SUSTAINABLE DESIGN THROUGH INNOVATION: AN INDUSTRIAL PERSPECTIVE

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Abstract

Innovation is the key for every company to survive in the competitive market. Various methods are being adopted by companies to improve the bottom-line and product life cycle. In this editorial article, I share my experiences on the product life cycle management strategy and propose a double 'S' curve Technology Life Cycle that is practically viable and has the potential to enhance the business gains and product life substantially.

Background

It was my first industrial job and within few weeks of joining, my senior manager asked me to attend an innovation meeting with a word, "since you are new to the organization you will see the product with a fresh mind and hopefully some new ideas will emerge". Such meetings are a part of the company culture that is held at different phases of Product Life Cycle. It is one of the methods that companies use to generate innovative ideas to reduce the product cost with enhanced performance. I attended the meeting with much excitement. About thirty people were present in meeting from various departments. A big table was placed at the centre with dismantled engine components on top of it. Within few minutes of the meeting, the entry register was filled with hundreds of ideas sans my name. I was getting anxious. I put my best effort to come up at least one idea. Finally I was able to register one idea on my name.

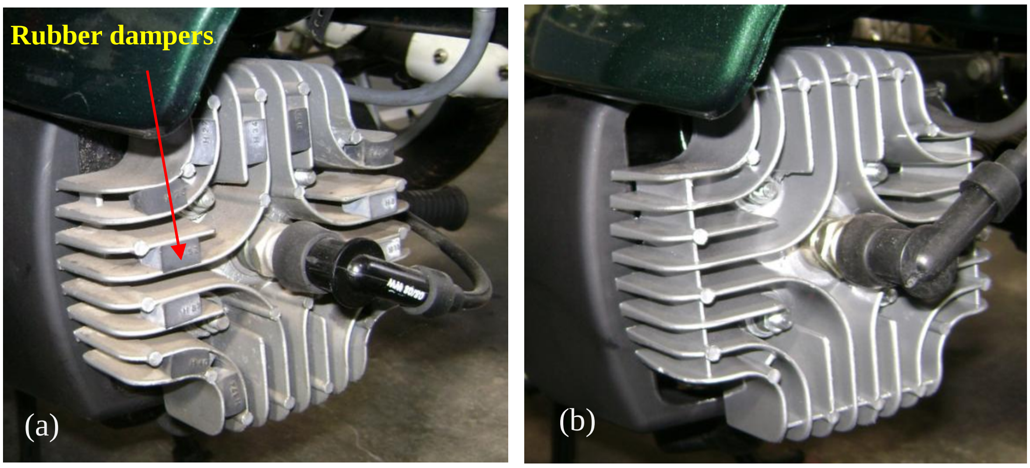

Figure 1: *(a) Old engine with rubber dampers, (b) new engine without rubber dampers.*

Figure 1(a) shows the original engine on which my idea was based. The engine had several rubber dampers packed between the metal fins. Fins are extended surfaces used for heat dissipation.

However, they vibrate with engine at higher frequencies and radiate irritating noise. These rubber dampers reduce the amplitude of fin vibration and thus reduce the radiated noise. Hence the only purpose of these dampers is to help the engine to run quieter with a 'solid' feel. My idea was to redesign the engine cylinder head having the same performance so that all dampers can be removed. These rubbers add extra cost to the vehicle and affect company's bottom-line. I'll discuss the other benefits later on. The problem in hand was multidisciplinary in nature. It involved NVH (Noise, Vibration and Harshness) and thermal fields. It took us about six months to master the technology involving different engineering fields. The higher management had the full support for this project. When I first thought of analyzing the design using CAE software, to my surprise, I found that there were no CAD (Computer Aided Design) parts available for this engine as it was designed in 1980s through pencil-drafter methods. With the help of a designer we measured the exact dimensions and reproduced it in CAD format. Numerical simulation, prototype making and testing took another six months. Finally we came up with a design (patent pending) that meets the function (NVH) of the older engine with improved engine cooling and few innovative features. Figure 1(b) shows the final design of the new engine without dampers on it, which is now being mass-produced with average monthly production of more than double the original vehicle.

It will be wrong to say that removal of these dampers is the only reason for increased production. Many other innovations have been implemented on the vehicle. However, removal of dampers has certainly removed a serious bottleneck that hindered the speed of production. Earlier, a huge inventory of rubber dampers was needed to be maintained. Manpower was required to hammer down these dampers into the cylinder head before assembling it to the engine system. Furthermore, these rubber dampers were produced in a separate factory running a parallel manufacturing process along with the cylinder head, adding further complexity to the production processes. In fact, rubber production is harmful to the environment wherein harmful gases are released into the atmosphere. In addition, these rubbers were getting brittle over a period of time on the engine and finally falling off thereby increasing the radiated noise again. Therefore, the purpose of providing these rubbers on the engine was short lived. Now, with the introduction of new engine design, these bottlenoses are removed and hence the capacity to ramp up the production was increased substantially to meet the growing demand. Apart from increased Product Life Cycle (PLC) the product has become 'green' and sustainable with lesser carbon footprint. With this illustration I now introduce and discuss a new double 'S' curved in the antique Technology Life Cycle (TLC) from an industrial perspective.

Technology Life Cycle

TLC described the commercial gain or profit of a product through the expense of research and development phase, and the financial return during its "vital life" [1]. The major factor concerning the TLC is the time and cost of developing the technology that finally goes into the product. TLC differs from PLC in the sense that latter is concerned with the life of a product in the market-place with respect to the timing of introduction, business strategies and cost whereas the former deals with the creation and management of technology underlying that product. The TLC curve generally follows 'S' curve or bell-shaped curve path (blue color) shown in figure 2 and it has four phases:

(a) the research and development (R&D) phase which starts from zero business gain at R and continues its downward trend (negative business gain or profit). Investment during this phase is risky. Market remains latent & less competitive,

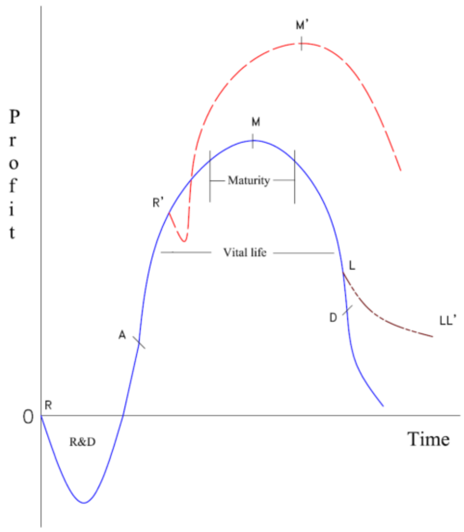

Figure 2: *The venerable 'S' shaped technology life cycle describes the profit from the technology during the product's life time. A new second bell-shaped curve is proposed that enhances profit and product life.*

product price is high and brand building awareness is promoted.

(b) the accent phase when investment in the R&D phase starts giving positive gains and a break-even point is reached at A.

(c) the maturity phase where the technology starts giving sustained business returns and reaches a saturation point M. Between A and M, business gain is steep, market becomes emerging, competition grows, product matures, and brand strengthens.

(d) the decline phase where the usefulness of the technology start to slump rapidly, market erodes, competition fades and product price drops.

Though every product does not have a predictable life cycle and the specified life cycle concept followed by different products vary substantially; however, the concept of life cycle management remains at the center of most company's' marketing strategies, facilitating them in managing innovation and processes along the bell-shape curve, from introduction and growth to maturity and decline. As this concept is being followed since last half century, companies are inclined to foresee only one trajectory for successful product i.e. to march along the conventional bell-shaped curve and adopt strategies as the product enters different phases of life cycle. For example, in decline phage, various options like licensing, advertising, price reduction, adding new features to the product, exploring new markets, new packing etc. are followed by most of the firms. Though it increases the product life cycle marginally (curve L to LL'), profit on the investment is also marginal.

The strategy: double 'S' curve

As the market becomes more competitive, it is hard to win competition by such strategies unless technological innovation is adopted early in the product life cycle. The strategic model I propose is the double 'S' curve shown in figure 2, though there can be more than two 'S' curves. As the product enters into the growth phase where the competition is intense, R&D on the existing product (point R') will provide better technology which may improve the design, eliminate production bottlenecks and enhance performance similar to the example of engine described earlier. Note that the negative business gain after R' may be substantially less compared to that after point R as the product has already been accepted by the customers and brand value is strong. Furthermore, increased maturity point M' over a longer period of time with higher profit justify early investment is R&D. Early initiation of R&D is also justified as once a product reaches decline phase, process innovation takes preference over product innovation and any major changes in the product becomes difficult to accommodate. In the process innovation stage focus shifts to realization, on scale economics and cost to improve productivity. However, the question of when to initiate R&D activities after the product launch should be decided judiciously. Too early and frequent changes in the design would reduce the part supplier's confidence. In long term it may harm the business prospective. Too delay will provide opportunity for competitor to take over with better, cheaper and sustainable products and eat away the market share. There are many instances where companies have survived on well-timed innovation, e.g. typewriter vs. computer. The continuous innovation by the company IBM from basic typewriter to electronic typewriter and finally to computers made it to survive and win customer base. Those who did not innovate, perished. Innovation should be seen as a continuous process and should be a part of the company culture. However, technology is easy to modify but culture is hard to change.

A successful company innovates first (R&D phase) and then brings its quality products in the market. However, reverse can also be true. A company can bring a product first by benchmarking competitor's products and then keep on innovating and refining the processes as product gathers momentum in the market. However, in certain product categories, trade secrets or know-how or certain innovation embodied in the product, while sold in the open market and thus available for detailed inspection by would-be imitator, manage nevertheless to defy analysis for some technological reason and that therefore cannot be benchmarked or reverse engineered [2]. In the former case, the company who believes in innovation first, people perceive it as a technologically mature company and believes in brand value. In the latter case, such companies will always be late in introducing innovative products in the markets and it takes long and arduous effort to build brand name. The culture of 'innovation first' comes as company matures. Nevertheless, innovation is the key. Both kind of companies need to innovate, sooner or later, to survive. The higher management of the company can play a vital role in percolating the culture of innovation through their visionary policies and methods. However, this will not happen overnight.

References:

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[2] von Hippel, Eric (1988). The Sources of Innovation. Oxford University Press. ISBN 0-19-509422-0

Dr. Om Prakash Singh's research interests cover a wide range of topics in heat transfer, computational fluid mechanics, convection, and tribology. He is presently working at TVS Motor Company as manager in thermal management. He filed many patents and developed numerous novel experimental/CAE methods to improve product performance. Prior to joining the company, he finished his PhD in mechanical engineering from Indian Institute of Science, Bangalore, India in 2006 in the area of double-diffusive convection. He is the recipient of Young Scientist Award. His detailed profile can be seen at www.omprakashsingh.com.