Advisory Opinion

# Human Resource Development and Ecosystem to Promote Industrial Competitiveness Based on Computational Science

September 1st, 2023

Science Council of Japan

Subcommittee on Computer Science Simulation and Engineering Design, Committee on Comprehensive Synthetic Engineering and Committee on Mechanical Engineering

This Advisory Opinion is issued in accordance with the outcome of the deliberations of the Subcommittee on Computer Science Simulation and Engineering Design, Committee on Comprehensive Synthetic Engineering and Committee on Mechanical Engineering, Science Council of Japan.

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## Summary

### 1. Background
　In the context of today's intricate and globally interconnected societal landscape, where concepts like Society5.0, IoT, Cyber-Physical Systems (CPS), and the pursuit of carbon neutrality are at the forefront, the pressing task is to construct new products, systems, services, and more that bring forth fresh value propositions and purposes distinct from traditional norms. Herein, the effective application of computational science is believed to gain increasing significance, particularly in propelling the progress of CPS. With the acceleration of technological competition, the gap between manufacturers and computational science is becoming infinitely closer than in the past, and it becomes vital to take a holistic view of the current status of computational science-related software development and usage, with a primary focus on its practical implementation in the industry.

　The objective of this endeavor is to illustrate how the distinctive characteristics of domestically developed computational science software can be leveraged to facilitate the creation of an environment that supports its utilization in the manufacturing sector, the development and enhancement of versatile software, talent cultivation, and other aspects. The approach involves objectively identifying existing challenges, conducting data analysis, fostering discussions through symposiums and surveys, and consolidating viewpoints.

### 2. Current Situation and Issues
　In the realm of manufacturing, computational science is advancing, primarily relying on general-purpose software from overseas, known for maintenance, updates, and user-friendly interfaces. Despite support for domestic software, practical integration in the manufacturing industry is limited. To address this, advocating for the "analysis quality improvement process" is crucial, emphasizing effective software use, analytical modeling expertise, and continuous improvement. The objective is to fortify the global standing of the domestic software industry, recognizing the importance of understanding software functionality for reliability and talent cultivation. To sustain and broaden the adoption of this process over time, it becomes essential to create a "new ecosystem" wherein various stakeholders from within the country, including relevant companies, professionals, and organizations, can naturally collaborate and coexist to enhance industrial competitiveness. And, traditional talent evaluation metrics like Impact Factor and h-index may no longer suffice in the evolving landscape of computational science within manufacturing. Fresh methodologies are needed to evaluate and enhance motivation effectively. The document proposes strategies to advance computational science for industrial competitiveness, focusing on talent development and expanding practical applications.

### 3.　Recommendations in this Advisory Opinion
(1)　Considering the Introduction of a New Evaluation Approach (Indicators, etc.)

In the changing landscape of modern manufacturing, individuals engaged in research and development, particularly in system integration and case studies, play a crucial role amid increasing collaborations with AI and information science. Recognizing their importance for nurturing technical talent and fostering competitiveness, it is vital to establish mechanisms that proactively elevate their status. This involves exploring new metrics models for evaluation, considering contributions to society and practical applications, and creating recognition systems and platforms for information exchange. Introducing new evaluation models requires careful consideration and thorough examination within both the manufacturing industry and academia, as it may elicit mixed reactions.

## (2) Building a Diverse Ecosystem for Computational Science:

To strengthen industrial competitiveness in computational science, a diverse ecosystem is crucial. This involves:

1）Facilitating collaborative partnerships among software vendors, universities, and users, promoting interactions between domestically developed general-purpose, open-source, and commercial software.

2) Involving academic associations, non-profits, and industry associations to support information sharing, including case studies based on analysis quality.

3) Providing consulting functions for developing human resources capable of analyzing simulation quality.

4) Establishing online systems, talent networks, and sharing mechanisms for continued computational science use in challenging circumstances.

5) Implementing training programs to nurture professionals for collaboration in software integration, AI, and information science.

6) Incubation organizations that serve as the driving force of the ecosystem.

## (3) Strategic Planning:

To advance the ecosystem, propose strategies for:

1) Developing mechanisms to explore, identify, and evaluate researcher activities related to computational science, incorporating data collection techniques like social networking services (SNS) beyond research papers.

2) Establishing innovation support organizations through collaboration between agencies, research agencies, academic associations, and industry.

3) Initiating government-led funding initiatives for practical implementation, including feasibility studies for domestically produced general-purpose software in the manufacturing industry.