

# Social and Moral Requirements for Engineers in Large Scale Projects

## Executive Summary

Mankind has always been an ambitious species. Driven by survival or necessity, prestige or simply an unquenchable thirst for knowledge, our history is marked by periods of invention that have culminated in the world we live in today. Large-scale projects and innovation has been a staple of our history; nations that have achieved technological superiority have often been able to leverage their new-found skill in conquest or other means to gain superiority over their neighbours, bringing the rise of various eras, empires and dynasties through the centuries. Each of these periods have had different needs, and each provided engineers and innovators with a different culture and climate in which to operate.

As today's post-modern society progresses through the Information Age, fully embracing the digital era and slowly adopting the rules of a connected global environment in data and social networking, we find new challenges that affect contemporary engineers. While projects, no matter how large, may have affected only certain communities in centuries past until such knowledge slowly spread beyond its borders, urbanization and the Internet today have created massive communities and instant dissemination of new research – the effects and responsibilities of engineers today have consequences that reach far beyond anything possible in previous eras. Similarly, the problems that face today's innovators have grown as well. Our economy is now a precarious global system, the failure or political upheaval of one may result in a chain reaction of panic and paranoia across the world. Beyond that, meeting the challenges of long-term survival of our species is no longer limited to just natural disasters, but our development in knowledge and industrialization has brought new concerns regarding both the sustainability of our planet and our fragile position in the cosmos. Indeed, we have moved forward as a species, but our challenges have grown with us.

It is with these problems in mind that we seek a solution for large-scale, multi-generational projects. We consider the traits of a leader that might excel under the

weight of such responsibility; the requirements for developing individuals equipped to face these challenges; and the cultural, political and economic environment that would be conducive to finding long-term solutions to global issues. This report will investigate the current state of the engineering profession with a focus on large-scale projects. We will discuss whether today's engineering motivation, philosophy and ethics are in line with the requirements of the ideal macro-engineer. We will then look at the role of post-secondary education in developing such an individual, and the changes modern universities and apprenticeships must adopt to develop prepare budding engineers with the skills necessary to succeed in innovating and leading multi-generational projects. Noise factors will be investigated through political, economic and cultural climates that have been conducive (or detrimental) to multi-generational projects in the past. Finally, we will apply our ideas in analyzing various case studies of multi-generational projects in progress today, reviewing their impetus, their principles and what ultimately might be required to see them prosper: the motivation for asteroid detection, environmental sustainability and mars colonisation may be obvious, but desire alone is insufficient for success and we will see what lessons we can apply to carry these objectives to fruition.

In conclusion, this report finds that there are a number of challenges and unforeseen risk in any long-term project and when it comes to the management and innovation of a multi-generational objective, we find that current engineers may be ill-equipped to handle the many challenges. Leading projects will require more than technical rigor, but also an understanding in ethics, philosophy and epistemology to guide them through an uncertain future without the fear of status anxiety in an evolving political, economic and cultural landscape. We've noted that while there are conditions conducive to the success of large projects, it is the management of both physical and social resources that is essential in sustaining a project through longer periods of development. Finally, we recognize the challenges that lie ahead of our planet, and acknowledge the role that the next generation macro-engineer might play in ensuring the survival of mankind.