Excellence at all Levels

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Departments (plus much more…)

- Biomedical Engineering
- Chemical and Biological Engineering
- Civil and Environmental Engineering
- Computer Science
- Electrical and Computer Engineering
- Engineering Sciences and Applied Mathematics
- Industrial Engineering and Management Sciences
- Materials Science and Engineering
- Mechanical Engineering

Products? Customers? PL?
McCormick
Robert R. McCormick School of Engineering and Applied Science

The Competition Landscape

Faculty size
Undergraduate size
Graduate size

Schools (with US News Graduate Ranking)

Biology & Medicine

Physiological Processes
Systems Biology
Biomolecular and Cellular Self Assembly
Neural information Processing
Information, Biology and Language

Physical & Chemical Sciences

Materials Self-Assembly Processes
IGERT
Sustainable Technologies

Engineering

Center for Connected Learning
Business and Engineering Networks

Social Systems, Organizations and the Law

International and Comparative Studies
Analytical Politics
Emergent Legal Structures Group

Mathematical Studies in Economics and Management Science

Schools (with US News Graduate Ranking)
Collaboration network in Social Psychology as obtained from the *Journal of Personality and Social Psychology*. The data cover the period 1965-2003, and includes 9112 researchers and 7865 collaborations (Luis Amaral et al. 2004)
Collaboration network in Economics as obtained from the journal *Econometrica*. The data cover the period 1965-2003, and includes 3350 researchers and 4254 collaborations (Luis Amaral et al. 2004).

Collaboration network in Astronomy as obtained from the *Astronomical Journal*. The data cover the period 1965-2003, and includes 10832 researchers and 13016 collaborations (Luis Amaral et al. 2004).
A century of innovation: twenty engineering achievements that transformed our lives.

- Electrification
- Airplanes
- Radio and Television
- Computers
- Telephony and Electronics
- Spacecraft (and GPS, etc.)
- Automobiles and Highways
- Petroleum and Petrochemical Technologies
- Advanced materials
- Medical technologies
- Internet
- Water Supply and Distribution

Imagine a world without Engineering and Technology…
Central Idea

Seeing ourselves

McCormick strengths

Large scale trends

Response to trends

Milestones

Compass

Map

Resource Needs

McCormick strengths

McCormick strengths

Seeing ourselves

Large scale trends

Response to trends

Strategic Plan
Trends

Energy
Environment
Health
Information
Security…

Not very useful…

Large Scale Trends

(1) The boundary between science, engineering, technology, and medicine is being completely blurred into a seamless chain.

(2) The waves of innovation are becoming shorter.

(3) Technology is permeating all areas of society

   Technological literacy essential ingredient of 21st century humanistic education;
   Essential to informed public-policy decisions.
A Picture of Innovation: Schumpeter waves accelerate

Nano, Bio, Info

The Economist, 1999

Large-scale trends: Needs

(1) The boundary between science, engineering and technology is being completely blurred into a seamless chain. → Broad Perspective; Interdisciplinary Outlook

(2) The waves of innovation are becoming shorter.

→ Adaptability

(3) Technological literacy; 21st century humanistic education; public-policy decisions. → Broadly educated engineers
Recognition, Reputation

(1) Largest component of reputation, e.g. US & World Report, NRC, depends critically on top-ranked peers.

**Placing people in academia**

(2) Core, size matter

..matching needs to strengths

- Core, the one-to-one areas where we are compared with others must be first rate
- Adopt Matrix view of faculty; excellent people who can be counted twice
- “Growth” strategy: synergistically leveraging small size across schools WCAS, Kellogg, SoC, Medill, and Law
State of the art of domain at time $t$

Core and periphery; Nature of expansions

“Break-with”
Breakthrough

But often…

State of the art at time $t$

Augmentation of knowledge base
Core-Periphery Interactions

Core unifies structure
Core may be formed by periphery

Recognizing Hurdles: The Faculty Pipeline

Career Span Longer, Waves of Innovation Shorter

40 year career span (and getting longer)
Assistant Professors
6 years

problem
Actions

Mentoring...

Add value

Increase Quality of Life

Use creatively; Retool

Need to transition from wave to wave

Select

Add value

“Must have” + Identity

“Must have” + Identity

Materials and Nanotechnology
Bioengineering and Biotechnology
Infrastructure and Critical Infrastructure
Systems and Complex Systems

IDEA
Africa AIDS Project
Art
Conservation
Learning
Sustainability?

Distinctiveness

Human Capital

Science Technology Driven Initiatives

Societal Driven Initiatives

Environment: Infrastructure and Organizational Structure

Teaching Learning

Professional Programs

Research

Development
**Consequences: McCormick’s Positioning**

**Students:** …leading edge engineering/science education with a big picture component

**Faculty:** …where interdisciplinary work can flourish

**Academia:** …faculty candidates trained in emerging areas and capable of adapting in times of change

**Industry:** …source of knowledge, future human resources, research collaborations

**Recruiters:** …undergraduate students who have superior technical knowledge, and innovation and team leadership skills

…graduate students who are not narrow but have a broad outlook

**Alumni:** …source of networking, a source of life-long knowledge…

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**A century of innovation: twenty engineering achievements that transformed our lives.**

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Imagine a world without Engineering and Technology…
Imagine the world 20 years from now

How will the list look like?

Well prepared if...

Cannot do everything...

People
- Deep knowledge, but adaptable
- Ability to traverse across domains, science-technology

**How will system look like?**
- Dynamic environment that encourages emergent structures and risk taking

Strategy
- Strengthening the core
- Enlarging the periphery
- Work on “changing the rules”

“Excellence at all Levels”
...approaches...

- Massive buildup...Purdue adding 75 positions
- Emergence in the midst of strong surroundings...Harvard adding 45 positions
- Strengthening excellence...Caltech, keeping faculty constant but adding resources

Can we become one of the (small) leading engineering schools in the world?

Do we have the will?