



Stimulating Engineers' Creativity

An Online Continuing Education Course for Engineers

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Stimulating Engineers' Creativity

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Motto: “What is a weed? A plant whose virtues have not yet been discovered.”

Ralph M. Emerson, philosopher

1 Preliminary Considerations

Creativity can be defined as “a mental characteristic that allows a person to think outside of the box, which results in innovative or different approaches to a particular task”ⁱ. People in general are expressing their creativity in various ways, as seen in various forms of creation conveyed by many artists. Within the professional universe, engineering is a discipline where the creative efforts that take place are bound by the practicality of the solutions proposed. Many people see those boundaries as a shackle difficult to loose and as an obstacle in the way of the creative process. In spite of all this, engineers and other technical personnel are able to either find creative solutions inside those boundaries, novel or even push those boundaries to define new solutions for old problems. Unlike engineers, artists are not limited by the requirements for practical application of the result of their work, and they can dream as much as they can to implement the results of their imagination. In technical terms, artists “define” the problems on their own and “propose solutions” that do not necessary need to be bound by reality and are not always constrained by tight timelines (although they can be constrained by the budget placed at their disposal by their benefactors). Unlike artists, engineers and other technical personnel need to define solutions that have explicit practical application, and can be implemented in a timeline and within a pre-defined and business-acceptable budget. This only shows that the engineers’ and other technical personnel’s job is more difficult than that of artists and other creative professions. That is not to diminish the importance of the later, but to recognize the differences and similarities between the two groups.

At the same time, the interaction between artistic and engineering domains in industries like entertainment (where artists “dream” of solutions, and the engineers implement them) proves that the two lines of work can understand each other and can successfully collaborate to achieve a common goal.

Typically, the Engineers are school-trained to select a solution to a problem from among a set of pre-defined possible solutions. The Engineering schools typically reward the students for solving pre-defined problems (whose solutions are a-priori known to the authors), and sometimes even attempt to train them to work with a real-world situation to extract the relevant information to define the problem by themselves. Although necessary, this approach is seldom sufficient for a graduate to become a successful Engineer. Upon graduation the new Engineers find that they need to imagine solutions to problems that are not even clearly articulated by the stakeholders or in many cases are actually misstated or at best incompletely defined. A good amount of practical creativity is needed to solve engineering problems, and the new engineers embark in a new learning journey, different from, and complimentary to what they learned thru during their academic years, where they try to discover on their own ways to deal with the real world problems. If this new practical learning process is not expected by the new engineers, it can become a long and frustrating experience and can lead to undue stress and disappointment. On the other hand when the new engineers are adequately prepared for this step in their careers, they are much more likely to embrace the process and succeed in their careers.

Why is creativity important? It is no secret that engineers have technical minds, and for many people the concept of “creativity” does not go hand in hand with the idea of “technicality”. The “technical” notion implies a rigid approach to things, a deterministic relationship between desires and outcomes, where a certain input generates a certain output every time, all of the times. However, one has to recognize that if that would be the case, there would no technological progress, no new products that ease or eliminate our daily chores, no new solutions to existing problems of our lives. There would be no thinking “outside the box” to generate novel answers and easier solutions. The Engineers are typically trained to identify problems and solve them using the limited set of technical tools that the school is providing them. However, the more their career advances, the more they realize that novel approaches are needed, or, in other words, more “creativity” is required for outstanding performance.

This course does not replace the actual mental creative process, but attempts to stimulate it and focus it by showing a few commonly used methods, best workplace practices and best approaches that can help deliver creative solutions to engineering problems. Although creativity itself by definition cannot be “formalized”, “organized”, “predicted” or even “demanded”, one can do things to improve the chances of obtaining valid innovative results by crafting an environment conducive to creative activities, and by using flexible and sophisticated thinking methods that are likely to result in creative solutions.

1.1 Terminology

A few general terms used throughout this course are defined as follows.

The “Analyst” is the person tasked with finding a solution to a problem. He/she can be an engineer, scientist, technician, etc., or just a person that has enough technical knowledge and education to solve the problem at hand.

The “Engineering Manager” is the person that manages the department tasked with the technically creative work (which can be the R&D, NPD or just Engineering). Typically he/she leads a team of analysts, engineers, scientists, draftsmen, technicians, etc. that together execute the Engineering or R&D work.

The “Development Team” is the team tasked with finding a solution for the problem at hand, or with the development of the product or process in question. This team typically includes people from all the departments that have an interest in the problem/product, not just from Engineering: Marketing, Sales, Manufacturing, Operations, Management, etc., as more than one type of expertise is needed for solving the problem at hand. In particular cases, when the problem at hand is simple and does not span across multiple disciplines, the “Development Team” can become the “Analyst” described above.

Motto: “We haven't money, so we've got to think”

Sir Ernest Rutherford - 1908 Nobel Prize in Chemistry

2 The Creativity Process

2.1 General remarks

When faced with a technical problem, many engineers are conditioned by their formal training to respond to problems by starting to look at known, tried-and-true solutions to similar problems. They are reproducing almost by instinct the same patterns of thought that others used before them, and as a result they are very likely to reach similar conclusions. Not only were the engineers taught this process in school (and rewarded for using this approach during those formative years), but this process has also helped them to generate solid solutions oftentimes in their career. Here is easy to recognize that if all the problems were “solved” this way, we would have very few, if any, new and innovative products. We do marvel at people who had the initiative, drive and courage to step out of the beaten path and imagine new solutions. Indeed, many entrepreneurs with engineering background are revered today for their achievements (see the cases of companies like Apple, Ford, Sony, etc.). Those pioneers used a different type of thinking, illustrated by terms like “think outside the box”, “leave the beaten path”, “think differently” etc. Some of the most interesting solutions that had almost lost their meaning due to overuse.

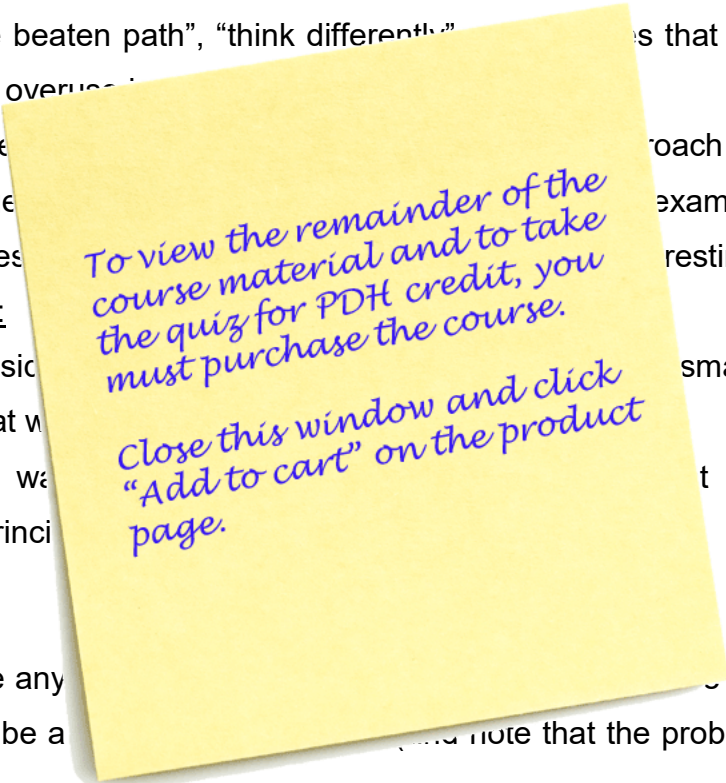
It became clear that the traditional approach to solve problems is necessary to get a solution, but a different approach is needed. This is an example of how creative thinking produces interesting solutions.

Example:

Let's consider a problem with a small number. For now, let's assume that we have a small number.

The first way to solve this is to apply the mathematical principle that this is to apply the

Are there any other ways to solve this? To drop the assumption that it needs to be a small number, note that the problem did not require a



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