Unconventional Methods for Engineering and R&D

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Unconventional Methods for Engineering and R&D

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1 General Remarks

It is a well-accepted truism that unconventional thinking is a sine-qua-non for progress, generating endless possibilities for new grounds of exploration and discovery[i]. It is also clear that the efficiency of unconventional thinking is supported by good access to unconventional methods, being it existing (and less used) methods, or by developing new methods all together.

When faced with a new technical problem, Engineers are starting the solution-finding process by looking at the known, tried-and-true answers to similar problems. Classical tools are often used, such as mathematical and computational calculations for specific Engineering disciplines, grid and graphical methods, comparisons, statistical evaluations, nomograms, etc. Although this approach can provide fast and acceptable solutions, there are situations when it may not necessarily be the most efficient, or it may not even lead to a feasible solution… Each one of us has probably already encountered situations that could not be resolved with the methods and tools learned in the Engineering schools.

When presented with unusual and atypical problems, the Engineers do not have the luxury to wait until all the relevant physics are explained[ii] or until all the pertinent scientific fundamentals are determined and validated. Even when the technical foundations may be available, the Engineers may not have the full access required, or the time needed to fully understand them and to produce acceptable solutions, especially when non-technical constraints are present.

The methods learned in College and University are helpful in solving the vast majority of the problems encountered by Engineers during their careers. However, experienced Engineers often testify that those methods are not always sufficient. Several studies have shown that more than two-thirds of the Companies have developed their own *in house* methods[iii] to answer to their specific needs. Moreover, a large majority of technical personnel believes that, to be effective, the methods should be *adapted* on a project by project basis[iv]. More techniques and tools have been devised and are available to help with solving new and atypical problems, with finding novel solutions to otherwise classic problems and with pushing the boundaries of technical possibilities.

Creativity, whether technical or non-technical, is a necessary trait that helps Engineers solve new problems and devise new, better solutions to old problems. It can only flourish in environments where the participants feel free[v], have enough latitude for trial-and-error practice[vi] and can experiment in unconventional, non-conformist and often taboo territories. It can be recognized that we only have small chances of reaching new, better solutions it we use the same old tools… hence new tools are often needed to uncover new ways of doing things, which are often thought of as "unconventional".

The term "unconventional" is defined as "out of the ordinary" or "non-conformist"[vii] and is often associated with attributes such as "original", "novel", "forward-looking", , "unique", "avant-garde" or "alternative". In the technical context this term implies a leap forward in knowledge or a step outside the previously accepted boundaries, into yet unexplored domains. It follows, then, that this term is also associated with creativity and originality of thought, inventiveness, all the while leading to the originality of results.

This Course will present a set of unconventional methods that will help the Engineers, Project Managers and Engineering Managers handle technical and non-technical problems in new ways, especially in cases where the classical solutions have been applied, but did not conclude with satisfactory results. Those can be used as purely alternative methods to solve a problem, or as novel, unique ways to reach new and valid solutions. Additionally, developing solid skills with such unconventional analytical methods is often increasing the practitioners' exposure to other non-technical domains (Project Management, Finance, Geology, Biology, etc.) which in turn is enhancing their understanding of Company's function in the industry. This implicit collaboration may even open new career horizons.

2 Definitions

The Analyst is the person tasked with solving a problem. This problem can be technical in nature, or can be non-technical. As such, the Analyst can be the Engineer, the Project Engineer, the Project Manager, the Engineering Manager, etc., but also a collaborator in non-technical domains, such as a Biologist, an Economist, a Finance Analyst, an Executive Manager, etc.

The problem is a situation, state of things, matter, etc, that is regarded as unwanted, or harmful, and needs to be resolved by mitigating or canceling its effects. It is often the case that the problem already has a solution implemented (often referred to as a "temporary solution"), but it may not be ideal for various reasons. Initially, the actual problem may or may not be clearly formulated by the stakeholders, being referred to only by its effects and symptoms, rather than the core issue. The problem's technical and non-technical constraints need to be fully understood in order to find a fully acceptable solution.

The Development Team is the team tasked with finding a solution for the problem presented, 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 resolving the problem or in the success of the product, not just from Engineering: Marketing, Sales, Manufacturing, Operations, Management, Finance, QC, etc., as often more than one type of expertise is needed for reaching a robust solution. In particular cases, when the problem is simple and does not span across multiple disciplines, the "Development Team" may be embodied by the one person, the "Analyst" described above.

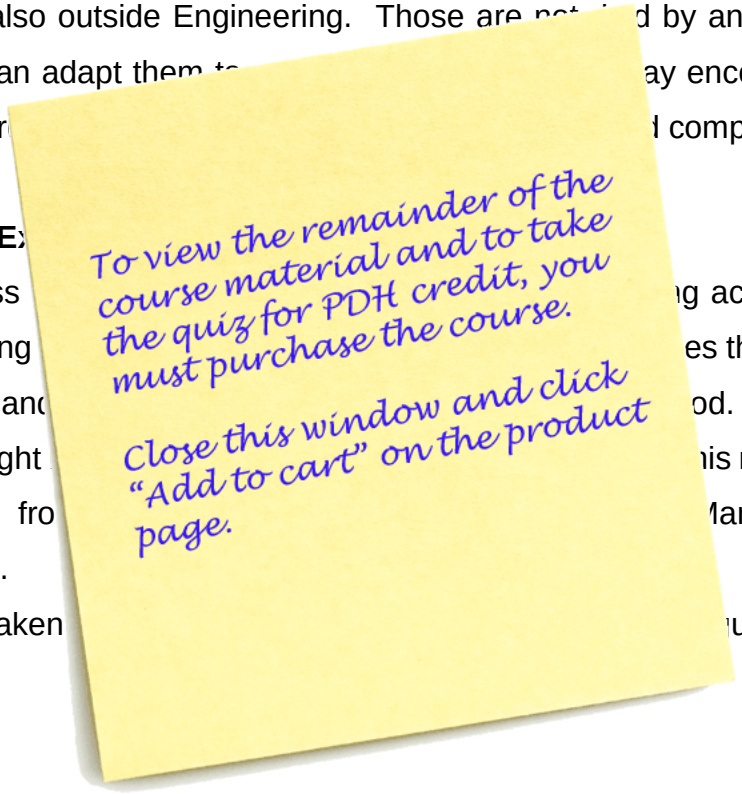
3 Problem-Solving Processes

A number of generic problem-solving processes have been developed by the industry over the years. They are used to solve problems in both the technical domains (Physics, Engineering, investing, agriculture, etc.) and in the non-technical domains (Business Development, Finance, Marketing, etc.). They all strive to find resolutions, define new and better ways of doing things, reach inventive solutions and to create faster, better, cheaper and more useful products. Given such a variety of applications, and in spite of some obvious commonalities (such as the need to have a robust problem statement to begin with) it can be safely said that there is not one problem-solving process that is more prevalent than others, or that is universally preferred. Moreover, many of those are at least partially overlapping and can sometimes be even interchangeable across domains.

Selecting a problem-solving process for a specific application depends on a number of factors, such as:

- the specifics of the problem at hand, both technical and non-technical;
- the Analysts' past experience with a given problem-solving process, and their sensitivities with others;
- the Analysts' personal intuition and their best-educated guesses related to the applicability of a specific process to the problem posited;
- the Analysts' openness to outside suggestions and their predilection to discover new ideas;
- generally, on the Analysts' abilities and willingness to explore unfamiliar territories;
- the tradition existing in the Company and the accepted best practices in their industry.

Below are presented a few problem-solving processes that are often used in the Engineering, but also outside Engineering. Those are not [illegible]d by any means, as well versed Analysts can adapt them to [illegible]ay encounter. They are presented in the or[illegible]d complicated.



3.1 The Problem E[illegible]

This process [illegible]g activities, being the most direct in finding [illegible]es that the problem is common, typical, an[illegible]od. This allows the Analysts to jump right [illegible]his method can apply to any domains, fro[illegible]Marketing, Finance, organizational, etc.

The steps taken [illegible]ure.