

## Chapter 3

# Innovation and Competitiveness: Case Study

### 3.1 Introduction

The foregoing analysis in the previous chapters of the book demonstrated that innovation constitutes the foundation and driver of competitiveness worldwide. Starting from its definition and based on a broad raft of experiences and results, innovation allows the addition of higher added value in a way that materially prevails constituting probably exclusivity (disruptive and discontinuous innovations).

For a better comprehension of all the above, it would be wise to quote a case study, for the XEROX company, where promotion and use of innovation as a recipe of corporate success and profitability has gone through a historic path. At the same time it is also interesting and enlightening to see the failure by XEROX in many occasions to commercially capitalize on the technological invention and innovation for various reasons ranging from lack of imagination or/and courage on behalf of corporate leadership up to dysfunctional corporate traditions and mindsets.

A critical issue is the presence or absence of ability and readiness for technological learning particularly at higher levels (learning new ways of learning), (Carayannis 1994a, b, c).

### 3.2 Innovation-Case Study XEROX

#### 3.2.1 XEROX Background and History

In the last years many changes have been observed in what we call **old and what we call new economy**. The old, industry-based economy has been traditionally characterized by economies of scale whereas the **new knowledge-based economy** is considered as the economy of networks (Shapiro and Varian 1999). The shift from the old to the new economy could be described as a change of technological paradigm.

According to Kuhn, a paradigm is defined as ‘an object for further articulation and specification under new and more stringent conditions’ 1 (Kuhn 1962). According to Moore, the traditional old economy is defined as the economy being developed against the competition, following a victory–defeat scenario (Moore 1996). The new economy paradigm is defined as the creation of a market or the co-evolution, according to a victory–victory scenario.

XEROX numbers many successes and failures in its history with regard to innovation. The successes are obvious at present in the office environment. Photocopy machineries, laser printers and network services are all around us, due to XEROX successful innovation. It is not only office equipment that made XEROX a success. Service provision (maintenance of photocopy machines) and consumables (ink cartridges, paper etc.) is very successful-similarly to support services and document processing services (solutions). XEROX innovations multiply; according to data, more than 7,000 active patents belong to its intellectual property. However, in the course of time, there were some unsuccessful innovations too.

The invention of a personal computer with a graphic imaging environment, a desktop, a mouse, Ethernet and the first document processor WYSIWYG has never been a XEROX innovation. The same is true for the first laser printer. In both cases, XEROX invented but did not innovate. It took the control of other companies and acquired their inventions to reach the stage of innovation. There are, however, three basic questions raised:

- **What criteria drove to success?**
- **What criteria drove to failure?**
- **What are the lessons to be drawn?**

These are very important questions. The answers could help us define the criteria of success, allowing for the elaboration of methodologies which would enable the creation and preservation of better innovation practices. When studying innovation, it is better to start analyzing successes and failures. This way of analysis is followed below for the example of innovation in Xerox.

On October 22, 1938, in Astoria, a suburb of New York City, Chester Carlson invented what was later called a photocopy. He considered the photocopy a revolution in the evolution of office but later he would realize that people did not view this invention in the same mood as he did. Carlson, born in 1906 and during the first steps of his career, worked as a pressman assistant; he even published a small newspaper in his hometown.

This early experience impressed him and particularly his difficulty to place words on paper and share the knowledge. He later obtained a physics diploma from the Institute of Technology of California and began to work as a researcher engineer at Bell laboratories. In an era of work slowdown, he obtained a Law diploma that led him to a second career as private practicing lawyer. As a lawyer he often faced the problem of not having enough carbon papers.

The only alternatives were to use an accurate photographic processing or to try broad patent applications. In his free time, he explored alternative technologies finding finally the study by the Hungarian physicist Paul Selenyi on photoconductivity. He made experiments in his kitchen, copying finally the image “10-22-38 ASTORIA”

on a tin plate coated with sulfur. He finally concluded that innovation was not an easy process. He looked for a company that would be interested in further financing a research on his invention. For 10 years he was not successful at all.

The market was not ready for alternative solutions—the common view that prevailed was that current technology, the photocopy carbons, were sufficient and there was no need for a new technology. In 1944, the Battelle Memorial Institute, a non-profit research institute, was interested in helping Carlson to further develop his invention. In Battelle times, selenium was introduced as an improved photoconductor and a shade of dry ink was developed. Finally, in 1947, the company Haloid, a photographic paper manufacturer, obtained a license to manufacture a photocopies machine. In a year's time, the first Xerox photocopy machines began operating, heralding the era of photocopy.

The first photocopy machine had a complex operation but found a place in the production of satisfactory mechanisms with the method of printing negative film. We should remember that the printing technology at that time was with 'a printing press', printing separately images of cast metal. This was a very costly procedure. Finally, the method of negative film was utilized in printing, in cheap printing environments.

Up until 1959, Haloid improved the equipment and circulated the copy machine #914—the first real photocopy office machine. #914 was a revolutionary innovation. The competitors, the 3 M Thermo-Fax polygraph by the company AB Dick and the Kodak Verifax were outstripped in a relatively short period of time. The machine #914 was so successful that spearheaded technology and dominated the market up until 1972.

The photocopy was discovered in 1938, but it was only in 1959 that the initial discovery was applied and became an innovation. The 19-year journey from discovery to innovation was wasted in finding a financial partner to further develop the idea (1938–1947) and later in trying to determine a market (1948–1959). From the '30s to the '50s, the office technology was characterized by the carbon paper and the upcoming offset printing method.

The carbon paper allowed for the copying of a document in real time in probably more than 8 copies but the cost for 8–500 copies was prohibitive. What Chester Carlson and Haloid initially found in the market research was that there was no need for innovation. The challenge for Haloid was to develop a market.

The first reproduction machine of copies through the photocopy was presented in 1949. The market gained was in between the developing offset printing technology. In particular, the first photocopy machine by Xerox fixed as direct target to manufacture document reproduction mechanisms with the offset method (conversion). The mechanisms would be used successively in the reproduction process of identical documents, making therefore photocopies. The copies' creation mechanism by Xerox for the reproduction with the offset method was expensive and complex to operate and soon would be replaced by another one, based on photography and being less costly. As long as Haloid Company was being focused again on substituting the carbon paper technology, it fared well with the introduction in 1959 of the photocopy machine #914. This combination of market pull and technology push would generate revenue and profit in the '70s. Since the early days of Haloid

unregulated innovation, Xerox has elaborated a culture for innovation organization. At the same time, in the organizational chart of Xerox, the Innovation Group refers directly to the chief executive officer. This stresses the primordial role of innovation for an organization.

Xerox kept on innovating throughout its history although it was not always successful. In 1973 the first desktop computer was presented driving the revolution of PCs. Xerox, due to its marketing strategies, to be discussed further down, did not profit from this development. For a second time in 1977, it developed the laser printer but did not move quickly to dominate the early laser printer market, as did the competitive company Hewlett-Packard.

Xerox corrected its innovation strategy when it introduced in 1990 the black-and-white high intensity printer system, DocuTech, creating thus a digital revolution in placing words on a piece of paper. Later in 2002, it introduced iGen3, a colored version of DocuTech technology, hoping that this would mark the launch of another revolution, that of digital color, and would bring Xerox the economic reward of innovation.

To fully understand Xerox, we should have a picture of the entire raft of products and services and the market share it holds. Therefore, the two main categories—products and services could be classified further (see Table 3.1):

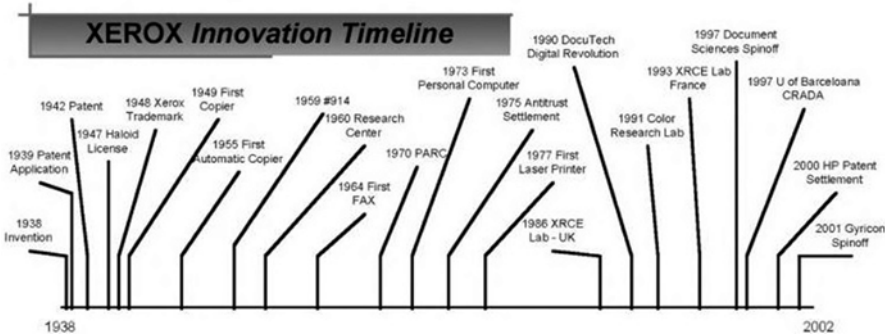
- **The products encompass office maintenance, production, equipment and**
- **The required support services and**
- **The services consist in resources, reverse engineering process, solutions**
- **(embedded services) and software applications.**

It is interesting to underline that searching for products and services on a diachronic basis revealed some interesting things, some of them being the heart of Xerox innovation portfolio—electronic typewriters, working mechanisms and computers. These do not figure in the current portfolio anymore.

**Table 3.1** Innovation measures—hard vs soft

Hard Measurables		Soft Measurables	
Characteristic	Measure	Characteristic	Measure
R&D	<ul style="list-style-type: none"><li>• Patents</li><li>• R&amp;D Budget</li><li>• New Products</li><li>• R&amp;D Staff</li><li>• Publications</li><li>• R&amp;D Incentives</li><li>• New Features</li><li>• Inventions</li><li>• New Markets</li><li>• Product Extensions</li><li>• Conferences</li><li>• CRADAs</li><li>• Partnerships</li></ul>	Impact	<ul style="list-style-type: none"><li>• Productivity</li><li>• Growth</li><li>• Lower Costs</li><li>• Flexibility</li><li>• Supply/Demand</li><li>• Firm Size</li><li>• Market Influence</li></ul>
		Social	<ul style="list-style-type: none"><li>• User Benefits</li><li>• Lower Prices</li><li>• Social Enablers</li><li>• Time Savers</li></ul>

**Table 3.2** XEROX innovation timeline (Carayannis et al 2003)



Xerox sells its products through various channels-in various ways including direct selling, telemarketing, after sales services, agencies, donations and through the web. These modes of selling are managed by various organizations—see the table below. The sales organization is global and is divided in regional departments. The largest sales organization is the one in USA and is covered by North American Solutions Group (NASG).

Almost 50 % of Xerox employees are working for Xerox Services, with most of them being placed in the customer-sales store. Xerox sales and the distribution channels are displayed in Table 3.2. Business solutions are an area of understanding that many Xerox researchers found hard to grasp. Xerox defines ‘Solutions’ as an ‘integrated proposal that includes materials, software and human-based services that solves a problem, improves a project, and creates a market or a competitive advantage’. Xerox has divided the provision of Solutions to 4 main business functions and focuses on market production (graphic arts companies), office market and services. The four groups are Documents Systems and Solutions Group (DSSG), Office Systems Group (OSG), Office Printing Business Group (OPBG) and Xerox Global Services (XGS).

**3.2.2 Innovation: Sequence of Errors**

In 1970, Xerox developed the Palo Alto Research Center (PARC), being famous as the center of computer revolution. PARC researchers were given the ease to conduct basic research from the beginning. This led, among other discoveries, to the first personal computer in 1973 and the first laser printer in 1977.

The personal computer was sophisticated for its era consisting of a software system, a text editor WISYWYG, a graphic environment for the user interconnected to a desktop surface, a mouse and an Ethernet connection. With this state-of-the-art discovery in its portfolio, Xerox would drive the computer revolution-but as history

shows us, Xerox did not profit from this unprecedented discovery letting others lead the genesis of a new market. The question addressed to researchers of innovation is why Xerox let this happen and what could be done to avoid this type of costly mistake in the future! In other words, what is the lesson to be taught from this?

In order to understand Xerox strategies, researchers are trying to find the solution exploring the history of innovation of Xerox and taking interviews from basic players of the era. In such an interview with Mr. RT, a Xerox veteran for 30 years and business executive connected with the control center of the business in West Coast for the largest part of his career, the following information was taken.

In '70s, besides PARC, Xerox held an important control center of the business in the West Coast. You should remember that the Xerox base is in Rochester of NY, where the largest labor force worldwide is placed (16,000). The man who envisaged the 'office of the future' was Joe Wilson II, later President of Xerox. At that time, except for PARC, Xerox—West consisted of Versatec (regionally), XSoft (development of software applications), Xerox Network Services (Ethernet, networks), Sughart (construction of discs), Total Recall (scanning and retrieve applications) plus a construction capacity of photocopy machines and materials. This was a very advanced portfolio of technical capacity and technical power of those times.

PARC since the beginning of '70s was a central institution for arranging computer information. It developed a professional forum as a tool to give incentives to researchers. Every week it used to host a public event ("FORUM") to allow its researchers to present the results of their researches. "FORUM" was addressed to professionals from universities outside Xerox, engineers from the developing computer industry and others interested in research. This early contribution of knowledge helped to the birth of computer industry in the area of Silicon Valley.

When the personal computer was initially developed, Xerox strategy was to promote PC as a private tool of an enterprise. It was mostly a 'portable' computer than a 'personal' computer. The computer would comprise a 32" broad portable unit and a hard disc that could be transported and be moved from place to place, as required. The computer was placed in an interconnection terminal. The initial software, MESA, was unique. We should stress that MESA finally became the base of artificial intelligence systems of our time.

The PC was named with the code STAR and was soon introduced in the market as the mechanism 6085. Finally, a by-product was formed called Global View and the computer later became known as Global View System. Approximately 50 applications were developed, such as text editor, spreadsheets programs, graphics programs, specialized graphics (chemical and mathematical applications), messenger programs, hyperlinks, browsers, etc. It contained many particular characteristics, such as the application "CLEARINGHOUSE" (clearance application), giving users a knowledge distribution area. An application enabled users to create applications upon demand (a JAVA precursor). All applications were privately owned and could be used only in the Global View system.

In the same time, Xerox started staffing the West Coast administration with former IBM management executives, most of them with powerful activity.

It should become known that the upcoming PC market was influenced by three large players of the era, i.e. Xerox, IBM and WANG. As we may know from various IBM studies, the management's ability and experience (former IBM executives) could not be harmonized with the PC market developments. Introducing the power of experienced IBM management executives, Xerox probably made its biggest mistake. Former IBM executives did not fit in well in the existing Xerox culture and had a hard time to disseminate their ideas in Xerox management infrastructure. Xerox management executives had the right vision and lagged behind in the appropriate execution.

While Xerox nurtured the vision of 'the office of the future', it was not sure how to promote it in the market. Xerox was known for the selling of photocopy machines and it fared very well. The PC market was established—overwhelming—standardized and Xerox management had a hard time foreseeing the progress of the industry. It focused its strategy on the commercial axis 'business-to-business' (B2B) disregarding the 'personal' or amateur market (B2C), as was known. As the market target was business to business, the selection of privately-owned systems showed it was the best strategy. It was later when it became known that the PC industry development was driven by amateurism that was the bridge between the offer of in depth knowledge and the computer usefulness for personal and business use.

The market was better delimited with the rise of Apple computer. It is interesting to highlight that the main attraction of Apple computer was the common graphic surface/desktop/mouse, an idea borrowed during a visit to PARC. Another point of discussion in Xerox, narrowing down the market strategy, was the alignment of sales power. Xerox possessed a well-trained and equipped sales team aligning the photocopy machines with the provision of material (H/W) and services of added value. For Xerox to capitalize on this novel innovation, the computer, a sales labor force was required which was aligned with a different fundamental product—the software (S/W) in the sense that it had the capacity and experience to sell services (software). Xerox strategy did not take into consideration the re-alignment of its sales labor force and in particular its remuneration objectives. Xerox had a successful sales team particularly because its remuneration objectives were very liberal.

In order for the existing trade-off plans to benefit each salesperson separately, the only solution for computers' sale, being attractive from an off-setting point of view, was to sell a multi-million dollar computer.

During '70s the only customers who were able to invest millions in computers were the current powerful computer customers of IBM, WANG, Digital and others. Therefore, the computer market based on B2B axis was not sustainable. Large companies were not ready to shift from high-power computers to personal computers even if they were networked. The results were obvious. Another barrier to success was the different corporate mindset or culture: Xerox was domiciled in Rochester of NY and the computer revolution rose in the West Coast of the USA; the mentality gap between East and West Coast is significant. The subsequent clash of cultures led to a Not-Invented-Here Syndrome that worked as a hindrance to the successful transfer of technology and XEROX innovation promotion.

The new inventions originating from the West Coast were not immediately understood because the sources of knowledge and the management for innovation support were based in Rochester. A case in point is the development of network technologies by Xerox. The technology was developed in West Coast control centers and was then transferred to Rochester for further development—a clear case of cultural conflict, as Rochester owned a small infrastructure to support the upcoming internet technology. Funding and marketing decisions, being based in Rochester, lacked the strategy to be aligned with the perceptions of the upcoming market. Focus was placed on the marketing strategy of photocopy machines and the PC marketing was not aligned with the marketing strategies for photocopy machines. The object of marketing strategies for recently emerging markets was erroneously explained. Cultural differences had not been promptly identified and XEROX executives did not handle them appropriately.

Finally, XEROX traded Global View in non-privately owned environments, such as IBM 6000 and with compatible concepts in IBM / Microsoft (MS) ideas adopting the strategy of “competitive cooperation” (co-opetition) but the decision taken was delayed so it failed to ensure a share in the market of said technology. Commercial isolation was encumbered with technological inconsistencies. For example, the personal IBM computer, when it followed the MS platform, did not have sufficient memory to run the Global View of XEROX and because the sufficient memory cost was too high for the era, the overall installation cost was prohibitive.

There was an effort to utilize the products of technologically advanced organizations but organizationally cultural influences and oppositions got in the way. In the beginning of ‘90s, Xerox strategy showed that technological research centers in West Coast are about to shut down and to merge with the Rochester-based organizations in NY State. At present, PARC in Palo Alto of California and the research centers of Xerox in Ontario, Canada and in Grenoble, France are guided, directed and managed by Rochester technological administration, NY.

Another influence on Xerox innovation strategy was the anti-trust arrangement of 1975. According to this arrangement, Xerox agreed to open the dossier of its intellectual rights property and issue a license to use some of them previously considered technology of Xerox exclusive ownership. While the arrangement did not impact directly on Xerox culture, it finally influenced its innovation strategy, as proven, by the current Innovation Group organization.

Intellectual property became a source of revenue for Xerox. It took a generation to change this culture and become fully applicable.

As typically described in the Xerox example, the other side of success is a list of innovation’s failures.

The failures of innovation are summarized as follows:

1. Management of intellectual property rights—Patenting and taking advantage of strategically corporate secrets
2. Influences of diverging mindsets and management strategies of technological and business risk
3. Strategic development of markets



One cannot accept the reasons of failure without making a valuation and assessment that would enable translating failures into successes in the future.

In the first failure, management of intellectual property rights—Patenting and taking advantage of strategically corporate secrets, the strategy used by PARC to recognize the production of researchers led to the disastrous result of exposing corporate secrets to competitors without managing exchange within certain legal boundaries—such as Credos (Cooperative Research and Development Agreement), i.e. licensing agreement or other arrangement to control the share of knowledge. Dissemination of technology needs to be safeguarded by suitable policies and practices for its protection. The creation of inventions and their commercialization via innovations is hard and should not be obstructed by uncontrolled flow of information undermining profit margins.

The second failure refers to the influences of diverging mindsets and management strategies of technological and business risk. This is a complex subject of discussion as the culture of an organization may not be directly obvious. In the case of Xerox, it can be considered that there are two distinct cultural influences.

Initially, the company was largely influenced by the aspect of creating a ‘home office’. Rochester in NY was the operational center of Xerox with an employee concentration of more than 20 % of the total labor force. Rochester is also home to the historical influence of innovation up until the middle of ‘40s. In 1970, when the innovation center (PARC) was developed in West Coast, there was a natural reaction by Rochester group of employees against the fact that Rochester was not the innovation center’s base. Moreover, the management of West Coast divisions mainly consisted of persons recently recruited by IBM. Xerox culture and IBM culture were not compatible resulting thus in an additional separation from Rochester.

The third failure, the market development strategy, is practically linked to the existing cultural influences. Since Rochester, home to the marketing department, was not culturally linked to the West Coast divisions, the marketing department failed to comprehend the essence of discoveries being made in PARC and in the West Coast divisions. This lack of understanding was deleterious for any marketing plans developed. Rochester was not grasping the real meaning of the discoveries, tending to challenge the place. The lack of understanding led to mistaken marketing plans and to underestimating market capabilities.

At the end of the day, what is the lesson drawn from XEROX case analysis study? Innovation can be considered as a coin with two different sides. On the one hand lies success—a history teeming with discoveries that can evolve into innovation. On the other hand, there is failure—either due to lack of discoveries or due to non-converting the discovery into innovation. Remember the definition of innovation given above, i.e. as a kind of implementation or application of a discovery for rendering new solutions or improving existing solutions, desires or needs of the market.

The case of Xerox provides us with examples of aspects of innovation, the rich history of successes and the disenchantment of failure. It also supports the definition given on innovation and the important criteria for the distinction between innovation and invention.