Chapter 2
Evolution of the Web

2.1 Evolution of Information and Communication Technologies

The importance of Information and Communication Technologies (ICT hereafter) in current society is highlighted in many sources. One illustrative example is the words of Kofi Annan, the ex-secretary general of the United Nations:

> Information and communication technologies are not a panacea or magic formula. But they can improve the lives of everyone on this planet. (...) We have tools that can propel us toward the Millennium Development Goals; instruments with which to advance the cause of freedom and democracy; vehicles with which to propagate knowledge and mutual understanding. (Annan, 2003)

In our current society of knowledge and information, considered by some to be the "Era of Information," has ICT at its very core, which affects all aspects of daily life including the economy and businesses (Garrido, 2010). The ICT are an amplification of the Information Technologies (IT), which includes a wide range of technologies based in information systems, apart from computing Martínez-López and Luna (2008) point out four major changes in the ICT's evolution in recent decades:

- Between 1960 and 1980 there was the first period characterized by the focus on large machines, mainframes (central units) and the beginning of minicomputers. In this phase they were primarily used by large companies and institutions.
- The eighties were characterized by the expansion of personal computer use, stemming from the appearance of IBM's PC in 1981. From then on, companies have progressively integrated their use into the business setting.
- The momentum of the Internet in the nineties produced a paradigm shift, gaining importance in external communications. This phase had the establishment of connections between all areas and levels as a priority, making the computer into a ubiquitous element of life.

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- The fourth phase, in which we currently find ourselves, is characterized by the appearance of convergent, digital multimedia content, promoted by the maturation and possession and use of information infrastructures at the global level, causing evolution towards the Society of Information and Knowledge.

Peattie and Peters (1997) summarized this process in three phases:

- *The computer age* (from the seventies through the beginning of the eighties): characterized by not yet generalized ICT due to their unavailability. However, there was a growing consciousness about the strategic importance of ICT in the collection, storage and management of information.
- *The PC age* (from the middle of the eighties through the beginning of the nineties): the availability of PCs to small and medium businesses and to consumers increased the use of ICT in the development and execution of business strategies.
- *The communication age* (from the beginning of the nineties): the capacity of communication and connection within and outside of companies grew, leading to changes in distribution channels and permitting direct contact with consumers.

Currently, the adoption of and investment in ICT is increasing on a global level, showing surprisingly high growth numbers over the last two decades. ICT offer extraordinary opportunities for the evolution of business information systems and for electronic commerce (Weber & Kauffman, 2011). The possible benefits derived from the use of ICT have been analyzed in various contexts including the labor market, education, health, commerce, etc. The interest in ICT stems from the radical changes caused by its adoption and its effect on the evolution of ways to establish relations between various economic agents (Pérez-Hernández & Sánchez-Mangas, 2011).

ICTs are ubiquitous in the social, work and business levels of society, and it is predicted that they will continually play an increasingly vital role in daily life. ICTs allow people to develop their activities more quickly, easily and efficiently, and allow companies to deduce their inefficiencies, accelerating and improving their processes. Additionally, improvements are seen in equal measure in communications within companies as well as between companies (Ghadar & Spindler, 2005).

Aside from the progress and change in life-conditions and the social change around the globe (Rico, 2005), ICTs have had a clear impact on the business world; they have brought about modifications of distribution and production processes (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013), as well as of work organization (Rico, 2005). Information is gaining ever greater importance and taking on a significant role in business. ICTs, by means of creating communication networks that increase the availability of information and improve compatibility among networks have become a key part of developing relationships with clients, employees and other businesses.

Lately, this has forced companies to redesign their organizational processes to avoid being left out of the game (Ahadi, 2004; Bharadwaj et al., 2013; Sieber,

2004). All these changes are made with the end in mind of adapting and improving companies' competitive edge. They contribute to the improvement of productivity in terms of fabrication, business efficiency, market penetration, cost reduction and elimination of manual work and processes, all of which help to strengthen a company's competitive advantage (Brynjolfsson & Hitt, 2000; Fuentelsaz, Maicas, & Polo, 2005; Martín, 2010; Rico, 2005; Sieber, 2007).

Additionally, ICTs have reformed traditional businesses, which have adapted to a strategy that is modular, distributed, interfunctional and oriented towards global business processes. They allow work to be done regardless of time, distance or function (Bharadwaj et al., 2013), and they blur the line between digital products and the concrete ICTs supporting them (Bharadwaj et al., 2013; El Sawy, 2003).

Bharadwaj et al. (2013) analyzed ICTs' current situation from a strategic point of view. They point out that, traditionally, the business strategy of a company directs strategies and actions related to ICT (alignment view). Due to businesses' becoming increasingly digital—from the transformations that have integrated ICTs into processes, capacities, products, services, etc.—it has become clear that, rather than there being a hierarchy between a business's strategic direction and the direction of the ITC, a fusion of the two must be created: digital business strategy. To better understand this, the scope of action of the ICTs, their scale, speed and the sources of value creation must be studied.

The ICT revolution is increasing both people's job skills and consumer sophistication, augmenting education and awareness on a global level. In this way the increased use of technology and the increase in work productivity are supported, which, in the end, leads to economic growth (Quah, 2002, p. 22) and transforms social relations among consumers and between consumers and businesses (Bharadwaj et al., 2013; Susarla, Oh, & Tan, 2012) (oh god, rework that).

Penetration of ICTs affects growth by diffusing knowledge and improving businesses' decision-making abilities, which in turn increase efficacy and efficiency of finding information sources. Additionally, product costs are reduced while demand and investment are increased, resulting in progress in both production and growth (Khuong, 2011). Therefore, the capacity to receive information more quickly and with greater security produces changes in the internal organization and structure of companies as well as in their external relationships (Martínez-López & Luna, 2008).

Since the middle of the nineties, researchers have been studying the organizational and economic changes that companies underwent when integrating the Internet into their production processes. It has been observed that information has improved decision-making, facilitated interconnectivity with other business and consumers and has increased productivity. Also, the Internet has increased consumers' choices, allowing consumers access to a considerable number of options, usually beyond the limit of what they can consciously analyze (Feldman, 2002).

2.2 Evolution of the Web

Friedman (2006) points out that the world is becoming flatter, due to diverse flattening agents including ICTs, which accelerate global changes. The modern world is increasingly virtual, globalized and connected thanks to the Internet (Castells, 2001).

At the beginning of the seventies, the web was created by the United States Defense Advanced Research Projects Agency (DARPA), with the goal of decentralizing electronic communications. In 1969, DARPA, together with other research groups, developed DARPANET, which came to be called ARPANET (Advanced Research Projects Agency Network) when certain universities and research groups were granted access. ARPANET, based on NCP (Network Control Program) protocols, was considered the backbone of the Internet. From 1982 on, ARPANET and all other existing networks switched to TCP/IP, which is a collection of general guide designs and specific protocol implementation that allows a computer to talk to a network. The same decade saw the appearance of DNS (Domain Name System), a system of hierarchical nomenclature for computers, whose objective is to make the equipment connected to a network localizable and controllable (Pfaffenberger, 2002).

At the beginning of the eighties ARPANET split into Milnet and NSFNET, each of which had different objectives. Milnet came to be used for North American government services, while NSFNET became a network used for academic and research purposes.

By the nineties, with the emergence of the World Wide Web (WWW) and the associated protocol, http (hypertext transfer protocol), the Internet was coming to resemble the web we know today. The emergence of the World Wide Web and hypertext transfer protocol alleviated the congestion of web traffic and increased the number of users who could access and use it. Since then many distinct versions of Internet protocol (IP) have emerged, the most noteworthy of which are IPv4 and IPv6. The latter of these came preloaded on the majorities of computer systems.

The use and expansion of the Internet, along with the appearance of a great amount of companies that were either web-based or were accessible via the web, occurred extremely rapidly over the course of the nineties. In 2001 the "dot-com bubble" burst, marking a crucial moment in the development of the web when many concluded that expectations about the web's business potential had been greatly exaggerated. However, this crisis was nothing more than the starting point of a great, continual ascension that continues into the present. This expansion has allowed agents and technologies with the right capacities to arise and take their place (O'Reilly, 2005).

The Internet has hugely affected how we live and completely modified the human experience. In a way, the Internet is used as another form of media, albeit one better suited than others to finding information, buying or selling products, watching television shows, searching for friends and entertainment and for participating in political circles (Correa, Hinsley, & Gil de Zúñiga, 2010). Tutschku, Tran-

Gia and Andersen (2008) have noted that the Internet is more than just a collection of physical networks made of IT equipment, but rather something that has evolved into a network of applications with information and content, making the user into a participatory element. Therefore, the Internet functions as a structure, within which users participate freely, with intelligent applications based in knowledge and services and whose rapid evolution forces the constant creation of new methodologies to implement and operate in layers of applications and networks superimposed on one another.

The Internet has evolved due to the changes and advances of the technologies supporting it. These technologies, as well as the focuses and philosophies underlying the management and development of the web, have been given various names for different versions, from the era of the PC through the future Web 4.0. As of yet, no one has come to an agreement about what to call the current era. It is generally accepted that we are witnessing phase 2.0 of the Web, although some believe us to be in phase 3.0 and others even go so far as to say we are living in the stage of Web 4.0. In any event, the defining elements lie in the differing opinions about which distinctive factors conform to each version. What is generally accepted is the importance of content created through user participation to the evolution of the Web.

Weber (2007) says that we are currently in the third phase of the web but that we will soon be entering the fourth. He explains that Web 1.0 (1989–1995) was the era of pages built using HTML. Web 2.0, which began with the arrival of browsers, allowed people to navigate the web, search and participate in e-commerce efficiently, which set the basis for the Social Web, the advanced version of Web 2.0. Web 3.0 has arrived in recent years and conforms more to the interests of users. Finally, Web 4.0 is known as the Emotive Web and is based in high bandwidth technology that allows for rich and visual content, allowing users to achieve feelings of satisfaction and accomplishment. In turn, WI-FI and mobile telecommunication technologies allow users to connect from anywhere, making access ubiquitous.

2.2.1 Web 1.0

The functionality of the Web was based on a system in which a Webmaster and a content generator (companies, generally) created a web page and added content, which users could then display in a static form (Bernal, 2009). Web 1.0, which is limited in terms of functionality compared with later versions, was mainly used to publish documents and conduct transactions; companies were limited to publishing information about themselves and their products to enable online sales (Cormode & Krishnamurthy, 2008). The following are some additional characteristics (Martorell, Solanas, & Sabaté, 2011):

- *Asymmetrical information flow*. Companies and consumers began having extensive sources of information at their disposal to shape their policies and affect their decision-making.
- *Consumer dispersion*. Few users could generate content as this demanded knowledge and software that was not available to most users.
- *Content created by organizations*. The majority of web sites were created by companies and communication media. They did employ unique languages or strategies for this new channel; the first corporate websites were basically places with advertisements for buying and selling online.

In summation, Web 1.0 had a business model that was based on offline models; it was thought of as another alternative sales channel with no significant differences from other channels.

2.2.2 Web 2.0: The Start of the Social Web

Web 2.0 can be seen as an update or second version of the Internet in which users actively participate in its development and expansion by uploading new content, a key difference from Web 1.0. Another basic aspect is the collaboration and interaction between users, a defining element that makes the web into what is known as the Social Web. This participation and collaboration are manifested in the form of virtual communities, virtual social networks, web aggregators, etc.; tools that will be analyzed later on. Web 2.0 represents a paradigm shift, a change from the distribution of products to the distribution of services, which can in turn be used and combined with other services (Bernal, 2009). The Web evolved from a top-down model to a model in which the users are the genuine protagonists (Maciá & Gosende, 2010).

The term "2.0" was coined by Tim O'Reilly, at the suggestion of Dale Dougherty, vice president of O'Reilly Media, after brainstorming ideas for a name for the "O'Reilly Media Web 2.0 Conference," which took place at the end of 2004. O'Reilly (2005) described the Web 2.0 as a series of principles and practices, including seeing the web as a platform as well as exploiting collective intelligence. He considered the derailing of the dot-coms to represent a crucial junction for the Web, being the starting point for the conference. Web 2.0 is viewed as a second generation of the Internet, based on new technical aspects that appeared towards the end of the last century; it is the result of the implementation and innovation of new technologies and standards within the platform itself (Bernal, 2009). It is based in services and information pushed forward by the communities and users themselves though virtual communities, social networks, blogs, wikis, forums, etc., which make it possible to have a society that is interconnected and able to communicate, collaborate and define the information existing in the Web (Levy, 2009; Paroutis & Al Saleh, 2009). The seven principals of the Web 2.0 as defined by O'Reilly are (Burgos & Cortés, 2009):

- *The Web as a platform*: we use websites as applications.
- *Exploitation of collective intelligence*: the sum of users' knowledge and activities increases the value and activity of the online setting.
- *Perpetual Beta*: software is delivered as a service whose first version (version "Beta") is infinite and the users act as co-developers.
- *Open Models*: open source permits programming and development to be transparent processes, which is imperative for constant improvement.
- *Software is not limited to a single device*: the PC is not the only way to access the Internet.
- *The user is king*: users' online experiences should be based on easy-to-use sites and applications.

Web 2.0's rapid development was a result of users' employing the web in new ways. It allowed the exchange of files peer-to-peer, facilitating communication, collaborative work, democratization of content, and creation of content by users (Lozano, 2008; Maciá & Gosende, 2010). Websites were forced to adapt, switching Web directories to sites that could be labeled as social pages—personal blogs—and online encyclopedias were converted to wikis (Tasner, 2010a).

Social networks, user-generated content, social and intelligent organization of information (RSS, bookmarking, etc.), applications and services linked by mashups stand out as the pillars of the Web 2.0 (Cobo & Pardo, 2007). There are other factors that supported Web 2.0's expansion: the ubiquity of Internet access, the emergence of powerful and accessible analytical systems that generate feedback, the standardization of Web formats that make the integration of content possible, and even the economic crisis, which forced companies to adopt Web 2.0 for competitive ends (Maciá & Gosende, 2010). In Web 2.0 the information, consumers are also producers or contributors; they are "prosumers" (producer + consumer).

Therefore, Web 2.0 is not only an evolution of the Internet, but rather of the use of the Internet as a platform with improves functionality, communication and collaboration; it has allowed an explosion of content, connectivity, and the emergence of new applications and means for interconnectivity between people (Fluss & Eisenfeld, 2009). Web 2.0's tools have switched the focal point of the Internet from business-centric to consumer-centric. This change is precisely what differentiates Web 2.0 from Web 1.0; Web 2.0 is centered on the consumer, and is user-generated, interactive and dynamic, thereby encouraging community participation and building collective intelligence (Singh, Veron-Jackson, & Cullinane, 2008). The consumers of information are also its producers, capable of creating it and distributing it thanks to the availability of a multitude of tools and publication platforms on the Web (Lozano, 2008). These technologies that facilitate publication are a part of Web 2.0's infrastructure; there are content system managers, which enable anyone to create pages for publication such as blogs with no need for Web programming expertise; additionally, there are standardized microformats available that allow the sharing of information with other websites, for example the case of RSS (Rich Site Summary), which will be discussed in a later section.

The websites and applications that emerged in this context exhibit an elevated social component; they allowed profiles to be created and interaction within the site or community, as well as the promotion of user-generated content (Cormode & Krishnamurthy, 2008). As a consequence, the co-creation of content between companies and users on the Web like YouTube, Facebook, Delicious, etc. completely changed the role of the user. Companies have had to familiarize themselves with the concepts born out of the Web 2.0, primarily with the new means of relating to users, beginning an assimilation process that is slow but is expected to create large benefits (Constantinides & Fountain, 2008). Companies must accept that people are becoming as important as the means of communication or the businesses themselves in the generation of knowledge and ideas since they now have the tools and applications needed to express their opinions; this has entailed significant changes in society and the economy (Dans, 2008). Some noteworthy examples of companies having successfully survived the evolution from Web 1.0 to 2.0 and exploited collective intelligence are: Yahoo!, Google, eBay and Amazon (O'Reilly, 2005).

2.2.3 Semantic Web

Many authorities consider the terms "Semantic Web" and "Web 3.0" to be synonymous (e.g., Socco, 2011; Weber, 2007). Other authors point out that the Semantic Web does not constitute a phase in the Web's evolution in and of itself, but rather deals with a series of IT applications and languages that have improved the intelligence of the Web (e.g., Berners-Lee, Hendler, & Lassila, 2001; Fumero, Roca, & Sáez, 2007; Gruber, 2008; Hendler & Berners-Lee, 2010). We share this viewpoint, although we prefer to treat the Semantic Web as an independent section within Web 3.0.

Credit for the idea of the Semantic Web is given to Tim Berners-Lee, who also promoted the languages of HTML (Hyper Text Markup Language), HTTP (Hyper Text Transfer Protocol) and of the URL (Uniform Resource Locator) system. With the goal of improving his research, Berners-Lee tried to include semantic information in the data contained in the WWW from the beginning, however, due to technological limitations, this was not possible. Berners-Lee et al. (2001) believed that the Semantic Web would make information understandable not only to human beings but also to intelligent systems. Since the emergence of the Semantic Web, many web-based applications have been released that would have previously been inconceivable, ranging from semantic search engines to intelligent agents.[1] In this way, the Semantic Web added semantic metadata and ontology-based data to the Web, making it possible for information to be automatically understood and evaluated by processing machines. The machines are conversing among one

[1] Computer programs without human operators that search for information.

another, making the Web into a huge intelligent library where the users program the behavior of the different data flows; this converts the Internet into a neuronal system capable of understanding itself (Cobo & Pardo, 2007). Because of this, Hendler and Berners-Lee (2010) consider the Semantic Web to constitute a paradigm shift, reaching the next level in the abstraction of the Web's basic infrastructure. However, it is important to note that there have been critical voices that point out the extreme technical difficulties related to its implementation (e.g., Codina, 2003).

The main reason that the Semantic Web is seen as a significant evolution within the Web is that it allows programmers and users to reference real objects without importing the underlying documents where the object,—abstract or otherwise—is described (Hendler & Berners-Lee, 2010). This implies that the Semantic Web allows the identification of real elements with words, images, etc. that are available on the Web. Said connection did not previously exist; the Web did not have any understanding of the real significance of the information it contained nor the connections with elements of reality. The Semantic Web implies an evolution of the Internet beyond its standard definition. In this way, the primary difference between the classic Web and the Semantic Web is that in the latter, data is presented in a structured form and are understandable to the system (Gruber, 2008). Therefore, the Semantic Web is a more expansive Web with greater meaning where, thanks to better defined information, users can find answers to their answers faster and more easily, interacting with the systems instead of merely being passive elements (Celaya, 2008; Hendler & Berners-Lee, 2010). Some of the basic motivations for the Semantic Web were born from the failures of the original Web that caused problems with searching and displaying Web 2.0's applications (Hendler & Golbeck, 2008).

The power of this new Web relies on people being able to find what they are truly looking for. The technologies of the Semantic Web, social networks and the labeling and linking of content will be truly useful when they permit people to do things that matter (Hendler & Golbeck, 2008). The Semantic Web permits a new generation of decentralized management of knowledge leading to an improved flow of information with metadata that can be processed by the machines themselves (Cayzer, 2004). Also, the Semantic Web's platform allows sharing and recycling knowledge (Zhou, Ding, & Finin, 2011). The possibilities of this new platform for automanagement of documents and information, both public and private, are infinite. The primary impact of having a self-analyzing Web is a matter of transparency and access to public information (Gross, 2011).

The power of the web increases through the effect produced by links between distinct elements according Metcalfe's Law, which states that the value of a network increases proportionally to the number of elements it is comprised of squared. In the Web 2.0, this effect is largely due to links between people but not to the labels attached to the data that comprise the Web since these have few labels and do not correctly conform in all cases. In the Semantic Web, however, the opposite situation occurs; the value is generated through ontologies and semantic information and their links but lacks connections between users. However it is, the

importance of both Webs is network-based, either between people or between data (Hendler & Golbeck, 2008).

The lines between Web 2.0 and the Semantic Web are established. However, by looking at various perspectives, it appears that the Semantic Web and Social Web are like two worlds with opposing purposes. Although these perspectives ought to be unified, allowing both families of technology the opportunity to advance together in the Web (Gross, 2011). The combination of both technologies is necessary. This will allow exploitation of the links' effect, revolutionizing the modes of interaction on the Web and aggregating sources of data that could then be shared and made available in different places of the users' choosing (Hendler & Golbeck, 2008).

2.2.4 Web 3.0

Many media have confirmed that the Web 2.0 has been rendered obsolete and that we now find ourselves in the next phase: Web 3.0, mentioned for the first time in 2006, which focuses on artificial intelligence and intelligent machines (Socco, 2011). Among the key elements of the Web 3.0, we find the changes in the habits and methods of website displays, the intelligence of available information, the users' search experiences and the opening of the Web (Tasner, 2010b). The combination of machine and human intelligence afforded by the Semantic Web make information richer, more relevant, timely and accessible by using more powerful languages, neuronal networks, genetic algorithms, etc. In this way, the Web 3.0 is focused on analysis, information processing and its later conversion into ideas.

The web 3.0 was constructed as a revision of the Semantic Web. It has a certain amount of artificial intelligence, which is enabled by exploiting patterns created by active users whose activity is registered as well as by analyzing the processes of collective intelligence generated by the dynamic relationships in the Social Web (Fumero et al., 2007). O'Reilly (2011) considers the next stage in the evolution of the Web to be the Web 3.0. She calls it the Web of feelings and collective intelligence; it is a global mind and network. From a marketing point of view, the Web 3.0 is comprised of five key components (Tasner, 2010b):

- *Microblogging*: sites that consist of sharing one's thoughts in few characters. Examples: Twitter, Plurk and Jaiku.
- *Virtual reality worlds*: spaces visited by users to interact with other users in a 3D platform.
- *Customization/personalization*: features that allow users to create a unique and individual experience. Examples: SendOutCards, Google and Amazon.
- *Mobility*: mobile devices and the ability to connect to the red through them make possible a huge amount of new applications.

- *On demand collaboration*: users interact by supervising documents, collaborating and making changes all in real time. Examples: Google Drive, salesforce.com, slideshare.net and box.net.

2.2.5 Web 4.0 and the Future of the Internet

The evolution of the Internet, since its creating, has developed organically, similarly to how the evolution of a living organism. It has been reconfigured spontaneously due to changes in its key components without following any strict model or design (Murphy, 2010).

Thanks to the proliferation of wireless communication, the connection between people and objects no longer has spatial limitations, allowing for real-time integration, reaching a new level of content and making improved analysis possible. In this way, the Ubiquitous Web that has been talked about for more than a decade has taken on a more important and expansive role (O'Reilly & Battelle, 2009).

When considering what would come next in the Internet's evolution, O'Reilly and Battelle (2009) explained that the future lies in what is known as Web Squared, a fusion between the Web and the real world; the Web's growth is no longer linear, but exponential, which is why the next phase is the Web Squared. This new Web would be an evolution of Web 2.0, a platform in which content is generated and shared by users. In this Web, the connections between users and their interaction with technology meld the Internet's users into a "global mind." In the Web Squared, technologies and applications based in semantic, collective intelligence, etc., learn from content, creating more information and making itself worth more than the sum of its parts. Furthermore, one must take into consideration the value created by the fusion of the mobile and social Webs and the convergence between the Web and reality, which will give rise to an augmented reality (López, 2011).

Although it is yet to be examined by the scientific community, various bloggers specializing in Internet and computation-related technological advances have already begun speaking about the Web 5.0 or the Sensory-Emotional Web. Currently, the Web, despite provoking reactions from its users, is itself unaffected by the emotional reactions of its users. However, technologies are being developed that would allow the Web's effects on users to be measured by the Web in such a way that it could register their emotions (e.g., through the phrases that they write or from their facial expression), allowing for greater personalization of each Web-user.