Epilog—Final Considerations

Paulo Fernando Ribeiro, Antonio Carlos Zambroni de Souza, and Maarten J. Verkerk

This book has grown out of cooperation among friends who have a common interest, expertise, and passion for engineering and social practice.

It has evolved from an initiative to create engineering courses at the Federal University of Itajubá, Brazil, and contacts with friends worldwide who have similar interests. Among the courses designed in the last five years are: Philosophy and ethics of technological developments, renewable energy integration for smart cities and grids, systems engineering for power and energy systems, etc.

The increasing complexity of critical-life-sustainable infrastructures requires integrating all disciplines to promote a harmonious and sustainable society. Engineers are not only crafters of physical infrastructures but also agents of environmental and social justice. This cooperation of engineers, philosophers, sociologists, and politicians is of paramount importance for a just society.

To access the fundamental role of engineering and technology in society, one must understand how these practices change society and the environment. To produce a more humane engineering practice, it is necessary to ask philosophical questions about technological artifacts and systems and their effects on different aspects of society, social development, and quality of life. With this understanding of the complexity in engineering practice, this book attempted to offer direction and guidance at all strategic, tactical, and operational levels.

Engineering and technology design is not something strict, rigid, and singular. There are different aspects and perspectives to be considered. Considering only one

P. F. Ribeiro · A. C. Zambroni de Souza (✉)
Federal University of Ltajubà, ltajubá, Brazil
e-mail: zambroni@unifei.edu.br

P. F. Ribeiro
e-mail: pfribeiro@ieee.org

M. J. Verkerk
Maastricht University, Maastricht, The Netherlands

© The Author(s), under exclusive license to Springer Nature Switzerland AG 2022

A. C. Zambroni de Souza et al. (eds.), *Interdisciplinary and Social Nature of Engineering Practices*, Studies in Applied Philosophy, Epistemology and Rational Ethics 61, https://doi.org/10.1007/978-3-030-88016-3_20

of these aspects can compound the effects in the face of interactions with different types of systems and sub-systems. When understanding the irreducibility and interconnectivity between the various aspects (physical, social, economic, aesthetic, etc.) that describe a system and its relations, it seeks to avoid a reductionist view of society's problems. Therefore, it is essential to develop a holistic normative design, so that complex systems such as smart grids and smart cities can consider all aspects combining human and technological development.

Following this thought, the engineer and his/her practices must have a primary role in society's positive transformation. However, the means of production must also seek improvements that corroborate with social factors and other aspects of society. The search for a more sustainable society, for example, has transformed several systems into practice for decades around the world. As stated in this book, agents, including ordinary people, must take responsibility for communities' problems and the environment. From this, engineers, when considering these aspects in their design, will be corroborating and magnetizing improvements at different levels.

Engineering practices have traditionally been based on a purely technical view without considering the social effects. However, the application and implementation of the engineer's work directly impact society, the economy, and the environment. Technologies can be used to improve efficiency, promote equality, resilience and reduce risks of adverse effects. Communication and Information Technologies (ICTs), for example, are being used on a large scale and have brought disruption to different sectors and also how people interact with others and with systems. The intensive use of ICTs must and is already trying to promote the quality of life in society, promoting a revolution from innovation. It also comes up against other technologies, such as renewable energy sources, artificial intelligence, computing, and automation.

In this book, the authors and editors have tried to integrate several topics related to engineering practice about technical, economic, environmental, and social aspects. Also, the book attempted to establish a philosophical and ethical basis for the development of holistic and normative designs which will help accomplish the desired goals defined in global projects that take into consideration technical aspects and social implications.

The book's objective was to show in different ways basic examples to cover in a comprehensive way the topics related to the social aspects of engineering and technology practices. For this sake, a coherent structure that enabled the reader to navigate the topics addressed was proposed. A framework to understand the development of the whole book was presented in Chap. 2. Such a chapter started from an essential point: acknowledging that the mass of humanly-created structures and products exceeded the total biomass on earth. It imposes a dramatic challenge for engineers that must respond to this call comprehensively and responsibly. It triggered the sequence of topics addressed by the book. Hence, engineering faced many times as the villain responsible for deteriorating the environment may help society fight global warming while preserving the fauna and extracting the most from renewable sources. Thus, the following chapters explored social and human aspects of engineering, bringing attention to holistic aspects of engineering and also a discussion

about how the labor environment may help (or harm) the well-being of a human person as a worker.

Once the importance of social aspects of engineering was established, a set of topics, generally addressed under strict technical points, was presented. However, this time, human aspects have been incorporated, offering a different perspective about economics, optimization, and statistics. That was an important goal since the interdisciplinary of the emerging power system requires an engineer to have a good sociological background. Therefore, acknowledging an engineer as a leader and a worker poses an interesting problem that pushes him/her to create a healthy labor environment. Social interactions in the labor environment must also be extended to society as a whole, and social inclusion must also be observed in designing engineering projects. It, if considered by the syllabus of engineering courses, tends to make better engineers. They will be social actors that promote society's progress by respecting minorities, low-income people, and the environment. It was the drive of some other chapters that addressed pandemic and societal models, for example. The discussions provided by the authors may work as an awakening process in readers eager to study engineering.

The engineer as a social actor must be ready to face the transformations of society. In this sense, he/she must have the necessary background to work on the technological changes. For this sake, the reader should be aware that the cycle of knowledge–science–technology is currently under transformation since technology enables new ways of acquiring knowledge and creating a quick-transforming society. Therefore, engineers are invited to be protagonists in this process.

If the technical background is vital in this era, social care is about to make the dominant difference. This point is crucial to implement ideas that must be proposed with the meaning of "nobody left behind," including people and improving processes. However, sometimes changes are not planned, as the pandemic paralyzed the economy and killed millions of people. In this case, besides economic relief, people need to embrace activities that bring hope and comfort. Once again, as described in this book, engineers may help society overcome difficult times by proposing new artifacts while respecting the different cultural aspects of the people involved.

Society can no longer afford to continue utilizing engineering without fully integrating it into its social and environmental implications. The global village is a reality, and global warming is a sign which needs to be taken seriously if we care for the future of our children and grandchildren and humanity as a whole.

The authors hope that this book will be received and used and help engineers and non-engineers understand the implications of engineering and technology practices. We also hope that the material discussed here breaks down the unnecessary wall that splits human studies from engineering, rendering a creative environment where the artist–engineer–designer–poet may bring hope and harmony to society.