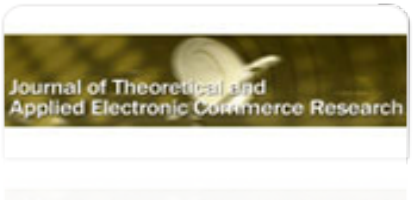

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Editorial: Technological Evolution in Society - The Evolution of Mobile Devices

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Introduction

Constant change is a fact of life, both for organisms and businesses. Just as changes in their environment alters the form of successive generations of organisms over time, changing market conditions cause businesses to adapt their product and service offerings. One of the fastest changing technologies is mobile technology, directly affecting how businesses conduct their operations and the products and services they offer in the current business ecosystem. Therefore it is helpful for companies to understand the big-picture forces behind this technological change.

Thus we ask if it is possible to view technological innovation as an evolutionary process? Certainly the idea is not a new one [4], [22], however recent developments in evolutionary theory could help strengthen the relationship. Central to these advances is the notion that the influence of organisms on the environment plays a much larger role than previously imagined. Just as in biological systems, there is a large influence of technological innovation on its environment. One of the fastest changing technologies is mobile technology, directly affecting how businesses conduct their operations and the products and services they offer in the current business ecosystem. In this article we will first provide a brief overview of current evolutionary theory, then discuss this theory in the context of technological innovation through the use of recent examples in the mobile technology world.

Evolution

To frame this discussion, we must ensure that we are clear in how we define evolution. We will use the basic principles of variation, heritability, and differential survival as the basis of our discussion.

1. *Variation* – individuals of a species show some variation in traits, be it physical or behavioral.

2. *Heritability* – offspring of an individual will in some way represent that individual more than another random individual.

3. *Differential survival* – an individual that is better adapted to its environment has more chances of surviving and leaving offspring than one that is not.

In relation to evolution, these processes are often thought of as a one way – the evolution of organisms is a result of their environments. Organisms that have beneficial mutations leave more offspring, and their genes survive and thrive. Those that don't perish. The criteria of what is beneficial is left to the environment – organisms that have characteristics that favor their survival and the survival of their offspring are *selected* by the environment. However there is an increasing realization among evolutionary scientists that the organism shapes the environment as much as the environment shapes the organism. This realization can be seen in recent theoretical ideas regarding niche construction [14], the extended phenotype [6], and heritable cultural variations [10].

The end result of this feedback is that instead of looking only at the organism as the evolutionary construct, we must also look at the entire system in which the organism resides and how it is affected by the organism's activities. A biological example of these feedbacks is that of parasites and their associated host organisms [7]. There are parasites that use their host's resources lightly and sustainably, causing little long term damage to the host. However, other parasites do not do this and cause great damage to the host in the search of rapid reproduction. But there is a trade-off, for if they cause too much damage to the host, it is possible that the host may die before the parasites have a chance to be transmitted to a new host. In the later scenario, over-exploitation lessens the survival chances of the parasite, and thus it ultimately is less fit than those of its relatives that use the host's resources more prudently.

In the technological market, we can envision the producers or products as the individuals in our system, depending on our focus, and the rest forms their *environment*. The immediate environment has the most effect on the individual – so if we choose to focus on a product, the most influential factors in its success apart from its own design are: its market, its maker, and the competing products. One can easily see that variations of a product and its competitors have *differential survival*. This covers two of the principles, leaving only heredity to be discussed.

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Do products have heredity? This is an interesting question, as at first glance they do not appear to have the requisite attributes. However, we argue that the heredity of a product can mainly be seen in the influence of its makers, and, if applicable, the prior versions of the product. The makers invariably have a design philosophy that influences the physical design of a product and how they undertake the engineering problems associated with the production of the product. At any given time and locale, there are a set of tools available for the fabrication of a technological artifact. These factors act, implicitly, as the genetic material of a product, with the final versions being the outward expression of the genetic material.

Systems Theory

Once we adopt a systems view of evolution, there is an added need to define what constitutes a successful system. Along these lines, Richard Dawkins has stated that evolution is just a "special case of the more general law of survival of the stable" [5]. So really, we are interested in those systems that persist for longer amounts of time – a system being defined as some *entity* containing parts with consistent and persistent patterns of interaction [16]. Successful systems are those that are stable in some form, such as a human, a business, an ecosystem, or an economy.

This is not to say that a stable system is one where there is no change – systems can adapt over time. Organisms adapt to changing conditions in their environment, ecosystems adapt to new constituent species and businesses adapt to changing market conditions and the loss of key employees. Characterizing this adaptation and its limits is of paramount importance to ecologists, biologists, and economists. When a system passes its limits of adaptation, it *breaks*, i.e., the patterns of interaction are no longer persistent and consistent.

One theory of breakage was posed by a cybernetician, W. Ross Ashby, who talked of ultrastability [1]. The idea behind ultrastability is that once systems move beyond the limits of their adaptability the patterns of interaction break down and the system ceases to exist. The constituent parts then reorganize themselves into a new system with different stable patterns of interaction. Expanding on this idea, evolution can be seen as the search for systems that exhibit this property of ultrastability, as it aids in the survival of the various subsystems.

For example, there is a qualitative difference in reactions when a rock breaks versus an organism dying. Both can be seen as an example of systems breaking, but when a rock breaks, the patterns of interaction do not change. However, when an organism dies it becomes host to a whole gamut of systems which form new patterns of interaction i.e., the various organisms that inhabit a dead organism and processes that occur as they break it down. This reorganization is an example of an ultra-stable system. Ecosystems, political systems, and technological systems show similar responses to breaks.

Evidence for the ideas of ultrastability can be seen in the phenomena of punctuated equilibrium, where long periods of relative stability are punctuated by rapid change [8], [22]. While there are many theories on why this happens, we take the view that these rapid changes are brought about when the limits of adaptability are surpassed and the system is forced into a new stable state.

Feedback between Technology and Society

Technology in general, and especially Information Technology, has affected people and society in different ways. In some societies information technology has positively impacted the economic development and the best example is today's global economy. This has also produced a new leisure class in society and affected the way people live. For example, the use of information and communication technologies such as the Internet has allowed people to see other places without physically visiting them, or taken a person to an artistic or sporting event that happened in another country. Based on these same technologies, businesses have adopted new ways of selling and buying goods and services. Mobile devices, such as smart phones, have changed the way people communicate and provided a new platform in which to offer services in a more expedited and agile manner than previously. In the past, we have assumed that the development and implementation of new technology was based on the fact that people usually adapt and learn to use it [20]. Researchers have supported this approach by studying users' motivation [9] and satisfaction [2] with the new technology. In other cases, they have studied the impact of technology on performance and productivity [3], [21].

So how does the previously discussed theory of evolution and systems theory help us to understand the dynamics behind shifts in technology? Technology and society are inexorably intertwined. The needs of society create the need for various technologies, and new technologies generate new needs for society. History is littered with products that have failed, even though they were more advanced than their competitors. Reasons for their failures are numerous – deficiencies in marketing, problems with the product, mismatches between societal needs and product specifications, etc. Looking at these from an evolutionary viewpoint, we can see these failures as environmental conditions not matching with the provided solutions.

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Ultrastability

Once technologies are generally accepted by society, they may experience only incremental updates to make them even more suitable to users' needs. Some technologies may settle into a stable and extended state where there is little change – a period of stasis in evolution theory. However, disruptive or competitive technologies may cause pressure on this state, eventually causing it to *break*. When the state created by the technology-society relationship (the system) breaks, the technology may die, it may survive unchanged with another use within society in general, or it may change and adapt until it settles back into another stable state.

An example of this is personal computer (PC) technology. For many years computer use has been associated with the desktop PC or notebook PC, where the devices are relatively large and stationary. However, advances in technology have permitted the development of smart phones, that offer small color touchscreens and constant internet connections. This has produced a break in the status-quo and caused upheavals in software manufacturers.

Microsoft (MS) built its fortune on products for the PC (desktop and notebook) market. This market remained fairly static for many years, and thus their product offerings did as well. When mobile devices started coming to the forefront MS attempted, with little success, to shift focus with products such as Windows CE, Mobile, and the various Phone versions. Instead, mobile phone, tablet, and music devices were dominated by other companies such as Apple, Google and Blackberry. Recent developments have seen Microsoft partnering with Nokia in an attempt to once again break into the mobile phone market. We consider this an example of the evolution of their technology and product offerings where they were seeking to transition into the post-PC world — equivalent to adapting to the changing technological landscape — looking for another stable state.

Maladaptive Features

In stable systems where adaptive change comes slowly, sometimes features can become maladaptive. In the natural world an example of maladaptation is the case of the feathers of a male peacock. The excessive plumage has a high cost for the male bird because it is heavy, requires massive energy investment to grow/maintain, and makes the bird more likely to be killed by predators. However, because the birds with the biggest plumage are more likely to be chosen by the females as mates, those with big feathers are more likely to leave offspring. This is analogous to Microsoft's initial attempts at an operating system for mobile devices. Their first attempt, Windows CE, was designed to be consistent with their desktop yet optimized for small screens [23]. While successful on the PC, this consistency harmed their mobile efforts [18]. In the mean time, their competitors were successful with a new interaction approach for mobile devices. The later version of Microsoft's Phone 8 is more similar to this new paradigm than to their initial attempts. In this example, we see how the success of the Windows PC interaction environment practically obliged them to make the wrong decision of basing the new mobile interaction software on an operating system that had been initially designed for completely different needs. In other words, successful features in one market can be maladaptive features in another.

Niche Construction

Niche construction is the process in which an organism alters its own environment or the one of other species, frequently as a means of increasing its chances of survival. It is as important to evolution as is natural selection. An environment causes changes in species through selection and species cause changes in their environment through niche construction. Apple's success in recent years can be seen as an example of this process.

The start of Apple's success was the iPod media player and the iTunes media store. Prior to the introduction of the iPod, many companies offered their own digital music and media players. However the iTunes media store offered consumers a means of cheaply obtaining legal digital music. The rapid availability of digital music and Apple's slick marketing campaign created a large demand for the iPod music player – creating a niche for its products [12]. A subsequent version, the iPod Touch, introduced the touch screen interface to consumers. From there, Apple introduced the iPhone – an iPod Touch with phone capabilities. Apple also leveraged its iTunes store know-how and created its application store, which is credited with the success of the iPhone [15]. Once again, this is an example of Apple creating a niche through services and marketing for its own products. In fact, part of the reason for the iPhone's success was the success of previous Apple products such as the first generation iPod. This is a clear example of technological products modifying their own environment.

Competition for The Same Niche

When two technologies compete in the overlapping parts of a niche but the overlap is minimal, both technologies can coexist. An example of this is notebook with tablets. Technologies that have a similar niche sometimes compete head to head in the niche for resources/consumers, and when one of the technologies is superior to the other in utilizing the niche, the second technology disappears from the market (ecosystem). The competition may be intraspecific (technologies of the same kind) or interspecific (technologies of different kinds). This situation has a

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clear example in IT now that some computer manufacturers have announced that they will stop making netbooks. Manufacturers developed the netbook, idealized as a solution to the communication needs of frequent travelers and Web surfers. Smaller and lower priced than notebooks, these devices had just enough power to browse the web and check emails.

The key to netbooks was that they were handy and could connect to the Internet almost anywhere. When introduced in 2007 they were extremely popular, but their popularity started to fall with the advent of the iPad tablet in 2010. Now tablets dominate the market, many with always on Internet connections supplemented with WiFi.

On the other side, full notebook prices have fallen to the point where they are competing on cost with the netbooks, but offer larger screens and more powerful processors. The high end of the market is dominated by ultrabooks – extremely thin and light notebooks favored by business travelers.

The rise of the netbook showed consumers the need for an ultra-portable device and that they did not need a large amount of computing power to fulfill that need. This created a niche in which the tablet computer form factor could survive and thrive – thus, the mobile evolution has created its own market conditions where the netbook seems unlikely to survive.

When two species compete for a resource, they can either do so through exploitative or interference competition. If the resource is indivisible, the competition is that of interference, the fight will be direct and only one or other will survive. If the resource is divisible, the competition may be exploitative. The species will share the resource, accessing it at different times or places.

Hardware and Software vendors (Apple, Intel, MS) are not open to full portability or interoperability among devices causing interference in access to a resource. Some Apple devices can only be connected to other Apple devices, even though they may be using a standard communication protocol such as Bluetooth. Another example is the lack of full compatibility between MS Office suite and Linux-based office software.

Technology manufacturers try to avoid competition for the same niche, sometimes building a new niche from scratch, or through product differentiation, and if it is really necessary to compete with others, they tend to protect themselves closing their ecosystem.

Niche Differentiation

The term niche differentiation refers to the process by which natural selection drives competing organisms into different niches or different patterns of resource usage. This partitioning allows coexistence within a certain market and avoids competitive exclusion – where one technology dominates to the exclusion of all others. This may occur through different modes and on multiple temporal and spatial markets. Niche partitioning may not occur if there is sufficient geographic and economic space for products to exist. Two important kinds of differentiation are morphological and conditional. Morphological differentiation happens when two competing technologies evolve into different forms, thus moving into distinct niches and conditional differentiation occurs when two competing technologies differ in their abilities to be used by consumers in a variety of environments.

The tablet had morphological and conditional differences compared to the netbook. Tablets outperform netbooks in the applications department, mainly because the tablet is seen as a mobile and developers considered it as such and built custom applications solely for tablets. Tablets are appropriate for both casual users and company workers, and mobile developers built useful applications such as Dropbox, Evernote, Expensify, Teamviewer, iBooks, among others.

As a counter example, there were few applications developed exclusively for netbooks, rather they usually were the desktop/notebook versions. The tablet with its touch keyboard is easier to use in a variety of conditions, especially on the go. Another niche where two technologies compete through differentiation is the one of netbooks and ultrabook.

The netbook has a small screen size (less than 10 inches) and light weight, but is too uncomfortable and underpowered to do development, spreadsheets and databases. The ultrabook retains the light weight, but has a larger screen, a more comfortable keyboard, and enough processing power to complete heavier tasks. To summarize, the netbook lost the competition for a niche with the tablet and ultrabook because it was not different enough from them and it did not provide what people wanted. In this case, we should say that society imposes its own needs that sometimes have been initially created and shaped by the same technology. Some manufacturers have seen the potential of tablets and ultrabooks in different niches and developed a dual use ultrabook that comes with a detachable screen that can be used as a tablet.

In this case, the key is to create a niche through product differentiation (morphologically or conditionally) to be able to coexist with other technologies competing in the same market, and the dual-use ultrabook with detachable tablet screen is a good example of a morphological differentiation approach in order to be competitive in two different niches.

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Selection Pressure

Selection pressure is any phenomena which affects and impacts the behavior, reproduction and fitness of living organisms within a given environment. The longer an organism lives and the more offspring it produces, in comparison to others organisms of its kind, the better adapted it is to its environment (the more fit it is). The rise of the smartphone is an example of selection pressure. It started having the basic capabilities of the basic mobile phone, and has evolved to have more advanced computing capability and connectivity. Initially it combined the functions of a personal digital assistant (PDA) with a mobile phone. Later models included the functionality of portable media players, compact digital cameras, pocket video cameras, and global positioning system (GPS) navigation device to provide one multi-use device. People used to carry most of these separate devices around and they were crying for this multi-device hardware. The environment pressure was sufficient to impact the fitness of the new versions of this technology. Many current smartphones have evolved to also include high-resolution touchscreens and web browsers for mobiles that are capable displaying standard websites as well as mobile-optimized pages. High-speed connectivity for data access is provided by Wi-Fi and mobile broadband. Nowadays, the prolific rise of mobile application markets, and of course the development of mobile commerce applications, has been the main driver of smartphone acceptance and adoption. Once again, pressure from society has made a technology adapt to the market in order to satisfy its needs, and at the same time produce new pressures.

This example highlights the importance of market research and other approaches to gathering requirements and desiderata from current and potential users of a particular technology with the aim of achieving a better and more useful product in a faster and more organized manner.

Evolutionary vs. Revolutionary Products

Most new classes of products start from scratch, and therefore there is not sufficient information to determine how they will be used. Including many features at the beginning does not provide much benefit. Initially MP3 players only permitted to load music files from a computer and play them on the go. Later users defined the main set of desired features. Nowadays, the MP3 player is a feature on a sophisticated smartphone. The challenge is for product producers to iterate sufficiently fast enough to deliver or integrate new features and improve existing features on their products. For example, in the IT industry, every year laptop manufacturers bring to the market new hardware that offers more power, more memory and more features in a smaller box. The tablet market is following the same approach, and newer tablets are much better and include more features than the first iPad of Apple. Breaking into a new technology market is the process of adapting a new technology to new user needs. The issue here is to create something that adds value for the customer. For example, the first computers were used by companies but were not popular and useful until the first spreadsheet program was developed in the 1980s. Java was developed for the electro-domestic industry, but was not considered useful and relevant until the World Wide Web was developed. These are examples of evolution of an adaptation.

To develop a successful revolutionary product is quite hard because there is no information to guide the new development, otherwise it would not be a revolution. However, not very often, a revolutionary technology appears when it is not expected to come. Companies that people usually associate with revolutionary innovation, such as Apple, Google, Facebook, MS, etc., have developed their products through iterative or evolutionary processes. While the design and development of revolutionary technology concentrate on things that no one else have thought of before and the needs of the future clients, evolutionary technology development does on the limitations of current product and the needs of current clients.

Therefore, the development of evolutionary technologies requires capabilities to extract and understand the customer needs, and the development of revolutionary technologies depends mainly on the visionary approach. Technology companies that seek to be successful need to work on both revolutionary and evolutionary products in order to be sustainable and profitable in the long term. Diversification may seem a good strategy to survive the unstable moments, but this will have a cost that not all organizations can afford in the long term.

Cultural Variations

Cultural evolution is the idea that human cultural change, that is, changes in socially transmitted beliefs, knowledge, customs, skills, attitudes, languages, and so on can be described as a Darwinian evolutionary process that is similar in key respects, but not identical, to biological/genetic evolution. More specifically, just as Darwin described biological/genetic evolution as comprising three key components: variation, competition (or selection), and inheritance. Cultural change also comprises these same phenomena. Yet while cultural evolution can be described as Darwinian in this sense, the details of the processes (e.g., how variation is generated, or how information is transmitted) are likely to be different in the cultural case compared to the details of biological/genetic evolution [6]. The other side of this is the idea that variation in cultural can cause changes within the genes of an organism [10]. This idea may not be immediately obvious, but it hinges on the idea that the environment of an organism (including its culture) influences the process of natural selection.

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These ideas of cultural variation are reflected in the advent of mobile technology to third world countries. The mobile environment has produced a change in Africa where until the introduction of this technology only the wealthiest part of the society had access to the Web (less than 10%). Currently, more and more youngsters are using mobile devices, especially phones to use the Web and digital media [13]. Part of this society has only experienced the Web using mobile technologies. Smartphone penetration is still low but it is spreading at steady pace from urban to rural communities as low price alternatives become available. The use of mobile phone in third world countries is quite different to the rest of world. In countries such Uganda and Tanzania, are used by small farmers to obtain useful information to their business (weather, market data, agriculture, logistics, food safety, traceability, etc.) through technologies such as SMS, MMS, and Mobile Web [11]. For example, mobile phone coverage has been related to a 10% increase in the probability of market participation of banana farmers in Uganda, and this effect was even greater for farmers from communities located further away from central districts [17]. Different service providers are offering services tailored to the needs of the new African society. Mobile technology is being and will be particularly important to improving the life and mobilizing those in rural communities, to break down the poverty and isolation dimensions of digital divide [19]. The effect that mobile technology is having in third world countries will be seen in the next generation of those countries. These examples show how technology is producing a cultural change in society and on the other hand society is adapting technology to its needs.

Conclusions

Throughout this text, we have seen examples of how evolutionary ideas provide insight into the adoption of technological innovations by society in general, and how society can exert its influence on technology. So now, based on these ideas, we wish to provide some guidelines of how a designer can see their product development life cycle. First, consider if your product is evolutionary or revolutionary. Revolutionary products are those that upset the current balance in the society, but unless society is ready to accept them, the first versions often fail. If you are introducing a revolutionary product, it may be necessary to create a new approach or new paradigm and work to create the base conditions for its success prior to its introduction in the marketplace.

Evolutionary products are based on existing design ideas, whether it be your own or another company's. However, these suffer from niche competition, and often fail to distinguish themselves among many similar products or solutions. Working to differentiate your product and move it into a slightly different niche is usually necessary for its success.

Last, if you have a well established product you must be prepared for its eventual downfall. Evolutionary, incremental, adaptations to the marketplace will only go so far before another technology comes and shifts the environment into a different state in which your product is no longer relevant. Product and service technology providers should be aware of the impact that their offerings may have on society, and specifically, on different cultures. They should also be ready to adapt the technology and/or service to new needs of society or specific groups with their own technological culture variations.

References

[1] W. R. Ashby, Design for a Brain. Oxford, England: Wiley and Sons Inc., 1953.
[2] T. K. Bikson and B. A. Gutek, Advanced office systems: An empirical look at use and satisfaction, in Proceedings of the AFIPS National Computer Conference, New York, 1983, pp. 319-328.
[3] S. E. Black and L. M. Lynch, How to compete: The impact of workplace practices and information technology on productivity, Review of Economics and Statistics, vol. 83, no. 3, pp. 434-445, 2001.
[4] P. Brey, Technological design as an evolutionary process, in Philosophy and Design: From Engineering to Architecture (P. Vermaas, P. Kroes, A. Light, and S. Moore, Eds.). USA : Springer, 2008, pp. 61-76.
[5] R. Dawkins, The Selfish Gene. Oxford: University Press, 1976.
[6] R. Dawkins, The Extended Phenotype. Oxford: University Press, 1982.
[7] S. A. Frank, Models of parasite virulence, The Quarterly Review of Biology, vol. 71, no. 1, p. 37, 1996.
[8] S. J. Gould and N. Eldredge, Punctuated equilibrium comes of age, Nature, vol. 366, no. 18, pp. 223-227, 1993.
[9] M. Igbaria, J Iivari and H. Maragahh, Why do individuals use computer technology? A Finnish case study, Information & Management, vol. 29, no. 5, pp. 227-238, 1995.
[10] E. Jablonka and M. Lamb, Evolution in Four Dimensions: Genetic, Epicgenetic, Behavioral, and Symbolic Variation in the History of Life. First mit edition, Cambridge: The MIT Press, 2005.
[11] T. G. Karippacheril, F. Nikayin, M. de Reuver, and H. Bouwman, Serving the poor: Multisided mobile service platforms, openness, competition, collaboration and the struggle for leadership, Telecommunications Policy, vol. 37, no. 1, pp. 24-34, 2013.
[12] K. Kelly, Case Study: The development of the apple iPod, in Music, Sound and Multimedia: From the Live to the Virtual (J. Sexton, Ed.). Edinburgh: Edinburgh University Press, 2007, pp.188-200.
[13] T. Kreutzer, Generation mobile: Online and digital media usage on mobile phones among low-income urban youth in South Africa, Centre for Film and Media Studies, University of Cape Town, South Africa, 2009.
[14] K. N. Laland, J. Odling-Smee and M. W. Feldman, Niche construction, biological evolution, and cultural change, The Behavioral and Brain Sciences, vol. 23, no. 1, pp. 131-46, 2000.

This paper is available online at
www.jtaer.com
DOI: 10.4067/S0718-18762015000100001

[15] J. Laugesen and Y. Yuan, What factors contributed to the success of apple's iPhone?, in Proceedings 2010 Ninth International Conference on Mobile Business and 2010 Ninth Global Mobility Roundtable (ICMB-GMR), Athens, 2010, pp. 91-99.
[16] M. Mitchell and M. Newman, Complex systems theory and evolution, in Encyclopedia of Evolution, (M. Pagel, Ed.). New York: Oxford University Press, 2002, pp. 1-5.
[17] M. Muto and T. Yamano, The impact of mobile phone coverage expansion on market participation: Panel data evidence from Uganda, World Development, vol. 37, no. 12, pp. 1887-1896, 2009.
[18] B. Myers, S. E. Hudson and R. Pausch, Past, present, and future of user interface software tools, ACM Transactions on Computer-Human Interaction, vol. 7, no. 1, pp. 3-28, 2000.
[19] J. Navas-Sabater, A. Dymond and N. Juntunen, Telecommunications and information services for the poor - toward a strategy for universal access, The World Bank, Washington, D.C., Technical report no. 432, 2002.
[20] M. B. Sokol, Adaptation to difficult designs: Facilitating use of new technology, Journal of Business and Psychology, vol. 8, no. 3, pp. 277-296, 1994.
[21] M. E. Thatcher and J. R. Oliver, The impact of technology investments on a firm's production efficiency, product quality, and productivity, Journal of Management Information Systems, vol. 18, no. 2, pp. 17-45, 2001.
[22] J. Ziman, Evolutionary models for technological change, in Technological Innovation as an Evolutionary Process (J. Ziman, Ed.). Cambridge: Cambridge University Press, 2003, pp. 3-12.
[23] S. Zuberec, Information appliances and beyond: Interactive design for consumer products, in Information Appliances and Beyond: Interactive Design for Consumer Products (E. Bergman, Ed.). San Francisco, CA: Morgan Kaufmann, 2000, pp. 103-130.