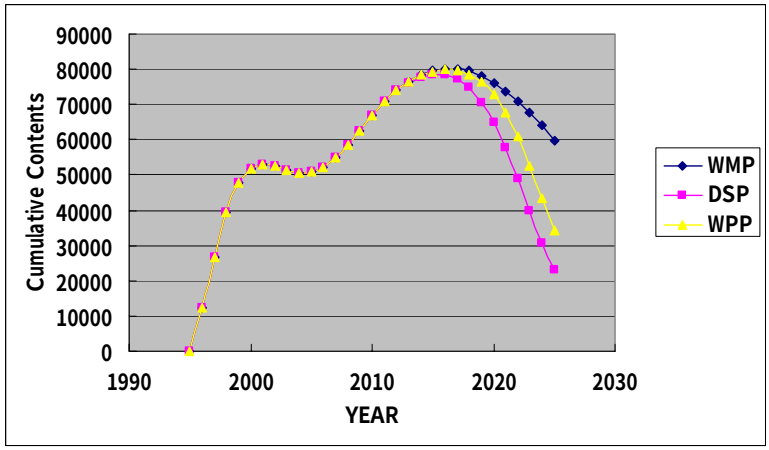


Source: Author, 2003.

Figure 5.32 represents the cumulative illegal contents in different wireless payment scenarios, revealing the high sensitivity of cumulative contents against the Copy Protection

Technology Index. Even slight differences in the Copy Protection Index lead to obvious differences in cumulative illegal contents, revealing a sensitive balance between copy protection technology and piracy technology. It makes only a slight difference in the Copy Protection Technology Index at first glance, but in fact complementary development fed by WMEP plays a huge role in reducing cumulative illegal contents.

Figure 5.32 Case 4: Cumulative Illegal Contents

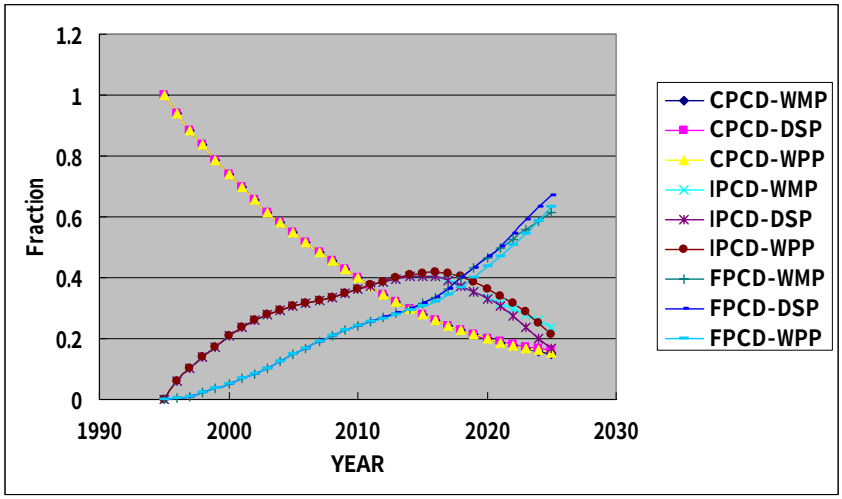


Source: Author, 2003.

5.6.3 Users by Business Type (Fraction)

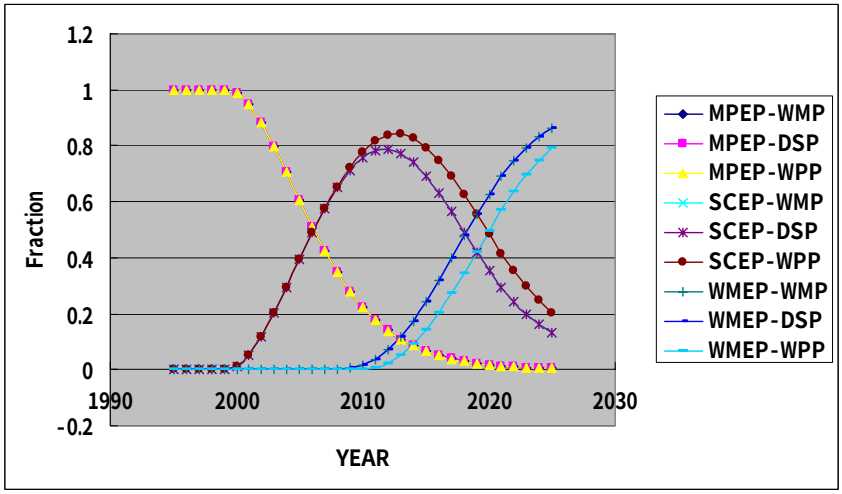
Figure 5.33 shows the diffusion of the online contents distribution business with the impact on business diffusion of different wireless payment models like Dual SIM card Payment (DSP), Wireless Micro Payment (WMP), and Wireless POS Payment (WPP). As shown in the figure, while no major difference is observed in online contents distribution businesses, it is obvious that in the electronic payment businesses the migration of WPP business is one year later than the other two businesses, reflecting a required delay to make a satisfactory investment of $8.2 billion to include POS infrastructure instead of a required investment of $1 billion in other businesses.

Figure 5.33 Case 4: Online Contents Distribution



Source: Author, 2003.

Figure 5.34 Case 4: Electronic Payment



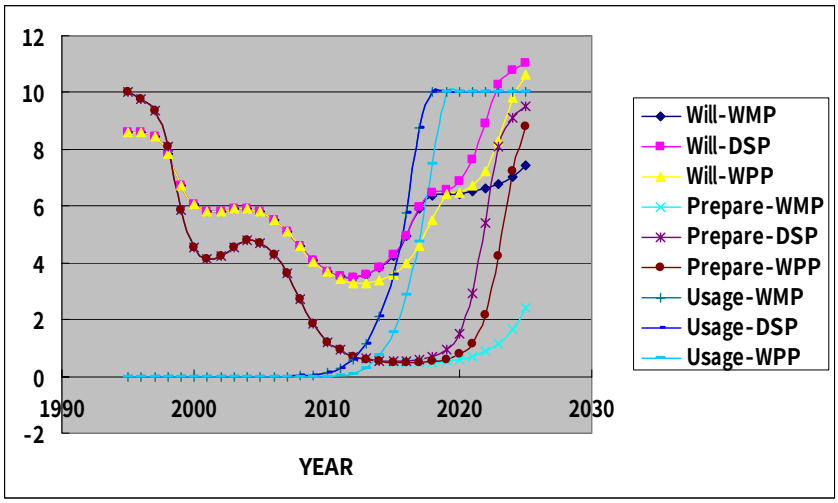
Source: Author, 2003.

5.6.4 Perceived Risk and Willingness to Switch to FPCD/WMEP

Figure 5.35 shows the Willingness to Switch to FPCD in different payment scenarios—DSP, WMP and WPP. As shown, starting from the mid-2010s, there are recognizable differences in observed Willingness to Switch to FPCD. Increased Willingness to Switch, especially beginning

in the mid-2010s, is mainly because of the complementary effect of the frequent WMEP users reward program (refer to Section 5.2.1.2) and shown in Figure 5.35 as well. As the number of WMEP users grows, FPCD users are highly motivated by being allowed to listen to more music for free. The delayed migration between WPP and the other two payment schemes in WMEP seems to affect Willingness to Switch to FPCD as well. Willingness to Switch to FPCD is further accelerated by increased availability of free contents reinforced by enforced copy protection technology fed by complementary copy protection technology in payment schemes.

Figure 5.35 Case 4: Willingness to Switch to FPCD

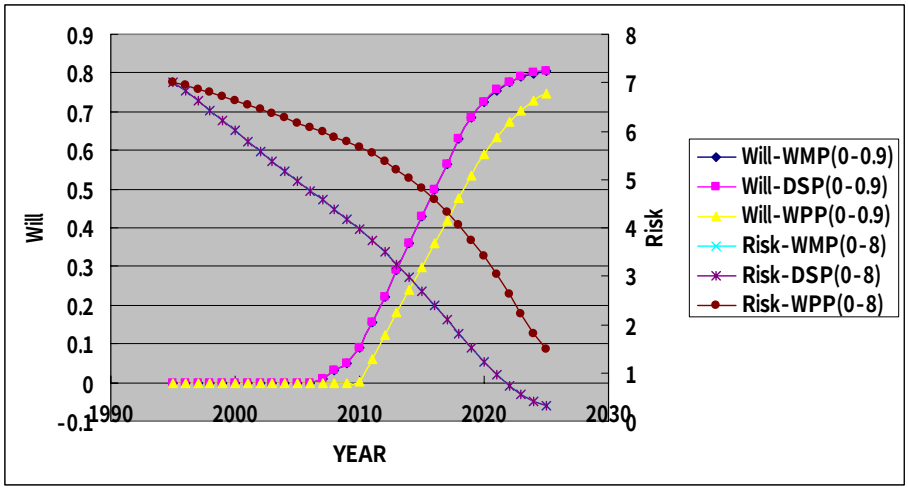


Source: Author, 2003.

Figure 5.36 depicts the Willingness to Switch to WMEP in different payment scenarios. As shown in the figure, Willingness to Switch to WMEP or WPP has a one or two year delay compared to the other two businesses, reflecting a heavier investment of $8.2 billion to build POS infrastructure instead of $1 billion for the other two businesses. The difference of Willingness to Switch to WMEP in different payment schemes is largely determined by Perceived Risk, as shown. Delayed Perceived Risk of WPP Payment originates from unsatisfied levels of investment on

imposed required infrastructure of both network communication and POS system for WPP payment scheme.

Figure 5.36 Case 4: Willingness to Switch to WMEP



Source: Author, 2003.

5.6.5 Summary

In this section, I explored the impact of different payment schemes like Dual SIM card Payment (DSP), Wireless Micro Payment (WMP) and Wireless POS Payment on business migration. In terms of the contribution of each business to accelerated migration of the sluggish wireless-related business, even with differing degrees of achievement, each payment scheme acts as the complementary factor that reduces cumulative illegal contents, thereby motivating users to refrain from the unprofitable IPCD business. WPP has a longer delay in business migration of one or two years in order to achieve satisfactory levels of required investment on POS infrastructure. WMP has a limitation on revenue generation since it is only fed by small payments. But the virtue of reduced required investment that does not require POS infrastructure seems to exceed the shortcomings of limited revenue generation.

How to reduce the required infrastructure seems to be the key issue that needs to be resolved with such new ideas as MVNO, taking into consideration the apparent business lag and required tangible assets needed to satisfy the physical investment that will lead to delays in business diffusion.

The key findings in this section are as follows.

1. ***The wireless POS infrastructure will require an additional one or two years for business migration into the wireless payment infrastructure due to required investment.***
2. ***Complementary copy protection technology development has a huge impact on reducing cumulative illegal contents, leading users to refrain from unprofitable IPCD.***
3. ***Integration of a frequent WMEP user rewards program acts as a dominant driver to encourage users to migrate into the FPCD business.***

Chapter 6
Conclusion

In this thesis, I discussed the current condition of the online music distribution industry which is suffering severe damage from illegal file-sharing. I developed a model of the industry using System Dynamics analysis. The major finding for the music industry as a whole is that piracy may not only harm the profitability of the music industry but may possibly destroy it, based on the results of the System Dynamics simulation.

The industry must recognize that it is at a turning point—whether to lose its entire profitability or to strategically implement whatever is necessary to counter piracy. Equally important is the recognition that simply imposing punishment on illegal activity under some form of strict government policy has only a delaying effect on the migration to unprofitable piracy content circulation.

Imposing penalties for illegal activity alone is not enough to prevent such illegal activity. But implementing a strategic business mechanism, such as a scheme to increase or feed sufficient levels of technology development, is the inevitable direction the industry must go in order to counter illegal activity.

Further, I touched upon the importance of copy protection technology against the usability of copy protection schemes which might otherwise conflict with each other. It is a virtue of System Dynamics analysis to be able to assess conflicting arguments quantitatively and allow users to reach concrete outcomes systematically.

In the next part of the thesis I analyzed the current business condition of the electronic payment industry using System Dynamics analysis. I echoed the important findings of Damian Balsan who found that the most important factor in the inevitable rapid migration to wireless mobile electronic payment is “Creating Trust,” which is reinforced by a well-organized, industry-wide infrastructure and security scheme (Balsan, 2002).

A similar finding can be found in this thesis. Although several factors tightly affecting each other in my proposed model, the maturity of technology development and/or infrastructure development can almost always be regarded as essential factors that drive migration in the business model.

Key findings as a manager are the importance of creating industry mechanisms that enable a drive toward influential technology and/or infrastructure development. Industry and/or governmental initiatives sometimes drive development, sometimes leading to industry standards that mitigate uncertainty. In terms of effective development, newly emerging infrastructure development schemes, such as Mobile Virtual Network Operator (MVNO), play an important role in quickly creating a trusted infrastructure.

Then I developed a model that integrated the two businesses, seeking to learn the impact of such integration on each business and trying to complement the advantages and disadvantages of each business. In this business migration, again technology development and/or infrastructure development plays an important role in accelerating migration to new business. Also important is the complementary effect of each business supplementing the other. It is important for a successful integration to clearly understand the benefits and shortcomings of each business and whether these factors can form sufficient complementarities to form reinforcing effects in business dynamics.

In the proposed integration case, the value of free content distribution and the additional revenue from wireless mobile electronic payment work together to supplement required value proposition and required development, each forming reinforcing relationships with the other.

It is important for managers to judge whether the value of each business unit together forms successful reinforcing loops that result in a successful and feasible business mechanism that feeds off the complementary value of each business and results in development that drives further reinforcement.

I will now summarize the key findings of this thesis.

ONLINE CONTENT DISTRIBUTION BUSINESS MODEL

1. ***In a situation of unsatisfactory copy protection technology, it is virtually impossible to prevent illegal copying due to a seemingly inexhaustible supply of volunteers who develop piracy schemes.***
2. ***It may be possible that the entire music industry will lose all profitability until the mid-2020s.***
3. ***It took only a few years for illegal contents to achieve a satisfactory level of accumulation due to the inexhaustible supply of volunteer content providers.***
4. ***Satisfactory levels of illegal contents accumulation prevent migration from IPCD to a manageable FPCD scheme.***
5. ***Increased illegal content accumulation plays a dominant role in determining risk for both accelerating migration to IPCD in a reduced way and preventing migration to FPCD in an increased way.***
6. ***Secondary government action against piracy has only a delaying effect on the migration from CPCD to the unprofitable IPCD business.***
7. ***It is important to impose strict government punishment, especially in the early stages, to restrict the formation of a reinforcing effect caused by illegal content accumulation.***

8. ***Moderate government punishment against piracy problem has only a delaying effect on migration from CPCD to IPCD.***
9. ***Industry initiatives to develop copy protection technology are effective for maintaining the profitability of the entire music industry.***
10. ***Improved copy protection technology not only prevents users from migrating to unprofitable IPCD, but also encourages migration from IPCD to controllable FPCD.***
11. ***Even with strict copy protection control, there are still permanent contents remaining in illegal contents accumulation.***
12. ***It is more essential to develop a secure copy protection technology than to develop a less-secure, user-friendly copy protection technology in order to beat piracy.***
13. ***The circulation of illegal content has less sensitivity to usability of the program than to the relative level of copy protection technology against piracy.***

ELECTRONIC PAYMENT BUSINESS MODEL

1. ***Lack of infrastructure for a new payment scheme is a major obstacle for both SCEP and WMEP, balancing the migration of potential users to a new payment scheme.***
2. ***Improved security protection technology largely accelerates migration from SCEP to WMEP, persuading potential users and creating trust in WMEP scheme.***
3. ***Lack of industry or government initiatives for new payment schemes slows the migration process to any new payment scheme, in contrast to the government initiative case in France.***
4. ***SCEP will become the dominant revenue generator in the 2010s and 2020s given the sluggish adoption of WMEP delayed by a lack of trusted infrastructure.***

INTEGRATED BUSINESS MODEL

1. ***Integration of online content distribution and electronic payment schemes will accelerate WMEP migration for at least five years based on System Dynamics analysis.***
2. ***Profitability of complementary WMEP reinforces the need for additional development of copy protection technology which will lead to less illegal content by the mid-2020s.***
3. ***MVNO plays a supplemental role in accelerating a successful integration of the two businesses, easing required infrastructure development which is required for trust creation.***
4. ***Value sharing by each business model is the key for successful complementary business models. Successful value sharing leads to reinforcement of value utilization.***
5. ***Wireless POS infrastructures will require an additional 1-2 years for business migration into wireless payment infrastructure due to required investment.***
6. ***Complementary copy protection technology development has a huge impact on reducing cumulative illegal contents, leading users to refrain from unprofitable IPCD.***
7. ***Integration of a frequent WMEP users reward program acts as a dominant driver to encourage users to migrate into an FPCD business.***

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Appendix: System Dynamics Equations for Integrated Business Model

(001) Avairable Development=
"Total Profit, CPCD"+Industry Fraction of Development
Units: Dollars/Year

(002) Avairable Illegal Contents=
*Fraction of volunteering Contents Provider*Average Contents per User*"Entrants, IPCD"*
Units: Titles/Year

(003) Avairable Work Force=
*"Cumulative Entrants, IPCD"*Fraction of Volunteering Engineer*Productibity of Volunteering Engineer*
Units: Dollars/Year

(004) Average Contents per User = WITH LOOKUP (
"Entrants, IPCD"/"Entrants Size, IPCD",
([(0,0)-(1,20)],(0,20),(0.0526316,16.5639),(0.115789,13.6564),(0.168421,10.9251),(0.235088,8.37004),(0.319298,6.25551),(0.410526,4.5815),(0.529825,2.90749),(0.642105,1.93833),(0.757895,1.14537),(0.866667,0.440529),(1,0))
Units: Titles/User

(005) "Average Downloads per User, CPCD" = WITH LOOKUP (
"Cumulative Entrants, CPCD"/"User Size, CPCD",
([(0,0)-(1,30)],(0,5),(0.0842105,6.87225),(0.164912,9.64758),(0.231579,12.2907),(0.284211,15.7269),(0.329825,19.5595),(0.375439,22.7313),(0.42807,24.4493),(0.5,25),(0.575439,24.185),(0.624561,22.9956),(0.670175,20.8811),(0.708772,19.0308),(0.757895,17.3128),(0.821053,15.9912),(0.884211,15.3304),(0.947368,14.9339),(1,15)))
Units: Downloads/User/Year
Normalized by 6e5\!\!\!

(006) "Average payment per purchase, Luxury purchase, MCEP" = WITH LOOKUP (
"Cumulative Entrants, MCEP" / "User Size, MCEP",
([(0,0)-(1,200)],(0,100),(1,100)))
Units: Dollars/Purchase

(007) "Average payment per purchase, Luxury purchase, SCEP" = WITH LOOKUP (
"Cumulative Entrants, SCEP" / "User Size, SCEP",
([(0,0)-(1,200)],(0,100),(1,100)))
Units: Dollars/Purchase

(008) "Average payment per purchase, Luxury purchase, WMEP" = WITH LOOKUP (
"Cumulative Entrants, WMEP" / "User Size, WMEP",
([(0,0)-(1,200)],(0,100),(1,100)))
Units: Dollars/Purchase

(009) "Average payment per purchase, Small purchase, WMEP" = WITH LOOKUP (
"Cumulative Entrants, WMEP" / "User Size, WMEP",
([(0,0)-(1,100)],(0,40),(0.5,40),(1,30)))
Units: Dollars/Purchase

(010) "Average Price per Download, CPCD" = WITH LOOKUP (
"Cumulative Entrants, CPCD"/"User Size, CPCD",
([(0,0)-(1,6)],(0,5),(0.0947368,4.99559),(0.2,4.86344),(0.287719,4.65198
),(0.364912,4.30837),(0.431579,3.91189),(0.491228,3.3304),(0.557895,2.80176
),(0.638596,2.35242),(0.719298,2.03524),(0.810526,1.77093),(0.901754,1.61233
),(1,1.5)))
Units: Dollars/Download
Normalized by 6e5\!\!\!

(011) "Average Price per Retail CD, IPCD" = WITH LOOKUP (
"Piracy Users, IPCD"/"User Size, CPCD",
([(0,0)-
(1,20)],(0,15),(0.0947368,14.978),(0.2,14.8018),(0.298246,14.6256
),(0.389474,14.0969),(0.487719,13.3921),(0.568421,12.4229),(0.652632,11.4537
),(0.733333,10.9251),(0.817544,10.3965),(0.912281,10.0441),(1,10)))
Units: Dollars/Download

(012) "Average Purchase per User, IPCD" = WITH LOOKUP (
"Piracy Users, IPCD"/"User Size, CPCD",
([(0,0)-
(1,20)],(0,10),(0.0385965,13.5683),(0.0842105,16.2115),(0.129825
,18.2379),(0.207018,19.3833),(0.280702,20),(0.364912,19.2952),(0.438596,17.7974
),(0.498246,15.859),(0.564912,13.3921),(0.610526,11.3656),(0.691228,9.07489
),(0.778947,7.22467),(0.877193,5.81498),(1,5)))
Units: Downloads/User/Year

(013) "Average purchases per user, Luxury purchase, MCEP" = WITH LOOKUP (
"Cumulative Entrants, MCEP" / "User Size, MCEP",
([(0,0)-(1,100)],(0,40),(0.5,50),(1,60)))
Units: Purchases/User

(014) "Average purchases per user, Luxury purchase, SCEP" = WITH LOOKUP (
"Cumulative Entrants, SCEP" / "User Size, SCEP",
([(0,0)-(1,100)],(0,40),(0.5,50),(1,60)))
Units: Purchases/User

(015) "Average purchases per user, Luxury purchase, WMEP" = WITH LOOKUP (
"Cumulative Entrants, WMEP" / "User Size, WMEP",
([(0,0)-(1,100)],(0,40),(0.5,50),(1,60)))
Units: Purchases/User

(016) "Average purchases per user, Small purchase, MCEP" = WITH LOOKUP (
"Cumulative Entrants, MCEP" / "User Size, MCEP",
([(0,0)-(1,200)],(0,80),(0.5,100),(1,120)))
Units: Purchases/User

(017) "Average purchases per user, Small purchase, SCEP" = WITH LOOKUP (
"Cumulative Entrants, SCEP" / "User Size, SCEP",
([(0,0)-(1,200)],(0,80),(0.5,100),(1,120)))
Units: Purchases/User

(018) "Average purchases per user, Small purchase, WMEP" = WITH LOOKUP (
"Cumulative Entrants, WMEP" / "User Size, WMEP",
([(0,0)-(1,200)],(0,80),(0.5,100),(1,120)))
Units: Purchases/User

(019) "Average Sales Commision, Luxury purchase, MCEP"=
0.025
Units: 1/Year
Based on England Case

(020) "Average Sales Commision, Small purchase, MCEP"=
0.25
Units: Dollars/Purchase/Year
Commision fee per purchase

(021) "Average Sales Commission, Luxury purchase, SCEP"=
0.025
Units: 1/Year

(022) "Average Sales Commission, Luxury purchase, WMEP"=
0.025
Units: 1/Year

(023) "Average Sales Commission, Small purchase, SCEP"=
0.25
*Units: Dollars/(Year*Purchase)*

(024) "Average Sales Commission, Small purchase, WMEP"=
0.25
*Units: Dollars/(Year*Purchase)*

(025) Average Units per User=
1
Units: Units/User

(026) coeff 1=
0
Units: Dmnl

(027) coeff 2=
0
Units: Dmnl

(028) "Commision Revenue, Luxury purchase, MCEP"=
*"Average Sales Commision, Luxury purchase, MCEP" * "Sales, Luxury purchase, MCEP"*

Units: Dollars/Year

(029) "Commision Revenue, Small purchase, MCEP"=
*"Average Sales Commision, Small purchase, MCEP" * "Purchase, Small purchases, MCEP"*
Units: Dollars/Year

(030) "Commission Revenue, Luxury purchase, SCEP"=
*"Average Sales Commission, Luxury purchase, SCEP" * "Sales, Luxury purchase, SCEP"*
Units: Dollars/Year

(031) "Commission Revenue, Luxury purchase, WMEP"=
*"Average Sales Commission, Luxury purchase, WMEP" * "Sales, Luxury purchase, WMEP"*
Units: Dollars/Year

(032) "Commission Revenue, Small purchase, SCEP"=
*"Average Sales Commission, Small purchase, SCEP" * "Purchase, Small purchase, SCEP"*
Units: Dollars/Year

(033) "Commission Revenue, Small purchase, WMEP"=
*"Average Sales Commission, Small purchase, WMEP" * "Purchase, Small purchase, WMEP"*
Units: Dollars/Year

(034) "Conversions, CPCD to IPCD"=
*Willingness to Switch to IPCD * "Potential Conversions, CPCD"*
Units: 1/Year

(035) "Conversions, IPCD to FPCD"=
*"Potential Conversions, IPCD" * Willingness to Switch to FPCD*
Units: 1/Year

(036) "Conversions, MCEP to SCEP"=
*Willingness to switch to SCEP * "Potential Conversions, MCEP"*
Units: 1/Year

(037) "Conversions, SCEP to WMEP"=
*"Potential Conversions, SCEP" * Willingness to switch to WMEP*
Units: 1/Year

(038) "Copy Protection Performance Index, CPCD"=
10"Cumulative Development on Copy Protection, CPCD"/Trend of Copy Protection*
Units: Dmnl
The level of maturity of technolgy against requirement. (0-10)

(039) "Cost of Player, CPCD" = WITH LOOKUP (
"Cumulative Entrants, CPCD"/"User Size, CPCD",

([(0,0)-(1,250)],(0,200),(0.0526316,174.009),(0.0947368,157.489),(0.147368,139.868),(0.196491,121.145),(0.252632,106.828),(0.312281,92.511),(0.382456,80.3965),(0.466667,71.5859),(0.557895,62.7753),(0.65614,57.2687),(0.761404,53.9648),(0.880702,50.6608),(1,50)))
Units: Dollars/Unit
Normalized by User Size of 6e5\!\!

(040) "Cumulative Development on Copy Protection, CPCD"= INTEG (
"Development spent on Copy Protection, CPCD",
0)
Units: Dollars

(041) Cumulative Development on Piracy Scheme= INTEG (
Development spent on Piracy Scheme,
5e+008)
Units: Dollars

(042) "Cumulative Development on Security Protection, WMEP"= INTEG (
"Development spent on Security Protection, WMEP",
0)
Units: Dollars

(043) "Cumulative Development on Technology, MCEP"= INTEG (
"Development spent on Technology, MCEP",
5e+008)
Units: Dollars

(044) "Cumulative Development on Technology, SCEP"= INTEG (
"Development spent on Technology, SCEP",
5e+008)
Units: Dollars

(045) "Cumulative Development on Technology, WMEP"= INTEG (
"Development spent on Technology, WMEP",
0)
Units: Dollars

(046) "Cumulative Development on Usability, CPCD"= INTEG (
"Development spent on Usability, CPCD",
5e+008)
Units: Dollars

(047) "Cumulative Development on Usability, FPCD"= INTEG (
"Development spent on Usability, FPCD",
8e+008)
Units: Dollars

(048) "Cumulative Development on Usability, IPCD"= INTEG (
"Development spend on Usability, IPCD",
5e+008)

Units: Dollars

(049) "Cumulative Entrants, CPCD"= INTEG (
"Entrants, CPCD",
2e+006)
Units: Users

(050) "Cumulative Entrants, IPCD"=
"Services in Use, IPCD"
Units: Users

(051) "Cumulative Entrants, MCEP"= INTEG (
"Entrants, MCEP",
2e+007)
Units: Users

(052) "Cumulative Entrants, SCEP"= INTEG (
"Entrants, SCEP",
0)
Units: Users

(053) "Cumulative Entrants, WMEP"= INTEG (
"Entrants, WMEP",
0)
Units: Users

(054) "Cumulative Illegal Contents, Eternal"= INTEG (
"Illegal Contents Creation, Eternal"-"Obsoletion of Contents, Eternal",
0)
Units: Titles

(055) "Cumulative Illegal Contents, Seasonal"= INTEG (
"Illegual Contents Creation, Seasonal"-"Obsoletion of Contents, Seasonal"
,
0)
Units: Titles

(056) Cumulative Illetgal Contents=
"Cumulative Illegal Contents, Eternal"+"Cumulative Illegal Contents, Seasonal"
Units: Titles

(057) "Cumulative Investment on Infrastructure, FPCD"= INTEG (
"Investment spent on Infrastructure, FPCD",
0)
Units: Dollars

(058) "Cumulative Investment on Infrastructure, SCEP"= INTEG (
"Investment spent on Infrastructure, SCEP",
0)
Units: Dollars

(059) "Cumulative Investment on Infrastructure, WMEP"= INTEG (
"Investment spent on Infrastructure, WMEP",
0)
Units: Dollars

(060) "Development spend on Usability, IPCD"=
"Fraction of Development on Usability, IPCD"
Units: Dollars/Year

(061) "Development spent on Copy Protection, CPCD"=
"Fraction of Development on Copy Protection, CPCD"
Units: Dollars/Year

(062) "Development spent on future generation, SCEP"=
*"Fraction of Development on future generation, SCEP" * "Development spent, MCEP"*
Units: Dollars/Year

(063) "Development spent on next generation, MCEP"=
*"Fraction of Development on next generation, MCEP" * "Development spent, MCEP"*
Units: Dollars/Year

(064) "Development spent on next generation, SCEP"=
*"Fraction of Development on next generation, SCEP" * "Development spent, SCEP"*
Units: Dollars/Year

(065) Development spent on Piracy Scheme=
Fraction of Development on Piracy Scheme
Units: Dollars/Year

(066) "Development spent on Security Protection, WMEP"=
"Fraction of Development on Security Protection, WMEP"
Units: Dollars/Year

(067) "Development spent on Technology, MCEP"=
"Fraction of Development on Technology, MCEP"
Units: Dollars/Year

(068) "Development spent on Technology, SCEP"=
"Fraction of Development on Technology, SCEP"
Units: Dollars/Year

(069) "Development spent on Technology, WMEP"=
"Fraction of Development on Technology, WMEP"
Units: Dollars/Year

(070) "Development spent on Usability, CPCD"=
"Fraction of Development on Usability, CPCD"
Units: Dollars/Year

(071) "Development spent on Usability, FPCD"=
"Fraction of Development on Usability, FPCD"
Units: Dollars/Year

(072) "Development spent, MCEP"=
*"Fraction of Revenue to Development, MCEP" * "Total Revenue, MCEP"*
Units: Dollars/Year

(073) "Development spent, SCEP"=
*"Fraction of Revenue to Development, SCEP" * "Total Revenue, SCEP"*
Units: Dollars/Year

(074) "Development spent, WMEP"=
*"Fraction of Revenue to Development, WMEP" * "Total Revenue, WMEP"*
Units: Dollars/Year

(075) Difficit from Piracy=
"Difficit from Piracy, IPCD"
Units: Dollars/Year

(076) "Difficit from Piracy, IPCD"=
"Average Purchase per User, IPCD""Average Price per Retail CD, IPCD"*"Piracy Users, IPCD"*
Units: Dollars/Year

(077) "Dupulication of Contents, Eternal" = WITH LOOKUP (
"Cumulative Illegal Contents, Eternal" / "Recuired titla size, Eternal",
([(0,0)-(1,1)],(0,1),(0.119298,0.969163),(0.22807,0.942731),(0.340351,0.894273),(0.445614,0.828194),(0.554386,0.762115),(0.65614,0.678414),(0.747368,0.577093),(0.82807,0.444934),(0.894737,0.312775),(0.957895,0.15859),(1,0)))
Units: Dmnl

(078) "Dupulication of Contents, Seasonal" = WITH LOOKUP (
"Cumulative Illegal Contents, Seasonal"/Recuired title size,
([(0,0)-(1,1)],(0,1),(0.119298,0.969163),(0.22807,0.942731),(0.340351,0.894273),(0.445614,0.828194),(0.554386,0.762115),(0.65614,0.678414),(0.747368,0.577093),(0.82807,0.444934),(0.894737,0.312775),(0.957895,0.15859),(1,0)))
Units: Dmnl

(079) "Effect of customer requirements for Standards, FPCD" = WITH LOOKUP (
"Fraction of Users, FPCD",
([(0,0)-(1,10)],(0,0),(0.14386,0.440529),(0.280702,0.92511),(0.424561,1.62996),(0.561404,2.46696),(0.684211,3.56828),(0.785965,4.88987),(0.866667,6.38767),(0.933333,8.01762),(1,10)))
Units: Dmnl

(080) "Effect of customer requirements for Standards, SCEP" = WITH LOOKUP (

"Fraction of Users, SCEP",
([(0,0)-
(1,10)],(0,0),(0.14386,0.440529),(0.280702,0.92511),(0.424561,1.62996
),(0.561404,2.46696),(0.684211,3.56828),(0.785965,4.88987),(0.866667,6.38767
),(0.933333,8.01762),(1,10)))
Units: Dmnl

(081) "Effect of customer requirements for Standards, WMEP" = WITH LOOKUP (
"Fraction of Users, WMEP",
([(0,0)-
(1,10)],(0,0),(0.14386,0.440529),(0.280702,0.92511),(0.424561,1.62996
),(0.561404,2.46696),(0.684211,3.56828),(0.785965,4.88987),(0.866667,6.38767
),(0.933333,8.01762),(1,10)))
Units: Dmnl

(082) "Effect of Enabling Technologies, SCEP"=
*"Relative Performance, SCEP to MCEP" + 0.3 * "Relative Performance, WMEP*
to SCEP"
Units: Dmnl
(0 - 10)

(083) "Effect of Enabling Technologies, WMEP"=
"Relative Performance, WMEP to SCEP"
Units: Dmnl
Scaling (0, 10)

(084) Effect of legal punishment = WITH LOOKUP (
Govermental Purnichment,
([(0,0)-(10,0.6)],(0,0),(10,0.05)))
Units: 1/Year
0 - 0.05

(085) "Effect of maturity of technology, FPCD"=
"Usability Performance Index, FPCD"
Units: Dmnl
Scaling (0,10)

(086) "Effect of maturity of technology, SCEP"=
0.5"Technology Performance Index, SCEP"*
Units: Dmnl
(0-20) -> (0-10)

(087) "Effect of maturity of technology, WMEP"=
0.25"Technology Performance Index, WMEP"*
Units: Dmnl
(0, 40) -> (0, 10)

(088) "Effect of Obsolescence, MCEP" = WITH LOOKUP (
"Relative Performance, SCEP to MCEP" + "User need for improved performance,
SCEP"
,

([(0,0)-(20,0.1)],(0,0),(20,0.1)))

Units: 1/Year

(0,20) -> (0, 0.1)\!\!\!

(089) "Effect of Obsolescence, SCEP" = WITH LOOKUP (

"User need for improved performance, WMEP" + 0.25"Technology Performance Index, WMEP"*

,

([(0,0)-(20,0.1)],(0,0),(20,0.1)))

Units: 1/Year

(0,20) -> (0,0.1); "Relative Performance, SCEP to MCEP" + "User need for improved performance, SCEP"\!\!\!

(090) "Effect of Perceived Risk on Willingness, FPCD"=

0.15"Perceived Risk of Usage, FPCD" + 0.15*"Perceived Risk from Switching Cost, FPCD"*

+ 0.35"Perceived Risk from Lack of Standards, FPCD" + 0.35*"Perceived Risk from Lack of Infrastructure, FPCD"*

Units: Dmnl

Scaling 0-10

(091) "Effect of Perceived Risk on Willingness, IPCD"=

0.15"Perceived Risk of Usage, IPCD"+0.15*"Perceived Risk from Switching Cost, IPCD"*

+0.35"Perceived Risk of Illegual Activity, IPCD"+0.35*"Perceived Risk from Lack of Contents, IPCD"*

Units: Dmnl

Scaling 0-10

(092) "Effect of Perceived Risk on Willingness, SCEP"=

0.4"Perceived Risk from Lack of Infrastructure, SCEP" + 0.4*"Perceived Risk from Lack of Standards, SCEP"*

+ 0.1"Perceived Risk of Usage, SCEP" + 0.1*"Perceived Risk from Switching Cost, SCEP"*

Units: Dmnl

Scaling 0-10

(093) "Effect of Perceived Risk on Willingness, WMEP"=

0.05"Perceived Risk of Usage, WMEP" + 0.05*"Perceived Risk from Switching Cost, WMEP"*

+0.3"Perceived Risk from Lack of Standards, WMEP" + 0.3*"Perceived Risk from Lack of Security, WMEP"*

+ 0.3"Perceived Risk from Lack of Infrastructure, WMEP"*

Units: Dmnl

Scaling 0-10

(094) "Effect of Willingness to Switch, CPCD" = WITH LOOKUP (

Willingness to Switch Based on Value Price,

([(-10,0)-(10,0.1)],(-10,0),(0,0),(10,0.1)))

Units: 1/Year

Scaling -10 to 10 -> Scaling 0 to 0.1\!\!\!

(095) "Effect of Willingness to Switch, IPCD" = WITH LOOKUP (
"Willingness to Switch Based on Value, FPCD",
([(-10,0)-(10,0.1)],(-10,0),(0,0),(10,0.1)))
Units: 1/Year
Scaling -10 to 10 -> Scaling 0 to 0.1\!\!\!

(096) "Entrants Size, IPCD"=
5e+006
Units: Users/Year

(097) "Entrants, CPCD"=
"Total Demand, Contents Distribution""Fraction of Users, CPCD"*
Units: Users/Year

(098) "Entrants, FPCD"=
*"Total Demand, Contents Distribution" * "Fraction of Users, FPCD"*
Units: Users/Year

(099) "Entrants, IPCD"=
"Total Demand, Contents Distribution""Fraction of Users, IPCD"*
Units: Users/Year

(100) "Entrants, MCEP"=
*"Fraction of Users, MCEP" * "Total Demand, Electrical Payment"*
Units: Users/Year

(101) "Entrants, SCEP"=
*"Fraction of Users, SCEP" * "Total Demand, Electrical Payment"*
Units: Users/Year

(102) "Entrants, WMEP"=
*"Fraction of Users, WMEP" * "Total Demand, Electrical Payment"*
Units: Users/Year

(103) Estimated Music Industry Revenue= INTEG (
Market Growth Opportunity - Difficit from Piracy,
1.2e+010)
Units: Dollars

(104) FINAL TIME = 2025
Units: Year
The final time for the simulation.

(105) Fraction=
0.001
Units: Dmnl

(106) "Fraction of Cipiable Contents, Eternal"=
Avairable Illegal Contents"Dupulication of Contents, Eternal"*Fraction of Copiability*

Units: Titles/Year

(107) Fraction of Copiability = WITH LOOKUP (
Relative Copiability of Contents,
([(-10,0)-(10,1)],(-10,0),(0,0),(10,1)))
Units: Dmnl

(108) "Fraction of Copiable Contents, Seasonal"=
*Fraction of Copiability*Avairable Illegal Contents*"Dupulication of Contents, Seasonal"*
Units: Titles/Year

(109) Fraction of Development=
0
Units: Dmnl

(110) "Fraction of Development on Copy Protection, CPCD"=
"Recuirement of Copy Protection under Trend, CPCD"(Avairable Development +Industry Fraction of Development on Copy Protection + WMEP Fraction of Development on Copy Protection*
)
Units: Dollars/Year

(111) "Fraction of Development on future generation, SCEP"=
0.1
Units: Dmnl

(112) "Fraction of Development on next generation, MCEP"=
0.33
Units: Dmnl

(113) "Fraction of Development on next generation, SCEP"=
0.1
Units: Dmnl

(114) Fraction of Development on Piracy Scheme=
*Avairable Work Force*Requirement in PSI under Trend*
Units: Dollars/Year

(115) "Fraction of Development on Security Protection, WMEP"=
*"Recuirement of Security Protection under Trend, WMEP" * ("Development spent on future generation, SCEP"*
+ "Development spent on next generation, SCEP" + "Development spent, WMEP"
)
Units: Dollars/Year

(116) "Fraction of Development on Technology, MCEP"=
*"Development spent, MCEP" * "Recuirement of Technology under Trend, MCEP"*
Units: Dollars/Year

(117) "Fraction of Development on Technology, SCEP"=

*"Recuirement of Technology under Trend, SCEP" * ("Development spent, SCEP" + "Development spent on next generation, MCEP")*
Units: Dollars/Year

(118) "Fraction of Development on Technology, WMEP"=
*"Recuirement of Technology under Trend, WMEP" * ("Development spent on future generation, SCEP" + "Development spent on next generation, SCEP" + "Development spent, WMEP")*
Units: Dollars/Year

(119) "Fraction of Development on Usability, CPCD"=
Avairable Development"Recuirement of Usability under Trend, CPCD"*
Units: Dollars/Year

(120) "Fraction of Development on Usability, FPCD"=
*"Recuirement of Usability under Trend, FPCD" * Industry Fraction of Development on Free Payment Contents Distribution*
Units: Dollars/Year

(121) "Fraction of Development on Usability, IPCD"=
Avairable Work Force"Requirement in UPI under Trend, IPCD"*
Units: Dollars/Year

(122) "Fraction of Investment on Infrastructure, FPCD"=
*"Recuirement of investment on Infrastructure, FPCD" * Industry Fraction of Development on Free Payment Contents Distribution*
Units: Dollars/Year

(123) "Fraction of Investment on Infrastructure, SCEP"=
*"Recuirement of investment on Infrastructure, SCEP" * ("Development spent, SCEP" + "Development spent on next generation, MCEP")*
Units: Dollars/Year

(124) "Fraction of Investment on Infrastructure, WMEP"=
*"Recuirement of investment on Infrastructure, WMEP" * ("Development spent on future generation, SCEP" + "Development spent on next generation, SCEP" + "Development spent, WMEP")*
Units: Dollars/Year

(125) "Fraction of Revenue to Development, MCEP"=
0.33
Units: Dmnl

(126) "Fraction of Revenue to Development, SCEP"=
0.33
Units: Dmnl

(127) "Fraction of Revenue to Development, WMEP"=

0.33
Units: Dmnl

(128) *"Fraction of Users Willing to Convert, CPCD"=*
"Fraction Retirements, CPCD"+"Market Growth Adding New Users, CPCD"
Units: 1/Year

(129) *"Fraction of Users Willing to Convert, IPCD"=*
"Fraction Retirements, IPCD" + "Market Growth Adding New Users, IPCD"
Units: 1/Year

(130) *"Fraction of Users Willing to Convert, MCEP"=*
"Fraction Retirements, MCEP" + "Market Growth Adding New Users, MCEP"
Units: 1/Year

(131) *"Fraction of Users Willing to Convert, SCEP"=*
"Fraction Retirements, SCEP" + "Market Growth Adding New Users, SCEP"
Units: 1/Year

(132) *"Fraction of Users, CPCD"= INTEG (*
-"Conversions, CPCD to IPCD",
1)
Units: Dmnl
Fraction of users to use CPCD technology

(133) *"Fraction of Users, FPCD"= INTEG (*
"Conversions, IPCD to FPCD",
0)
Units: Dmnl

(134) *"Fraction of Users, IPCD"= INTEG (*
"Conversions, CPCD to IPCD" - "Conversions, IPCD to FPCD",
0)
Units: Dmnl
Fraction of Users who uses IPCD technology

(135) *"Fraction of Users, MCEP"= INTEG (*
- "Conversions, MCEP to SCEP",
1)
Units: Dmnl
Fraction of users to use CPCD technology

(136) *"Fraction of Users, SCEP"= INTEG (*
"Conversions, MCEP to SCEP" - "Conversions, SCEP to WMEP",
0)
Units: Dmnl
Fraction of Users who uses IPCD technology

(137) *"Fraction of Users, WMEP"= INTEG (*
"Conversions, SCEP to WMEP",
0)

Units: Dmnl
Fraction of Users who uses IPCD technology

(138) *Fraction of volunteering Contents Provider = WITH LOOKUP (*
"Entrants, IPCD"/"Entrants Size, IPCD",
([(0,0)-
(1,0.1)],(0,0.1),(0.0526316,0.0832599),(0.101754,0.0682819),(0.150877
,0.0572687),(0.2,0.045815),(0.263158,0.0348018),(0.34386,0.0255507),(0.424561
,0.0180617),(0.519298,0.0140969),(0.617544,0.0101322),(0.708772,0.00748899
),(0.803509,0.00484582),(0.891228,0.00220264),(1,0)))
Units: Dmnl

(139) *Fraction of Volunteering Engineer = WITH LOOKUP (*
"Cumulative Entrants, IPCD"/"User Size, IPCD",
([(0,0)-
(1,0.1)],(0,0.05),(0.0491228,0.0378855),(0.101754,0.0277533),(0.157895
,0.0193833),(0.224561,0.0123348),(0.308772,0.00748899),(0.407018,0.00528634
),(0.501754,0.00396476),(0.596491,0.00264317),(0.691228,0.00176211),(0.782456
,0.00132159),(0.866667,0.000881057),(1,0)))
Units: Dmnl

(140) *"Fraction Retirements, CPCD"=*
"Retirements, CPCD"/"Services in Use, CPCD"
Units: 1/Year

(141) *"Fraction Retirements, IPCD"=*
"Retirements, IPCD"/"Services in Use, IPCD"
Units: 1/Year

(142) *"Fraction Retirements, MCEP"=*
"Retirements, MCEP" / "Services in Use, MCEP"
Units: 1/Year

(143) *"Fraction Retirements, SCEP"=*
"Retirements, SCEP" / "Services in Use, SCEP"
Units: 1/Year

(144) *Govermental Purnichment = WITH LOOKUP (*
"Perceived Piracy Problem, IPCD",
([(0,0)-(10,10)],(0,0),(10,10)))
Units: Dmnl
Scaling 0 -10 1st Scenario: Punishment is consistantly low. 2nd
Scenario: Punishment is linear: 3rd scenario: Punishment is
quite high \!\!\!

(145) *Growth=*
0.01
Units: 1/Year

(146) *"Growth Demand, Contents Distribution"=*
"Market Growth, Contents Distribution""Services in Use, Contnts Distribution"*

Units: Users/Year

(147) "Growth Demand, Electrical Payment"=
"Market Growth, Electrical Payment""Services in Use, Electrical Payment"*
Units: Users/Year

(148) "Illegal Contents Creation, Eternal"=
"Fraction of Cipiable Contents, Eternal"
Units: Titles/Year

(149) "Illegual Contents Creation, Seasonal"=
"Fraction of Copiable Contents, Seasonal"
Units: Titles/Year

(150) Industry Fraction of Development=
*Fraction*Music Industry Revenue*
Units: Dollars/Year

(151) Industry Fraction of Development on Copy Protection=
Music Industry Revenue"Requirement of Copy Protection, Industry"*
Units: Dollars/Year

(152) Industry Fraction of Development on Free Payment Contents Distribution =
*Music Industry Revenue * "Requirement of Free Payment Contents Distribution, Industry"*
Units: Dollars/Year

(153) "Infrastructure Penetration Index, FPCD"=
10"Cumulative Investment on Infrastructure, FPCD"/"Required Infrastructure, FPCD"*
Units: Dmnl
The level of maturity of technolgy against requirement. (0-10)

(154) "Infrastructure Penetration Index, SCEP"=
10"Cumulative Investment on Infrastructure, SCEP"/"Required Infrastructure, SCEP"*
Units: Dmnl
The level of maturity of technolgy against requirement. (0-10)

(155) "Infrastructure Penetration Index, WMEP"=
10"Cumulative Investment on Infrastructure, WMEP"/"Required Infrastructure, WMEP"*
Units: Dmnl
The level of maturity of technolgy against requirement. (0-10)

(156) INITIAL TIME = 1995
Units: Year
The initial time for the simulation.

(157) "Investment spent on Infrastructure, FPCD"=

"Fraction of Investment on Infrastructure, FPCD"
Units: Dollars/Year

(158) *"Investment spent on Infrastructure, SCEP"=*
"Fraction of Investment on Infrastructure, SCEP"
Units: Dollars/Year

(159) *"Investment spent on Infrastructure, WMEP"=*
"Fraction of Investment on Infrastructure, WMEP"
Units: Dollars/Year

(160) *"Market Growth Adding New Users, CPCD"=*
0.05
Units: 1/Year

(161) *"Market Growth Adding New Users, IPCD"=*
0.05
Units: 1/Year

(162) *"Market Growth Adding New Users, MCEP"=*
0.05
Units: 1/Year

(163) *"Market Growth Adding New Users, SCEP"=*
0.05
Units: 1/Year

(164) *Market Growth Opportunity=*
*Growth*Estimated Music Industry Revenue*
Units: Dollars/Year

(165) *"Market Growth, Contents Distribution"=*
0.05
Units: 1/Year

(166) *"Market Growth, Electrical Payment"=*
0.05
Units: 1/Year

(167) *Music Industry Revenue=*
*unit const*Estimated Music Industry Revenue*
Units: Dollars/Year

(168) *"Natural Obsolescence, FPCD"=*
0.05
Units: 1/Year

(169) *"Natural Obsolescence, MCEP"=*
0.15
Units: 1/Year

(170) "Natural Obsolescence, SCEP"=
0.15
Units: 1/Year

(171) "Natural Obsolescense, WMEP"=
0.15
Units: 1/Year

(172) "Normal Growth, SCEP"=
1.2
Units: Dmnl

(173) "Normal Growth, WMEP"=
1
Units: Dmnl

(174) "Obsoletion of Contents, Eternal"=
"Cumulative Illegal Contents, Eternal""Obsolution Rate, Eternal"*
Units: Titles/Year

(175) "Obsoletion of Contents, Seasonal"=
"Obsolution Rate, Seosonal""Cumulative Illegal Contents, Seasonal"*
Units: Titles/Year

(176) "Obsolution Rate, Eternal"=
0.01
Units: 1/Year

(177) "Obsolution Rate, Seosonal"=
0.5
Units: 1/Year

(178) "Perceived Piracy Problem, IPCD" = WITH LOOKUP (
"Fraction of Users, IPCD",
([(0,0)-
(1,10)],(0,0),(0.119298,0.08811),(0.207018,0.2203),(0.294737,0.4405
),(0.389474,0.7489),(0.484211,1.145),(0.564912,1.762),(0.659649,2.511),(0.750877
,3.392),(0.824561,4.449),(0.887719,5.639),(0.936842,6.828),(0.97193,8.238)
,(1,10)))
Units: Dmnl
Scaling 0 - 10 1st Scenario: Industry is too late to notice the
piracy problem / 2nd Scenario: Industry is sensitive to notice
piracy poblem\!\!\!

(179) "Perceived Risk from Lack of Contents, IPCD" = WITH LOOKUP (
Cumulative Illetgal Contents/Recuired title size,
([(0,0)-(1,10)],(0,10),(0.0912281,9.82379),(0.175439,9.69163),(0.252632,
9.47137),(0.326316,8.98678),(0.392982,8.19383)

,(0.435088,7.18062),(0.470175,6.12335),(0.5,5),(0.533333,4.00881),(0.57193
,3.03965),(0.610526,2.11454),(0.666667,1.23348

),(0.736842,0.704846),(0.821053,0.396476),(0.905263,0.176211),(1,0)))
Units: Dmnl
Scaling 0-10\!\!\!

(180) "Perceived Risk from Lack of Infrastructure, FPCD"=
10 - "Infrastructure Penetration Index, FPCD"
Units: Dmnl
Scaling (0, 10); 10 - "Infrastructure Penetration Index, SCEP"

(181) "Perceived Risk from Lack of Infrastructure, SCEP"=
10 - "Infrastructure Penetration Index, SCEP"
Units: Dmnl
Scaling 0-10

(182) "Perceived Risk from Lack of Infrastructure, WMEP"=
10 - "Infrastructure Penetration Index, WMEP"
Units: Dmnl
Scaling (0, 10); 10 - "Infrastructure Penetration Index, SCEP"

(183) "Perceived Risk from Lack of Security, WMEP"=
10 - "Security Protection Performance Index, WMEP"
Units: Dmnl
Scaling 0 - 10; 10 - "Infrastructure Penetration Index, WMEP"

(184) "Perceived Risk from Lack of Standards, FPCD" = WITH LOOKUP (
0.5"Effect of customer requirements for Standards, FPCD" - 0.5*"Effect of maturity of technology, FPCD"*
,
([(-10,0)-(10,10)],(-10,0),(0,0),(10,10)))
Units: Dmnl
0.5"Effect of customer requirements for Standards, SCEP" -*
0.5"Effect of maturity of technology, SCEP"\!\!*

(185) "Perceived Risk from Lack of Standards, SCEP" = WITH LOOKUP (
0.5"Effect of customer requirements for Standards, SCEP" - 0.5*"Effect of maturity of technology, SCEP"*
,
([(-10,0)-(10,10)],(-10,0),(0,0),(10,10)))
Units: Dmnl

(186) "Perceived Risk from Lack of Standards, WMEP" = WITH LOOKUP (
0.5"Effect of customer requirements for Standards, WMEP" - 0.5*"Effect of maturity of technology, WMEP"*
,
([(-10,0)-(10,10)],(-10,0),(0,0),(10,10)))
Units: Dmnl
0.5"Effect of customer requirements for Standards, SCEP" -*
0.5"Effect of maturity of technology, SCEP"\!\!*

(187) "Perceived Risk from Switching Cost, FPCD" = WITH LOOKUP (
"Fraction of Users, FPCD",

([(0,0)-
(1,10)],(0,10),(0.0350877,8.28194),(0.0736842,7.18062),(0.115789
,6.12335),(0.154386,5.11013),(0.214035,3.96476

),(0.291228,2.81938),(0.378947,1.89427),(0.480702,1.32159),(0.596491,0.881057
),(0.691228,0.572687),(0.785965,0.30837),(0.880702
,0.176211),(1,0)))
Units: Dmnl
Scaling 0 -10

(188) "Perceived Risk from Switching Cost, IPCD" = WITH LOOKUP (
"Fraction of Users, IPCD",
([(0,0)-
(1,10)],(0,10),(0.0350877,8.28194),(0.0736842,7.18062),(0.115789
,6.12335),(0.154386,5.11013),(0.214035,3.96476),(0.291228,2.81938),(0.378947
,1.89427),(0.480702,1.32159),(0.596491,0.881057),(0.691228,0.572687),(0.785965
,0.30837),(0.880702,0.176211),(1,0)))
Units: Dmnl
Scaling 0 -10\!\!\!

(189) "Perceived Risk from Switching Cost, SCEP" = WITH LOOKUP (
"Fraction of Users, SCEP",
([(0,0)-
(1,10)],(0,10),(0.0350877,8.28194),(0.0736842,7.18062),(0.115789
,6.12335),(0.154386,5.11013),(0.214035,3.96476),(0.291228,2.81938),(0.378947
,1.89427),(0.480702,1.32159),(0.596491,0.881057),(0.691228,0.572687),(0.785965
,0.30837),(0.880702,0.176211),(1,0)))
Units: Dmnl
Scaling 0 -10\!\!\!

(190) "Perceived Risk from Switching Cost, WMEP" = WITH LOOKUP (
"Fraction of Users, WMEP",
([(0,0)-
(1,10)],(0,10),(0.0350877,8.28194),(0.0736842,7.18062),(0.115789
,6.12335),(0.154386,5.11013),(0.214035,3.96476),(0.291228,2.81938),(0.378947
,1.89427),(0.480702,1.32159),(0.596491,0.881057),(0.691228,0.572687),(0.785965
,0.30837),(0.880702,0.176211),(1,0)))
Units: Dmnl
Scaling 0 -10\!\!\!

(191) "Perceived Risk of Illegual Activity, IPCD"=
Govermental Purnichment
Units: Dmnl
Scaling 0-10

(192) "Perceived Risk of Usage, FPCD" = WITH LOOKUP (
"Fraction of Users, FPCD",
([(0,0)-(1,10)],(0,10),(0.0807018,9.86784),(0.150877,9.77974),(0.224561,
9.64758),(0.298246,9.42731),(0.368421,9.20705)

,(0.431579,8.85463),(0.501754,8.5022),(0.561404,8.14978),(0.62807,7.57709

),(0.684211,7.13656),(0.740351,6.38767),(0.789474
,5.63877),(0.849123,4.6696),(0.898246,3.52423),(0.947368,2.15859),(1,0)
))
Units: Dmnl
Scaling 0 to 10

(193) *"Perceived Risk of Usage, IPCD" = WITH LOOKUP (*
"Fraction of Users, IPCD",
([(0,0)-(1,10)],(0,10),(0.0807018,9.86784),(0.150877,9.77974),(0.224561,
9.64758),(0.298246,9.42731),(0.368421,9.20705),(0.431579,8.85463),(0.501754
,8.5022),(0.561404,8.14978),(0.62807,7.57709),(0.684211,7.13656),(0.740351
,6.38767),(0.789474,5.63877),(0.849123,4.6696),(0.898246,3.52423),(0.947368
,2.15859),(1,0)))
Units: Dmnl
Scaling 0 to 10\!\!

(194) *"Perceived Risk of Usage, SCEP" = WITH LOOKUP (*
"Fraction of Users, SCEP",
([(0,0)-(1,10)],(0,10),(0.0807018,9.86784),(0.150877,9.77974),(0.224561,
9.64758),(0.298246,9.42731),(0.368421,9.20705),(0.431579,8.85463),(0.501754
,8.5022),(0.561404,8.14978),(0.62807,7.57709),(0.684211,7.13656),(0.740351
,6.38767),(0.789474,5.63877),(0.849123,4.6696),(0.898246,3.52423),(0.947368
,2.15859),(1,0)))
Units: Dmnl
Scaling 0 to 10\!\!

(195) *"Perceived Risk of Usage, WMEP" = WITH LOOKUP (*
"Fraction of Users, WMEP",
([(0,0)-(1,10)],(0,10),(0.0807018,9.86784),(0.150877,9.77974),(0.224561,
9.64758),(0.298246,9.42731),(0.368421,9.20705),(0.431579,8.85463),(0.501754
,8.5022),(0.561404,8.14978),(0.62807,7.57709),(0.684211,7.13656),(0.740351
,6.38767),(0.789474,5.63877),(0.849123,4.6696),(0.898246,3.52423),(0.947368
,2.15859),(1,0)))
Units: Dmnl
Scaling 0 to 10\!\!

(196) *Piracy Scheme Performance Index=*
*10*Cumulative Development on Piracy Scheme/Trend of Piracy Scheme*
Units: Dmnl
The level of satisfaction of the technology against requirement,
0-10 (maximum).

(197) *"Piracy Users, IPCD"=*
"Services in Use, IPCD"
Units: Users

(198) *"Potential Conversions, CPCD"=*
"Fraction of Users Willing to Convert, CPCD""Fraction of Users, CPCD"*
Units: 1/Year

(199) *"Potential Conversions, IPCD"=*

*"Fraction of Users Willing to Convert, IPCD" * "Fraction of Users, IPCD"*
Units: 1/Year

(200) "Potential Conversions, MCEP"=
*"Fraction of Users Willing to Convert, MCEP" * "Fraction of Users, MCEP"*
Units: 1/Year

(201) "Potential Conversions, SCEP"=
*"Fraction of Users Willing to Convert, SCEP" * "Fraction of Users, SCEP"*
Units: 1/Year

(202) "Price of Player, CPCD"=
1.2"Cost of Player, CPCD"*
Units: Dollars/Unit

(203) Price Range=
5
Units: Dollars/Download
Maximum Price for Normalization

(204) Productibity of Volunteering Engineer=
10000
Units: Dollars/User/Year

(205) "Profit from Downloads, CPCD"=
"Average Downloads per User, CPCD""Average Price per Download, CPCD"*"Services in Use, CPCD"*
Units: Dollars/Year

(206) "Profits from Player, CPCD"=
"Revenue from Player, CPCD"-"Cost of Player, CPCD""Entrants, CPCD"*Average Units per User*
Units: Dollars/Year

(207) "Purchase, Small purchase, SCEP"=
*"Average purchases per user, Small purchase, SCEP" * "Services in Use, SCEP"*
Units: Purchases

(208) "Purchase, Small purchase, WMEP"=
*"Average purchases per user, Small purchase, WMEP" * "Services in Use, WMEP"*
Units: Purchases

(209) "Purchase, Small purchases, MCEP"=
*"Average purchases per user, Small purchase, MCEP" * "Services in Use, MCEP"*
Units: Purchases

(210) "Recuired titla size, Eternal"=
5000
Units: Titles

(211) Recuired title size=
100000
Units: Titles
For Normalization

(212) "Recuirement of Copy Protection under Trend, CPCD" = WITH LOOKUP (
10-"Copy Protection Performance Index, CPCD",
([(-20,0)-(20,1)],(-20,0),(0,0),(10,0.5),(20,1)))
Units: Dmnl

(213) "Recuirement of investment on Infrastructure, FPCD" = WITH LOOKUP (
10-"Infrastructure Penetration Index, FPCD",
([(-20,0)-(20,1)],(-20,0),(0,0),(10,0.5),(20,1)))
Units: Dmnl

(214) "Recuirement of investment on Infrastructure, SCEP" = WITH LOOKUP (
10-"Infrastructure Penetration Index, SCEP",
([(-20,0)-(20,1)],(-20,0),(0,0),(10,0.5),(20,1)))
Units: Dmnl

(215) "Recuirement of investment on Infrastructure, WMEP" = WITH LOOKUP (
10-"Infrastructure Penetration Index, WMEP",
([(-20,0)-(20,1)],(-20,0),(0,0),(10,0.5),(20,1)))
Units: Dmnl

(216) "Recuirement of Security Protection under Trend, WMEP" = WITH LOOKUP
(
10-"Security Protection Performance Index, WMEP",
([(-20,0)-(20,1)],(-20,0),(0,0),(10,0.5),(20,1)))
Units: Dmnl

(217) "Recuirement of Technology under Trend, MCEP" = WITH LOOKUP (
"Technology Trend Index, MCEP"-"Technology Performance Index, MCEP",
([(-10,0)-(10,0.5)],(-10,0),(0,0),(10,0.5)))
Units: Dmnl

(218) "Recuirement of Technology under Trend, SCEP" = WITH LOOKUP (
"Technology Trend Index, SCEP"-"Technology Performance Index, SCEP",
([(-10,0)-(20,1)],(-10,0),(0,0),(10,0.5),(20,1)))
Units: Dmnl

(219) "Recuirement of Technology under Trend, WMEP" = WITH LOOKUP (
"Technology Trend Index, WMEP" - "Technology Performance Index, WMEP",
([(-10,0)-(40,2)],(-10,0),(0,0),(10,0.5),(40,2)))
Units: Dmnl

(220) "Recuirement of Usability under Trend, CPCD" = WITH LOOKUP (
10-"Usability Performance Index, CPCD",
([(-10,0)-(10,0.5)],(-10,0),(0,0),(10,0.5)))
Units: Dmnl

(221) "Recuirement of Usability under Trend, FPCD" = WITH LOOKUP (
"Usability Performance Index, FPCD",
([(-10,0)-(10,0.5)],(-10,0),(0,0),(10,0.5)))
Units: Dmnl

(222) Relative Copiability of Contents=
Piracy Scheme Performance Index-"Copy Protection Performance Index, CPCD"
Units: Dmnl
Scaling -10 to 10

(223) "Relative Legitimacy of Contents Download, FPCD"=
10 - "Perceived Risk of Illegual Activity, IPCD"
Units: Dmnl
Scaling 0 - 10

(224) "Relative Performance, SCEP to MCEP" = WITH LOOKUP (
"Technology Performance Index, SCEP" - "Technology Performance Index, MCEP"
,
([(-10,0)-(10,10)],(-10,0),(0,0),(10,10)))
Units: Dmnl
(-10 - 10) -> (0 - 10)\!\!

(225) "Relative Performance, WMEP to SCEP" = WITH LOOKUP (
"Technology Performance Index, WMEP" - "Technology Performance Index, SCEP"
,
([(-20,0)-(20,10)],(-20,0),(0,0),(20,10)))
Units: Dmnl
(-20 - 20) -> (0 - 10)\!\!

(226) Relative Preparedness of Contents based on Frequent WMEP Usage = WITH LOOKUP (
"Total Sales, WMEP" / Sales threshold,
([(0,0)-(100,10)],(0,0),(1,10),(50,10)))
Units: Dmnl

(227) "Relative Preparedness of Contents, FPCD"=
"Perceived Risk from Lack of Contents, IPCD"
Units: Dmnl
Scaling 0 - 10

(228) "Relative Price, IPCD to CPCD" = WITH LOOKUP (
"Average Price per Download, CPCD"/Price Range,
([(0,0)-(1,10)],(0,0),(0.045614,1.54185),(0.0807018,2.81938),(0.122807,4.18502),(0.178947,5.4185),(0.242105,6.65198),(0.315789,7.7533),(0.403509,8.59031),(0.498246,9.11894),(0.596491,9.42731),(0.684211,9.69163),(0.775439,9.82379),(0.877193,9.91189),(1,10)))
Units: Dmnl
Willingness to Switch to IPCD, Scaling 0-10\!\!

(229) *"Relative Usability, FPCD to IPCD"=*
"Usability Performance Index, FPCD" - Usability of IPCD
Units: Dmnl
Scaling -10 to 10

(230) *"Relative Usability, IPCD to CPCD"=*
"Usability Performance Index, IPCD" - Usability of CPCD
Units: Dmnl
Scaling -10 to 15

(231) *"Replacement Demand, Contents Distribution"=*
"Retirements, CPCD"+"Retirements, IPCD" + "Retirements, FPCD"
Units: Users/Year

(232) *"Replacement Demand, Electrical Payment"=*
"Retirements, MCEP" + "Retirements, SCEP" + "Retirements, WMEP"
Units: Users/Year

(233) *"Required Infrastructure, FPCD"=*
6e+009
Units: Dollars
The required investment to achieve sufficient level of performance.

(234) *"Required Infrastructure, SCEP"=*
4e+009
Units: Dollars
The required investment to achieve sufficient level of performance.

(235) *"Required Infrastructure, WMEP"=*
6e+009
Units: Dollars
The required investment to achieve sufficient level of performance.

(236) *Requirement in PSI under Trend = WITH LOOKUP (*
10-Piracy Scheme Performance Index,
([(-20,0)-(20,1)],(-20,0),(0,0),(10,0.5),(20,1)))
Units: Dmnl

(237) *"Requirement in UPI under Trend, IPCD" = WITH LOOKUP (*
10-"Usability Performance Index, IPCD",
([(-20,0)-(20,1)],(-20,0),(0,0),(10,0.5),(20,1)))
Units: Dmnl

(238) *"Requirement of Copy Protection, Industry" = WITH LOOKUP (*
"Perceived Piracy Problem, IPCD",
([(0,0)-(10,0.002)],(0,0),(10,0.001)))
Units: Dmnl

(239) "Requirement of Free Payment Contents Distribution, Industry"=
0.001
Units: Dmnl

(240) "Retirements, CPCD"=
*"Services in Use, CPCD" * (0.05 + "Effect of Willingness to Switch, CPCD"*
)
Units: Users/Year

(241) "Retirements, FPCD"=
*"Natural Obsolescence, FPCD" * "Services in Use, FPCD"*
Units: Users/Year

(242) "Retirements, IPCD"=
*"Services in Use, IPCD" * (0.05 + Effect of legal punishment + "Effect of Willingness to Switch, IPCD"*
)
Units: Users/Year

(243) "Retirements, MCEP"=
*"Services in Use, MCEP" * ("Natural Obsolescence, MCEP" + "Effect of Obsolescence, MCEP"*
)
Units: Users/Year
*"Services in Use, CPCD" * (0.05 + "Effect of Willingness to*
Switch, CPCD")

(244) "Retirements, SCEP"=
*"Services in Use, SCEP" * ("Natural Obsolescence, SCEP" + "Effect of Obsolescence, SCEP"*
)
Units: Users/Year
*"Services in Use, MCEP" * (0.05 + "Effect of Obsolescence, MCEP")*

(245) "Retirements, WMEP"=
*"Natural Obsolescense, WMEP" * "Services in Use, WMEP"*
Units: Users/Year

(246) "Revenue from Player, CPCD"=
*"Entrants, CPCD"*Average Units per User*"Price of Player, CPCD"*
Units: Dollars/Year

(247) Sales threshold=
1e+011
Units: Dollars

(248) "Sales, Luxury purchase, MCEP"=
*"Average payment per purchase, Luxury purchase, MCEP" * "Average purchases per user, Luxury purchase, MCEP"*
** "Services in Use, MCEP"*

Units: Dollars

(249) "Sales, Luxury purchase, SCEP"=
*"Average payment per purchase, Luxury purchase, SCEP" * "Average purchases per user, Luxury purchase, SCEP"*
** "Services in Use, SCEP"*
Units: Dollars

(250) "Sales, Luxury purchase, WMEP"=
*"Average payment per purchase, Luxury purchase, WMEP" * "Average purchases per user, Luxury purchase, WMEP"*
** "Services in Use, WMEP"*
Units: Dollars

(251) "Sales, Small purchase, WMEP"=
*"Average payment per purchase, Small purchase, WMEP" * "Average purchases per user, Small purchase, WMEP"*
** "Services in Use, WMEP"*
Units: Dollars

(252) SAVEPER =
TIME STEP
Units: Year [0,?]
The frequency with which output is stored.

(253) "Security Protection Performance Index, WMEP"=
10"Cumulative Development on Security Protection, WMEP"/"Trend of Security Protection, WMEP"*
Units: Dmnl
The level of maturity of technolgy against requirement. (0-10)

(254) "Services in Use, Contnts Distribution"=
"Services in Use, CPCD"+"Services in Use, IPCD" + "Services in Use, FPCD"
Units: Users

(255) "Services in Use, CPCD"= INTEG (
"Entrants, CPCD"-"Retirements, CPCD",
2e+006)
Units: Users

(256) "Services in Use, Electrical Payment"=
"Services in Use, MCEP" + "Services in Use, SCEP" + "Services in Use, WMEP"
Units: Users

(257) "Services in Use, FPCD"= INTEG (
"Entrants, FPCD"-"Retirements, FPCD",
0)
Units: Users

(258) "Services in Use, IPCD"= INTEG (
"Entrants, IPCD"-"Retirements, IPCD",

1)
Units: Users

(259) "Services in Use, MCEP"= INTEG (
"Entrants, MCEP" - "Retirements, MCEP",
1.8e+007)
Units: Users
Based on England Case

(260) "Services in Use, SCEP"= INTEG (
"Entrants, SCEP"-"Retirements, SCEP",
1)
Units: Users

(261) "Services in Use, WMEP"= INTEG (
"Entrants, WMEP"-"Retirements, WMEP",
1)
Units: Users

(262) "Technology Index Unit, MCEP"=
1e+009
Units: Dollars
Required Technology Development to form Unit Index

(263) "Technology Index Unit, SCEP"=
1e+009
Units: Dollars
Required Technology Development to form Unit Index

(264) "Technology Index Unit, WMEP"=
1e+009
Units: Dollars
Required Technology Development to form Unit Index

(265) "Technology Performance Index, MCEP"=
10"Cumulative Development on Technology, MCEP" / "Technology Index Unit, MCEP"*
Units: Dmnl
The level of maturity of technology against requirement 0 - 10 (maximum).

(266) "Technology Performance Index, SCEP"=
10"Cumulative Development on Technology, SCEP" / "Technology Index Unit, SCEP"*
Units: Dmnl
The level of maturity of technology against requirement 0 - 10 (maximum).

(267) "Technology Performance Index, WMEP"=
10 "Cumulative Development on Technology, WMEP" / "Technology Index Unit, WMEP"*

Units: Dmnl
The level of maturity of technology against requirement 0 - 40 (maximum).

(268) "Technology Trend Index, MCEP"=
10
Units: Dmnl
Required Technology Index to invest to satisfy customer requirement

(269) "Technology Trend Index, SCEP"=
20
Units: Dmnl
Required Technology Index to invest to satisfy customer requirement

(270) "Technology Trend Index, WMEP"=
30
Units: Dmnl
Required Technology Index to invest to satisfy customer requirement

(271) TIME STEP = 0.25
Units: Year [0,?]
The time step for the simulation.

(272) "Total Demand, Contents Distribution"=
"Growth Demand, Contents Distribution"+"Replacement Demand, Contents Distribution"
Units: Users/Year

(273) "Total Demand, Electrical Payment"=
"Growth Demand, Electrical Payment" + "Replacement Demand, Electrical Payment"
Units: Users/Year

(274) "Total Profit, CPCD"=
"Profits from Player, CPCD"+"Profit from Downloads, CPCD"
Units: Dollars/Year

(275) "Total Revenue, MCEP"=
"Commision Revenue, Luxury purchase, MCEP" + "Commision Revenue, Small purchase, MCEP"
Units: Dollars/Year

(276) "Total Revenue, SCEP"=
"Commission Revenue, Luxury purchase, SCEP" + "Commission Revenue, Small purchase, SCEP"
Units: Dollars/Year

(277) "Total Revenue, WMEP"=

"Commission Revenue, Luxury purchase, WMEP" + "Commission Revenue, Small purchase, WMEP"
Units: Dollars/Year

(278) "Total Sales, WMEP"=
("Sales, Luxury purchase, WMEP" + "Sales, Small purchase, WMEP")
Units: Dollars

(279) Trend of Copy Protection=
3e+009
Units: Dollars
The required investment to achieve sufficient level of performance.

(280) Trend of Piracy Scheme=
1e+009
Units: Dollars
Required investment to achieve satisfied level of Piracy Usability. I assumed the same level of sificulties as developmnt of usability.

(281) "Trend of Security Protection, WMEP"=
3e+009
Units: Dollars
The required investment to achieve sufficient level of performance.

(282) "Trend of Usability, CPCD"=
1e+009
Units: Dollars
Requirec Dollars to invest to satisfy customer requirement

(283) "Trend of Usability, FPCD"=
1e+009
Units: Dollars
Requirec Dollars to invest to satisfy customer requirement

(284) "Trend of Usability, IPCD"=
1e+009
Units: Dollars

(285) unit const=
1
Units: 1/Year

(286) Usability of CPCD=
"Usability Performance Index, CPCD"-0.1"Copy Protection Performance Index, CPCD"*
Units: Dmnl
Scaling -5 to 10

(287) *Usability of IPCD=*
"Usability Performance Index, IPCD"
Units: Dmnl
Scaling 0 to 10

(288) *"Usability Performance Index, CPCD"=*
10"Cumulative Development on Usability, CPCD" / "Trend of Usability, CPCD"*
Units: Dmnl
The level of maturity of technology against requirement 0 - 10 (maximum).

(289) *"Usability Performance Index, FPCD"=*
10"Cumulative Development on Usability, FPCD" / "Trend of Usability, FPCD"*
Units: Dmnl
The level of maturity of technology against requirement 0 - 10 (maximum).

(290) *"Usability Performance Index, IPCD"=*
*10 * "Cumulative Development on Usability, IPCD" / "Trend of Usability, IPCD"*
Units: Dmnl
The level of maturity of technology against requrement (0-10)

(291) *"User need for improved performance, SCEP" = WITH LOOKUP (*
"User Requirements, SCEP" - 0"Technology Performance Index, MCEP", ([(0,0)-(20,10)],(0,0),(16,10)))*
Units: Dmnl
(0-16) -> (0-10) Ignoring Technology Performance since already reflected in relative performance\!\!\!

(292) *"User need for improved performance, WMEP"=*
"User Requirements, WMEP" - 0"Technology Performance Index, WMEP"*
Units: Dmnl
(0-10); Ignoring Technology Performance since already reflected in relative performance

(293) *"User Requirements, SCEP"=*
*"Effect of Enabling Technologies, SCEP" * "Normal Growth, SCEP"*
Units: Dmnl
(0 - 16)

(294) *"User Requirements, WMEP"=*
"Normal Growth, WMEP""Effect of Enabling Technologies, WMEP"*
Units: Dmnl
(0-10)

(295) *"User Size, CPCD"=*
1e+007
Units: Users

(296) *"User Size, IPCD"=*
3e+007

Units: Users

(297) "User Size, MCEP"=
4e+007
Units: Users
Based on England Case

(298) "User Size, SCEP"=
4e+007
Units: Users

(299) "User Size, WMEP"=
4e+007
Units: Users

(300) "Willingness to switch based on performance,SCEP"=
0.5"Relative Performance, SCEP to MCEP" + 0.5*"User need for improved performance, SCEP"*
Units: Dmnl
(0-10)

(301) "Willingness to switch based on performance,WMEP"=
0.5"Relative Performance, WMEP to SCEP" + 0.5*"User need for improved performance, WMEP"*
Units: Dmnl

(302) Willingness to Switch Based on Value Price=
0.6"Relative Price, IPCD to CPCD"+0.2*"Relative Usability, IPCD to CPCD" +0.2*Relative Copiability of Contents*
Units: Dmnl
Scaling -10 to 10

(303) "Willingness to Switch Based on Value, FPCD"=
0.5"Relative Preparedness of Contents, FPCD" + 0.3*"Relative Legitimacy of Contents Download, FPCD"*
+ 0.2"Relative Usability, FPCD to IPCD" + coeff 2 * Relative Preparedness of Contents based on Frequent WMEP Usage*
Units: Dmnl
Scaling -10 to 10

(304) Willingness to Switch to FPCD = WITH LOOKUP (
*- 0.5 * "Effect of Perceived Risk on Willingness, FPCD"+"Willingness to Switch Based on Value, FPCD"*
,
([(-20,0)-(10,1)],(-20,0),(0,0),(10,1)))
Units: Dmnl
Scaling -20 to 10 -> Scaling 0 to 1\!\!\!

(305) Willingness to Switch to IPCD = WITH LOOKUP (
*- 0.5 * "Effect of Perceived Risk on Willingness, IPCD"+Willingness to Switch Based on Value Price*

,
([(-20,0)-(10,1)],(-20,0),(0,0),(10,1)))
Units: Dmnl
Scaling -20 to 10 -> Scaling 0 to 1\!\!\!

(306) Willingness to switch to SCEP = WITH LOOKUP (
*"Willingness to switch based on performance,SCEP" - 0.5 * "Effect of Perceived Risk on Willingness, SCEP"*
,
([(-10,0)-(10,1)],(-10,0),(0,0),(10,1)))
Units: Dmnl
(-10,10) -> (0,1)\!\!\!

(307) Willingness to switch to WMEP = WITH LOOKUP (
*"Willingness to switch based on performance,WMEP" - 0.5 * "Effect of Perceived Risk on Willingness, WMEP"*
*+ coeff 1*Willingness to Switch to WMEP based on FPCD favority,*
([(-10,0)-(10,1)],(-10,0),(0,0),(10,1)))
Units: Dmnl
(-10,10) -> (0,1); "Willingness to switch based on performance,SCEP" - "Effect of Perceived Risk on Willingness, SCEP"

(308) Willingness to Switch to WMEP based on FPCD favority = WITH LOOKUP (
"Fraction of Users, FPCD",
([(0,0)-(1,10)],(0,0),(0.0315789,1.4978),(0.0596491,3.12775),(0.0947368,4.88987),(0.150877,6.38767),(0.217544,7.79736),(0.315789,8.67841),(0.438596,9.2511),(0.554386,9.60352),(0.687719,9.77974),(0.814035,9.86784),(1,10)))
Units: Dmnl
Complementary Effect. The more free download usage, the more likely to use MCEP\!\!\!

(309) WMEP Fraction of Development on Copy Protection=
*Fraction of Development * "Total Revenue, WMEP"*
Units: Dollars/Year