Foreword

Engineering science and technology is a real and direct productivity that changes the world, and engineering fronts represent important directions for the future innovation of engineering science and technology. Currently, the world is facing major changes unseen in a century. The Corona Virus Disease 2019 (COVID-19) has aggravated the uncertainty of global development. The new round of scientific and technological revolution and industrial transformation continue to deepen and evolve. Engineering innovations are advancing in an interdisciplinary and integrated manner, and the engineering fronts continue to integrate with each other to achieve breakthroughs.

The Chinese Academy of Engineering (CAE), the most honorable consulting academic institution in China, shoulders the historical mission of playing an academic leading role and promoting the development of engineering science and technology. Since 2017, the CAE has been organizing a project known as “Global Engineering Fronts” every year, which aims to assemble talents in the field of engineering science and technology to represent the global engineering research and development fronts by reviewing global papers, patents, and other data. The results are also expected to provide a reference for people on responding to global challenges and achieving sustainable development.

The 2021 Global Engineering Fronts project continues to rely on nine academic divisions and academic journals of the CAE to identify 93 global engineering research fronts and 93 global engineering development fronts. This is done by paying equal attention to the engineering research and development fronts, integrating quantitative analysis and qualitative research, and combining data mining and expert argumentation. Among these, 28 key engineering research fronts and 28 key engineering development fronts are selected for detailed interpretations.

In 2021, more experts from the field of engineering science and technology and informatics science were invited, and there were deep interactions between experts and diversified data sources. In the process of data analysis, experts are involved in reviewing and adjusting the results to effectively maximize the utility of papers, patents, and data indicators, thereby ensuring the reliability and objectivity of the results.

This report presents the results of the 2021 project and comprises two parts. Part A explains the data and methodology. Part B presents the technology reports focusing on nine fields: (i) mechanical and vehicle engineering; (ii) information and electronic engineering; (iii) chemical, metallurgical, and materials engineering; (iv) energy and mining engineering; (v) civil, hydraulic, and architectural engineering; (vi) environmental and light textile engineering; (vii) agriculture; (viii) medicine and health; and (ix) engineering management. Each report describes and analyzes the engineering research and development fronts in these fields and explains the key fronts in detail.

Identifying engineering fronts is a complex and challenging task. In the process, the research team gradually explored a unique research path, that is, the research, forums, and journals were closely integrated to promote each other. The project was supported by nearly a thousand of academicians and experts from various fields and institutions. We are grateful to all of them!