MITsdm

JUDGEMENT IN FRAMING, BUILDING, AND USE OF SYSTEMS MODELS AND COMPUTATION

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MIT System Design and Management

Topic: Engineering Education

Systems Workforce Summit

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MIT System Design and Management (since 1996)
School of Engineering + School of Management

Masters of Science degree, Graduate Certificate, Customed Professional Education
Research on Engineering Strategy, Organizations, Projects, and Teamwork

“For those who want to lead, not leave, engineering”

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Changes to Engineering Practice

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Rapid changes in engineering practice

- (Data), Models and Simulation – pandora's box open, non-experts rapidly applying.
- Processes and infrastructure of prior generation to govern large, complicated projects are deeply embedded; may be a competitive disadvantage.
- Supply chain uncertainty/ risk.
- Devolution of engineering team size, distribution, and return to vertical integration?

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MIT Responses to Engineering + Computation

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- Hiring of Transdisciplinary Engineering Faculty/ dual appts
- Parley (common AI platform, budgets; vendor neutral), guardrails, and experiments.
- Promote but don’t dictate. Parallel initiatives.
- Significant reset of assignments. Pedagogic intent wrt/AI stated.
- Working prototypes. Team-based. Quickly.

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MIT SDM – Curriculum Considerations

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- Decadal re-design of integrated SDM curriculum underway.
- Year long design process with faculty, students, alum, partners.

Five priorities from our dialogue follow:

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Priorities for Education for Model-based Transformation of Systems Teamwork

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1. **Extend, rather than Displace, Experience-based Judgement**
2. **Increase *Collective* Cognitive Capacity**
3. **View Engineering Organization as Ecosystem**
4. **Gain Comfort and Skill when facing Complex, Ambiguous Challenges**
5. **Question Assumptions, Not What, but HOW to think.**
6. **Lead with Integrity and Patience in Methods and Claims**

A focus remains on human attention, decisions, and behavior during problem framing, conceptualization and design exploration. Given new techniques, do tacit skills and judgement improve? Are **experience-based mentals models** displaced or are they extended?

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Increasing cognitive capacity of teams to focus on meaningful challenges, lead others to pay attention, and generate differentiated solutions for daunting systems problems.

Likewise, removing processes and tools which promise operational efficiency yet interrupt healthy cross-functional dialogue, ongoing learning, and evolution of the deep engineering capabilities.

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View the **engineering organization as ecosystem** rather than structure, fixed processes, control, and standard work.

An emphasis on *usefulness of methods* in organizational context.

Witness how ecosystem choices affect the *emergent* depth and breadth of problem framing, conceptualization, system architecture, and then design of actions (project, operations, capability gains).

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Recognize trade-offs, tensions, uncertainty, and **surprises as natural** to innovative engineering systems, often beyond disciplinary conventions and experienced based engineering.

Project-based learning is **rehearsal of teamwork and systems capabilities** with stepped increases in ambiguity and complexity.

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Nurture healthy skeptics and motivated innovators who embrace that engineering practices are not fully mature and that the **disciplines continue to evolve**.

As methods are introduced, ask, “Does the method increase, or decrease, the capacity of the org. to solve the problem? Is the (visible) tradespace expanded? Are the alternatives differentiated and of better quality? Is the team of teams ready and rehearsed to leverage these new systems capabilities? Are deep assumptions from prior development, embedded in the standards, infrastructure, and conventional wisdom, revealed and addressed robustly?”

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Include **scientific and social mindsets** in the response to new tool and process fashions, reminded that the physics of systems, teams and work do not change when new trends are introduced with enthusiasm.

Recognize that **systems leaders shape** the organization system as well as the product system. They design the experiment and instrument activity which tests claims; nudging teams to evolve capability faster and better than convention, fashions, and competition.

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Actions

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1. Develop a ***shared research agenda*** to develop and rigorously evaluate critical capabilities needed next 20 years, especially for mission-driven and advanced engineering projects.
2. Pilot ***case studies*** relate to state of the art in engineering projects across a sample of domain contexts
3. Prepare ***workshops as experiments*** to test proposed advances in practice and tools (a meta-experimental approach)
4. Co-create new ***curriculum and pedagogy*** at university degree and professional recurrent education levels.
5. Create an ***engineering teamwork studio*** to emulate the emerging engineering professional experiences.

A call for partners

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