Effective Innovation

by Don Clausing & Victor Fey

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Six steps to meeting the innovation challenge

Innovation leads to new products that lead to sustained high rates of business growth. It is the planned, systematic high-rate introduction of new innovative products that tends to produce high corporate growth rates of seven per cent or greater, a doubling of revenue in 10 years or less. While, holding fast to tried and true technologies, and the mere polishing of existing products, leads to growth rates of less than three per cent, or, all too often, to a downward spiral and business extinction.

Few companies would dispute this observation, yet most still struggle to deliver the necessary innovations. In 1917 B. C. Forbes formed his list of the one hundred largest American companies. In 1987, Forbes republished its original list and compared it to its 1987 list of top companies. Of the original group, 61 had ceased to exist. For the most part, these companies had failed to generate the innovations needed to sustain themselves.

As Don Clausing and Victor Fey, authors of the recently published book ‘Effective Innovation; The Development of Winning Technologies’, note, the challenge to growth innovation is great. The challenge to innovations that launch a new product and company, such as the Xerox copier in 1960, is even greater. However, as they also explain, these challenges can be far more successfully met, if companies move away from the often chaotic and random activity of traditional innovation approaches, and recognise the need to focus on six proven key innovation steps;

1. Technology strategy – what to focus on
2. Concept generation – apply the historical patterns of invention for success
3. Concept selection – pick the best before investing
4. Robustness development – early achievement of reliability and integrability
5. Technology readiness – don’t transfer any technology before its time
6. Technology transfer – effective delivery to portfolio architecture and the product pipeline

These steps, and the world class methods they incorporate, provide a systematic approach for effective innovation, and creating innovative new products that succeed in the commercial marketplace. It is typically when one of these steps is not done well, that innovation is less than completely successful.

The right focus

According to Clausing and Fey, within **technology strategy**, the vital first step in the innovation process, the greatest opportunities are the satisfaction of latent needs. Chester Carlson realized that there was a huge latent need for a copier. Most businessmen were confused because the existing technology for making copies was terrible, so few copies were made. The crucial fact that the “prudent” businessmen missed was that there was a huge latent desire for a machine that would make copies efficiently.

The innovative TRIZ methodology has nine laws of evolution, which are of great help in suggesting the next directions for innovation. One of the laws of evolution is the Law of Increasing Flexibility. A new system is designed to perform in a specified environment with specific operational states. The system usually features rigidly defined connections between its components, which tend to prevent it from adapting to the changing environment. Therefore, its application environments and its performance potential are limited. Studies of numerous systems have demonstrated that they tend to evolve through flexibility phases, during which the structure of the system becomes less rigid and

more adaptable to the changing environment. Examples are windshield wipers and integrated circuits (IC). Windshield wipers evolved from rigid metal bars trimmed with a rubber blade (good for flat windshields only) to curved bars that could conform to the specific glass curvature to multi-pivoted structures that adapt themselves to any glass shape. A growing trend in application of integrated circuits is their use in various flexible packages, such as “smart” cards and ID tags. This trend is inhibited by the high stiffness of conventional IC chips made of silicon. When bent too far, the silicon breaks. Emerging responses to this problem are evolving to more flexible IC structures. One promising approach, being developed by Philips, IBM, and others, is to use a plastic as a flexing structural and/or conducting medium of an IC. The nine TRIZ laws of technological evolution are a great guide for technology strategy.

The right concept

Concept generation, step two, is greatly aided by the patterns of invention that have been identified as part of TRIZ. Physical conflicts try to require that a material be in two states at the same time. Armour plate should be both hard (to break up projectile) and tough (to prevent its shattering by projectile). However, knowledge of materials science confirms that hard and tough don’t come together. One TRIZ approach is to separate the conflicting requirements in space. Make the front half of the armour plate hard and the back half tough. This dual-hardness plate has much greater resistance to bullets than the conventional armour plate. The two conflicting requirements were separated, the requirement to be hard to the front and the requirement to be tough to the rear. TRIZ has many such approaches, which when combined with scientific knowledge quickly and directly lead to inventions.

The outstanding approach for **concept selection**, - the need to pick the best innovative idea- is the Pugh process that was developed by the late great design professor Stuart Pugh at Loughborough and later at Strathclyde. The concepts are arrayed in a table relative to the requirements. The team evaluates the concepts as being better, the same as, or inferior to a datum concept. This approach has been highly effective in practice.

Converting ideas into products

The next key innovation step is **robustness development**, and making the new invention inherently reliable. Most new concepts work well in ideal conditions, but the real challenge is to make them work well under the wide range of actual conditions that they will encounter in production and in the hands of the customers. During initial experiments a new invention will be kept near ideal conditions, with any variations that might cause the performance to degrade – temperature, humidity, and voltage from the main supply – kept to a minimum. The key to robust reliability is to subject the invention to these noises, and then change the values of the critical functional variables to move the system as far as possible from all failure modes. After this robust performance has been developed, reliability is easy to achieve in the downstream commercialization activity.

A **technology readiness** audit of an innovation saves much subsequent expenditure of time and money. All too often new innovations are hurriedly and all too casually transferred into a product commercialization program. The inventor raves about the merits of his new baby. The receiving program manager says that he could certainly use one of those. But, then the delays begin, because the technology is not ready. It is critically important that the new technology is robust against noises, and that all of the remaining development is easily within the capability of the downstream commercialization team.

Finally in **technology transfer** step, the invention is transferred to a commercialization program. It is selected for the new product in comparison with other alternatives, again using the Pugh process. The transfer of the new innovation must be done very carefully to avoid the notorious “throw-it-over-the-wall” syndrome. The two organizations that must make the transfer are very different in their cultures. The effective method for technology transfer is to temporarily transfer people. For

example, one or two people who have been working on the new innovation are transferred into the commercialization organization along with the innovation itself.

In conclusion, these six proven steps, and the world class methods that they encompass, provide an effective innovation framework for any size of company. Through the systematic execution of each step, companies are able to create innovations that they would not otherwise create, and reduce development times, while ensuring high inherent innovation reliability, and the smooth transfer into product commercialization. This results in products that have a far greater rate of success in the commercial marketplace and that deliver business growth.

This item is based on the book 'Effective Innovation; The Development of Winning Technologies', by Don Clausing (formerly of MIT) and Victor R. Fey (of The TRIZ Group, LLC) It was published in 2004 by ASME Press, and is available in the US from the ASME at www. Asme.org/catalog/ or in Europe from the Institute of Mechanical Engineering, www.pepublishing.com/frm bookshop.htm