DISRUPTIVE INNOVATIONS AND TECHNOLOGIES AND THEIR IMPACT ON THE TELECOMMUNICATION INDUSTRY: AN EXPLORATORY STUDY

This exploratory study explores the disruptive innovations and technologies in the telecommunication industry, first by defining the difference between sustaining innovations and disruptive innovations, using examples of past and current technologies from the telecommunication industry. Then, it describes the context of the manufacturing segment of the telecommunication industry and it explains how the disruptive technologies led to an intense wave of acquisitions in this segment and the development of the acquisition and development business model by some companies. Similarly, it describes the context of the service provider segment of the telecommunication industry and it explains how the disruptive technologies led to the integration and convergence of services and the development of new business models such as the triple and quadruple play.

Introduction

The information technology and telecommunication industries are different than any other industry. Firms established in this knowledge intense sector of the economy face turbulent environmental challenges. The information technology and telecommunications products are technically complex and the embedded knowledge is tacit in nature, non codified and non transferable as a public good. The rate of innovation of new technologies and products is high and the industry face continuous waves of new technological generations and disruptive technologies, which render the product obsolete, possibly even before being launch to the market and received by the end user customers. In fact the rate of obsolescence is higher the time required to recover the skyrocketing investment needed in research and development in order to produce new products and technologies that would built on the core competencies of the company and sustain competitive advantage. The complexity of the technology is coupled with a high level of uncertainty due to a lack of dominant standards, a lack of credible forecast for the potential new product and a lack of specific requirements from the customers’ side.

Furthermore, the telecommunication industry has witnessed a continuous and intense wave of innovation and disruptive technologies (Christensen, Anthony, & Roth, 2004; Christensen & Raynor, 2003), which represents an illustration of the pattern that affected many high technology sectors from 1997 to 2003. Researching this pattern, give an explanation to the real reasons of why some companies survive, while others fail, in the face of such environmental challenges. In addition and as Clayton Christensen (2004) put it, the telecommunication industry is a very interesting case study because: “(1) it is a large and important industry: (2) it has a long and illustrious history of innovation and is credited with countless groundbreaking innovations such as the transistor, the laser, stereophonic and motion picture
sound, cellular telephones, and high-definition television. With this long history of important innovations, telecommunications seems like a perfect environment to study the forces of innovation; and (3) the role of the government, where telecommunications represents an opportunity to apply the theories of innovation within an industry characterized by heavily regulated competition.”

The telecommunications industry is composed of two major industry segments: (1) the equipment manufacturers segment, where companies conduct research and development (R&D), design, manufacture, commission telecommunications equipment and distribute them to consumers, corporate customers (banks, hospitals, education institutions, etc.), government (civil and defense), utilities and service providers (telephony, mobile, cable operators); and (2) the service providers segment, where companies (public and private) provide telecommunications services, such as residential telephony, mobile communications, satellite services, video conferencing, cable TV programming, Internet and email access, to consumers, corporate customers and government.

The telecommunications equipment manufacturers segment is subdivided into sub-categories such as transmission equipment, satellite, microwave, mobile, internet, cabling, submarine cabling, local area networks, wide area networks, wireless, etc. Until recent years, each of these sub-categories was a specific area of expertise and companies were limited to working in one or few areas of those sub-categories. However, due to the intensive and continuous emergence of disruptive technologies and innovations, we are witnessing the integration, merging, and convergence of those sub-categories into fewer technical platforms and systems or into a single platform.

Moreover, the telecommunications service provider segment, until recently, was subdivided into sub-categories such as residential telephony, mobile or cellular communication, cable television, and Internet access. Recently, and due to the emergence of disruptive technologies and innovations and to the integration and convergence of those technologies taking place in the telecommunications manufacturer segment, many of those sub-categories of services are merging and converging into bundled and packaged services and offered to the end user customer in a variety of modules and prices. As an example, traditional incumbent residential telephony providers (Bell Canada) now offer mobile telephony and data (Bell mobility), variable speed (dialup and ADSL) internet and email access (sympatico) and cable television programming through the means of satellite service (ExpressView). On the other hand, traditional cable television service providers (Videotron) offer very high speed internet access (cable internet) and residential telephony.

Consequently, we see an intrinsic relation between the intensive emergence of disruptive technologies and innovations in the telecommunications industry and the change in the industry structure of both the equipment manufacturing and service provider segments of the telecommunications industry. Therefore, this exploratory research intends to explore this relationship, by firstly linking the intensity of the disruptive technologies and innovations in this industry to the intensity of mergers and acquisitions in the equipment manufacturer segment, and then secondly by linking the integration and convergence of technologies due to the emergence of disruptive technologies in the equipment manufacturer segment, to the integration and convergence of service in the service provider segment of the telecommunications industry.

As a result, this research will (1) explain the various disruptive technologies and their impacts on both segments of the industry; (2) describe the environmental context of each segment and the challenges faced by companies operating in each segment; (3) explain and highlight how did this lead to the acquisition spree in one segment and to the convergence of business models in the other; and (4) describe the impact it had on the telecommunications industry and forecast the future of the industry under the current and future potential circumstances.
To better understand how disruptive technologies and innovation affected the firms in the equipment manufacturing segment of the telecommunication industry, three firms from the high technology sector will be used as examples: Lucent Technology, Nortel Networks and Cisco Systems. For the service provider segment of the telecommunications industry, no particular example is given as a case study, based on secondary data and extensive field work is yet to be conducted in a later phase.

This exploratory research on the telecommunication industry is based on a survey conducted on trade publications and newspapers’ articles from The Economist, Fortune, NetworkWorld, The New York Times, The Wall Street Journal, The Financial Times and The Washington Post, among others. A special focus was given to The Economist, where all articles and industry surveys under the categories “telecommunication”, “networking”, “computer”, “internet”, “mobile”, “media”, “television”, “digital” and published between the year 1997 and 2007 were carefully classified and analyzed as a secondary source of data.

Background

The telecommunications industry has been going since the 1990s through a quiet major shift. New technologies, products, services and innovations are continuously emerging, with their impact changing every aspect of our lives and the way business is conducted. Some of them are well known to the end-user customers such as Wi-Fi, Wi-Max, Skype, Vonage and mobile video. Others are not transparent to the end-user customers and are less known due to their technical nature, such as voice over internet protocol (VoIP), MPLS, optical switching, IPTV, broadband, triple and quadruple play. Some of them represent improvements to existing technologies and services, not radical change, and are categorized as “sustaining innovations”. Others represent a radical change with the potential of destroying value for existing technologies and services and creating value by introducing new technologies and services (Christensen, 1997). Those “disruptive technologies and innovations” are substituting existing technologies and services, posing a great challenge to locked-in incumbent service providers by eroding competency, market share and boundaries, and facilitating the entry of new and smaller dependence-free service providers, by reducing barriers, and providing more competitive advantages based on new services and business models (Christensen et al., 2004). This major shift is happening at different levels and causing a major change in the industry structure of the telecommunications industry. It is creating a new “digital ecosystem” in which data, voice, and video, wireline and wireless, traditional telephony and TV broadcasting, are all converging, in addition to the entry of new players such as the application, content and entertainment service providers.

The telecommunications industry major shift is in line with the work of the Austrian economist Joseph Schumpeter, who in 1950 coined the term “perennial gale of creative destruction” where he described how companies and monopolies are challenged by the competition, not based on price, but on “competition from the new commodity, the new technology...competition that strikes not at the margin of the profit of the existing firms but at their foundations and their very lives” (Schumpeter, 1950 p. 84). This “creative destruction” and the emergence of the disruptive technologies do not start in the service provider segment of the telecommunications industry or by just being introduced to the end-user customer. It is transferred to the service provider segment, as new services and business models, through the buyer-supplier relationship that exists between the service providers and the equipment manufacturers in the telecommunication industry. Therefore, this convergence of services and business models, are the end products delivered to the service providers by the equipments manufacturers.

However, the products delivered by the equipment manufacturers are the result of the system integration, and assembly of a variety of technologies, which are then produced in modules or a single platform, then packaged and bundled to offer a variety of options and prices. Those technologies are
either the product of internal innovation through internal R&D capabilities and strategic assets or external innovation through strategic alliances, joint ventures, or acquisitions. Some of the technologies are the combination of lower level technologies, or the permutation of various technologies. Due to the high velocity and intensive emergence of new and disruptive technologies in the manufacturers’ ecosystem, it is difficult for the manufacturers to only rely on internal R&D capabilities and strategic assets that are built on the core competencies of the firm.

Furthermore, the equipment manufacturing firms established in this knowledge intense sector face a variety of turbulent environmental challenges (Bahrami & Evans, 1989; Romanelli, 1989). Their products are technically complex (Bettis & Hitt, 1995; Jemison & Sitkin, 1986), in which the embedded knowledge is tacit in nature (Oliver, 1997), non codified and non transferable as a public good (Hagedoorn & Duysters, 2002; Peteraf, 1993). The complexity of the technology is coupled with a high level of uncertainty (Hoffman & Schaper-Rinkel, 2001; Quelin, 2000) due to the lack of dominant standards or standard wars (Besen & Farrell, 1994; Shapiro & Varian, 2003), the lack of credible forecast for the potential future new products and the lack of specific requirements to respond to the customers’ needs (Quelin, 2000; Roberts et al., 2001; Robertson & Gatignon, 1998; Walker & Weber, 1984). The rate of innovation of new technologies and products is higher than any other industry (Hitt, Hoskisson, & Ireland, 1990; Hitt, Hoskisson, Ireland, & Harrison, 1991a; Hitt, Hoskisson, Johnson, & Moesel, 1996) and the industry faces continuous waves of new technological generations and disruptive technologies (Christensen, 1997; Christensen et al., 2004; Christensen et al., 2003; Utterback & Acee, 2005), which render the products obsolete, possibly even before being launched to the market (Mayer & Kenney, 2004b). The rate of obsolescence is such that products often become obsolete before their development costs can be recaptured (Roberts & Liu, 2001). The new and disruptive technologies emerge either inside the firm or in the environmental ecological system, following a pattern of an epidemic technology diffusion, mutation and permutation of characteristics. In the literature we could not find any research linking these environmental challenges to the disruptive technologies, in a cause/effect relationship.

Moreover, one technology does not necessarily constitute a product in itself. It could be a computer algorithm, a network protocol, an encryption code, a specific technique, a process, a class of fiber, a processing chip, etc. The product is created by assembling and integrating this mosaic of technological ecology. Each of these technologies emerges in the environmental ecology of the firm, in different temporal brackets, and not in a sequential pattern that would eventually lead to the creation of one stand alone product. In addition, these technologies are created and developed independently, although their innovation teams collaborate informally through personal networking and the participation in technical forums, presentations, and standards bodies.

Therefore, it is difficult for one company to rely on internal innovation through R&D capabilities and existing strategic assets alone. Besides, the integration of technologies and the convergence of services we are witnessing in the service providers segment are not the results of the system integration, conducted by the service providers, of separate and independent products that were transferred from the equipment manufacturers. It is achieved by the equipment manufacturers, through a deliberate strategy of an intensive wave of acquisitions with the objective of achieving platform leadership among competitors (Gawer & Cusumano, 2002). This imageneering of the future and the enactment of the industry structure and directions, leads to the strategically reengineering of the core competencies of some manufacturing firms to create a dominant logic and a sustained competitive advantage (Prahalad & Hamel, 1994). Thus, the link between the emergence of disruptive technologies in the ecosystem to the acquisitions intensity in the manufacturer segment, which is not documented in the literature.

Since the 1990 there was a substantial increase in mergers and acquisitions activities in the high technology industry. More than 11,000 acquisitions were completed in 1997 for a value estimated at over US$ 900 billion (Chaudhuri & Tabrizi, 1999). This intensity of acquisition’s activities Hitt et al., 1990;
Hitt et al., 1991b) is motivated by different reasons. Beside traditional motivations of economizing and empire building, high-tech firms used acquisitions mainly to acquire external strategic resources, gain access to valuable human talents, reduce the cost and risk of R&D, expand their portfolio of products, reduce product time to market and provide for an external source of continuous innovation.

The networking segment of the telecommunications industry was created by the fusion of information technologies and traditional telephony technologies to connect computers to each other using computer networks and protocols through public telephone networks. In the networking segment, several firms have used acquisitions as their main growth strategy. For example, Cisco Systems, a Silicon Valley based company working in the manufacturing of networking and telecommunications equipment and software, acquired more than 107 companies during the period from 1993 to 2006. In the year 1999 alone it acquired 18 companies and in the year 2000 it acquired 23 companies, with an average of almost two acquisitions each month, or in other words, an acquisition every two weeks. It completed 12 acquisitions in 2004 and another 12 in 2005. Moreover, Nortel Networks completed 21 acquisitions in the period between 1996 and 2006 and Lucent Technologies completed 41 acquisitions during the same period. Lucent was later acquired by Alcatel in December 2006. Today, Cisco Systems stands as the leader in the telecommunications industry and as the company who created this trend of using a successful aggressive acquisition strategy as its main growth engine.

This strategy, termed “acquisition and development” or “A&D”, combines acquisition activities for external sources of innovation, while maintaining the internal innovative capacities of the firm (Mayer et al., 2004b). It starts by identifying the firm’s internal needs (resources) and assessing the potential players for acquisitions in the strategic group within the industry, by means of continuous scanning of the competitive environment (Chaudhuri et al., 1999). During this scanning of the environment, informal relations (links) are established with the objective of identifying and evaluating potential emergent new technologies and innovation, assessing human assets (resources) involved in those activities and estimating the real economic value (cost) of these resources, in terms of technologies and human capital.

When deciding on an acquisition, the firm would evaluate the potential target’s existing product line and portfolio of technologies. Those potential technologies could be sustaining or disruptive. They could be supplementary or complementary technologies and products. Supplementary technologies are similar in nature to the firm’s existing products portfolio and complementary technologies are different products that strategically fit with the firm’s existing products’ map. In addition to supplementary and complementary products, a firm could choose to acquire a target firm because of the competitive threat of substitute products or disruptive technologies. By acquiring those substitute products, the firm would reduce the competitive threat and produce new entry barriers to other firms developing similar technologies and products, which would ensure a better market positioning and a sustained competitive advantage. In the post acquisition phase, the acquired technologies and products are system integrated into the existing product portfolio to create synergy. The integrated technologies are redesigned based on modularity or single platforms (Gawer et al., 2002; Mayer et al., 2004b; Olleros, 2006), to provide bundles and solution packages with a variety of prices and options to meet the potential needs of future customers (Stremersch & Tellis, 2002). The integration process is very critical, as it provides the technical basis for the convergence of services, later used by the services providers, when the products are transferred to the service providers through the buyer-seller relationship. For a successful post acquisition integration of the acquired company and its technologies, the integration complexity, strategic fit, and potential synergy, must all be anticipated and evaluated in the pre-acquisition phase and prior to the acquisition decision.

In most of the research on corporate mergers and acquisitions, they are viewed as strategies for corporate control and empire building, and they are dealt with using financial and economic perspectives, while neglecting their social, strategic and organizational dimensions. The motivations of acquisitions in
the high tech industries, and specifically the telecommunications industry, are different than the motivations of acquisitions in other industries. Many of the high tech acquisitions in the 1990s appeared to be motivated by the firms’ need to obtain critical technologies or capabilities, in contrast to acquisitions in other industries, which are motivated by economies of scale, gains in market share, geographical expansion, empire building or CEO hubris. Despite the importance of the intensive acquisition trend within the context of the telecommunications industry, the research on acquisitions in the literature of strategic management could be categorized as contradictory, incoherent and incomplete. It is contradictory because the findings present contradictory performance outcome related to acquisitions, even in the same industry sector. It is incoherent, because most of the researches focus on the economic aspect of acquisitions including performance, economies of scope and scale, market penetration, growth, position, net gain, etc., while the others focus on the strategic aspect of acquisition including human talent, tacit knowledge, strategic resources, strategic fit, organizational culture and core competencies. Each approach neglects the other, which leads to an incoherent picture of the factors involved. Each approach gives a perspective to the study of acquisitions, however the whole picture remain fragmented and unclear. Third, it is incomplete because the literature has not shed enough light on the factors, criteria, conditions, motivations, causes and consequences related to the acquisition formation in high velocity and turbulent environments. When companies such as Cisco Systems and others participate in intensive acquisition activities during a small period of time, the critical success factors and the process of decision making for the acquisition formation has not been fully researched, under those extreme and intense environmental conditions.

In the service providers segment of the telecommunications industry, the integrated technologies provided by the manufacturers, give rise to new disruptive innovations and the convergence of services and business models. This is creating a new landscape for the telecommunications industry and changing the rules of the game that were established decades ago, leading to a change in the industry structure of the telecommunications industry. The change in the industry structure refers to the change in the competitive dynamics and market forces, the change of the firms’ competitive advantage, the changing and blurring of market, the erosion of market share, the destruction of competency, the lack and need for a new regulatory environment, the cannibalization of services and the subsequent loss of revenues in traditional markets (Evans & Schmalensee, Forthcoming; Parker & Alstyne, 2005; Porter, 1980).

For example, the ability to have an overseas voice conversation on the internet with a reasonable quality of service (QoS) using embedded software such as Microsoft Messenger or unbundled software such as Skype, is sharply reducing the traditional international calls’ revenues for the telephony operators. New telecommunications alternative providers, such as Vonage and others, offering service providers-like’s quality of service with a fraction of the cost, are challenging the traditional telephony operators locked-in with long term investment based on old technologies and infrastructure, in the local and international business segments. Enterprise voice over internet protocol equipments, or simply VoIP, sold by the equipment manufacturers directly to the end-user customers, are bypassing the telephone operators and sharply reducing their PABX (private automatic branch exchange) traditional business.

On a larger scale, the Wi-Max disruptive technology is decreasing the barriers for new investors to enter the service provider market and provide city-wide coverage of wireless-fixed broadband services, including data, voice, and video, with a fraction of the cost and lower technical expertise. Traditional cable TV operators are offering residential telephony and broadband Internet access, competing directly with traditional telephony operators in their core business. Telephony operators would be able to offer TV programming services using a technology called IPTV, competing directly with cable operators in their core business. The last two examples are based on the convergence new business model called “triple-play”. The convergence of fixed and wireless broadband, adds another emerging business model, the quadruple play. Finally, the entrance of new nontraditional telecommunications players, such as content and entertainment providers such as YouTube, Google, AOL, Microsoft, NBC and Virgin, gives rise to a
new business model. In this model, the industry change concerns the market boundaries and the ownership of the network. It is already contemplated that the ownership of the network and services could be transferred to the media giants who would provide the content in addition to the traditional telecommunications services, while the network would become just a conduit. All this is happening while the regulatory environment is lagging behind, with large variations and differences between countries in industrial markets, emerging economies, highly and less competitive markets and geographic areas.

**Disruptive Technologies and Innovations**

The term disruptive technologies was first coined by Clayton Christensen in his book “The Innovator's Dilemma” (Christensen, 1997) and then used in the subsequent books “The Innovator's Solution” (Christensen et al., 2003) and “Seeing What’s Next” (Christensen et al., 2004). The concept behind the new term “disruptive technology” and more generally “disruptive innovation” could be traced back to the Austrian scientist Joseph Schumpeter who developed the theory of creative destruction in his book “Capitalism, Socialism and Democracy”, published in 1942. In his book “The Process of Creative Destruction”, Schumpeter wrote “The opening up of new markets and the organizational development from the craft shop and factory to such concerns as US Steel illustrate the process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one ... [The process] must be seen in its role in the perennial gale of creative destruction; it cannot be understood on the hypothesis that there is a perennial lull.”

Christensen et al. (2004) describe the disruptive innovation theory in such situations where “new organizations and market entrants can use relatively simple, convenient, low cost innovations to create growth and win over powerful incumbents and that the theory holds that existing companies have a high probability of beating entrant attackers when the contest is about sustaining innovations, but established companies almost always lose to attackers armed with disruptive innovations.” (Introduction, XV)

Christensen et al. (2004) identify three types of innovations: “(1) Sustaining innovations, which move companies along established improvement characteristics, and are improvements to existing products on dimensions historically valued by customers. Disruptive innovations, introduce a new value proposition, and are either creating new markets or reshaping existing markets. There are two types of disruptive innovations: (2) Low-end disruptive innovations can occur when existing products and services are too good and hence overpriced relative to the value existing customers can use; and (3) New market disruptive innovations, can occur when characteristics of existing products limit the number of potential consumers or force consumption to take place in inconvenient, centralized settings.”

The theory is related to the Resource Based View, as it takes into consideration the resources, “which are assets the company can build or destroy, the processes, which establish patterns of work to transform inputs into outputs, and values, which determine the criteria by which the companies allocate the resources.” Christensen states that “incumbent firms fail in the face of disruptive innovations because their values will not prioritize disruptive innovations, and the firm’s existing processes do not help them get done what they need to get done.” The disruptive innovation theory is also related to the value chain evolution theory as the companies have a choice: “They can choose to integrate, executing most of the activities themselves, or they can choose to specialize and focus on a narrow range of activities, relying on suppliers and partners to provide other elements of value added.”

The book “Seeing What’s Next” (Christensen et al., 2004) introduces a process model for analyzing and predicting industry change based on a three part process: “(1) identifying signals of change, where we can expect companies to emerge with products, services and business models that look very different from what we have seen in the past; (2) evaluating competitive battles, between companies
classified as “attackers” and “incumbents”; (3) identifying strategic choices that can influence the outcome of the competitive battles, by showing what attackers can do to tilt the balance of power in their favor and what incumbents can do to withstand attacks.”

In general the process of disruptive technologies and innovations can be associated with the destruction of values and the creation of value, for both the providers and the end-user customers. For example, the destruction of value is represented in the loss of previously estimated revenues from the voice telephony in the incumbent telephony service provider, for the new cable operator providing the same service to end-user customer. This new cable telephony service represent a creation of value for the cable operator, and for the end-user, who is offered alternative service breaking the monopoly of incumbent operator, and for a better price.

Examples of Disruptive Technologies

**Packet switching technology vs. circuit switching.** The telephony voice service was based since its inception on a technology called “circuit switching” where a circuit is reserved each time a call is established between point A and B on a telephone network, even if the call conversation included intervals of silence. With the emergence of computing and personal computer, the need was for connecting those computers through a network, to exchange information such as document, statistics, and database information. As the telephony network and its circuit switching technology where not economically suitable for the connection of large number of computers, data networks were developed in order to connect computers and transfer data between them. Several protocols were devised for this purpose such as X.25, TCP/IP (Transport control protocol/Internet protocol), frame relay, ATM (asynchronous transfer mode) and MPLS (Multi protocol layer service). Over time those data networks, using data transfer protocols to transfer data mainly, begin to be used to transport voice, as in voice telephony, after the voice call is digitized from its analog form and transformed into binary numbers if 1s and Os and after being packetized, or in other words divided into small packets if data and switched over the different nodes of the packet switching network.

**Voice over ATM (Asynchronous transfer mode) and MPLS (Multi protocol layer service).** Same as in Frame Relay, however, the issues of latency, delay, quality of service (QoS), and guaranteed service for the voice calls were greatly enhanced. As a result, voice calls could be transported between end-users, using an alternative data network service provider instead of the incumbent telephony provider network. In addition, it provided an efficient and economic mean of transporting backbone traffic between central offices of traditional telephony voice service provider.

**Wi-Fi and Wi-Max.** Wi-Fi provides a basis for a wireless local area network (LAN) connecting computer over a localized (limited) area. It’s suitable for connection computers in an apartment, an office, a coffee shop, a university, a hotel, etc. Wi-Max, however, is an evolution of the Wi-Fi, and it is capable of providing computer connections over a much larger area, such as a city, a village or a cosmopolitan area. The technology is suitable for the transfer of data, voice and video. Unlike mobile communication, it is license free and provide an alternative for new market entrant for providing alternative services.

**Broadband access.** Allow for the transmission of voice telephony and high speed internet access over the existing local loop or last mile, running from the central office equipments to the end-user establishment. High speed internet could be suitable for down-streaming video content such as Realmedia, and YouTube, etc.

**Voice telephony and Internet over cable television.** It provides the existing cable companies with the ability to transport and switch voice calls service and internet access and traffic over existing cable television infrastructure in the cosmopolitan area to end-user subscribers.
Internet protocol television (IPTV). It provides the existing telephony incumbent service providers with the ability to transport, switch, and broadcast television programming over the existing telephone infrastructure, using the Internet protocol television or IPTV.

Examples of Disruptive Innovations

Skype. A free downloadable application offering the possibility of making voice calls between computers connected to the internet. The transport technology uses the Internet for transporting data and voice messages and traffic, and therefore does not constitute any additional cost, other than the subscription to the internet service provider (ISP). However, the quality of service (QoS), latency, delay, noise and guaranteed service, are not resolved.

Enterprise voice over IP (VoIP). Offer an alternative for transporting voice traffic over a local area network in a localized area such as offices, universities, hospitals, etc. It replaces the traditional private branch exchange equipment, offered by the telephony incumbent provider.

Service provider like VoIP services (Vonage). This service offers the capability of transporting voice services over the internet, using either a computer connected to the internet or simply a phone equipment. Unlike skype and similar innovations, a service provider such as Vonage (and others) offer a guaranteed service, with a quality of service (QoS) equivalent to the voice-toll service offered by the incumbent or mobile service provider. However, the service is not for free, but is offered at a more competitive price than the incumbent provider.

The Telecommunication Industry: Manufacturing Segment

Intensive Acquisitions

In the high technology industries, including information technology, telecommunications, biotechnology and aerospace, firms face a challenging environment including a high level of uncertainty, a continuous fast pace of change, the emergence of disruptive technologies, the shortening cycle of product development, the high rate of obsolescence of technologies and products, the intensity of the research and development required, the volatility of the market and the extremely high cost of innovation. In this challenging environment the uncertainty (Bettis et al., 1995; Hoffman et al., 2001; Quelin, 2000; Roberts et al., 2001) is a result of technological uncertainty (Quelin, 2000; Roberts et al., 2001; Robertson & Gatignon, 1998; Walker & Weber, 1984) due to the lack of standards being still under development, competing technologies without a clear potential winner and the intensive emergence of disruptive technologies which render existing products obsolete; demand and market uncertainty (Quelin, 2000; Roberts et al., 2001; Robertson et al., 1998) due to the lack of credible demand forecast for competing and under developed technologies, the ignorance of the customers’ perception of the potential new products; and product uncertainty (Quelin, 2000; Roberts et al., 2001) due to the lack of understanding of the potential customers’ preferences for the future products’ specifications and requirements.

This uncertainty is amplified because of the limitations facing the firm in this environment and in dealing with its challenges. One of those limitations is the embedded nature of the technical knowledge required to deal with uncertainty. This technical knowledge is not codified, and has a tacit nature. It is in the mind and experience of the technical engineers and scientists and cannot be transferred as a public good without a price to pay and an effort to make. This tacit knowledge (Oliver, 1997) could be in the technical expertise and know-how of the technical teams, the research and development capabilities, the management practice, the entrepreneurial spirit or the innovation track record. This knowledge cannot be
transferred to the firm simply by recruiting or by the free mobility of its agents. It is related to a technical idiosyncrasy and specific assets as part of the research, development, operations and maintenance phases. The asset specificity (Coff, 1997; Hoffman et al., 2001; Oliver, 1997; Robertson et al., 1998; Williamson, 1975; Williamson, 1999) owned by a firm determines the potential for it to join in an alliance or to be acquired by a larger firm.

Those highly specialized assets could be human, physical, or material and would represent for the potential partner or acquirer external assets needed to maintain a sustained competitive advantages. Those strategic assets (Hagedoorn et al., 2002; Oliver, 1997; Peteraf, 1993) are characterized by being unique, inimitable, difficult to duplicate and part of the core competencies of the firm. If the firm finds those assets in its environment, it could either form an alliance to have access to them or form an acquisition to acquire them internally, as an external source of innovation. The objective for the acquirer or the allied firm is to build upon the core competencies (Hitt, Hoskisson, Ireland, & Harrison, 1991b; Prahalad & Hamel, 1990; Prahalad et al., 1994; Quelin, 2000; Singh & Montgomery, 1987) of the firm by relying on external sources.

Facing those environmental challenges, firms established in the information technology and telecommunications industries tend to use alliances, acquisitions or both, to survive, enhance their performance, and guarantee their growth. Working together would reduce the level of uncertainty and risk imbedded in the required high investments in research and development. Moreover, it would give access to external resources of innovation, which are strategic assets that would complement or supplement the firm’s existing assets. Sharing the cost of research and development would produce economies of scale and scope and achieve synergetic opportunities, producing efficiency and net gain. The formation of an alliance or acquisition would give access to new products, reduce the product life cycle and penetrate new markets and industry segments, which would increase the firm’s market position and power.

When choosing alliances or acquisitions, the firm would evaluate and target the partner or the acquired firm’s existing products line and portfolio of technologies. Those potential products for alliances and acquisitions could be supplementary or complementary products. Supplementary products (Shelton, 1988; Wernerfelt, 1984) are similar in nature to the firm’s existing products portfolio and complementary products (Mayer & Kenney, 2004a; Shelton, 1988; Wernerfelt, 1984) are different products that combine well with the firm’s existing products’ lines. The firm would choose to have access to those resources through an alliance or acquire them through an acquisition, in order to increase its core competencies and improve its product portfolio competitiveness (Ferrary, 2003), which would ensure a sustained competitive advantage (Oliver, 1997; Porter, 1980; Prahalad et al., 1994). In addition to supplementary and complementary products, a firm could choose to acquire a target firm because of the competitive threat of substitute products or technologies (Gawer et al., 2002), which could result in barriers to entry (Wernerfelt, 1984; Yip, 1982) for the acquirer firm. By acquiring those substitute products, the firm would reduce the competitive threat and produce new entry barriers to other firms developing similar technologies and products, which would ensure a better market positioning (Gulati, 1999; Hopkins, 1987; Walter & Barney, 1990; Yip, 1982) and a sustained competitive advantage.

The Telecommunication Industry: Service Provider Segment

Integration of Services and Convergence

In the past, telephony networks were built using the “circuit switching” technology, as described earlier. With the emergence of a data communication network, as a result of the DARPA project (Defense advanced research projects agency) in the 1960s, telephony service providers and newly private companies begin to establish such networks (independent from the voice telephony networks) for the
transport of digital data between interconnected computers. At first, those data networks using X.25 and TCP/IP protocols were used to transport data only and the telephony voice networks were used to transport voice toll traffic among the network subscribers. With the evolution of data networks protocols, such as Frame Relay, ATM and MPLS to name a few, it was made possible for the first time to carry voice toll traffic over such networks originally designed to carry data. Therefore, private data network companies started to offer voice service by carrying voice traffic over their data networks and competing with telephony voice providers, and telephony service providers started to carry their voice toll traffic on larger capacity data networks, for more efficiency, cost reduction, redundancy, and better network monitoring and management. With the continuous evolution of data networking protocols, it was even possible to start carrying video (characterized by the need for larger transport capacity or bandwidth).

From the other hand the integration of the different technologies, systems and protocols, in the equipment manufacturer segment of the telecommunication industry and the creation of more modular and versatile products, allowed for the integration of services such as data, voice, and video and for the convergence of the voice, data and video network infrastructure into one consolidated network platform able to carry all type of signals and services.

As a simplified example to better illustrate to concept, consider the Microsoft application MSN or better known as messenger. In the past, the messenger was designed to connect internet users for exchanging online messages or chat messages. However, with the evolution of the service, it became possible, not only to write and exchange text messages, but also voice signals by exchanging a voice conversation and video signals by using a webcam and seeing the other end’s online video. The explanation is that all type of online messages, whether text, pictures, voice or video, are transformed into a digital form or digitized using binary matrixes composed of streams of 1s and 0s, and then they are packetized, or divided into small portion of data called packets, and transported over the network.

Implications

The emergence of those disruptive technologies in the telecommunication industry paved the way for the integration of technologies and the convergence of services and networks. This created disruptive innovations that threatened the incumbent service providers and made it easier for new entrants to the ever changing market place. The boundaries between market segments became blurring as the services converges and the companies operating previously in one market segment were forced to rethink their strategy and develop new business models to sustain their competitive advantage, or in some case, simply to survive. Incumbent service providers are seeing their revenue streams shrinking by the cannibalization of some of their services as an effect of disruptive technologies, or by the competitive threats of new business models and innovative services introduced by their existing competitors or new market players. In other words, disruptive technologies in the telecommunication industry reduced and in some cases eliminated the barriers to entry and decreased the switching cost.

For example, until recent years the voice telephony service providers were limited in providing residential fixed voice telephony, mobile communications and international calls services and the cable television service providers were limited to offering cable television programming using their own cable network, whether terrestrial or through digital satellite links services. In recent years, this has changed dramatically. Voice telephony service providers were enabled, based on new disruptive technologies, to offer internet access in variable speed (dial up and high speed using ADSL technology) and most importantly video television programming through the use of their own cable network, or digital satellite services.

Moreover, cable television service providers were enabled, based on new disruptive technologies, to offer internet access in higher speed than the one offered by telephony service provider, and most
importantly voice telephony fixed-residential services, which was previously a monopoly service to incumbent operators. The new disruptive technologies offered both, the voice telephony and the cable television service providers, the technical capability to compete in each other market segment, and to draw new sources of revenues.

A voice telephony residential customer, who chooses to switch from his preferred telephony service provider to the new service offered by his cable operators, will benefit from reduced cost because of bundling and packaging of services and a one stop shopping with a unified bill of service for all his communication needs. By doing this, the customer will increase the revenue streams of the cable operator, in a service area previously perceived as not in its core business competency, and in the same time, decrease the revenue streams of the telephony service provider in an area of service considered for a very long time to be its core business competency.

Another example is the different applications and disruptive innovations emerging from the voice over IP, Frame Relay and ATM disruptive technologies. The first variation, such as the one offered by skype and other similar developers, provides the customer with the opportunity to place local or international calls using its own computer and pre-paid internet access, to other internet connected computers. It’s true that the quality of the voice and the availability of the service is not guaranteed compared to the traditional voice telephony service, however, the service being free of charge and user friendly, the customer usually price prefers over quality. Another variation of the VoIP technology is the one offered by service provider-like such as Vonage, where the customer is giving an alternative for placing local and international calls to either internet connected computers or just any telephone equipment, with a guaranteed service availability and a similar toll voice quality as in the traditional voice telephony services, for a reduced bill.

This shift in market segment, and the resulting disruptive innovations, create enormous challenges to all the players in the telecommunication service provider market segment, mainly the incumbent telephony service providers, to come up with new devised business strategies and new innovative business models, in face of fierce competition from unprecedented sources, in order to be able to sustain their competitive advantage or at least survive in this ever changing market place. In fact those radical changes caused by the continuous emergence of new disruptive technologies and innovations causing a restructuring of the telecommunication industry and are forcing the incumbents and new players to rethink their strategies. Most incumbent service providers, facing those challenges are trying to find answers, innovative solutions, and new business models.

The Future of the Telecommunications Industry

Here are some of the trends governing the thinking in the telecommunications industry. Those trends support the objectives of the research and shed some light on what was previously described in this exploratory paper.

The telecommunication industry has witnessed a sharp decrease in the net revenue per minute in the international call business. This is due to several reasons, among them internal price adjustment (high prices were fictitious), the effect of the calling cards wholesale and retail business, but also, the impact of the other technologies such as Internet email, online messaging and lately voice calls over the internet or simply voice over IP (VoIP) using applications such as Skype. Since its launch in December 2003, Skype have seen a rapid growth in the worldwide subscriber base. There are several attributes about the application among them the ease of use, and the no cost fees. It is expected that more people specially younger generations and computer savvy are using this application to place international calls, which has a negative implication on the international call business.
Another variation of the voice over IP technology is the service provider-like services offered by companies such as Vonage. In this case, customers switch to this service from the traditional voice telephony service provider, including cable television operators offering voice telephony services (such as Videotron). The subscriber base to this type of service has witnessed an important growth, which is expected to continue in the future due to reduced billing fees, a similar quality of service (QoS) to that offered by traditional service providers, the ease of use by non-computer savvy, and the possibility of placing calls to non-subscribers.

The revenues from long distance and local phone calls continue to drop in the near future. This is due to several reasons, chiefly among them the end-users switch to the use of various applications using voice over IP technologies, whether with the no-fees over the internet variation (Skype) or based on the service provider-like services offered by alternative providers such as Vonage. Due to the drop in voice calls revenues (international and local), the traditional telephony service providers who will be most affected are the one relying on voice services in their core business and revenue streams. For example, Vodafone would be most affected as it relies in 80% of their revenues on voice services, while BT would be less affected as it relies in less than 20% of their revenues on voice services and more than 80% on data, video, business and other services. This shows the need for traditional voice telephony providers to move into new business models and more innovative solutions.

As a direct effect of disruptive technologies in the telecommunication industry, technologies are being integrated and services are converging. The effect of this convergence would be mostly noted in the voice and data telecom business, followed by the fixed and mobile communication services, then the media and entertainment and finally the IT and computing area in general. The convergence between the fixed and mobile services will continue to grow sharply in the future, especially in the consumer markets. More and more customer would prefer mobile communication over fixed communication lines. In the enterprise market segment, the mobile trend will continue to grow; however, fixed lines communications would remain the preferred choice, because of the need to access fixed physical resources.

The convergence of media and telecommunications (known as Triple-Play as a short for voice, data and video) will continue to grow in the near future. In addition to the converged cable services (including voice telephony and Internet), the nascent Internet protocol television (IPTV) technology offered by telephony service and alternative providers will witness a steady growth, as well as the expected growth in online video-on-demand using Internet online streaming. The convergence of media and telecommunications will continue to grow, making the Triple-Play business model and services (voice, data and video) a main revenue growth area in the future and a shift of paradigm towards being the core business competency of traditional telecommunication service providers, cable operators, alternative providers, and content (and entertainment) providers.

The convergence of the telecommunication industry and the media (and entertainment) industry would continue to grow in the future, giving rise to a new innovative business model called Quadruple-Play for voice, data, video and content (and mobile). This would encourage media and online content providers, such as NBC, Disney, Virgin, MTV, AOL, Time Warner, Microsoft, Google and YouTube, to enter the new realm of the telecommunications and media industries. One would expect giant content providers to try to play a major and dominant role in the provisioning of the other telecommunication services (data, voice and video), and that it is possible that the ownership of the telecommunication and media infrastructure would be acquired by those giant and emerging content providers. Should this be a potential future strategic scenario, the business models of both the telecommunications and the media industries would change radically and both industries would go through a major radical restructuring phase.
Construction of a Theoretical Model

In an attempt to work on few potential general propositions and before embarking on the field research and investigation, here are some potential hypotheses to be considered for evaluation, discrimination and future research:

Proposition 1: The intensive emergence of disruptive technologies in the telecommunications industry has led equipment manufacturers to resort to external sources of innovation through the mean of mergers and acquisitions of complementary, supplementary and substituting technologies and products.

Proposition 2: In intensive acquisition mode, equipment manufacturer use a process of acquisition for successfully completing, integrating and managing acquisitions and acquired companies.

Proposition 2a: In the pre-acquisition phase, it is crucial to rely on a continuous scanning of the environment, a real and deep assessment of internal needs, a network of formal and informal alliances and a thorough due diligence.

Proposition 2b: During the acquisition phase, criteria such as strategic fit, creating synergy, technology and product integration, management of complexity and proximity play a crucial role in completing a successful acquisition.

Proposition 2c: In the post acquisition phase, the integration of the acquired company while keeping certain autonomy for the innovation team, and the talent recruitment and retention, play an important role in successfully managing and benefiting from the strategic objectives of the acquisition and creating synergy.

Proposition 3: Disruptive technologies in the telecommunications industry and the successful reliance on acquisitions as a source of external innovation could lead the company to adopt a new business model described as “acquisition and development” (A&D), instead of research and development (R&D).

Proposition 4: The integration of disruptive technologies by companies in the equipment manufacturer segment of the telecommunications industry, coupled by the emergence of disruptive innovations, lead companies in the service provider segment to integrate their services, based on integrated and converged technologies

Proposition 5: The integration of services by the service providers in the telecommunications industry, lead to the convergence of services, bundling and packaging of services, and the emergence of new business models.

Proposition 5a: The convergence of services poses a challenge to incumbent service providers in the telecommunications industry. It reduces the effect of historic monopoly, reduce the barriers to entry and reduce the switching cost.
Proposition 6: The convergence of disruptive technologies and services in the telecommunications industry and the consequently convergence of the telecommunications and the media industries, have a restructuring effect on the telecommunications industry and would change and reshape the market boundaries, give rise to new business models, and invite new entrants from outside those two industries.

Figure 1

Proposed Theoretical Model
The impact of disruptive technologies and innovations on the telecom industry

Conceptual Model
Disruptive technologies and innovations and their impact on the telecommunication industry
References


