Panel 4D: Capstone Resource Management (Budgets, Supplies, Workspaces, Shops)

Description: The projects are recruited and the teams are assigned—now the real puzzle begins. Join this panel for a lively discussion on how prototype-heavy capstone programs manage budgets, supplies, shops, and workspaces while preparing for the growing wave of future capstone students.

Facilitator: Shraddha Sangelkar (RHIT)

Panelists: Kurt Stresau (UCF), William J. Endres (MTU), Daria Kotys-Schwartz (CU Boulder)

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Add Panelist Background information here, Capture the size of the programs, the structure of your program and your role in it

- **Kurt Stresau** (University of Central Florida)
    - *Kurt Stresau is a Senior Lecturer for Capstone in the Mechanical and Aerospace Engineering (MAE) Department and Director of the IDesign program for the College of Engineering and Computer Science (CECS) at the University of Central Florida. MAE has ~900 seniors in Capstone this year, and CECS has ~2,000+. IDesign serves as the gateway for both Interdisciplinary and industry-sponsored projects, with several dozen such projects this academic year. IDesign typically has $200K-$300K in sponsored projects each year, and the IDesign program manages approximately three dozen Faculty, Adjunct Faculty, and Staff Engineers as mentors for the project teams.*

- **William J. Endres** (Michigan Technological University)
    - *Bill Endres holds a Richard and Elizabeth Henes Endowed Professorship and has served for 17 years as Director of the Capstone Design Program in the Department of Mechanical and Aerospace Engineering at Michigan*

Technological University (MTU). He brings his experience as the founder of a small cutting-tool commercialization business to his director role where he leads a team of 8 – 10 faculty colleagues who advise the 150 – 200 students per year working on 35 – 40 projects — spring-fall and fall-spring. Most projects are externally funded by industry, some by federal contracts, all at firm-fixed price direct cost of typically $15K yielding an annual budget of about $300 – 400K after cost of sales. Since 2023 he has introduced, from his latest business venture, a Leader Development Series of one-credit courses that support growth of "top performing, high potential" students at the junior through grad levels.

- **Daria Kotys-Schwartz** (CU Boulder)
    - *Daria Kotys-Schwartz is a Teaching Professor and the Design Excellence Faculty Fellow in the Department of Mechanical Engineering (ME) at the University of Colorado (CU) Boulder. She is the Founding Director of the Idea Forge, a flexible, cross-disciplinary prototyping facility at CU; the Director of Design Center Colorado, the primary industry connection in ME, which encompasses fabrication facilities, 50+ industry sponsored and entrepreneurial capstone projects each year (for 300+ students), and hands-on design curricula throughout the ME Department. She serves as coordinator for all of the sections of ME Senior Design and co-instructs the Industry Section of the ME Senior Design course (~240 students), which has 30 teams per a year (8-12 students per a team) and ~$300k in revenue. There are two other sections that make up the mechanical engineering Senior Design program - Engineering for Startup Innovations (ESI) and the Competition Section.*

Potential Questions

1. Current picture: How is your capstone program funded, and what balance do you strike between recurring institutional support and program-generated revenue (soft money)?
2. Current picture: What administrative or campus partnerships have been most critical to running your capstone program successfully (HR, legal, safety, contracts, grants, facilities etc.)?
3. Current picture: How do you currently structure staffing for your program, including technical staff, machinists, industry liaisons, faculty, or other support roles?

4. With growing enrollment and increasing demand for capstone experiences, what changes do you believe programs need to make to remain sustainable over the next several years?

    a. What financial model do you use for managing project budgets, shop costs, and administrative overhead, and how do you decide who pays for what? How will this change?

    b. What systems or strategies can be leveraged for managing materials, equipment, workspaces, and prototype-heavy project needs?

    c. How do you envision handling changes to staffing to manage the incoming class size?

    d. In general what thoughts do you have to prepare for the higher enrollment in mechanical and related disciplines? Especially the wave that is expected to hit us in 3 years?

Notes:
Question: How is your capstone program funded, and what balance do you strike between recurring institutional support and program-generated revenue (soft money)?

Daria Kotys-Schwartz:

- The program is currently transitioning in how its funding is structured and managed.
- Originally, the senior design/capstone program was funded entirely through industry partnerships.
- Industry-sponsored projects are handled as research contracts, primarily to manage intellectual property transfer.
- A research center was established within the Mechanical Engineering department to help manage and protect capstone-related funding.
- Industry contracts generate overhead revenue, which serves as the program's primary source of soft money.
- The department does not provide direct funding for most capstone operations.
- The program operates like a business within the department, a model described as "educational entrepreneurship."
- Students are encouraged to view their work as part of a professional consulting organization.
- Faculty responsible for teaching course and lecture components are funded by the department through institutional (hard-money) support.
- The department provides support for core staff positions, while additional staff may be shared with other programs.
- Soft money is used to support functions such as industry relations, financial management, and contract administration.

- Aside from core faculty support, the capstone program is largely self-sustaining.
- The university receives relatively little state funding.
- Many advisors are adjunct instructors who are also alumni and practicing engineers.

Kurt Stresau:

- State tuition rates have remained unchanged for many years, reducing the proportion of university costs covered by tuition.
- To compensate, the state legislature provides direct appropriations to state institutions.
- Annual state funding provides university leadership with flexibility in allocating resources.
- As the program expanded, staffing and workload demands increased, creating challenges in securing sufficient funding for personnel. Industry sponsor funds are used to support many program operations and personnel costs.
- Many adjunct instructors are alumni who participate primarily out of passion and a desire to give back rather than for financial compensation.
- Program leadership continually seeks to shift positions from soft-money funding to recurring departmental funding.
- A staff engineer/lab manager position was successfully transitioned to department-funded support.
- Additional faculty positions have also been secured through departmental funding rather than grants or industry revenue.
- Industry partnerships provide project funding, but much of that revenue is spent on personnel, project support, materials, and supplies.
- Adjunct instructors play a major role in mentoring and supporting project teams.
- When teams pursue especially ambitious projects, additional soft-money funds may be used to supplement project budgets.
- The program actively reclaims components and equipment from completed projects for future reuse.
- Recovered materials are cataloged and maintained as a parts inventory for future student projects.

William J. Endres

- The program is similar to Colorado's and is intentionally run like a business.
- The standard industry project fee is treated as a direct cost.
- Industry partners can structure their involvement as a contract.
- A typical project budget is divided into multiple allocations:
    - A portion is allocated to a small sales or outreach team to support project acquisition.
    - A portion supports the student project team's budget for materials, manufacturing, components, and occasional travel.
    - Remaining funds are used to support technical staff in the student shop and related departmental operations.
- The program has evolved its funding and sales model over time to improve financial stability.
- Internal projects exist but are generally deprioritized in favor of funded industry projects because they are not generating revenue.

Question: Do you have a system in place for tracking all of the parts? Will students be able to access the parts by themselves? Do students return the parts when they are finished?

Answers:

- Students submit an Excel file that functions as either a checkout form or a purchase form.
- Checkout forms are sent to the inventory manager.
- Inventory items are physically organized in labeled storage locations (e.g., drawers labeled by section and number such as A1, A1.1).
- Each drawer contains multiple labeled components, allowing most items to be located quickly (typically within a few minutes).
- Students submit checkout requests, and staff retrieve items for them during office hours.
- Students verify that they are receiving the correct items upon pickup.
- If requested items are already assigned or unavailable, teams may need to identify acceptable replacements and adjust their design calculations accordingly.
- Printed checkout and purchase forms are used to manage inventory tracking.
- Checkout forms are returned to storage for future reference.
- Purchase forms are reviewed by staff and updated with purchase links before being added to the inventory system.
- Common materials (e.g., structural components) are made available in open-access bins where students can take items on a first-come, first-served basis without formal tracking.
- More sensitive or high-value items (e.g., sensors or measurement devices) are tracked and require sign-out.
- If these items are unavailable, staff can track who last checked them out to locate them if needed.
- Inventory is managed using a living Google Sheet database.
- Students search the database to locate items, check availability, and then complete checkout forms based on what they find.
- Most students-bought items are consumables such as carbon fiber.

Question: What administrative or campus partnerships have been most critical to running your capstone program successfully (HR, legal, safety, contracts, grants, facilities etc.)?

William J. Endres:

- There is a separate intellectual property (IP) and legal coordination group that handles NDAs and IP acquisition requests from companies.
- The university strongly advises students not to sign NDAs directly, as students may not fully understand the implications.
- The sales function has evolved from a single sales role to a broader, multi-department sales team due to organizational growth.
- The current sales model is more effective because it can route industry problems to the appropriate departmental “product lines.”
- The sales team is treated as an integrated partner in the program rather than a separate organization.

Kurt Stresau:

- In the early years, industry partners were primarily philanthropically motivated and supported the program as donations rather than for product development or intellectual property (IP).
- Over time, it became clear that students were developing technologies and products with potential commercial/IP value, which created a conflict with the foundation’s philanthropic role.

- As a result, the program shifted from the philanthropic structure to the research contract side of the university.
- This transition introduced standard research contracting processes.
- The program later worked with the university's research foundation to create a hybrid structure between philanthropic donations and research contracts.
- The legal department advises against involving directly in NDAs or IP agreements between companies and students.
- Students retain ownership of their intellectual property in many cases, particularly for class-related work.
- IP agreements, NDAs, and related contracts are handled directly between companies and students, not mediated by program staff.
- Program staff are only allowed to facilitate administrative/document transfer and are not permitted to provide legal advice.
- Students are directed to university student legal services for any legal questions or contract review.

Daria Kotys-Schwartz:

- The speaker manages multiple roles, including director of design center, co-instructor for the industry senior design program, etc. Over time, the speaker has built extensive cross-campus relationships to support program operations.
- Strong relationships with the Office of Contracts and Grants are essential for managing industry-funded work.
- As the program grew, it created significant administrative workload due to many small contracts requiring similar effort to large grants.
- This led to attention from senior university leadership due to increased administrative burden.
- To improve efficiency, the program helped develop standardized processes such as:
    - Short, standardized 2 page contracts
    - A memorandum of understanding (MOU) used as a template across engineering departments
- The program actively collaborates with university legal advisors but avoids requiring students to sign NDAs or non-compete agreements.
- Instead of NDAs, confidentiality is handled through contract-based clauses that protect project information without restricting student employment opportunities.
- Students are explicitly advised not to sign external NDAs and are protected from doing so.
- The program includes an industry liaison role that communicates expectations to companies regarding confidentiality agreements.
- There is close collaboration with the university's entrepreneurship and IP commercialization office, which supports student and faculty innovation and startup formation.
- The program maintains a strong relationship with the Office of Institutional Equity and Compliance.
- They also work closely with campus fire marshals to ensure safety compliance for experimental and fabrication activities.
- There is a strong relationship with risk management due to frequent student work in machine shops and fabrication environments.
- The program relies heavily on HR for hiring large numbers of adjuncts, lab engineers, and staff.
- HR processes are streamlined by the program preparing much of the required documentation in advance.

Question: What do you perceive as the biggest challenges for the capstone program over the next three years, particularly in light of the large incoming freshman class in mechanical and related disciplines?

Kurt Stresau:

- Managing program growth with adjuncts works at small scale, but becomes increasingly difficult as the number of instructors grows.
- There is a natural limit to how many people can be effectively coordinated without losing efficiency in communication and management.
- Scaling to dozens of adjuncts would fundamentally change the nature of the role, shifting it toward large-scale organizational management similar to industry rather than academia.
- To scale effectively, the program would require more full-time faculty positions rather than relying on adjunct or part-time instructors.
- These faculty should not be traditional research-focused tenure-track academics, but rather teaching- and project-oriented instructors with industry experience.
- Sustainable growth cannot be achieved through soft money alone; it requires stable, recurring (hard-money) funding.
- Industry project revenue is not sufficient to support the level of permanent staffing required for long-term expansion.
- Need to understand long-term budget trends at the university and college level.

Audience: How do you make formal resource requests to your administration, and what strategies have you found most effective when advocating for additional faculty or resources?

Kurt Stresau:

- Despite submitting data-driven proposals (e.g., enrollment growth, population trends, staffing needs), responses from administration often indicate that additional resources are not available.
- Take a more proactive approach by seeking greater transparency into the full budget.
- If access is not granted at lower administrative levels (budget director, dean, provost), escalate through higher channels and formal public records requests.
- Undergraduate tuition revenue may be disproportionately allocated toward research-focused tenure-track faculty rather than teaching capacity.
- There is concern that budget decisions are being driven by individuals who may not fully understand engineering educational workload and instructional needs.
- A key challenge is identifying the correct decision-makers, as financial authority and educational needs may not align within the administrative structure.

Daria Kotys-Schwartz:

- Study how university financial and budget models actually work before making requests.
- Acknowledge that decision-makers may not have an engineering background and may not fully understand engineering education needs.
- Anticipate a potential disconnect between administrative priorities and hands-on, project-based engineering education.
- Educate higher-level decision-makers about how engineering education operates and what resources it requires.

- Build alignment within the department before escalating requests upward.
- Engage alumni as advocates for program needs.
- Leverage advisory boards to strengthen institutional pressure and credibility.
- Frame discussions around educational outcomes and student experience rather than only funding requests.
- Highlight long-term consequences of underfunding, including reduced educational quality.
- Identify who the actual budget decision-makers are and who influences them.
- Use collective, unified advocacy rather than individual requests.
- Recognize that effective change often requires coordinated institutional pressure across multiple stakeholders.

William J. Endres:

- The engineering program is often perceived as a “large resource consumer” due to its scale, even if proportional funding is limited.
- Engineering enrollment is expected to grow significantly, increasing pressure on staffing and instructional capacity.
- There is concern that enrollment growth is not yet matched with immediate resource allocation, with funding often expected to follow later.
- This creates tension between planning needs and delayed institutional support.
- Outreach and communication across campus are important to help other units understand engineering education needs and structures.
- A key recommendation is to improve internal communication so the rest of the university better understands engineering program operations and value.
- Strong undergraduate education is positioned as the foundation of the university, with graduate research building on top of it.

Question: How do you currently structure staffing for your program, including technical staff, machinists, industry liaisons, faculty, or other support roles?

Kurt Stresau:

- Use multiple capstone start terms throughout the year to distribute enrollment and balance workload across semesters.
- Machine shop capacity is a major constraint.
- Machine shop resources must support both educational and research activities, creating competing demands.
- Shared university facilities can be funded through internal cost-recovery models rather than being directly supported by the capstone budget.
- Consider shifting some fabrication activities toward additive manufacturing to reduce dependence on traditional machining resources.
- Safety requirements and facility limitations restrict the number of students who can access machine shop spaces simultaneously.
- Expanded use of technologies such as metal 3D printing could help address capacity limitations.
- Explore partnerships with local community colleges to increase manufacturing capacity and provide mutual educational benefits.
- Securing inclusion in a university master plan can be an important first step toward obtaining future facility funding.

Daria Kotys-Schwartz:

- Use a combination of department-specific staff and shared university facilities to support student projects (two lab engineers, machine shop personnel, two manufacturing engineers, one machine manager).
- Conduct formal manufacturing reviews before fabrication begins to identify design and manufacturability issues early.
- Use multidisciplinary review panels involving engineers, machinists, technical staff, and teaching assistants.
- Review engineering drawings in detail to identify manufacturing challenges before parts enter the machine shop.
- Identify early which components can be manufactured internally and which should be outsourced.
- Use external fabrication vendors strategically to supplement internal manufacturing capacity.
- Explore partnerships with community colleges and technical programs to expand machining capacity.
- Every program has growth thresholds where existing systems begin to fail.
- Operational challenges grow exponentially rather than linearly as enrollment increases. Need to regularly evaluate operational processes as enrollment grows.

William J. Endres:

- Conduct formal manufacturing reviews with each team. Involve technical staff directly in design reviews. Staff spend one hour with each team.
- Develop operational processes and tools with scalability in mind.
- Larger programs may benefit from economies of scale, as staffing increases can be made incrementally rather than requiring large percentage increases.
- Plan staffing needs several years in advance when enrollment growth trends are visible.
- Balance team-size decisions with risk management considerations (e.g., student attrition, co-op participation, or project changes).
- Use the lead time before enrollment growth reaches capstone courses to prepare staffing and operational capacity.
- Advocate for proactive planning rather than reactive resource allocation.
- Consider expanded use of additive manufacturing.

Question: Do you have any closing thoughts, or any urgent actions you are planning to take in your program in the next week, month, or six months that you would like to share?

Kurt Stresau:

- The core issue is identified as a need for flexible resources, including funding, space, and trained staff.
- The focus is on forward-looking strategic planning rather than retrospective analysis.
- Current leadership is perceived as largely reactive rather than proactive in addressing program growth needs.
- ABET review reflects the health of programs and can influence administrative attention.

Daria Kotys-Schwartz:

- Internal reviews (not only external ones like ABET) can also be effective opportunities to surface program needs and highlight capacity constraints in a constructive way.
- Persistence is essential when advocating for resources in constrained environments; repeated, consistent communication is often what eventually leads to action.
- A common institutional pattern is that resources always follow student enrollment rather than anticipate it, resulting in delayed support to the capstone faculty.
- It is important to develop scalable models for program operations early, rather than reacting after growth has already occurred.
- Sudden changes in enrollment can occur due to shifting student interests or external factors (e.g., industry trends), and may not always be predictable.
- Awareness of institutional “valves” helps identify where adjustments can be made to manage growth.

William J. Endres:

- Effective leadership is not only about analysis but also about communicating through stories that connect inputs (effort, resources, systems) to outcomes.
- Leadership communication should help decision-makers understand why successful programs and outcomes exist.
- Strong programs often attract significant industry engagement and recruiting interest.
- High levels of industry engagement (e.g., large numbers of companies recruiting students) demonstrate the strength and value of the program.
- Consistent, ongoing communication helps reinforce the value of programs that may otherwise be taken for granted.
- Continuous learning, reading, and reflection is part of developing leadership practice.

For people who would like to continue the discussion please put your name and email address below.

Name	Emails