Case Studies Illustrating Disruptive Technologies: The Impact of the MP3 Format and VoIP

Norma Harrison, Don Anderson, Edmund Chan and Rosa Mak
Macquarie Graduate School of Management
Macquarie University, Sydney, Australia
Norma.Harrison@mgsm.edu.au

Abstract

The focus of this paper is the effect of two disruptive technologies, MPEG-1 layer 3 (MP3) audio file format and Voice Over Internet Protocol (VoIP), on existing organisation structures, business strategies and operations of leading multinationals like Sony Corporation Ltd and Hong Kong-based telecom operator PCCW. After devising and applying a Disruptive Technology Management Framework, a review will be conducted of the projected impacts of disruptive technologies on the various levels of the organisations and their respective supply chains, the stakeholders affected, and how disruptive technologies may be regulated to ensure their control. The paper assesses the short and long-term effects of disruptive technologies on the telecommunications and consumer electronics industries, and the positioning of industry players.

1. Introduction

Organisations are increasingly finding themselves faced with the ongoing threat/opportunity of Disruptive Technologies (DT), defined as something that has the potential of displacing a major product or process without a costly price tag and without warning. If companies are unprepared or ill-equipped for the emergence of a disruptive technology – which may be a new form of technology, business model, production process, or delivery format – their competitive position and advantage will inevitably be undermined and eroded. This paper analyses two emerging technologies perceived as disruptive technologies (DT) – Voice over Internet Protocol (VoIP) and Mpeg-1 layer 3 (MP3) – and their effect on the telecommunications and music recording industries, respectively. It examines how the organisations are battling against the reality that "all advantage is now temporary". This phenomenon has been largely has been attributed to the introduction and growth of disruptive technologies.

The organisations examined, viz., the Sony Corporation and PCCW Ltd. of Hong Kong, are currently grappling with the challenges of disruptive technologies, and have invoked measures to either defend their existing product markets, adapt operational strategies to position themselves as market leaders of the disruptive technologies, or neither. Although Sony has traditionally been known as a leading innovator in the consumer electronics industry, its unwillingness to move swiftly and transform its business strategy and operations management plan in time to capitalise on the emergence of the MP3 format, has loosened its grip on the portable music market and reduced its industry dominance. Similarly, Hong Kong-based telecommunications provider PCCW Ltd. has attempted to subvert the growth of VoIP by tightening its stranglehold on the supply chain (broadband access) to the objection of competing suppliers (Hong Kong Broadband Network) and government regulators.

This paper analyses the impacts and implications of MP3 and VoIP on current supply chain relationships, the possible hybrid applications and implications for their respective industries, regulatory effects, security concerns, and how they are shaping organisations' ongoing commitment to R&D and innovation.

A "Disruptive Technology Management Framework" was devised to provide a structure for discussion of the internal and external obstacles and drivers that companies must consider. A corporation's ability to innovate and thus move toward the development and acceptance of disruptive technologies is typically driven by a combination of internal factors such as quality control challenges, restructuring and, often, dramatic declines in profit. Externally, corporations face continuing shifts in the marketplace, changing customer demands and the constant threat of competitor activities.

2. Disruptive Technologies explained

According to Christensen, DT is something that displaces a major product or process without a costly price tag and without warning [1]. Disruptive technologies emerge as a result of small, non-mainstream companies attacking a product or industry market segment where stronger competitors – typically multinationals – cannot or will not initially target. Companies challenged by disruptive technologies are ones that fail to acknowledge the opportunity and potential of these technologies, instead preferring to address the current wants of their customer base. A further weakness of established companies is viewing disruptive technologies as financially unattractive and incapable of providing "meaningful contribution to corporate growth."[8] As a result, these organisations will allocate investment to sustaining technologies which its current customers already value, while continuing to provide managerial and financial incentives based on proven technologies and products with market acceptance.

The disruptive company will naturally aim to improve its margin (from low commodity level) and therefore innovate to capture the next level of customer requirements. The incumbent will not want to engage in a price war with a simpler product with lower production costs and will move up-market and focus on its more attractive customers. After a number of iterations, the incumbent will have been squeezed into successively smaller markets and when the disruptive technology finally meets the demands of its last segment, the incumbent technology disappears.

2.1 Examples of Disruptive Technologies

Whilst Christensen has proposed that disruptive technologies are typically of lower performance and cost, this is not always the case. There are several examples where the disruptive technology has outperformed the existing technology but has not been adopted by major firms in the market, especially in industries with a high capitalization sunk into the older technology.

Table 1. Disruptive and displaced technologies

Disruptive Technology	Displaced Technology
Digital Photography	Silver halide photographic film
Personal video recorders	Video Home System
Mass-market cellular telephony	Fixed-line telephony
Container Ships and Containerization	"Break cargo" ships
Flash Drives	Floppy disk drivers

Similarly, not all technologies promoted as disruptive technologies have actually prospered as well as their proponents had hoped. The delay of their development may stem from the time required to convince people to abandon traditional behaviours/habits and adopt the new technology, or legal or economic constraints. However, some of these technologies have only been around for a few years, and their fate is still undetermined, e.g., online shopping [13].

Finally, a disruptive technology may not necessarily be a new product or service supported by advanced technology. It could be a new business model, new production process, or a new delivery format. For example, Dell Computer, whose introduction in the 1980s of direct computer sales via telephone, fax and, later, the Internet, may be considered a disruptive business model that has forced the computer industry to move from mass production to mass customization.

2.2 DT and 'Clockspeed'

Adding to the disruptive technology debate is the theory that all competitive advantage is temporary (ie. 'clockspeed'). According to Fine, in the vertical industry structure with integral products, companies attain profitability by maximum control of their supply chain [31]. New entrants to the supply chain will replace those who resist the new technological innovations and their associated new business models. Companies' failure to harness the "radical breakthrough nature of innovations" stems largely from the associated management challenges. This may explain the Sony Corporation's diminished status as innovator; it has struggled with internal management challenges since adding new elements to its supply chain in the 1980s, Columbia Pictures and CBS Records. Only recently has it replaced traditional business practices (eg. lifetime employment) with organizational structures to spur breakthrough improvements.

3. Constructing the Disruptive Technology Management Framework

The Disruptive Technology Management Framework has been constructed by adapting two other frameworks, as follows:

- *Processual approach to change* – the external drivers (ie. competitive activities, marketplace changes, customer demands, etc.) and internal drivers (ie. profit decline, operational efficiencies, quality problems, restructuring, etc.) that lead an organisation toward innovation [40]
- *Management of adoption and implementation of technology* – internal processes, structural strategies (ie. new product/service development, facilities, technology, workforce and organisation strategy) and infrastructural strategies (ie. supplier development strategy, planning and control, capacity adjustment strategies) [17]

The framework suggests that organisations will require a combination of variables leading to the development of disruptive technologies. A corporation's ability to innovate and thus gravitate toward the development and acceptance of disruptive technologies is typically driven by a combination of internal factors such as quality control challenges, restructuring and, moreover, shrinking margins and dramatic declines in profit. Externally, corporations face continuing shifts in the marketplace, changing customer demands and the constant threat of competitor activities. Sony's positioning shifted in the 1990s and early 21st Century from a company that valued innovation and set the tone of the consumer electronics market and consumer demand, to a company resting on its laurels (eg. Walkman, Triniton) and constantly playing catch-up with the competitive environment (eg. Playstation, MP3 players, plasma screens).
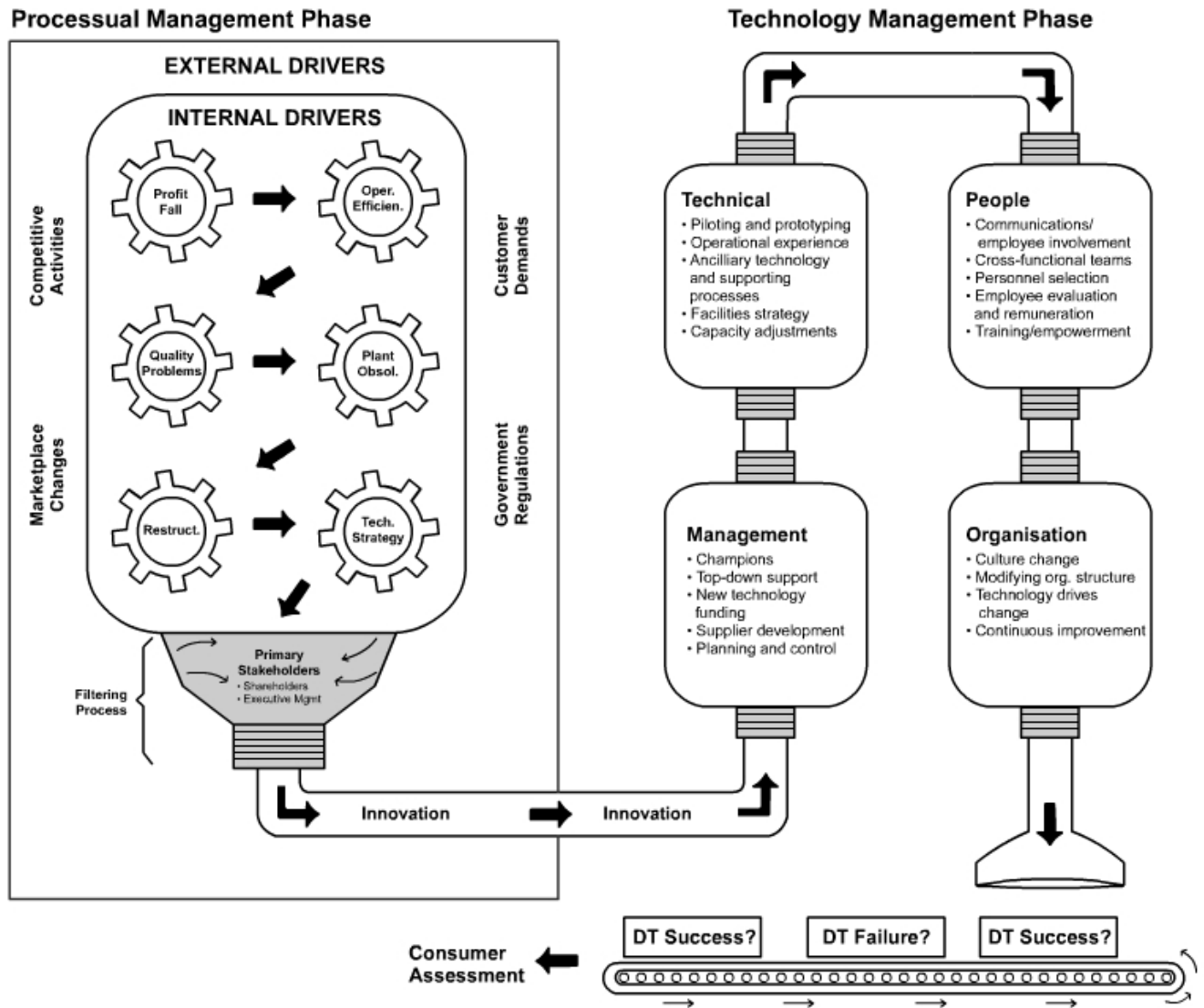
Figure 1. Disruptive Technology Management Framework
Source: Adapted from Sheather et al [40] and Harrison et al [17]

Likewise, Microsoft Corporation is facing the spreading threat of open-source code (Linux), government regulations and growing convergence of technologies and mediums. In similar ways, the organisation has rested on its past successes (eg. Microsoft Windows) and its global domination of the desktop PC interface is being eroded, particularly in emerging markets such as China, whose Central Government has developed its own version of Linux and Office using open-source code. This has required Microsoft to shift its pricing strategies in the emerging markets, reveal the Windows source code, and explore new businesses and markets (eg. game consoles, consumer-electronics). Previously, without a major threat to its dominant operating system, the company was able to release less-than-perfect, virus-prone software, with the Windows OS providing a profit margin of 85 per cent [29]. Today, with concern mounting over competition and

security, Microsoft software development teams are agonising over its next OS release, Longhorn. It has made it clear that its follow-up OS must be "perceived as offering significant new functionality or value to prospective purchasers", otherwise its "revenues and operating margins could be adversely affected" [30]. Thus, internal and external drivers have forced its transformation, leading to increased reliance on innovation to capture new markets. However, despite ongoing commitment to innovation, the company has yet to capture or create new markets, preferring to enter existing markets and push its existing OS technologies onto every available communications device and application. Meanwhile, rival Apple Corporation is increasing its grip on the portable music player industry and defining what customers will want [20].

As illustrated by the DT Management Framework, once the primary stakeholders react to internal and external drivers and accept that innovation is a necessary component for their survival, how innovation is carried out by a company and its ability to produce disruptive technologies will depend on four core structural and infrastructural strategies: technical design and management; management alignment; people; and organisation structure.

4. Case study 1: The rise of the MP3 format

4.1 Situation analysis

The introduction of the MP3 format, first patented in 1986, has dramatically transformed the music industry and associated business models. In the US, illegal filesharing has been blamed for roughly US$5 billion in lost revenues for the recording industry since 1999 [12].

As the MP3 format has developed and gained consumer acceptance, it has introduced a number of different new challenges and opportunities for the industry. Statistically, music sales in the U.S. dropped by 11 per cent in the first half year of 2002; at the same time, sales of blank CDs increased 40 per cent. More importantly, the number of users of Kazaa, the biggest online file-trading service provider, has since tripled [28]. Reeling from the effects of the MP3 filesharing wave, recording companies initially sought to protect their content from copyright infringement by launching lawsuits against illegal websites and individual downloaders. The Recording Industry Association of America (RIAA), an official body established by the major recording labels to promote the awareness of "legal online music services" and "legitimate peer-to-peer distribution systems" [37], sued 754 "individual file-sharers" for copyright infringement in 2004 [38].

Wholesalers and retailers have also been seriously affected. According to the 2003 Consumer Profile issued by RIAA in 2003, the percentage of CDs retail sales fell from 42.5 per cent to 33.2 per cent between 2000 and 2003. As a result, retailers have moved into online distribution, spawning partnerships and alliances with technology firms. In 2004, music retailer HMV announced that it would launch a new digital music downloading service with Microsoft in 2005. The group expected to invest around £10 million to launch the new service that enables "HMV digital music customers to find, buy, enjoy and manage their music online all in one place" [18].

The MP3 format has affected the way distributors, music player manufacturers, customers, government and other stakeholders interact, while posing both threats and opportunities for incumbent firms such as Sony, Warner Brothers Music and others.

4.2 The evolution of the MP3 format and its disruptive effect

Traditionally, consumers tended to seek out record stores for their favourite albums. Over time, as mail ordering and Internet became available, consumers have been able to bypass the retail, 'bricks and mortar middle man'. With the Internet, consumers have been able to share or download the music from the Internet – often illegally. The Internet, which is perceived as having provoked the spread of the MP3 format, has provided consumers a convenient and often 'free' mode of obtaining music, therein directly impacting music and recording industries, suppliers, distributors, broadcasters, and others.

4.2.1 Channels of distribution

Traditionally, record companies will sign musicians, assist them in recording their songs and produce the CD album or cassette tape for volume distribution through its wholesalers and retailers. The explosive growth on the Internet access and the demand of MP3 format player (e.g., Apple iPod) has since altered the traditional distribution channel. The direct sales channel is gradually being exploited, with music distributed through the Internet in individual song format or by album ("in bulk") as digital files that can be transferred, between devices, thereby requiring little need for the retail middleman.

Music distribution is direct and low cost, and built on consumer preferences. MP3 websites provide trials to customers before purchase, therein reducing distributor strength and the competitive strength of retailers such as HMV and Virgin Music Store. It has forced these traditional outlets to adapt to the competitive landscape and customer demand. They have had to launch similar and competing e-commerce sites, which has led to increased costs to account for managing and marketing this new channel, and administering partnerships with technology firms.

4.2.2 Consumers

Growth of the MP3 and the resulting effect on distribution channels has created a 'purchase revolution' and provide the consumer more power. Previously, the consumer relied mostly on traditional retail outlets for access to music. The introduction of sites such as Artist Direct (www.artistdirect.com), Napster (www.napster. com), MP3.com and iTunes has redefined the music purchase process, allowing customers easy access to their favourite music.

In addition to altering the buying behaviour of customers, the MP3 increases product variety. Today, consumers have literally hundreds of thousands of music files to choose from via online distribution channels. The emphasis today is less on a full album of songs by one

recording artist; iTunes has transformed the pricing and packaging model by offering individual song downloads, while Napster has introduced a competing subscription model allowing consumers to pay a flat monthly fee for unlimited downloads [32].

Outside the online distribution channel, the MP3 format has allowed consumers to convert their library of CDs into digital format that can be exchanged among friends across varying portable music players, thereby creating another product industry. To protect digital content, music companies and portable music player producers have responded by investing in technologies to prevent "swapping", creating another industry, Digital Rights Management (DRM).

4.2.3 Suppliers: recording artists

The introduction of the MP3 has created opportunities for independent and established artists, allowing them to develop own website distribution channels, maintain control and ownership of the intellectual property. This has transformed their relationship with the consumer and record companies.

Traditional music producers will sign a recording contract with an artist to market their songs in exchange for a large percentage of the artist's music sales and/or performance grosses. But record companies have limited resources and budgets, and only a select few artists may see their music pressed to CD. With the broad coverage of the Internet, artists have found a way to act as their own music distributors and labels. Artists like Phish, Prince, David Bowie, REM and the Beastie Boys "are trying to use the Internet to deal directly with their fans and bypass the middleman." [28] As demonstrated in the late 1990s, "unsigned artists could set up their own Web sites and market and sell their music directly to the music consumer eliminating their need for record contracts or music retailers."[3]

4.2.4 Partners: media and broadcasters

The media and broadcaster industries have also felt the pressure from the MP3 and Internet wave. Independent Internet broadcasters such as Live365.com have diverted attention away from traditional broadcast outlets (radio, cable, satellite). The popularity of Apple's iPod portable MP3 music player has created a new industry of "podcasters" – another form of independent broadcaster.

For traditional broadcasts, the MP3 has changed the standards of product design, packaging, delivery and storage/inventory, wherein record companies can now email their new songs in digital format. As a result, both parties stand to benefit with record companies saving on the cost of producing and delivering CDs, while broadcasters save on storage and create production efficiencies through simplified song searches via internal or external databases.

However, the transaction costs of moving to this medium have required ongoing investment in related technologies and equipment, including new broadcast systems that support the MP3 format, secure computer networks, and staff training.

4.2.5 Suppliers: manufacturers

CD manufacturers have been directly affected by the advent of the MP3. CD album sales fell 11 per cent in the first six months of 2002 in the US, leading to production cuts. For survival, manufacturers may need to rely on other sources of business, such as blank CD or DVD sales.

4.2.6 Music player manufacturers

In the 1980s, the Sony Walkman was the dominant portable music-playing device, later to be followed by the Discman player in the 1990s. In recent years, as the industry succumbed to the growing popularity of the MP3 format, compatible portable and home devices have begun to displace these earlier technologies and created industry leaders out of Apple Computer, previously known more for its niche-oriented, high-end laptop and desktop computers. Caught in the MP3 disruption, former portable music industry leaders Sony have been a reluctant, late-to-market follower. Other consumer electronics manufacturers are following suit, establishing internal divisional and external supplier partnerships. Samsung, which has challenged Sony's market position in the consumer electronics industry, has produced a mobile phone with a built-in MP3 player [34].

4.2.7 Government and associations

With the inception of MP3, music can be saved, transferred, and shared between computers regardless of time and location. This has accelerated the popularity of illegal download and filesharing, and resulted in alliances forming among the major recording labels. The first involved MP3.com, which allowed users to instantly access digital versions of CDs in January 2000 was eventually sued by the RIAA.

4.2.8 Competitors

In view of protecting the privacy and copyright of music, the Big Five recording companies – BMG Entertainment, Sony Music, Warner Music Group, EMI Recorded Music, and Universal Music Group – have developed a secure system for disseminating music over the Internet called Secure Digital Music Initiative (SDMI) [23]. While it may be assumed that security technology will improve over time as the technology matures, the music and consumer electronics industries are facing internal disagreements over format controls. Many other companies have produced competing playback compression technologies and anti-piracy software

options to determine which songs are allowed to be played on certain devices. Apple Computer, RealNetworks and Sony each have developed proprietary playback and Digital Rights Management technologies to stop pirates, creating an "alphabet soup of technologies" that may actually baffle consumers and ultimately cause more business failures [36].

4.3 Analysis: Sony Corporation and Disruptive Technologies

Sony has typically used a "latecomer" approach as its business strategy and, in many cases, has successfully garnered market share in a number of product categories, notably televisions (Sony Trinitron), game consoles (Sony PlayStation) and computers (VAIO). At various times in its history, it has demonstrated strength as inventor (miniaturization of radios) and innovator (commercialization of the tape recorder).

In the past, the organisation has experimented with new devices, certain that it will be able to "stretch the imagination of consumers, demanding that they think beyond what they know."[27] This concentrated focus on innovation carries with it considerable risk of failure, as experienced with its investment in the Airboard tablet, which was initially popular in PC-phobic Japan among older users [47] but failed to capture consumer interest elsewhere. In other instances, it has propelled the organisation to great heights, as witnessed by the introduction of the PlayStation in 1994 by the Sony Computer Entertainment division, at a time when the market was dominated by console-makers Nintendo and Sega. By leveraging its competence of reinventing and refining, and creating supportive internal networks for its "maverick" engineers – Ken Kutaragi, in the case of PlayStation – Sony redefined the game console industry. It was able to leverage the company's strong financial resources, enabling it to market the PlayStation widely and create supplier agreements with hundreds of developers to license games for the console [4]. Having learned from the failed Betamax project, Sony reviewed the weaknesses of its competitors, and created relationships with their most prized game developers and suppliers. It also chose direct distribution with independent retailers which gave them a "network of informers" [27] that could keep them apprised of new game title launches and pricing strategies of competitors, thereby allowing Sony to undercut them if necessary.

4.3.1 Sony and the 'MP3 Effect'

While Sony managed to establish itself in the game console market, and create a revenue stream that, at one time, accounted for more than 40 per cent of the company's operating profits [5], it has been unable to match the success of Apple Corporation's MP3-based iPod/iTunes products. Apple's iPod commands 65 percent of the portable player market, and its online iTunes Music Store 70 percent of online music sales [21]. Despite

recent MP3 player product launches and integration of Microsoft-licensed MP3 technologies into its handhelds and Sony-Ericsson mobile phones, Sony has lost its grip on the portable music market. How and why did this occur? The answer may be found within the internal framework and legacy of the Sony Music Entertainment division.

4.3.2 People and management

Between 1999 and 2003, the Sony Music Entertainment division experienced a decline in market share of roughly 2 per cent and operating loss in 2002 (Figure 2: Sony – Music Segment Performance [44]). Based on the belief that part of an organisation's transformation is product of its people – one of the "5Ps" of operations management – much of Sony Music's downfall has been attributed to the "overly independent" [27, p.66] management style of former chief executive Tommy Mottola. During his 14 years as CEO, Mottola may have obstructed Sony's innovation processes by refusing to involve top Sony executives in discussions on division operations, failing to cut costs to address declining CD sales, online piracy or improve relations with recording acts, the latter a critical component in the division's supply chain.
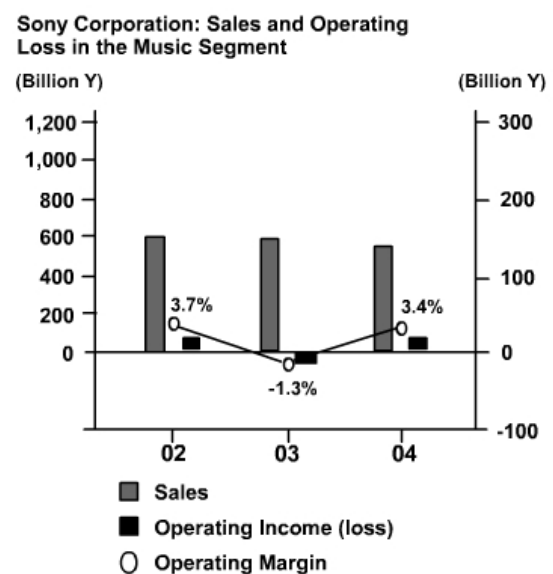

Figure 2: Sony – Music Segment Performance
Source: Sony Corporation [44]

4.3.3 Strategic agility

Its inability to capitalise on the rise of the MP3 format, and develop a consumer electronics platform that would rival the success of the Walkman, may also stem from the company's inflexibility and unwillingness to quickly adjust its strategy and product range. By not encouraging

enough collaboration and knowledge sharing across divisions [27, p.93], the company has missed capturing the success that Apple has experienced with the iPod and iTunes. While the company continues to generate revenue from its various divisions, its competitive edge and profit margins in stand-alone products have fallen.

4.3.4 Network strategy

Sony is also facing stiff competition across every division, and having to interest consumers who are less loyal and able to access many different channels to make their purchases. In an effort to replicate the success of Apple and better target its customers, Sony opted to go "downstream" in 2004 and secure more of the supply chain. It opened additional retail outlets in the ten leading metropolitan markets in the United States in 2004 [41] and expanded the VAIO brand to include non-PC devices, such as MP3 players. It has extended its distribution streams, launching an online music store ("Connect") that operates as a wholly owned subsidiary and combines content from all the major labels [42].

4.3.5 Internal value chain

Much of Sony's decline has been attributed to its diverse product range and the resulting ongoing internal battles fueled by its investments in a major music label, computer manufacturer and consumer-electronics business. According to Fader, the extreme autonomy of its business units has contributed to the internal company conflict. The company offerings are likened to a "North American/Japan split that corresponds to the content and hardware pieces of their business." [42]

Sony Chairman Nobuyukio Idei labels the internal collaboration between Sony divisions as "creating a value chain" [27, p.139], but it does not appear that collaboration exists. And if there is collaboration, not a lot of it has been positive, the digital Walkman device being the most recent example. Where the iPod allows users to synchronise the contents of their music collection on their computers, the Walkman requires monotonous "check-in/check-out" procedures designed to prevent piracy. This suggests an internal conflict between the electronics and entertainment divisions: the electronics division needs to let customers move files with ease, while its entertainment division is seeking to protect its content, and has built in restraints for Sony products [39].

4.3.6 Organisational restructuring 1995-2003

Sony has made a number of organisation changes since the introduction of the MP3 music format. One of the strategic aims of Sony is to exploit the synergy between the audio-video equipment business and the entertainment business of entertainment business and audio-video software. To date, this effort would appear hampered by cultural divides between the strategic business units.
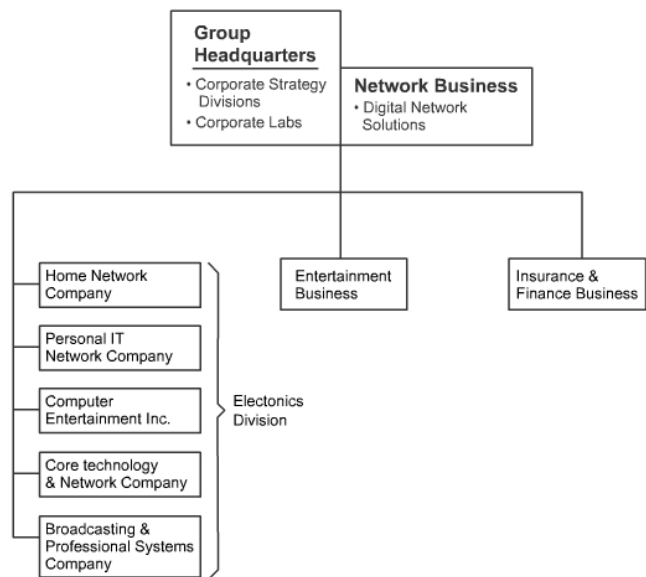
Sony Group Structure 1999

Figure 3: Sony Group Structure Circa 1999

In the early 90s, its CBS Records and Columbia Pictures acquisitions led to the initial transformation from a division structure to a company system, with Sony Music Entertainment remaining outside the sphere [43, p.12]. In 1995, Nobuyuki Idei was appointed president and soon introduced "The Age of Networks" strategy, which identified three major components of Sony's value chain: Electronics (core business), Content (music, movies, computer games) and Network Services (broadcasting, network distribution, Internet, ecommerce). Idei took a more hands-on approach for American operations, and sought to create a balance between corporate intervention and business-unit autonomy, while encouraging the sharing of tangible resources among units [27, p.160].

4.3.7 Group structure 1999

In 1999, the company established four main gateways for hardware – TV combined with contents, Games, also combined with contents, PCs, and Mobile phones. It also integrated its manufacturing, mainly into one entity – Engineering Manufacturing Customer Services (EMCS) – and created wholly owned subsidiaries: Sony Music Entertainment (Japan) Inc., Sony Chemical Corporation, and Sony Precision Technology, Inc.

There were three objectives of the restructuring as follows [43, p.14]:

- Strengthen the electronics business;
- Privatize three Sony Group subsidiaries;
- Strengthen Group management capability.

The Sony Corporation division companies were

grouped into three main business units with computer entertainment positioned as the fourth pillar of electronics business: Home Network Company; Personal IT Company; Core Technology and Network Company; and Sony Computer Entertainment, Inc.

Essential support functions and R&D laboratories were transferred from the corporate headquarters to each business unit A board and management committee within each network company was established and given the authority to allow the units to "operate independently, while enjoying benefits of the current company system." [45] It also planned to reduce the number of manufacturing facilities worldwide from 70 to 55 facilities by early 2003, and reduce its workforce by 10 per cent.

4.3.8 Group structure 2001

In 2001, Sony set out to reform headquarters, and create "global hubs" for activities including finance, while integrating R&D, sales, and manufacturing. It announced its repositioning as a Personal Broadband Network Solutions Company, as a preparation for the "coming broadband network society that is forecast to arrive around the year 2005."[46]

Its five pillars of global business – electronics, entertainment, games, internet/communication services and financial services – were also to undergo major realignment.

4.3.9 Group structure 2003

Following a major downturn in profitability, the company announced "Transformation 60" in October 2003, which set out an agenda for downsizing and restructuring resulting in significant reductions in labour. Other reasons given for restructuring were lateness in addressing problems such as overstaffing, outdating manufacturing system and neglect of important inputs such as semiconductors and flat-panel displays [43, p.17]. Sony's abrupt shift supports the Processual Management Phase of the DT Management Framework theory, which suggests companies are most likely to restructure in times of crisis (ie. profit decline).

The major objectives of the reforms were as follows:
- Clarifying operational structure and concentrating technology and resources for growth;
- Fundamentally reforming operational profit structure.

The home electronics and mobile electronics sectors, and the semiconductor technology sector that supports them were designated as core sectors. It made reducing fixed costs a priority by concentrating on strategic business and reform of the manufacturing and procurement sectors, producing a significant reduction of its labour force.
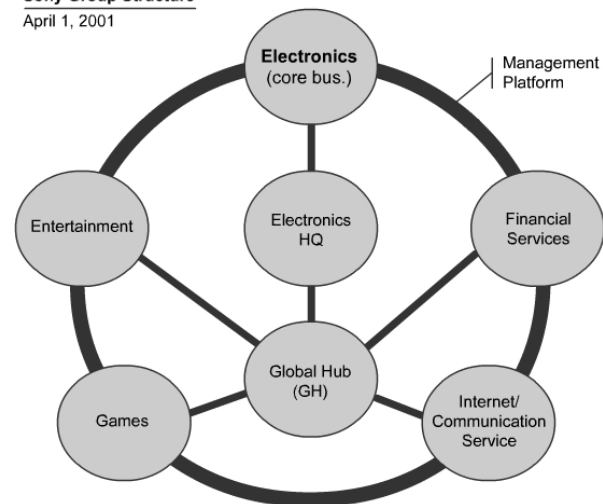

Figure 4: Sony Group Structure, April 1, 2001

4.3.10 Location of operations

Sony has developed a convergence strategy for its electronics and entertainment businesses, and its home and mobile electronics sector. Acknowledging the critical positioning of engineering and production technology in maintaining product competitiveness, the company has reorganized its global operations to include distribution functions to achieve advanced supply-chain management. A number of Sony factories designated Customer Frontier Centres (CFCs). The engineering and production system was reorganized to meet specific needs in various regions, and manufacturing links between Japan, China and other parts of Asia reinforced. Sony units in Europe and Americas were given the responsibility of mass-producing single-category product to meet demand in local markets, in addition to CFC functions and a strengthening of regional systems for production and sales. Sony-Europe would integrate the consumer AV marketing groups in a new location in the UK, while electronics headquarters and marketing functions in the US were to be re-allocated mainly to the West Coast, bringing this area of operations closer to the home country.

The reforms sought to strengthen Sony's management of group procurement and make outsourcing functions more integrated [43, p.18]. Greater emphasis was placed on standardization of components and all suppliers of components and raw materials assessed reduced from 4,700 to roughly 1,000.

The implementation of these reforms sent a strong signal to the corporate community that Sony culture was slow to accept changes and would not respond until met with financial crisis. "In technology, Sony has been attached to a development concept which is based in tacit

knowledge and continuous development. However, the technology landscape is now characterized by non-tacit knowledge and non-continuous development for which Sony was not fully prepared." [43, p.19]

4.4 Internal influences towards the company

The MP3 format has transformed the recording industry, and recording companies have reacted and modified their strategies accordingly to tap new business opportunities. From this case study, a number of internal organisational functions may be considered:

4.4.1 Human Resources

To coincide with the move from CDs to electronic music, entire production designs of companies must be modified. Training and recruitment of employees should be well-planned and executed to develop individuals with the requisite skills and experience. In the early stages of MP3's growth, Sony hired experienced engineers and marketers from its competitors to tap potential markets and support continuous improvement [27, p.65]. Managing turnover as a result of production redesign and business strategy modifications will present additional issues for the Human Resources Management team.

4.4.2 IT

Record companies have adjusted their value chains and business models by establishing Internet distribution channels with music offered on a per-track or subscription basis, and in-store CD burning [28]. Additional capital investments have been required for equipment and personnel. Issues of security and prevention of peer-to-peer transfer have also become more important, leading to investment in copyright protection technologies and joint-funding of associations such as the RIAA.

4.4.3 Finance

Investment in personnel and IT has created additional financial stress for companies, requiring careful planning and management. With MP3 still in its early phase of its lifecycle, further investment for improvement of the technology may be necessary. Top-down support from executive management support will be necessary to promote the technology's development and application across other product markets.

5. Case Study 2: VoIP and the Telecommunications industry

5.1 Situational analysis

VoIP, or Voice over Internet Protocol, involves sending voice information in digital form in discrete packets over IP-based data networks rather than in the traditional circuit-committed protocols of the public switched telephone network. This technique of packet switching can provide a number of benefits when contrasted with the currently established circuit-switching network. Data transmission is more efficient as multiple parties are able to share the digital lines. VoIP transforms networks, making them more flexible, because the lines have multiple uses – allowing users to adjust bandwidth and add new voice lines as needed, without the additional costs typically associated with traditional fixed-line connections. Companies with multiple office sites are expected to benefit the most from VoIP by saving on long-distance and connection charges. Furthermore, with VoIP calls can be sent to several phones at once, sequentially or simultaneously – meaning, calls can be answered wherever is most convenient [7].

However, VoIP presents concerns about security, reliability, additional costs and a number of voice quality factors including latency, jitter and packet loss [11]. In 2004 VoIP was put into distribution in Hong Kong, and is expected to enter the growth phase in 2005 [6]. Various broadband service providers have begun to provide VoIP services, including i-Cable[1], Hong Kong Broadband and Hutchison Global Crossing. Pressure will increase on fixed-line operators over the next five years with VoIP providing 39 per cent growth in related services.

In September 2004, The Office of the Telecommunications Authority, OFTA stated that it would not interfere with the development of the VoIP market and that it should be driven by the consumers. It will only impose a minimum set of requirements to safeguard public interests.

The technology, perceived to be in the introductory phase of its lifecycle, has already sent shockwaves throughout the Hong Kong telecom industry. According to Standard & Poor, the surge in competition in the Hong Kong telecom industry in the past few years is expected to continue [24]. This competitive challenge arose out of industry deregulations and new technologies. There have also been influences from Mainland China in this industry. For example, mobile operator Sunday Communications and Huawei Technologies, a network hardware manufacturer, formed a partnership which revived Sunday's position. There are predictions that PCCW will sell its fixed-line business to China Network Communications Group.

With most of the US and many Asia nations hotwired with broadband, the quality and reliability of VoIP calls has improved, and new VoIP-related products have been released, such as adapters that allow customers to use phones rather than computers to make VoIP calls. In South Korea and Japan, where more than two-thirds of the population have broadband access, VoIP is spreading rapidly. In Japan, 10 percent of households use Internet

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[1] i-cable's sister company Wharf T&T is a fixed line operator.

telephony, and this growth has directly affected the revenues of telco NTT, which has responded by starting its own Web-calling service. It has since announced a plan to migrate 30 million customers to high-speed Internet-based networks by 2010 [16].

5.2 VoIP: Effect on industry – stakeholder analysis

Applying VoIP against the DT Management Framework, an assessment of the internal external drivers critical to an organisation suggests that stakeholders' perspectives of the technology will vary. The key supporters of VoIP are perceived to be the Media, Distributors, Competitors and New Service Providers. Key drivers of VoIP are investors, customers, existing telecom providers and new entrants to this industry.

In 2004, the number of broadband subscriptions in China increased 50 per cent [9]. It is assumed that the number of prospective customers for VoIP will also increase. Driving this increase will be the reduced cost of long distance calls via VoIP versus conventional circuit telephony. There is also strong support from network equipment distributors, who provide the foundation of VoIP.

Product suppliers are a key driver for VoIP because this technology is not patented and many different suppliers can build solutions that they can sell to new service providers and/or existing telecommunication companies. There are many different suppliers that provide VoIP solutions for different segments of the telecommunications industry. For example, Global PSTN, which installed its VoIP solution in China, USA, Philippines, Canada, and Taiwan, provides a retail VoIP product for individual customers. Excel provides a B2B solution with its VoIP enabled voice switch [14] allowing for carrier-to-carrier wholesale long distance call traffic through a IP network instead of convention copper wire lines.

Existing telecommunication providers and/or new service entrants are also key drivers for VoIP. New entrants are pushing this technology to obtain market share from the fixed line telephony market. For example, PCCW has extensive fixed line network coverage. This provides a largely untouchable customer base. For competitors to tap into the market they would need to make significant investment in fixed-line networks. With VoIP, new entrants like Hong Kong Broadband Limited can "piggyback" on PCCW's broadband network to provide a fixed line service using its rival's data network.

5.3 VoIP and the supply chain relationship

Considering Phase II (Technology Management) of the DT Management Framework, it is clear that the introduction of VoIP has altered the telecom industry's supply chains. The areas affected include agreements with international carriers, traditional phone handset suppliers, switching equipment manufacturers, phone line installation technicians and customer service representatives.

Agreements with international carriers have changed as the number of telephony circuits required for voice transmission has declined. With VoIP, voice is broken down into data packets that can share a single copper line as opposed to traditional methods which require the same number of available lines per call. The type of switching equipment required in VoIP is also different to traditional telephony, leading to probable supplier replacement. Long term service maintenance agreements will cease for the traditional equipment providers once they have been totally phased out.

The same applies for manufacturers of traditional telephony handsets. VoIP will provide more features in one handset so new manufacturers will be required for production of these units. The commissioning of a telephone previously required a technician to perform the on-site installation. The VoIP telephone, which runs on broadband, does not require additional external technicians for new line installation as, in most cases, this can be facilitated by the customer.

Finally, customer service, regarded as a crucial part of the customer's supply chain, will require modification. Customer service representatives (CSR) will be required to adapt to new ways of addressing issues with telephones as a result of bundled product packages that VoIP offers. The number of CSR departments may also be reduced as separate products are phased out, thus providing improved customer service experience for the customer because all activities may be conducted under the one department.

5.4 VoIP hybrid applications and industry implications

Like many disruptive technologies, VoIP stands to redefine the telecommunications industry through the development of various hybrid applications. It has been predicted that a mass movement of corporations adopting VoIP will occur, followed by a similar movement by consumers. According to a study by the New Millennium Research Council, the Net will carry 40 per cent of calls made in the U.S [22]. This may spawn a wave of competition among consumer electronics and technology firms such as Sony, Samsung, Microsoft and Apple to get into the VoIP product/accessories marketplace.

- *Industry Consolidation*: VoIP uptake may lead to the possible merger and acquisition of telephone companies by prominent computer software, consumer electronics or mobility product providers such as Microsoft, Sony and Nokia [22]. The

technology also allows cable companies and Internet service providers to get into the telephone business, and promotes the convergence of cable television, high-speed Internet and telephone under one provider (eg. Time Warner Cable and Cablevision Systems in the US). This concept has been dubbed "the converged network." [19]

- *Product/Service offerings*: Experts expect companies to bundle different media, devices and technology platforms, while new alliances between retailers and telcos will emerge.

- *Diversification:* Telephone companies may enter other data services, including video on demand or streaming audio. It is predicted that smaller firms such as Skype and the US-based Vonage will likely either fold or be taken over by incumbent firms.

- *Price wars:* Hong Kong Broadband Network (HKBN) is offering a HK$38 a month VoIP package. Others, such as Skype, provide the software for free and rely on users' bandwidth to build an ad hoc peer-to-peer phone network.

- *Vertical integration and distribution:* Vonage and VoIP-offering cable companies are using retail electronics stores in the US, while DSL provider Siemens is setting up kiosks in retail stores, creating three-way partnerships with carriers and electronics chains [33].

5.5   Effect on the incumbent, PCCW

As maintained by Christensen, PCCW's response to VoIP would seem predictable of an incumbent firm unprepared for and threatened by a disruptive technology. In 2004 the company was accused of blocking rival VoIP providers HKBN and Hutchison Global Communications (HGC), which access PCCW's broadband network. It also delivered a warning letter to customers stating that installing rival VoIP broadband phone service "may lead to disconnection of customers' PCCW broadband service."[25]

VoIP is expected to continue to be a major point of competitive confrontation between local operators. PCCW has seen its dominant market share of fixed-line telephone services steadily eroded by competition. Between January and August 2004, the company lost 117,000 fixed-lines and saw its market share fall 12 points since the end of 2002 [26]. Subsequently, PCCW has repositioned itself as a "triple play" communications service and product provider, offering a package of Internet, pay-TV and VoIP for less than it charges for conventional voice service alone. PCCW has admitted that profit margins for traditional voice service is declining, leaving it no choice but to respond to the VoIP threat [26].

5.5.1   VoIP adoption

It is perceived that the benefits of adopting VoIP are two-fold: value-added services enabled by VoIP (e.g., videoconferencing) will make it more attractive for potential customers to use PCCW's services or sustain its current customer base, and customers will be able to make use of their existing residential broadband subscription services to make or receive phone calls.

Such value-added services may also have a positive impact on other peripheral industries (eg. now.com entertainment, interactive TV), increasing uptake, development and additional revenue streams. VoIP could increase PCCW's operational and management efficiencies and reduce their total cost of investment since voice is carried like IP traffic allowing existing equipment to be maintained. PCCW currently offers many different applications including voice mail, fax with email, video conferencing, SMS and other services. A VoIP handset has the potential of combining these separate features into one marketable package. Moreover, PCCW has the potential of capturing revenue from competitors which do not have the traditional infrastructure and network coverage capacity for deploying quality VoIP services to residential customers.

5.5.2   Regulatory effects on competition

At the time of writing, the Office of the Telecommunications Authority (OFTA) in Hong Kong is currently reviewing the rules governing VoIP, and has not yet rejected its development or deployment. PCCW's position as the dominant fixed-line operator leaves it open to greater restrictions according to the regulatory statutes of the OFTA. On the other hand, PCCW has accused OFTA of allowing HKBN to launch its VoIP phone service prematurely [25]. The OFTA ruled in August 2004 that Hong Kong Cable Television (HKCTV) was a non-dominant player in Internet telephony and broadband Internet services and was able to price the services according to their liking without regulatory constraint [26]. As a result, HKCT-owned i-Cable is anticipated to launch VoIP in partnership with its sister company, Wharf T&T, and is free to bundle and price its VoIP Internet and pay-TV service for its 682,000 subscribers.

5.5.3   People

VoIP is a new, immature technology and, therefore, presents a number of internal technology management challenges as identified by the DT Management Framework, particularly for the existing culture and capabilities of employees. PCCW will be required to re-train their existing voice and communication engineers to cope with anticipated changes in support and maintenance services.

5.5.4 Quality of service

VoIP traffic accesses the same pipeline through which the traditional data network uses. This may lead to some jitter and noise which needs to be avoided by tuning and configuring carefully in the infrastructure. However, power interruption should not disrupt this voice service. Quality of service and clarity of reception is an area which PCCW should ensure to its customers if it supports VoIP.

5.5.5 Security

Adopting VoIP adds another layer of security and privacy challenges. PCCW will be required to establish new security policies and procedures, effectively communicate this information across its divisions and to customers via internal and external marketing programmes, and leverage existing security technology supplier relationships to safeguard its deployment of VoIP services.

5.5.6 Planning and control: internal transformation and restructuring

Following the acquisition of Cable & Wireless HKT in 2004, PCCW has made the transition from a technology-driven telecommunications company to a customer-led, integrated-communications services provider. As part of this transition, it has modified its network to become a New Generation Fixed Line Service and to provide users SMS services and information downloads to mobile phones [35].

Customer privacy and security issues directly influence PCCW's core service. This is especially critical when PCCW enters a country market that has strict privacy controls. To address this issue and to protect customer data, the company is applying ISO/IEC 17799 standards and attaining certification to the British standard BS 7799-2 (Part 2 of ISO/IEC 17799) [2].

Since 2000, PCCW has undergone many attempts at restructuring. To guide this process, its internal finance and planning teams need to calculate and forecast the varying scenarios anticipated by restructuring plans. In 2002, the company implemented an Oracle Financial Analyzer (OFA) solution to help with this analysis [48]. PCCW has also relocated its call centers to China. This has reduced its operating costs by 30 per cent while staff costs have been lowered by 75 per cent. However, its turnover rate in China is 50 per cent higher than it is in Hong Kong and this would have implications on the need to train more often. Therefore, to cope with this problem, more complex activities and requirements of workers are retained in Hong Kong [10].

6. Conclusions

While Clayton Christensen's disruptive technologies theory has its critics, organisations cannot refute the effect that emerging technologies, products, business models and individual corporations can have on organisations. The MP3 has transformed the recording industry, made the playing field more challenging for music companies, and redefined its order winners, supply chains and business models. Similarly, VoIP is positioned to do the same for the telecommunications industry. If the predictions that have been made of its impact are realised, communication service providers will be dramatically altered, and consumer behaviour and preferences dramatically changed. The incumbents in these industry sectors, Sony Corporation and PCCW, seem to be unable to respond to the disruptive technologies in a quick and effective manner. This lack of agility is exemplified in these companies being unprepared and unwilling to modify their business strategies, strategic operations decisions, structural and infrastructural strategies and order winners to reflect the competitive environment and consumer behavioural trends. If this continues, they will become complacent bystanders to be pushed aside in the face of innovation and disruptive technology adoption.

The firms that gain or maintain competitive advantage and set the trends will, as Christensen notes, recognise the importance of good business planning, solid market research and market plan implementation. They will create "autonomous yet connected organisations" [31] that will establish new businesses based on disruptive technologies, and know when to avoid staying too close to their customers. They will recognise that sustainable competitive advantage is an oxymoron, that any competitive advantage is only temporary and "the ultimate core competency is the ability to choose capabilities well."[15]

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