DESIGN CENTER COLORADO

A Qualitative Investigation of Success and Challenges with Team Roles in Capstone Design

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Motivation

What are the successes and challenges of functional team roles in a mechanical engineering Capstone Design course?

Industry and research have recognized the need for clearly defined functional roles and responsibilities for team members to work productively. This study is an initial, exploratory investigation into the use of functional team roles to structure engineering Capstone Design teams.

Course Overview

- Team-based
- Industry-sponsored projects
- Year-long:
  - Fall – design Spring – build/test
- Designed as a transitional experience, emulating industry
  - Structured as consulting agency
  - Professional behavior emphasized
  - Language shifted from academic to corporate
- Teams negotiate many timelines and deliverables with client according to project needs

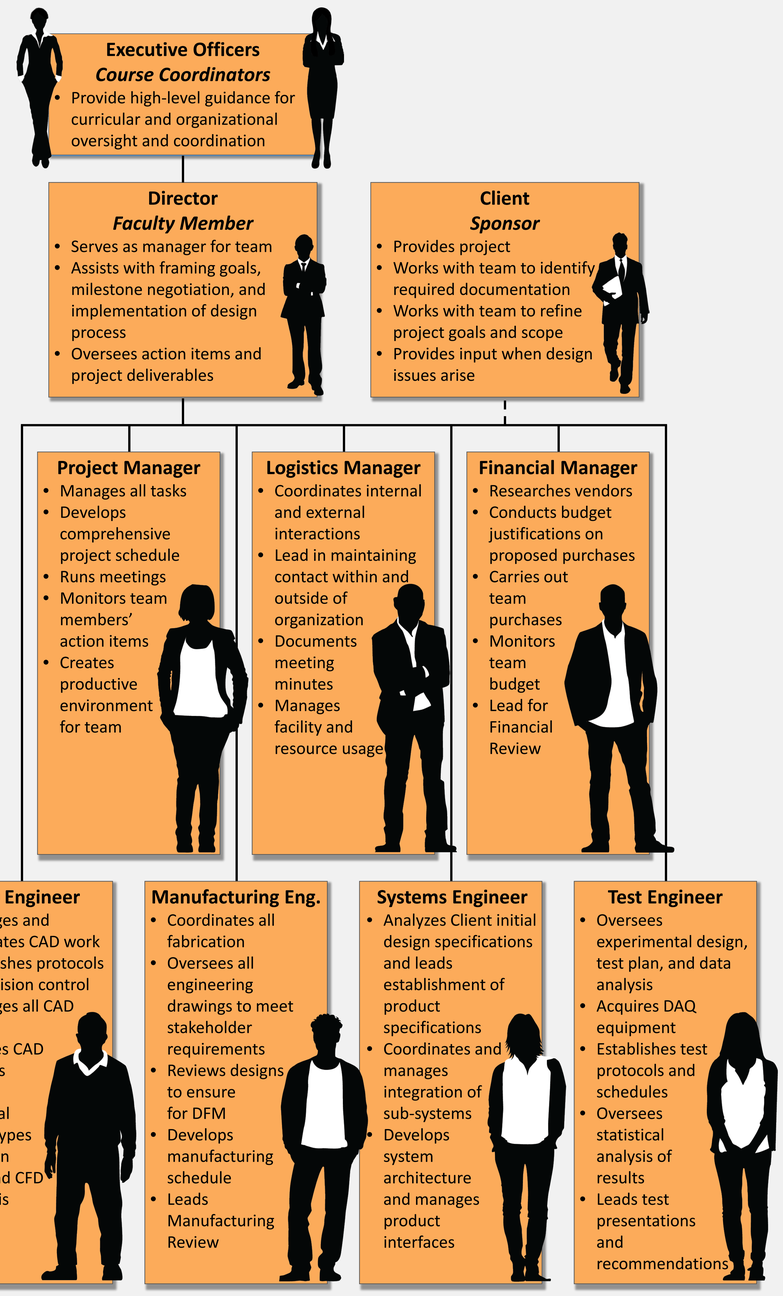
Research Methods/Analysis

- Post-survey using Qualtrics software
- Participants: 4 cohorts n = 719
  - Cohort 1-3 n = 491, qual. analysis
  - Cohort 4 n = 193, quant. survey
- Coded by role until two themes emerged for each guiding question

Guiding Questions

Initial investigation of Capstone Design team role implementation explored:

- What did you do in the role that worked particularly well?
- What do you wish you had done differently for your role?



Role Implementation

- **All team members have technical responsibilities (design, analysis, fabrication, and testing) for their project in addition to the leadership/management responsibilities defined by their team role**
- Team members discuss traits and responsibilities, then negotiate roles
- Team members receive role-specific training in workshops
- While responsibilities may shift as teams adapt to project needs, students very rarely switch roles mid-project

Preliminary Results

Table 1: Qualitative Survey Results (total n=491)

Role	n	What Worked?	Do Different?
Project Man.	77	Keeping project on target	Handle conflict early
Logistics Man.	77	Managing communications with team, Director, Client	Clear up communication problems individually
Financial Man.	86	Keeping on top of the budget	Work better with vendors
CAD Eng.	71	Organizing CAD files for accessibility	Divide up CAD responsibilities among team
Systems Eng.	71	Ensuring compatibility of all project components	Work to integrate teammates not just components
Test Eng.	65	Developing a test plan	Prioritize testing throughout
Manufact. Eng.	79	Outsourcing simpler parts to teammates	Schedule more time to learn skills

Table 2: Benefits to Team Having Functional Roles (n=193)

Team Benefit	Average (out of 5)
Individual Responsibility	4.21
Accountability	4.18
Division of Tasks	3.97
Team Dynamics	3.91

Table 3: Quantitative Follow-up Survey Questions (n=193)

82.5% of students report listing their roles on their resume
Students report one benefit of defined roles is allowing them to articulate their individual contributions to the project (average = 4.12 / 5.0)

Preliminary Conclusions

- Students are able to enact and articulate functional roles, adopting organizational structure and ownership of leadership responsibilities
- Functional roles can strongly benefit a Capstone Design team with regards to individual responsibility and accountability
- Teams utilized roles and associated responsibilities as a baseline to assess peer performance
- Defined roles provided a framework for professional development and critical self-reflection before transition to industry

PM: Project Manager | LM: Logistics Manager | FM: Financial Manager
CE: CAD Engineer | ME: Manufacturing Eng. | TE: Test Engineer | SE: Systems Engineer