



Future Engineering – Leadership Skills in the VUCA World

An Online Continuing Education Course for Engineers

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Future Engineering – Leadership Skills in the VUCA World

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Contents

1	Preliminary Considerations	4
2	The VUCA world and the engineering leadership	5
2.1	VUCA states in Engineering Management	7
2.2	Sources of VUCA situations in Engineering Management	7
2.3	Strategic actions to mitigate VUCA situations in engineering leadership .	8
2.4	Specific actions to mitigate VUCA situations in engineering leadership ...	9
2.5	Managing VUCA situations by preserving optionality - leadership tools.	11
3	Future trends in engineering leadership - competencies	13
3.1	Future demands on engineering leadership	14
3.2	Engineering leadership stances needed in the future.....	15
3.3	Engineering leadership as an empowering tool.....	16
3.4	Engineering leadership in VUCA situations - generics	18
3.5	Situational management tools in engineering contexts	19
3.6	Leadership pitfalls in the new frameworks.....	21
3.7	Crisis management	22
4	Future trends in engineering leadership - tools.....	24
4.1	Flexible thinking as a leadership proficiencies	24
4.2	Trends in driving and managing innovation.....	25
4.2.1	The new innovation process paradigm.....	26

4.2.2	Co-innovation and Innovation Platforms	28
4.2.3	Formal and informal capital networks.....	31
4.3	Model Based Engineering and Digital Ecosystems	32
4.4	Hyperautomation / Industry 4.0	32
5	Expected changes in education	35
6	Conclusion	36

1 Preliminary Considerations

The future is closer to us than at any time in historyⁱ. Being at the forefront of societal development, the engineering discipline is best positioned to drive positive changes, to adapt faster to new developments, and to improve the well-being of the general population. The leadership aspect of engineering has a pivotal role in directing and driving the technical teams toward optimal outcomes by guiding all the decisional factors and development teams to be ready for such new developments. Indeed, part of the leadership duties is the definition and the implementation of strategic actions that make the organizations ready to deliver future benefits to society.

The world is expected to see more than 3% increases in the use of STEM disciplinesⁱⁱ over the next decades, with the pace of automation increasingⁱⁱⁱ, while the US is likely to add more than 160,000 additional engineering jobs by the next decade^{iv}. The engineering leadership is expected to manage those developments in such ways as to deliver the full potential of those changes. This context will intensify the situational volatility, increase the uncertainties faced by individuals, teams, and companies, add to the complexity of the internal and external functional environments, and amplify the ambiguities that everyone will face... in other words, the VUCA world will be prevalent.

It is practically impossible to scientifically predict the future^v, let alone the types of jobs needed in the future^{vi}, but it is always possible to prepare for the future by focusing on the panoply of skills that will likely be in demand. Several industry leaders have recognized trends in this direction, where successful companies have increasingly blurred lines between their functions, displaying a healthy overlap among the organizational/hierarchical rungs^{vii}. This implies that quasi-omnipotent personnel will be able to resolve a high variety of tasks in very flexible work environments faster and more efficiently. It is evident that this setting will need a different type of leadership in order to succeed. Readiness (the acquired ability to do almost anything) and adaptability (the capacity to blend disciplinary approaches and integrate various functions^{viii}) are believed to become critical traits of effective leadership^{ix}. Furthermore, it has been appreciated that collaborative approaches to decision-making^x, ^{xi}, and leading continuous improvement via coaching and learning of both technical skills and soft skills^{xii}, ^{xiii} will be keys to success.

With all this in mind, what can engineering leaders do to be ready to deliver in the new world? A quick answer relies on gaining deeper insights about past evolutions and then deep-diving into the future with a deeper and multifaceted comprehension of the situation. Such profound understanding, combined with a knowledgeable estimation and intuitive extrapolation, should allow the engineering leaders to reveal trends and generate educated guesses about how the engineering leadership may look in the future...

Building on the ideas about getting the engineers ready for the impending future introduced in the course “Future Engineering – Engineers’ Skill in VUCA World,” this course covers trends in engineering leadership future needs and expectations, skills that the engineering leadership will need to become adept at in order to deliver the expected outcomes. The course will also present the likely shape of the

innovation process, and a couple of emerging technologies, along with the educational needs of the technical workforce.

This course will benefit all the established and aspiring engineering leaders, technical team leaders, and project leaders to be ready to deliver future engineering.

2 The VUCA world and the engineering leadership

The VUCA concept (an acronym that stands for Volatility, Uncertainty, Complexity, and Ambiguity) was introduced by the US Military at the end of the Cold War^{xiv} to characterize modern world realities. This idea describes the world as a set of multilateral connections between volatile relationships and knowledge, marked by increased uncertainty, emerging in increasingly complex relationships, and covered by ambiguous facts and circumstances. It is expected that being unprepared to deal with those characteristics will either lead to decisional paralysis or even to bad decisions. The course “Future Engineering – Engineers’ Skills in VUCA World” has introduced this concept in detail, and the following material will recap the main ideas as a quick reference.

The VUCA attributes are defined as follows:

- Volatility - a situational variability of any kind characterized by erratic developments, unexpected changes, and fluctuating inputs. The current technical and non-technical knowledge allows for the situational elements to be understood at the moment. However, the elements surrounding the situation evolve frequently and unpredictably, requiring a new understanding of the situation. This leads to waste driven by rework and missed deadlines.
- Uncertainty – this happens when there is no complete understanding of the situation at hand. Here, the inputs and outputs, as well as the causes and effects, are not fully understood, as the relationships between them are not sufficiently explained. The situation cannot be managed with confidence, as the changes to the inputs result in unexpected and unpredictable changes in the outputs. The situation is not well controlled, leading to project stagnation.
- Complexity – the situations with a very large number of influencing factors, that have numerous and intricate relationships. While the connections between individual elements are well understood, the significantly large number of variables at play makes a thorough understanding of the situation or system behavior very difficult and sometimes even impossible.
- Ambiguity – the case when the situational elements and/or the situation as a whole are viewed and understood differently by various participants and stakeholders, with all various versions of the facts being considered “valid” by the various team members. This led to the teams marching to different beats and arriving at different targets than anyone had planned, leading to evident problems.

The following Figure helps the understanding of each of those concepts. This shows the knowledge about a situation on the abscissa and the ability to predict the situational outcomes on the ordinate^{xv}:

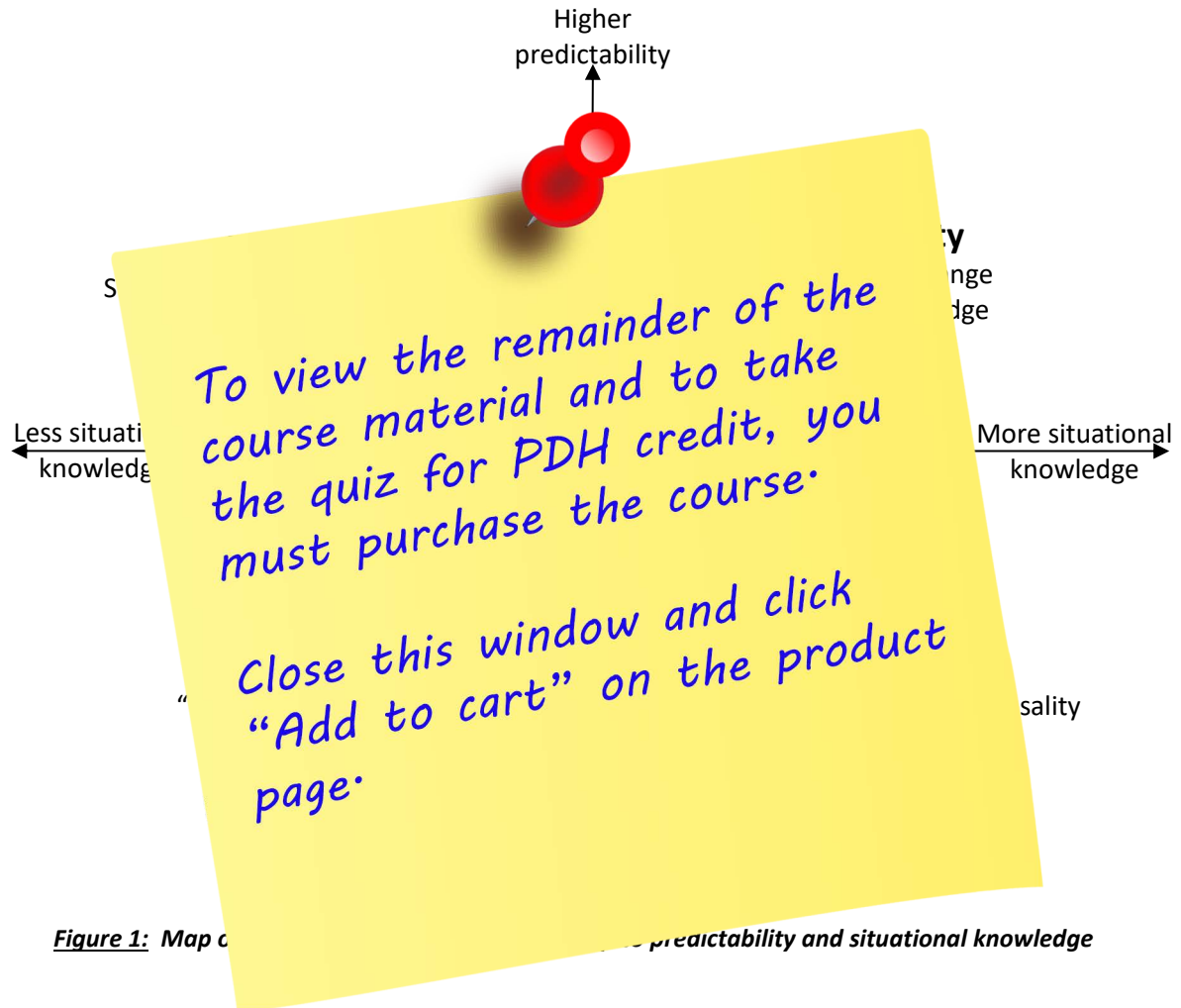


Figure 1: Map of predictability and situational knowledge

This approach to understanding the world becomes increasingly relevant in the context of engineering leadership. Indeed, not only are the projects becoming larger and more complex, but the entire working environment and operating ecosystem will be increasingly multifaceted (showing increased complexity) and will face rapid changes in requirements, tools, and resource availability (espousing intensified volatility and ambiguity), while the decisional process will be affected by an ever increased number of unknown factors (revealing elevated uncertainty).