

**BBVA**

# Two Knowledge Dynamics for Innovation

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## 1. INTRODUCTION

Innovation is the engine of progress in our society. We can define innovation as “dramatically changing people’s lives through the introduction of new products or services”. Thus, innovation is not a mere technological discovery nor an experimentation of a new product idea. Unless it impacts people’s lives, its social significance is minimal. Only when dramatic changes occur in people’s lives, does it deserve to be called innovation.

For innovation to be realized in the form of new products or services, two knowledge dynamics are necessary—i.e., knowledge-accumulation dynamics and knowledge-utilization dynamics. Corporations usually introduce new products or services to society and in so doing they utilize various types of knowledge, such as technology and other intangibles which have been created and accumulated by themselves and others in society—e.g. in universities. Thus, for us to understand innovation in our society, we need to understand two dynamics concerning knowledge: how knowledge was accumulated and how knowledge is used. That is the topic of this essay.

Our two main conclusions are: first, organizations are good at accumulating knowledge, and markets are good at using knowledge and second, too much emphasis on the market mechanism can be detrimental to the continuation of innovation since there must be someone who accumulates knowledge in the first place.

## 2. A TALE OF THREE INNOVATORS: APPLE, MICROSOFT AND GOOGLE

Nowadays, the pace of innovation worldwide is accelerating. For example, many amazing innovations have been achieved in connection with the personal computer over the past three decades, truly changing our lives dramatically. Among the firms which have led this innovation, all of us know that three innovators stand out: Apple, Microsoft and Google. Apple introduced one of the first commercially successful personal computers into our lives and then led the innovation of the user-friendly PC with a mouse and icons. It is now changing the way we read books, through iPad. Microsoft is another innovator in personal computer software, introducing the first widely-used operating system for the Intel chip PC, DOS, and then the user-friendly

Windows operating system, with huge success. Indeed, it is not too much to say that these two firms have been writing the history of personal computers.

After the PC became everybody's tool, the arrival of the internet age led to communication between them, and it brought the famous Google, which made the PC the gateway to the wide world of information on the internet. Google's innovation was the fabulous search engine and super-powerful data centers with innumerable servers which search the web unceasingly. These data centers are now the source of the next generation of computer-related innovation: cloud computing.

All three firms started as small ventures in the US not too long ago, each led by a quintessential entrepreneur—Steve Jobs at Apple, Bill Gates at Microsoft, and Sergey Brin (together with Larry Page) at Google. However, these individuals did not fight single-handedly to make their innovations possible. Behind their entrepreneurial activity lies a huge amount of knowledge accumulated by large organizations. For Jobs and Gates, the large organization was Xerox Corporation, and for Brin it was Stanford University.

The basic technology for the user-friendly personal computer that we know today was developed by Xerox Corporation's Palo Alto Research Center (PARC). This technology was first applied in a workstation called "Alto", which was the precursor of the modern personal computer. However, despite the technical success of the technology, Xerox failed to allocate sufficient resources to this project as a result of various administrative troubles within the company and the poor financial success predicted to the management by the corporate-marketing and accounting departments. Thus, Xerox

unfortunately failed to become the market innovator for the personal computer. Even though the technology developed for the personal computer was successful as a result of the large resources devoted to it by Xerox, the accumulated knowledge was not used well by them for their own commercial success.

Feeling disappointed, many engineers left PARC. One group went to Steve Jobs of Apple and created Lisa and Macintosh, the forerunner of today's personal computers. Another group of engineers from PARC was invited by Bill Gates to join Microsoft, where they developed the Windows operating system. Thus, Xerox accumulated most of the necessary basic knowledge for the personal computer age at PARC, but this was later used for commercialization by the small venture firms in Silicon Valley. Entrepreneurs with an acute business sense detected the potential of the technology accumulated by large organizations and capitalized on it by appropriating it through the market mechanism.

For Sergey Brin, the co-founder of Google, the main large organization on whose knowledge accumulation he was able to capitalize was Stanford University. Wikipedia describes his life story until he founded Google as follows:

Brin immigrated to the United States from the Soviet Union at the age of six. Earning his undergraduate degree at the University of Maryland, he followed in his father's and grandfather's footsteps by studying mathematics, double-majoring in computer science. After graduation, he moved to Stanford to acquire a Ph.D in computer science. There he met Larry Page, whom he quickly befriended. They crammed their dormitory room with inexpensive computers and applied Brin's data mining system to

build a superior search engine. The program became popular at Stanford and they suspended their Ph.D studies to start up Google in a rented garage.

Education at Stanford and the network of professors and students there provided both the accumulated knowledge he could use and the seedbed of ideas and feedbacks for the technological development of the Google search engine.

### 3. TWO KNOWLEDGE DYNAMICS BY TWO DIFFERENT GROUPS?

The tale of three innovators shows that for an innovation to succeed, the two functions of knowledge about innovation (accumulation of the necessary knowledge and the use of knowledge), are often performed by two separate groups of people or organizations. There are those who accumulate knowledge and others who use it. Of course, there may be happy cases where the same individuals or organizations both accumulate and use, but that is an exception rather than the rule.

Why so? The reasons seem to lie in the nature of the innovation process itself. Usually innovation is a long process and has to go through three very different stages. First, there is a technology-nurturing stage. A new technology is nurtured and developed, using a variety of knowledge that has been accumulated. Second, the new technology must find an entry point into the market in the form of a new product. Let us call this second stage the market-entry stage. Third, the new product introduced must be accepted by a large number of people so that a small entry into the market will become a huge outpouring of demand. Only when this outpouring occurs, will the new product actually be used by many people and thus change their lives. In a sense, society agrees and moves with the new product. Let us call

the third stage the societal moving stage. Only when the third stage is successful does innovation finally become a reality.

Knowledge plays an essential role at every stage of innovation. In the first stage, the technological nurturing stage, technological knowledge has to be created and accumulated to make the new technology applicable in reality. Knowledge accumulation dynamics is the key to the first stage. Note that we include knowledge creation in knowledge-accumulation dynamics, since knowledge accumulation presupposes creation of new knowledge to be accumulated. During the second stage of innovation, the market-entry stage, knowledge utilization dynamics is the main knowledge activity. Here, not only the technological knowledge that has been accumulated during the first stage, but also market knowledge is necessary in order to develop a new product. During the third stage of innovation, the societal moving stage, large-scale knowledge diffusion has to occur so that many people may recognize the new product and be interested in trying it out. This is a kind of knowledge use in that many people end up sharing the knowledge about the new product, and the result of knowledge use is its wide dissemination. Thus, knowledge use is the central activity in the last two stages of the innovation process.

Although we categorize the knowledge-relating activity into knowledge-accumulation process and knowledge-utilization process here, each process is a very dynamic and closely-linked activity. For example, knowledge-accumulation itself includes some form of utilization of old knowledge to create new knowledge, and then the combined total of all knowledge, old and new, is accumulated. On the other hand, in the process of knowledge-utilization,

a situation is often faced in which the knowledge one starts to use is not enough to develop a new product for market entry, and therefore it is necessary to create new knowledge in order to fill the gap. The newly created knowledge will not disappear after it is used. It will certainly be accumulated in some way after creation. In this sense, knowledge use may be the beginning of another round of knowledge accumulation.

Viewed this way, we can find at least two reasons why two separate groups are often necessary for the entire process of innovation to be successful. One reason is that it is usually a long process from the beginning of an innovation—the technology nurturing stage, till the end—the societal moving stage. Since it is such a long process, a single group of people often cannot last the entire process alone and different groups have to take turns and pass on the baton. Another reason is the difference between knowledge accumulation and knowledge utilization. Those who are good at accumulating knowledge may not be good at using it in the market place.

Even though knowledge accumulation and knowledge utilization are intertwined, it is still meaningful to conceptualize both knowledge-accumulation dynamics and knowledge-utilization dynamics as two separate concepts. Our main point here is that, in order for innovation to occur, both knowledge-accumulation dynamics and knowledge-utilization dynamics are necessary and responsibility for these two dynamics often lies with two different groups of people or in two different places.

#### 4. ORGANIZATIONS ACCUMULATE AND MARKETS UTILIZE

The tale of three innovators also tells us that knowledge-accumulation dynamics often occurs in large organizations, like Xerox

and Stanford University, while knowledge is used by the entrepreneurs like Jobs, Gates and Brin, in the market place. It transpires that organization accumulates knowledge and then market uses the accumulated knowledge.

Organizations are the places where people get together and form teams, building a stable human network. In that network, people learn and accumulate together and from each other. Organizations are good at knowledge accumulation. However, they are often not very good at using the accumulation themselves, as in the case of Xerox. Organizations, both corporate and non-corporate, have hierarchical mechanisms of decision-making and resource allocation within their boundaries. This hierarchy often becomes an obstacle to free entrepreneurial experimentation inside the organizations, especially when it involves a large amount of investment. But that kind of investment is inevitable in the second stage of innovation, the market-entry stage. The amount of money involved often becomes huge, whereas at the technology-nurturing stage it is much smaller. The organizational hierarchy is generally not good at selecting the worthwhile risks and thus is not so good at knowledge utilization.

Xerox's failure to invest in the personal computer is an example of such hierarchical failure. Xerox is not, however, an abnormal example. Many large IT firms, like IBM and ATT (American Telephone and Telegraph) accumulated much of the basic knowledge that we have today of IT and communication technology in their labs, at Watson Research Center for IBM and Bell Laboratory for ATT. They were unable, however, to realize the full business potential of their knowledge. Entrepreneurs and the spin-offs from these organizations, like Steve Jobs at Apple, Bill

Gates at Microsoft, Scott McNealy at Sun Micro Systems, Larry Ellison at Oracle, and John Chambers at Cisco Systems, reaped the huge economic benefits from the knowledge that IBM and ATT had accumulated.

Moreover, those entrepreneurs who succeeded in the final two stages of innovation, the market entry stage and the societal moving stage, were often former employees of these big firms. Among the entrepreneurs I have mentioned here, McNealy, Ellison and Chambers all worked once either for IBM or ATT. Only Jobs and Gates were entrepreneurs from the beginning. Ironically, IBM and ATT not only contributed greatly to basic knowledge accumulation for today's IT industry, but also supplied many entrepreneurs who completed innovation in this industry.

Restructuring at IBM and ATT in the 1980's under anti-trust pressure from the US Government was the major trigger for these entrepreneurs to spin off. Thus, the IT revolution in the US would have been impossible without the basic accumulation in those large firms. But it would also have been impossible without the restructuring of these firms who not only released many future entrepreneurs into the new business market but also supplied many engineers who had to leave these big organizations and enter the labor market.

A significant advantage of the market in knowledge utilization comes from its ability to broaden the possibility of combining different items of knowledge accumulated in different organizations across the organizational boundaries. Entrepreneurs are not constrained by organizational boundaries and they are also free from hierarchical control. When they detect an innovation opportunity, they can obtain accumulated knowledge from

a large organization by recruiting talent from it or by learning themselves through working for it. Resources can be recombined and reallocated as a result of intelligent moves, thereby enabling the opportunities envisioned to become a reality. The market works as the place for experiment. However, the market is not very good at knowledge accumulation. For knowledge accumulation, a stable human network is needed, like a team, in which learning takes place among its many members. The market is not easily equipped with the capacity to foster such a stable human network since freedom of action by market participants, and in particular the freedom of entry and exit, is the basic principle of market transactions.

In any market economy, we have corporate organizations as its main economic players and we also have non-corporate organizations like universities which specialize in knowledge accumulation. These organizations are linked together by the markets through market transactions to complement their division of labor. Markets also link corporate organizations to consumers. Thus, organizations and markets are two very basic units in any market economy, be it a national or a regional economy.

If we imagine the total picture of knowledge-accumulation dynamics and knowledge- utilization dynamics in the entire economy, our discussion so far implies that organizations, both corporate and non-corporate, function as the main arena for accumulation dynamics. Organizations are the places where accumulation occurs. For utilization dynamics, however, the main arena is the market. The market is where utilization occurs. Obviously, the person who uses accumulated knowledge for the purpose of innovation is the entrepreneur and

the corporate organization which he or she leads. That utilization, however, occurs in the context of the market. In short, “organizations accumulate and markets utilize”, or a little more precisely, the market allows a firm to utilize the organizations’ accumulation.

Certainly in the tale of three innovators and in many other cases, the market mechanism makes it possible for the entrepreneurs to use knowledge accumulated somewhere in the economy. However, it is important to note that there must be someone who accumulates knowledge in the first place. There is no utilization of knowledge unless it is accumulated beforehand.

To summarize, knowledge accumulation is done through learning by a team of people who share a common goal and a common knowledge base. An organization is good at this. Knowledge utilization for innovation is done by experimenting with a new combination of knowledge across organizational boundaries and providing this combination with the right resources at the right time. Entrepreneurs with outstanding ideas are the ones who use this knowledge. The market is the place for this kind of experiment to happen.

## 5. THE US EXPERIMENTS AND JAPAN DEVELOPS

Although there are corporate organizations and a market in any market economy, the ways they actually work and their relative share of importance in the total economy vary from country to country. Any market economy is a mixture of the organizational (hierarchical) resource-allocation mechanism and the market mechanism.

Within a corporate organization, resources are allocated to the organizational members through the organizational mechanism of

hierarchical authority and coordination. In the market place, the market mechanism of competition and price regulates the demand-supply relationship and allocates resources among the market participants. Both mechanisms can vary from time to time and from one country to another in their actual details and the basic patterns of behavior of the participating actors.

If we compare the US and Japan in terms of the mixture of the organization and the market in an economy, much research and the stylized facts seem to indicate that Japan is a more organization-oriented market economy than the US, while the US is more market oriented. For example, in the Japanese intermediate goods market, buyers and sellers tend to maintain long-term transaction relationships and often cooperate long term in innovation. The relationship in automobile-parts transactions in the Japanese automobile industry, often referred to as the Keiretsu relationship, is a typical example, whereas in the US auto parts market, shorter-term, arm’s length relationships are the norm. I once termed the pattern of market mechanism with these close relationships the ‘organizational’ market (a kind of market mechanism with certain features of the organizational mechanism), compared with the freer competitive markets in the US.

If so, it then follows that Japan is better at knowledge-accumulation dynamics and the US is better at knowledge-utilization dynamics. Certainly this seems to be the case and one example is the different nature of innovation activities in the two countries. The US is the country of industrial experiment and Japan is the country of industrial nurturing or development.

The US is well suited for experimental activity aimed at starting up and trying out

new businesses or new business models in many industries., Both the capital market and the labor market in the US have the mobility to supply resources for such experiments, and there is ample venture capital as well as a large public-offering market for new companies. Attracted by these markets, both capital and labor flow into the US from all over the world—for example into Silicon Valley.

Over the course of history, there have been many times when the US played a very dominant role in the early stages of commercialization of innovation. Even if we limit our scope to the last forty years, when Japan came to approach the US in industrial strength, the US led the world in semiconductors, liquid crystal display, information technology and biotechnology, among others.

Japan was not too far behind when it came to the development of an industry after the seed was planted. Both in semiconductors and liquid crystal displays, Japan has led the world at various stages of industrial development after the initial experimental stage was over and the pace of technological innovation was accelerating. Another historical example is automobiles. Japan has been overtaking the US as the main player in this industry after the US established it so many years ago. In this process, the Japanese Keiretsu system of inter-firm cooperation, a kind of 'organizational market', played an indispensable role.

How can the US maintain its position? The American knowledge-utilization dynamics seems to be as strong as ever, even now—Google being one of the latest examples. As I noted before, any knowledge utilization presupposes knowledge accumulation. Without accumulation, there is nothing to be utilized. Then, where does knowledge

accumulation come from for the American knowledge-utilization dynamics? Perhaps not so much from the American corporate organizations' accumulation as before. For example, the famous Bell Lab disappeared after ATT was broken up and at the IBM Watson Research Center, the glory of its former days is said to be fading.

There are at least two sources of knowledge accumulation still available to American firms and American entrepreneurs. One is the open knowledge base accumulated in American universities. The other source is knowledge accumulation done in other countries, both in corporate organizations and non-corporate organizations. The US can tap and attract those accumulation sources outside its national border.

## 6. THE US AS THE MARKET ARENA FOR THE WORLD

A particular strength of the American economic system lies in the very openness of this system. One of the clear ways for American firms to capitalize on this openness is to broaden the scope of the open knowledge base they can tap. American firms have been much more active in international sourcing of their knowledge base, either in the form of foreign R&D activities or of inviting foreign university personnel to different American organizations, universities or firms. This is in a sense an effort to broaden the open-knowledge base for American firms.

Another example of broadening the open-knowledge base is to have marketplaces of venture activities for innovation, such as Silicon Valley, in the US. These marketplaces attract many people from all over the world, who bring their accumulated knowledge with them. People from many corners of the world flock to America in order to capitalize on the knowledge accumulation in the market

arena that the US provides. In a sense, the US is tapping the large open-knowledge base throughout the world by providing the market arena for knowledge holders outside America.

As we already mentioned, this is made possible partly because of the existence of a very mobile labor market and a very active venture-capital market in the US. There are, however, three more basic conditions that enable the US to function as the market arena for the world.

The first condition is that the native language of the US, English, is the lingua franca of the world. People from other parts of the world can come to the US without fearing language problems, as long as they can speak at least broken English. English has become the lingua franca thanks to the British Empire. The second condition is that the American dollar is the international key currency. People who earn money using the American market system have not had to worry too much about the international value of what they earn, at least until the Lehman shock. The third condition is that the US is a country of immigrants not only in its origin but also in terms of the current immigration policy. The US is thus a melting pot of many people with different ethnic origins where anybody can come from different parts of the world. Those who come to the US do not have to worry too much about their origin.

In a sense, Google is a good example of the US attracting knowledge originally accumulated elsewhere in the world. Sergey Brin came to the US at the age of six from the then Soviet Union, where his father was a mathematics professor at one of the major universities. Sergey followed the family tradition and was educated by his father to become another mathematician, in a sense

utilizing the knowledge accumulated in the Soviet Union university system. The rest of the story is now history.

These three conditions—i.e. language, currency and ethnic origin, are something that no other country can currently emulate. Only the US enjoys this special position resulting from its historic and ethnic circumstances. That is why it is able to maintain its knowledge utilization dynamics.

## 7. FAIR EMPHASIS ON ORGANIZATIONAL KNOWLEDGE ACCUMULATION

In a sense, the US is unique: an exception rather than a rule. If other countries were to try to repeat the glamour of American-style knowledge-utilization dynamics, by trying, for instance, to develop a Silicon Valley of their own without making a substantial effort to accumulate knowledge within their own national borders, they would likely fail. Knowledge utilization does not work without knowledge accumulation in the first place.

Behind the knowledge utilization dynamics in the US lies the very active market mechanism. Economists tend to overemphasize the merits of the market mechanism. But after the fall of communism and the planned economy in the 1990s, the American ideology seems to have swept the world.

It is one thing to use the market mechanism to allocate resources in a stable economy where the knowledge or technology bases do not change very much. The basic theory of a market economy almost always assumes a given set of technology. It is another thing, however, to have too much faith in the market mechanism when we have to consider how to broaden our knowledge base in society by accumulating new knowledge, as in the case of innovation. Who would want to accumulate knowledge if too

many economic actors were busy trying to use what they already know?

Moreover, when utilization dynamics become bigger, accumulation dynamics may get smaller. The utilization dynamics would become more active (i.e., get bigger) if there were sources of knowledge that corporations could depend on for utilization. It is often the open knowledge base outside the corporate organizations upon which they become dependent. Such an increase in external dependence could have a negative impact on the corporate organization's efforts to accumulate internal knowledge, because people in the corporate organization might consider it more profitable to use external knowledge rather than invest in obtaining internal knowledge accumulation. Since corporations play an important part in knowledge accumulation through their internal R&D efforts, an increase in their external dependence would mean that the accumulation dynamics in society as a whole would shrink.

Innovation is essential for economic growth, be it a national or a regional economy. We have to be deeply concerned about the mechanism to make innovation more active in the economy as a whole. As I have been emphasizing, an organization accumulates and the market utilizes. There are currently tendencies to emphasize the importance of the market mechanism to such an extent that the importance of the organizational mechanism is neglected. We have to pay attention to the organizational knowledge-accumulation mechanism in both corporate and non-corporate organizations. Too much market orientation may be detrimental to sustainable innovation, to the economy and to society as a whole.

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