



Revolutionizing Engineering Departments at Colorado State University and Beyond

Colorado State
University

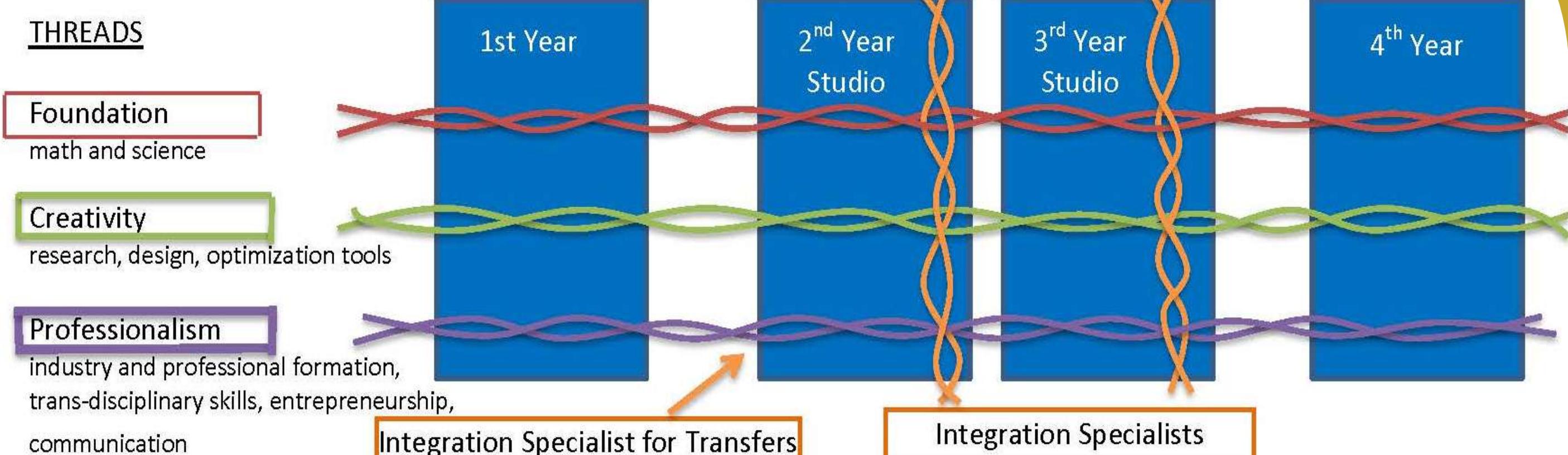
Anthony A. Maciejewski, PI, ECE Department Head; Tom W. Chen, Co-PI, ECE faculty lead; Michael A. De Miranda, Co-PI, engineering education expert; Zinta Byrne, Co-PI, social scientist; Gerhard Dangelmayr, Head of Mathematics at CSU; Thomas J. Siller, Associate Dean for Academic and Student Affairs; Branislav Notaros, decorated ECE educator; and Alma Rosales, industry expert.

Need

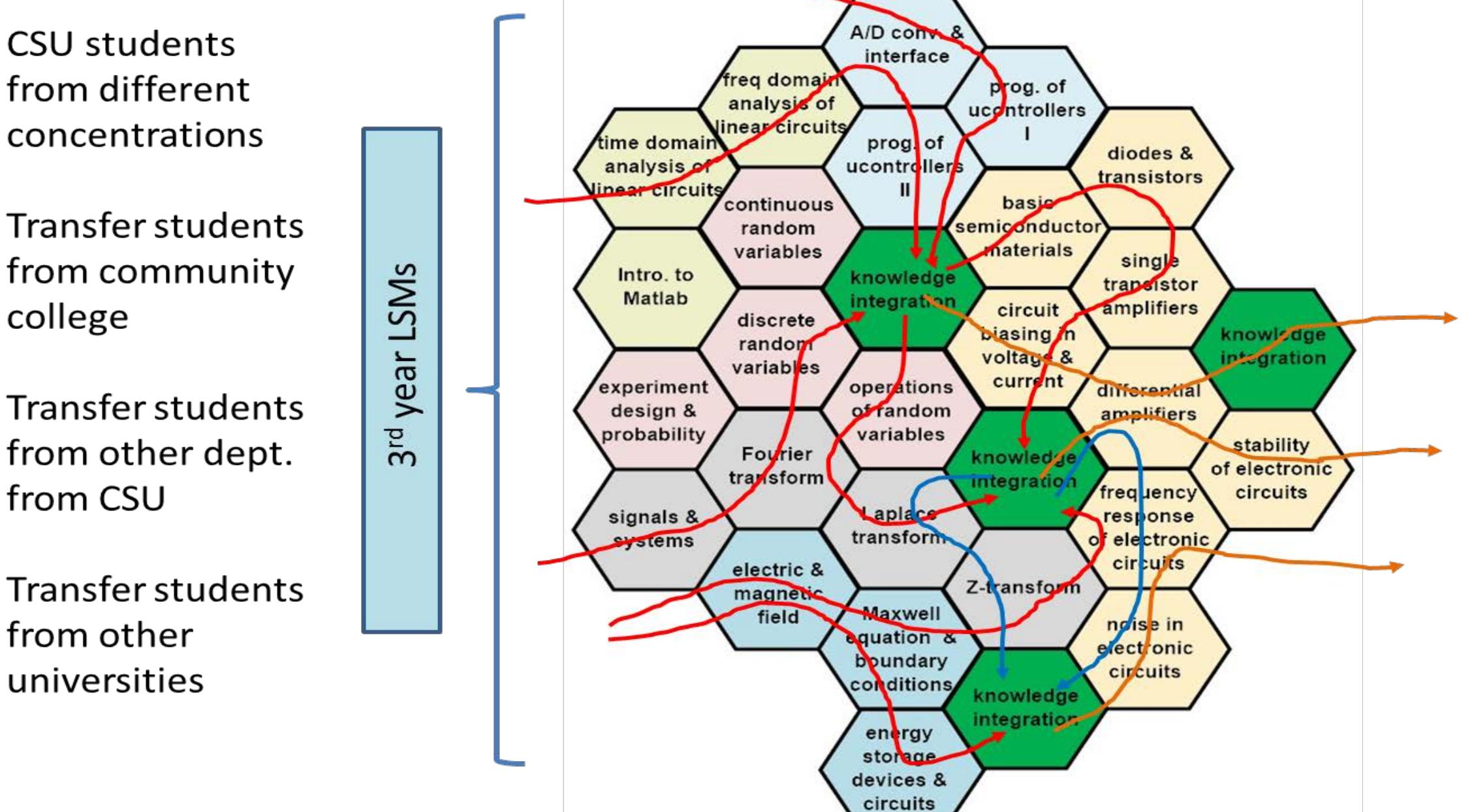
The current undergraduate engineering education system fails in two critically important ways. First, students with the desire and aptitude to become productive engineers are not seeing the relevance of current curricula, and, consequently, they are abandoning the discipline. Second, those who ultimately graduate from undergraduate engineering programs may not fully understand the role of an engineer and the scope of the field.

revolutionizing
Engineering Departments

Vision



- New breed of engineering educators with revolutionary roles take a holistic view of a degree as an integrated system
- Multifaceted teams of Content Experts, Integration Specialists and Thread Champions weave threads throughout curriculum, while instilling deep knowledge of discipline
- Learning Studio Modules (LSMs) enable knowledge integration and connections to professional practice



Barriers

- Faculty resistance to change and role strains
- Slowness of bureaucratic decision-making in academic institution
- Course-centric university model

- Contingency Plans:
- Increased communications, mentoring, and training to alleviate resistance and role strains
 - New P&T assessment criteria and faculty evaluations
 - Movement from individual course evaluations to fine-grained assessments
 - Changes seamless to Registrar, dramatically new and different processes within the department

Goals

- Constituents will have holistic view of engineering and how it relates to the profession and society
- New roles will energize faculty to collaboratively weave threads throughout curriculum
- Learning Studio Modules will illustrate the utility of knowledge and connections to professional practice
- Pedagogical and organizational changes will serve as a prototype for other institutions
- Students at 2- and 4-year institutions, faculty, staff, industry, and society will be impacted by the change

Objectives

- Faculty instructional duties and metrics shift to evaluate ability to work as teams to weave threads, integrate content, show utility of knowledge, and make connections to professional practice
- Course-centric evaluations replaced by fine-grained assessments of Learning Studio Modules and Knowledge Integration Modules
- Regular communication and teamwork across the organization ensure every component gives consideration to the big picture

Approach

Pedagogical

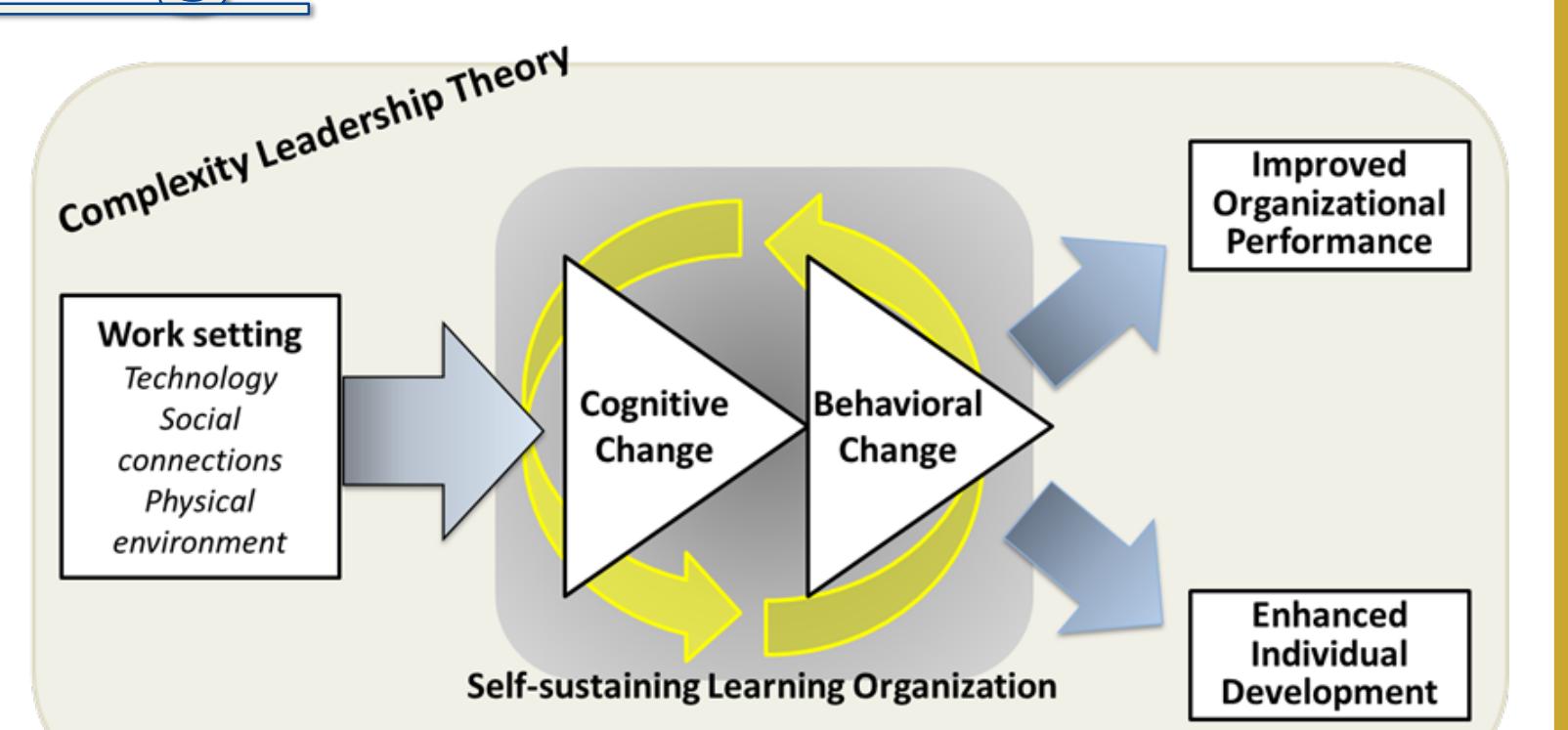
- Content experts decide "what are the fundamental concepts that make up the core of an electrical engineering degree?"
- Each of these concepts is broken down into an LSM with active in-class learning, assigned pre-work, and functional assessment
- Content Experts and Integration Specialists determine content and timing of Knowledge Integration (KI) modules
- In parallel, each Thread Champion determines critical components of their respective threads
- Thread Champions, Content Experts and Knowledge Integration Specialists work collaboratively to determine where and how thread content is woven through LSMs and KIs

Organizational

- Discussions at faculty meetings identified an existing culture of improving engineering education as evidenced by previous failed efforts, e.g., Tiger Team
- Brainstorming at initial faculty retreat on ways to revolutionize engineering education, second faculty retreat to develop the holistic model of an engineering education
- Identify Knowledge Integration Specialists, Content Experts, and Thread Champions to lead teams to meet the pedagogical objectives
- Weekly meetings of key teams, monthly meetings of RED core team, and periodic updates to the department faculty
- Communication to university administration and external constituencies and peers, e.g., ECE Industrial Advisory Board
- Faculty are provided training and tools to facilitate teamwork and holistic approach to education in collaboration with The Institute of Learning and Teaching
- Faculty duties shifted to weave threads, integrate content, and foster collaboration in multifaceted teams
- New promotion and tenure (P&T) assessment criteria adopted by department faculty and communicated through college and university P&T committees
- Faculty evaluations, awards criteria and annual raises adjusted to mirror the new pedagogical structure to incentivize faculty to adopt their new roles

Theories of Change

- Organizational Development
- Learning Organizations
- Complexity Leadership Theory
- Sustained through changes in reward system, student outcomes, and org structure
- Learning Orgs are self-sustaining through cultural shift



Roadmap for Scaling and Adaptation

- Engineering departments at CSU serve as starting points for adoption
- Close collaboration with Colorado Community College System
- Share vision and successes via relevant conferences, e.g., ECEDHA
- Initial partnerships with Georgia Tech and Purdue
- Detailed communications plan

