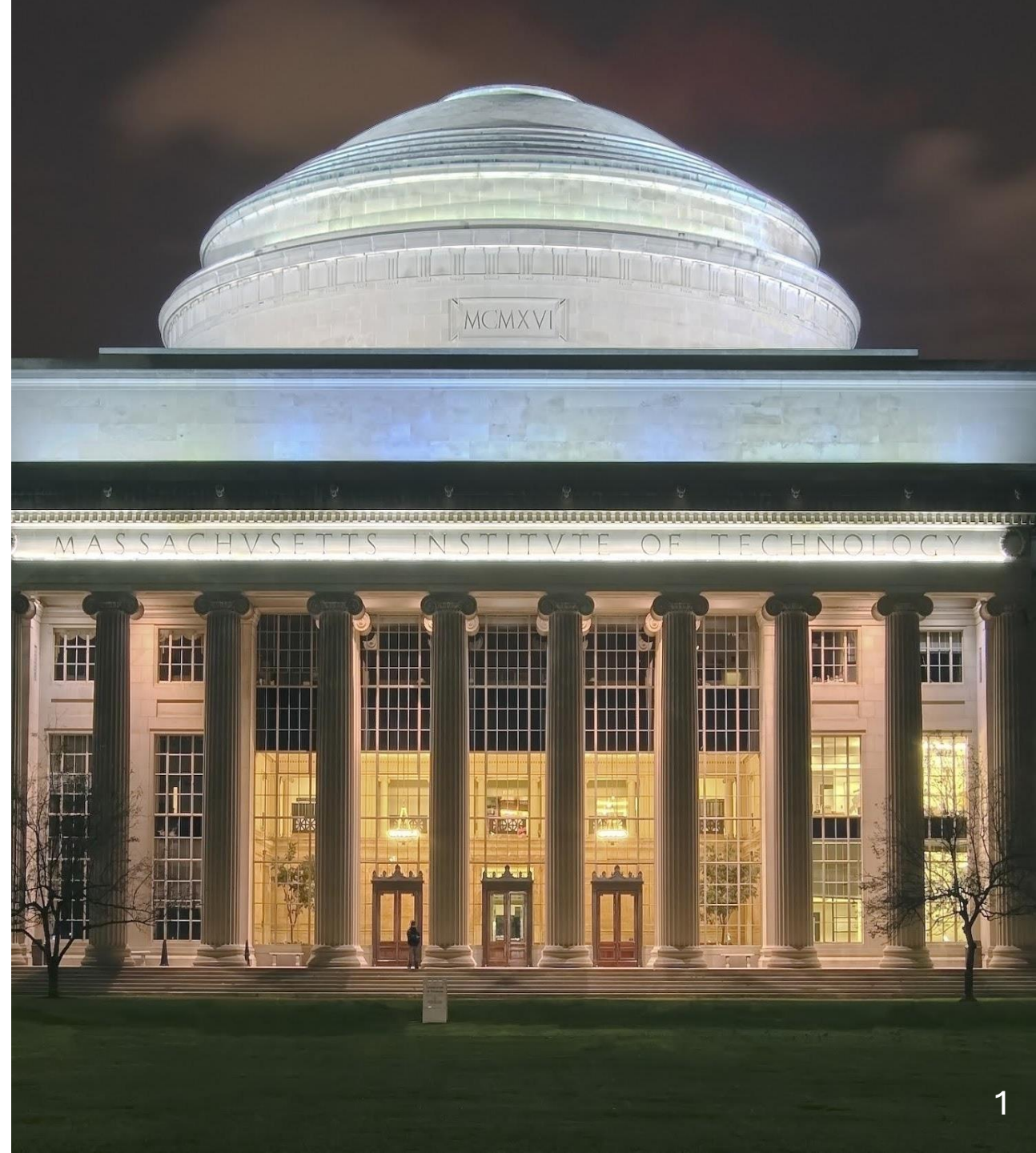


# An MIT Perspective on Systems and Engineering Education

Systems Workforce Summit  
Delft October 2024

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Not a new debate.  
Tensions in Engineering Education:

- Science or Practice
- Principles or Methods
- Decomposition or Holism
- Centralized or Federated
- Structure or Behavior
- Control or Culture
- Reflection or Process

From MIT's origin, these tensions are not seen not in conflict but in practical synergy. Mind *AND* Hand





# MIT's Systems (and) Engineering journey

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- **1930s** : A practical, undergraduate institution. **Wiener** brings mathematics and scholarly frame to EE. **V.Bush** pioneers differential analyzer device, worked on by **Shannon**. **Compton** strengthens science.

**1940s**: **Rad Lab** at MIT developed radar, stimulates progress in control systems and feedback. MIT **Lewis Report** expands science requirements in engineering education and calls for **MIT School of Humanities and Social Science**. Wiener frames “**Cybernetics**”.

**1950s**: **Operations Research Center (OR)** founded by Morse. **System Dynamics** established by Forrester. “**Systems Engineering**” emerges from Bell Labs ; **Hall** teaches early subject at MIT. The **Systems Engineering Group** established within MIT Lincoln Lab.

**1960s**: **Draper** leads navigation systems for Apollo. NASA's Webb funds **R&D Management research at MIT** and other top universities, the only Apollo funds for social science. **Zacharias Committee** triggers education reform to broaden engineering education.

**1970s**: Wiesner promotes **vision of broader educational mission**. Engineering Dean Keil emphasizes multidisciplinary study on impacts of science and technology. **Science Technology and Society (STS)**, **Center for Transportation and Logistics (CTL)** and **Technology and Policy Program (TPP)** established.

**1980s**: Growth of graduate student population and research. Studies on **Lean Manufacturing** and the **Center for Technology, Policy and Industrial Development**, precursor to ESD, established.

**1990s**: **Leaders for Manufacturing (now LGO)** and **System Design and Management (SDM)** created. The **Engineering Systems Division (ESD)** created to foster interdisciplinary collaboration and research on complex systems (“Big E engineering”). Faculty with “dual slots” hired.

**2000s**: **Technology, Management, and Policy (TMP)** doctorate started. Departments increase joint degrees, especially between domains and computer science. **Biological Engineering** department established.

**2010s**: **ESD transitions and expanded as Institute of Data, Systems, and Society (IDSS)**. MIT continues to innovate in systems education, incorporating advancements in computation, data analytics, and sustainability. Emergence of **online courses and certificates**.

# Systems Engineering Trends Across MIT

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**Many departments** deliver systems courses:

- Aero/Astro
- Biological Engineering
- Chemical Engineering
- Civil Engineering
- Management
- Urban Planning
- ***System, Design, & Management*** (more later today)

**Emerging initiatives:**

- **New engineering degrees**, joint amongst departments by their nature systems focused. (e.g. 1-12, 6-11,...)
- **NEET** (*New Engineering Education Transformation*) innovative undergraduate cross-departmental engineering
- **College of Computing**
- **Morningside Academy for Design**
- **Energy** and **Climate** initiatives
- **Human Insight Collaborative**

Not only what we teach, but **how**.

- Research on Learning
- Research on Engineering Projects
- Online delivery

## MIT Programs in Complex Systems Engineering

- **LGO** – manufacturing; global operations
- **SCM** – logistics and supply chain management
- **SDM** – system design and management
- **TPP** – technology and policy
- **IDSS PhD** – Social and Engineering Systems

### Common denominators:

- Broader than classical engineering
- Cross industry
- Dealing with the extended enterprises
- Management and social science, incl. economics
- Dialogue of Expert and Non-expert stakeholders

MIT has a **long history**, across domains, of research and teaching on systems and engineering.

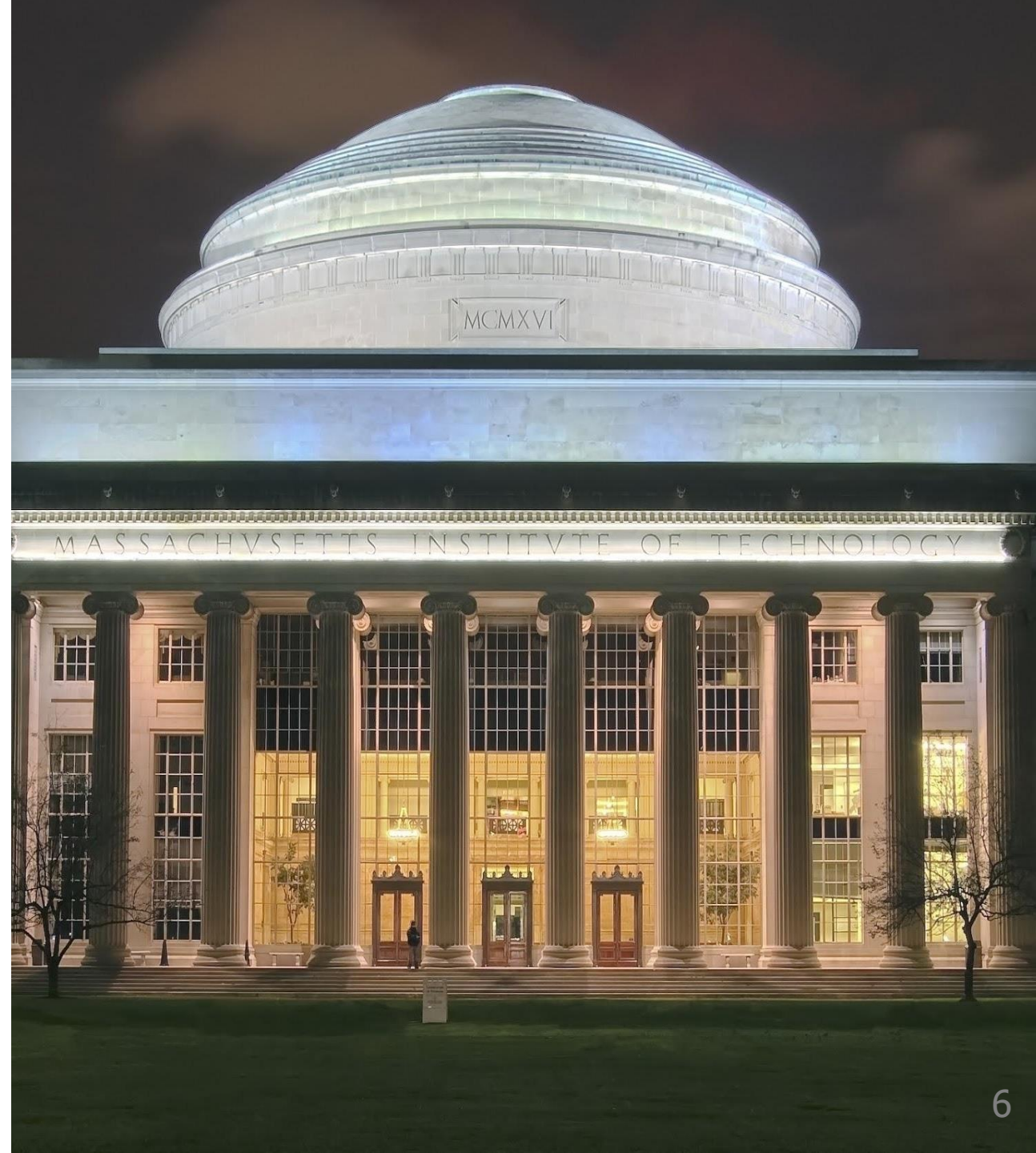
Tensions -- between principles and tools, between science and practice -- in systems engineering are natural, and to be embraced. *Mind AND Hand*.

Today, transdisciplinary engineering to solve complex systems challenges is accepted and **diffuse across MIT**. Relevance and linkage of systems education to many fields increasing.

**No single group owns Systems Engineering at MIT.** SDM, closest to industrial practice, is investing in curriculum, with emphasis on *transdisciplinary problem-framing, model-based (MB) engineering, MB project management, and computation*.

Thank you.

[bry@mit.edu](mailto:bry@mit.edu)



# Background

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- **MIT**  
S.B. Computer Science ('87)  
S.M. Tech. & Policy ('89)
- **U. Tokyo**  
Ph.D., Grad School of Frontier Sciences ('12)
- **Nissan Motors, Kanagawa Japan**  
AI Systems for Product Dev.('89)
- **United Technologies (UTC)** – Global Product Development and Manufacturing ('90-'99)
- **GPD** – founder '99; CEO. Transformation of project performance. Model, simulation, and data analytics-based teamwork.





# Current Roles

## MIT, Academic Director & Sr. Lecturer System Design & Management (SDM)

- Taught core SDM courses (SA+SE+PM) and advanced courses in engineering teamwork and agent-based modeling. MIT xPro and MIT PE courses on project management.
- Director of Engineering Teamwork Lab (part of GTL).



## Tokyo Institute of Technology, Visiting Professor Innovation Design Platform

- Research and curriculum in innovation ecosystems, design, and entrepreneurship. Focus on transforming engineering teamwork, research, and education.



## University of Tokyo, Sr. Researcher Maritime and Ocean Digital Engineering Lab (MODE)

- Strategic roadmap and integrated capacity development for the digital transformation of the commercial maritime industry.



## Global Project Design (GPD), Founder and CEO

- Transformation of R&D and engineering performance. Makers of TeamPort, a model-based platform for teamwork.

