

The Power of Innovation

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Human beings are characterized by creativity, the ability to perceive and express inner and outer reality in novel and non-stereotyped ways, leading to new ideas and concepts. Creativity can be seen in the earliest human artifacts and cave paintings; in the development of language and writing, in the various social structures, and in all the technological achievements, starting with the control of fire, the discovery and use of metals, the invention of agriculture and so on. The history of man can be seen as a chronicle of his creativity, in war as much as in peace.

In common parlance, innovation and creativity are often considered synonyms. However, innovation requires much more than creativity. Creativity is necessary, of course, but not sufficient for innovation. For a creative idea to become an innovation, it must first be made to work, and then it must be made to take roots in the world. Thus, innovation requires three very distinct and different phases: 1) a creative idea; 2) making the idea work; and 3) making the working idea take roots in the world. Very specific human qualities, tools, methods and structures are necessary in each of these three phases. Thus, innovation is more a characteristic of a group of people than a characteristic of a single individual.

Another common misconception is that innovation is limited to technological or product innovation. In fact, there are as many types of innovation as there are human endeavors. For example, in addition to technological innovations like the internal combustion engine and the integrated circuit, or product innovations like the car and the personal computer, think of innovations like the use of animal power in plowing; manufacturing innovations like the assembly line, factory automation and quality circles; marketing innovations like advertising and internet commerce; organizational innovations like the military and the modern corporation; transportation innovations like ships, automobiles, airplanes, roads and traffic control; financial innovations like money, the stock market, venture capital and credit cards; system innovations like the internet, the airline reservation system and the global positioning system; social innovations like democracy, social medicine and public education. Human progress is underpinned by innovations in the most disparate fields of human activity.

I would now like to briefly review the three phases of the innovation process to more clearly describe what innovation really is and to explore what are the specific qualities and challenges that are required at each of the three critical phases. I will then continue with the exploration of the strong connections between innovation and economic prosperity.

The first phase, the creative phase, generally starts with a creative idea emerging in the mind of a single individual who is generally stimulated by an environment full of suggestive elements. We can call this person, the “idea-man.” He may work alone or he may

be part of a small team of people faced with a particular problem in need of a solution. In the latter case, the idea may emerge out of interactive discussions among the team members. Sometimes it may even be difficult to determine exactly how the idea came into being, appearing like a character built stroke after stroke by the contributions of many team members. In this case the idea-man may be later identified as the person who contributed the last stroke that completed the character or the one who provided its most defining stroke, though nobody could have generated the entire idea without the efforts of the team. The fact that an innovation often starts with a problem to solve shouldn't mislead us to believe that there is always a problem at its core, or that even if there is a problem, it is explicit. Sometimes the principal creative act is to conceptualize the problem itself, out of a confused set of issues, in a way that it can be clearly seen and thus solved.

There is a saying that necessity is the mother of invention, and that is true. However, there is also a father. The father of invention is the desire to find a better way, whether there is a problem or not, and creativity springs out of that desire. A good idea-man or inventor is never happy with the status quo; he is always looking for ways to either do something that couldn't be done before or to do more effectively what could already be done. A good idea-man sees no problems at all, he only sees opportunities. This is the attitude that turns a naturally creative person into an inventor.

This is a subtle point that deserves further clarification. The problem a creative idea is intended to solve – the necessity – is seldom explicitly identified beforehand, and rarely is the idea-man told by someone to solve such and such a problem. Many inventions are actually the result of the recognition by the idea-man that the way we are doing something can be improved, even if nobody is complaining or has yet recognized the existence of a problem. Only after the new solution has been provided would the user recognize that he had a problem. Seminal innovations often require the conceptualization of a new paradigm before a fundamental new idea can emerge. For example, the invention of the integrated circuit required the paradigm shift created by the invention of the planar process. With the planar process, for the first time, hundreds of transistors could be batch fabricated on the surface of a silicon wafer, instead of the earlier fabrication method of building one transistor at a time. Once the transistors were built next to each other, it became a simple step to imagine connecting them together into an integrated circuit.

After a new idea comes to life, we need to validate it using domain-specific knowledge to insure that it is sound and likely to work. Sometimes there are a number of good ideas that need to be sorted out; in this case validation involves selecting the most promising one. The first phase is completed when there is a validated idea that is ready for a feasibility study. By feasibility study I mean the process of experimentally proving that the idea is sound and that there are no fundamental impediments to making it work.

The second phase of the innovation process involves making the idea work by transforming it into a concrete product or process that can be made available in the market. This phase often starts with a feasibility stage, followed by a design and development stage. During the feasibility stage, the idea is tried out by building a combination of physical models, computer models or other simulations intended to verify the viability of the most

risky elements of the idea. During this step, the idea may be further refined to make it more suitable for a cost-effective implementation. At the end of the feasibility process the idea is either rejected or ready to enter the next step: the detailed design and development of the idea, producing a product or process that can be actually used by others. This task often requires a large team of specialized people working over a prolonged period of time to achieve the desired levels of cost and performance.

For example, let's consider the case where the product is a new microprocessor generation with novel architectural ideas and with a more advanced manufacturing technology than the prior generation. During the feasibility study, the specific high risk areas are identified and then tested by a relatively small number of engineers and scientists. After the feasibility study has been successfully completed, the detailed design and development stage can start. This task may require several hundred highly specialized people led by a very talented and experienced project leader. Using very sophisticated and expensive hardware and software tools, and working very hard for about three years, the team can develop the product to the point where volume production can start. The cost of the feasibility and development stages for such a product may add up to several hundred million dollars.

I would also like to point out that the second phase – making the idea work -- requires a much higher diversity of skills and qualities than the first phase. In addition to the creativity, the right attitude and the domain-specific knowledge required in the first phase, there are many other additional factors that will determine the success or failure of this second phase. Substantial financial resources, suitable tools, correct methodology, organizational excellence, exquisite team effort, motivation, commitment and leadership, all become essential to success.

The third phase of the innovation process -- making the idea take roots in the world -- generally requires an even greater effort and a longer time span than the second phase. Often this phase requires one or more large organizations entirely dedicated to producing, promoting, marketing and selling the innovation and proving its economic value by making a profit. This process sometimes is sparked by a startup company entirely dedicated to making the new idea become a part of society. In this case the leader must be an entrepreneur, at least during the early stages of the company, with skills and attitudes quite different than either the idea-man or the project leader -- the people who played a key role in the prior two phases.

The idea-man is primarily motivated by creating something that didn't exist before; the project leader has the skills and commitment to turn a new idea into a great product by creating and leading an effective team of people; the entrepreneur has the vision, motivation and capacity to build a profitable company while disseminating a new product in the market.

Only after the market has irreversibly adopted the new idea can one say that an innovation has occurred. Sometimes this process may be very turbulent, with more than one company involved, many successes and failures, including companies going out of busi-

ness for a variety of reasons. Making the idea take roots in the world is the most complex and less understood of the three phases and requires the widest array of skills, talents and financial resources, over a prolonged period of time, to come to pass. At this stage it is not enough to have a good idea and a good design team, there must also be a strong manufacturing, marketing, selling and financial base to support the wide adoption of the idea in a competitive environment. At the human level this phase requires people with courage, endurance, business acumen, passion, organizational capacity, leadership, entrepreneurial spirit and will to win, particularly during the beginning of this phase.

During this phase, the role played by the competitive forces unleashed by the introduction of a new idea in the market is an extremely important factor. In general, competition causes a refinement of the original idea and a rapid evolution into new versions that have lower cost and improved performance. Over time, the idea transforms into forms far richer and effective than the original reduction to practice.

Although the competitive forces may play a role during the first two phases of the innovation process, it is possible to come up with an idea and develop it in stealth mode, with no way for the competition to find out what's happening before the idea is finally made public. After the market introduction, however, such protection no longer exists.

A competitive environment insures that only the best ideas and the best implementations survive, ultimately serving the interests of the entire market, and sometimes even causing the economic demise of the very organization that developed the original idea.

In summary, an enduring innovation is the result of the efforts and skills of many people, over a prolonged span of time and within a competitive environment; forcing the highest level of achievement humanly possible, and surviving for a long time against the very forces of change that brought it about.

Many people believe that innovation is sparked by a large R&D investment. However, no amount of R&D investment alone is going to produce ideas capable to compete in the global market against other ideas produced by companies which already have an inside track on the markets, understand the customer requirements and have access to the key personnel, the key distribution channels and to the supply chains required to create an enduring success in the global economy. And without enduring success, not even a wealthy government could sustain long term the amount of investment required to stay competitive against products that have better market acceptance.

Many metrics that are commonly used to measure innovation, such as R&D investment, number of patents granted per year, number of engineers graduated per year, and so on, are not a reliable measure for it, although they are positively correlated with it. Take patents, for example. Only a small number of them are actually practiced, the rest of them are never used for the simple fact that there are better ways to do what such patents teach. However, patents are invaluable in protecting the intellectual property after it has been deployed in the market at great risk and expense. Therefore it is the quality of the patents that matters and not their number. Furthermore, even if an inventor were to patent a great

idea, unless that idea is made to work and made to take roots in the world, as I have explained, we do not have innovation and the economic prosperity that comes from it.

So far I have described the innovative process as is generally practiced for the creation of high technology products in the developed world. However, the basic principles that I have discussed are also applicable to all other fields of activity, though much variation exist in the evolution and interplay between the various phases.

I would now like to make a few considerations about the innovative process that can help transform an economy from emergent to developed. However, I must say at the outset that although I have a lot of experience with high technology innovation, I have no experience with innovation in the context of a developing economy, therefore my comments have only the authority of educated conjecture rather than proven facts. One thing I can definitely say is that to transform an economy, change is necessary and for effective change to occur, innovation and entrepreneurial spirit are essential.

In this regard, I would like to say a few words about the extraordinary success in Kenya of mobile banking or m-Banking. This is a novel and effective method to transfer money at low cost, person-to-person, via SMS. The idea is to use the prepaid usage and SIM card of a mobile phone as a form of credit that can be transferred to another mobile user by the mobile operator. Introduced by Safaricom with the name M-PESA in March 2007, the user base has rapidly grown to 3.6 million users by July 2008. From inception to July 2008 -- in a period of only 16 months -- 21 billion Kenyan shillings, equivalent to US\$288 million, were moved. This unsuspected economic success means that m-Banking will now be extended to mortgage payments and other services encouraging a period of experimentation that will fill all possible market niches of mobile banking, with the potential to make branchless banking a reality.

This pattern is almost always repeated: success encourages, motivates and finances the exploration of all adjacent market areas where a similar successful business idea can be applied. Once the new business idea -- the innovation -- proves successful it will also be widely copied and adapted by other Countries where similar conditions exist. Furthermore, the success in one field also encourages the search for innovations in other fields, cementing and spreading the belief in the power of innovation.

This is just an example of how a technology developed in the Western world can be adapted, using innovation informed by local conditions, to a different usage model than originally intended by their developers. In fact, m-Banking has little or no applicability in a developed economy where credit cards and a fully developed banking system exists, yet makes a lot of sense in developing economies.

I believe that much more of this kind of innovation is possible, allowing people to leverage and adapt the power of Western technology to the different conditions existing in developing Countries with many benefits for that Country's economy.

Once systemic innovation is sparked in an economy, it becomes like a self-reinforcing fire in dynamic equilibrium between what's consumed and what's produced, and capable of producing much economic wealth and improving the quality of life of all people that are part of that economy.