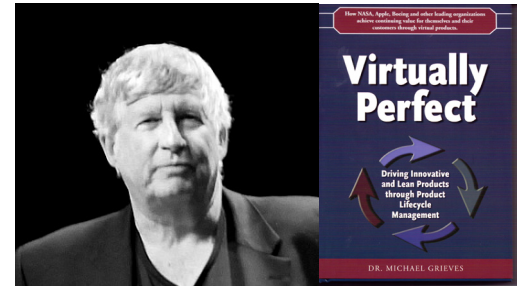


VIRTUALLY PERFECT Dr. Michael Grieves INNOVATION

Dr. Grieves is the pioneer and internationally recognized thought leader and expert in the field of Product Lifecycle Management. Dr. Grieves' current book, *Virtually Perfect: Driving Innovative and Lean Products through Product Lifecycle Management* extends the concepts of his first book, *Product Lifecycle Management: Driving the Next Generation of Lean Thinking* deeper into the realm of producing value for product producers and users alike.

Dr. Grieves is a consultant to a number of leading industry and government organizations, including NASA. Dr. Grieves has a number of academic appointments, including the CIMBA, Italy, the University of Iowa, and the Florida Institute of Technology.



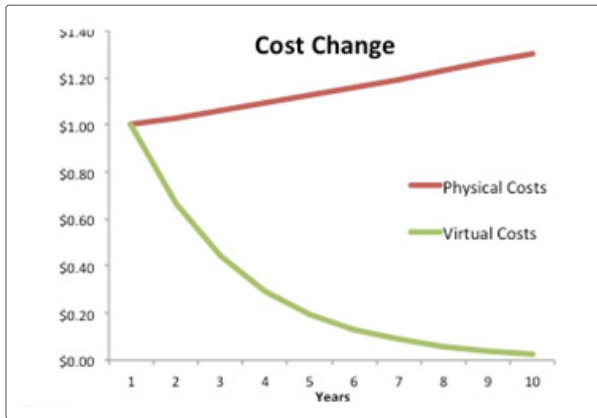
In survey after survey, when CEOs are asked for their priorities, the consistent number one priority on their list is innovation, rather than productivity. The reason is that productivity, or decreasing the cost of what they produce, will only take these organizations so far. As the saying goes, "You can't save your way to prosperity." While increasing productivity is important, it does not differentiate the company's products from their competitors.

To continue to attract old customers and create new customers, a company needs to innovate. Innovative products and services are the keys to a company competing on the value of their products and not on the product's price. Innovative products do differentiate products from those of a company's competitors.

The issue is that innovation is both expensive and unpredictable. By the very nature of being innovative, a company does not know whether they can actually accomplish making the product with the functionality that they perceive the customer wants. Rarely, if ever, does a company set out to do something highly innovative and accurately projects the cost and timeframe that it will take to accomplish this new product.

Examples abound of company's making multiple attempts to produce innovative products. Edison is reputed to have tried thousands of materials over an extended period of more than a year before he found the right combination that would make a long-lasting light bulb. Pharmaceutical companies engage in long, expensive development efforts, many which fail, in order to produce new and innovative drugs. Both Boeing and Airbus underestimated the time and budget in order to create their respective innovative, new airplanes, the Boeing 787 and the Airbus A380.

It is in creating and bringing to market these innovative products that virtually perfect products demonstrate their value. "Virtually Perfect" products are the digital representations of actual products and potential products-to-be. Prior to the time that virtual digital representations became technologically possible, "virtually perfect" described products that were good, but lacked perfection. As described in my book, *Virtually Perfect: Driving Innovative and Lean Products through Product Lifecycle Management*, the rich, digital representations of products are the ideal representation of physical products.



Building, testing, and manufacturing less than perfect and, in some cases, outright crude physical prototypes of a product are very expensive propositions. These physical prototypes can run from thousands of dollars in the case of smaller products to hundreds of thousands, millions of dollars, and even tens of millions of dollars for major products such as airplanes and rockets. The underlying premise for using virtual products is that bits are cheaper than atoms. In addition, as shown in the accompanying Figure 1, the cost curve for bits and atoms are going in different directions. The cost of bits is decreasing at an exponential rate, while the cost of atoms is rapidly increasing.

While innovation is hugely dependent on the talent of the personnel involved with the product creation task, there are structural elements that impact the

ability of organizations to create and bring to market innovative, useful products. There are three main structural elements that put pressure on innovation: the cost of innovation itself, the resources available in the company to support innovation, and the processes that have been developed in order to facilitate innovation.

As noted above, the cost of doing innovation with physical prototypes, that is the development, testing, and manufacturing, continue to increase at the cost of inflation, at a minimum. However, as product innovation deals with new materials and capabilities, cost increases accelerate at rates much greater than inflation. Designing, developing, and manufacturing physical prototypes are costly process in terms of both material and labor. In addition, working with these physical prototypes takes elapsed time. This elapsed time that has its own costs involved with it, as overhead costs continue irrespective of the time it takes to produce physical prototypes. Ignoring the issues around time-to-market, bringing an innovative product to fruition that takes three months is much less expensive than that same innovation that would take one year, even if the total number of man-hours are the same.



'Airbus' A380'

The second pressure on innovation is that the resources that companies have to allocate to innovation are decreasing. This is not due to any unwillingness to allocate resources to innovation, but is simply due to the fact that in a global environment, there is more competition that will lower the profitability of organizations. All companies in a competitive environment will feel pressure on their profitability, which is why there are such an emphasis on lean initiatives and in reducing costs organizations. These pressures are continued to increase and to impact how much companies have available in order to fund innovative efforts.

The third pressure on innovation is one that is not particularly obvious and would be viewed by some as controversial. This pressure is the pressure of processes that have been developed in order to facilitate innovation. While the intent of these processes is beneficial and, used intelligently, can facilitate innovation, these same processes can have the opposite effect of stifling innovation.

The focus of innovation is to produce some new, novel product with a capability that either has not existed before or has not been economically feasible. The focus on innovation is on obtaining an end result. This end-result focus with an attempt to determine the means, i.e., the inputs and operations on those inputs, to produce this desired result is called practice.



Processes, on the other hand, are about performing predetermined operations on predetermined inputs. The assumption that processes make is that the end result will be the desired one. While this works for situations where it is known that performing certain actions on certain inputs will always give the desired results, it does not work so well where we want a desired result, but have never obtained it before.

When Edison was developing his light bulb, he had an end result in mind. However, he didn't know how he was going to obtain it. While he was systematic in his approach, he was hardly following a process. Edison was engaged in a practice.

These development processes have been defined to make innovation more efficient. Because of the rising costs of classic physical-based innovation, organizations have developed processes, such as stage-gate, in order to minimize the amount of resources to obtain new, innovative products.

However, organizations with the slavish devotion to processes lose sight of the desired end goal. This results in projects being prematurely cancelled, development that falls short of its desired results, or the settling for small, incremental innovation when major innovation is obtainable.

Major innovation is not the result of a serial process. Instead, it is a coalescing of ideas and approaches over time. The key to innovation is to envision the desired results and examine the possible means to obtain them.

Again, having some sort of innovation process is desirable, because, without one, end results that cannot be reached or innovation that is never completed because improvements are always possible would cause innovation projects to never end.

Major innovation is not the result of a serial process. Instead, it is a coalescing of ideas and approaches over time. The key to innovation is to envision the desired results and examine the possible means to obtain them. Often, an approach that might have been ruled out early on during development turns out to be the desired approach as other elements of the design start to crystallize.

This is where virtually perfect innovation shows its value. If we can design the project virtually, tested virtually, manufacture virtually, and support virtually, we can afford to try many different approaches, which would be cost prohibitive if we had to use physical methods, such as prototypes, destructive testing, and test build on a factory floor.

In addition, we can leave designs open with more alternatives for a longer period of time. Where in the past, using physical prototypes, physical testing, physical test manufacturing builds, and, usually as an afterthought if done at all, physical support scenarios, product companies would have to settle for suboptimal and in many cases inferior product innovations. Using virtual products for innovation allow for a much more robust and superior innovative capability.

For organizations still wedded to physical methods, the pressure of increasing physical costs will continue to handicap them. The profit pressures on organizations due to global competitiveness will continue on all organizations. However, those organizations that moved to virtual innovation will free up resources that have been previously tied up in physical methods.

Virtually perfect products, if used properly, will foster innovation by allowing companies to focus on the desired end results of products that create value for customers. By using these virtually perfect products in place of physical ones, companies can look at more options, keep designs open longer, simulate manufacturing and support activities, all while reducing costs. ■