Digital Engineering – Executive Summary

The fourth industrial revolution, also known as Industry 4.0, encompasses several significant trends, including the digital revolution or digital transformation. This document explores various aspects of digital transformation with a focus on its components and perspectives for digital engineering. These aspects include strategic considerations and implementation factors. Major organizations and companies, such as the Department of Defense and leading automotive and aerospace firms, have developed strategic programs for advancing and implementing digital engineering. This information identifies the goals, challenges, opportunities, and barriers to effective implementation and highlights the key benefits, including improved product and system quality, cost savings, and reduced development, manufacturing, maintenance, and delivery timeframes. It empowers organizations, managers, and engineers to develop effective strategic plans for implementing digital engineering in their areas of responsibility, which will address marketing, technology, engineering, and process challenges. Effective implementation of these plans is expected to significantly improve the processes in which engineering and its derivatives are utilized in companies and projects.

The Samuel Neaman Institute-led Forum for Engineering Education for the 21st Century is promoting digital engineering and digital literacy in academia and industry in Israel. This document serves as a component of the knowledge base for these initiatives.

In line with the strategic plans for implementing digital engineering, there is a requirement for education and training of managers, engineers, and professionals involved in the development, engineering, manufacturing, maintenance, and delivery of complex systems.

In this report, we present a survey of academic institution programs in Israel and internationally aimed at training the next generation of engineers for the digital engineering era and providing education to acquire digital competencies. Additionally, we describe lifelong learning programs for the current engineering workforce to upgrade their skills for the digital age.

In this framework, we conducted a digital literacy survey through questionnaires and interviews to assess the current gaps in digital competencies in academia, industry, and the business sector. The main findings are:

• Most industry participants expressed a desire for engineers to possess diverse digital competencies to support modern engineering processes in their companies. However, there is a gap between this desired status and reality, and concern that this gap will worsen.

• Most academic participants highlighted the need for incorporating enhanced digital competencies in engineering education programs to prepare students for the changing digital workplace. Unfortunately, the integration of digital content into the syllabus is slow and does not meet the requirements and expectations.

In this report, we summarize various digital engineering methodologies, including:
- Generative design
- Design for 3D printing
- Model-based systems engineering
- Data-based engineering
- Digital twin

It also includes an overview of the implementation of digital engineering in specific areas, such as:
- Advanced manufacturing and Industry 4.0
- Predictive maintenance and health monitoring
- Internet of Things (IoT)
- Quality 4.0 engineering
- Model-based conceptual design
- Integrating artificial intelligence and machine learning into digital engineering.