Electrical Engineering, Systems Science and Mathematics, Electrical and Systems Engineering

Joseph A. O'Sullivan
Ronald S. Indeck
Presentation to SSM Faculty 06/05/02

- Committee on Future of EE
- Assessment of EE
- Research First Strategy
- Future: ESE?
Report of Committee on Future of Electrical Engineering

Ron Indeck, Jody O’Sullivan (chair), John Schotland, Jon Turner (CS)

Presented to the National Council April 19, 2002
Ad Hoc Committee on EE at WU

- Appointed by Dean September 28, 2001
  R. S. Indeck, J. A. O’Sullivan, J. C. Schotland, J. S. Turner
- Mission: Provide a vision for the future of Electrical Engineering at Washington University
- Think broadly: EE, SSM, CS
- Meet regularly
- Invited Dean to join committee in November 2001
- Progress report to EE faculty January 21, 2002
- Extensive discussions in EE and CS Spring 2002
- SSM enters dialog April 2002
- Presentation to National Council April 19, 2002
- Dean appoints new committee May 22, 2002
  R. S. Indeck, J. A. O’Sullivan, H. Mukai, B. Ghosh

Ad Hoc Committee on Electrical and Systems Engineering at Washington University
Roots of Electrical Engineering

from The Story of Washington University

by Alexander S. Langsdorf

Revised 10/29/56
Curriculum established in 1886
First chair in 1901

Electrical Engineering Research Laboratory in 1930
Alexander S. Langsdorf 1901-1921
Walter L. Upson 1921-1937
Roy S. Glasgow 1937-1949
Richard J.W. Koopman 1949-1964
Russell R. Pfeiffer 1970-1975
Robert O. Gregory 1975-1976
Donald L. Snyder 1976-1986
Harold W. Shipton (interim) 1986-1987
Barry E. Spielman 1987-2002
Unknown 2002
Endowed and Senior Professors

Endowed

Samuel C. Sachs Professor ($3.9M market value)
  Donald Snyder
Hugo F. and Ina Champ Urbauer Professor ($1.9M market value)
  Mark Franklin
Das Family Distinguished Professor ($1.9M market value)
  Ronald Indeck
Gene and Martha Lohman Professor ($1.4M market value)

Senior

William Pickard
Charles Wolfe
EE Deficit

Cum = ($5,607,000)
Excludes $700K bad debt in Telecom
EE UG Tuition Income

(in thousands)

Undergraduate  UMSL
EE Financial Summary

- For FY01
  UG Tuition Income = $1,305K
  Faculty Support = $2,927K
  UGTI / FS = 45%

- With UG sources we are covering
  18.5 FT TT faculty x 45% = 8 FT TT faculty
  5 FT TT without UMSL
Assessment

- Healthy undergraduate programs
  » but, consuming disproportionate share of faculty attention - ABET, UMStL program

- Struggling research enterprise
  » low research productivity (publications, impact)
  » inadequate external funding levels

- CoE constrained by interdepartmental status
  » difficult to attract high caliber new faculty
  » research strength more on CS side

- Some faculty making only weak contributions
  » entitlement attitude
  » limited willingness to take responsibility
Toward a Plan for the Future

Clean Start: Reset All Departmental Missions?

- Undergraduate Curriculum
- Graduate Curriculum
- Service Missions
- Research
Departmental Missions

Undergraduate Curriculum
» DSP First—Ga. Tech
» Analog First—UIUC
» Systems and Signals First—UC Berkeley
» Information, Communication

Graduate Curriculum
» “Students are not useful until they know electromagnetics”
» “Students need to know random processes before they can contribute”
» Students need <<insert here>> first
A Strategy for Organizing a Department

- Undergraduate Curriculum
- Graduate Curriculum
- Service Missions
- Research

→ Research First
Excellence in all areas
Research First Organization Strategy

- Examine outstanding departments → Research organization
- Consider visions for future of EE → Potential areas of growth
- Identify unique opportunities for Washington University → Unique current strengths, unique potential
Potential Models: Other Universities
Other Universities: Some Lessons Learned

Research Organization Strategy

- Few Areas
- Laboratory or Center Based
- Several (> 5) areas

Organization Depends on Institution
Organization Depends on Institution

- EE-CS-CoE-Systems Structure
- Institutional/Departmental Strengths
  - Medical School
  - Unique National Lab or Center
  - Location
- Emphasis on a Scientific Problem
- History
- Personnel

Recommend: Form Follows Function
New Directions for EE: Plummer, etc.

- Bioengineering (Biology and EE)
- Photonics (including optics)
- Materials (including nanotechnology)
- Computational Math and Engineering
- Continuing directions: Information Technology, Communications, Computing, Sensing

Research Trends

- Multidisciplinary Research Driven by Scientific Questions
- Increasing levels of complexity
- Increasing speed to implementation
- Rapid change
- Increasing breadth
Research First Approach

- Support multi-departmental multi-university research
- Importance of pursuing fundamental research
- Increasing complexity
  - Importance of systems view
  - Importance of computational issues (Math and CS)
- Breadth of Training
Research First Strategy

- Identify 2, 3, or 4 research areas
- Consolidate current strengths within areas
- Build from strength
  *Form Follows Function*
- Follows mandate from Dean
Dean Mandate: Future Directions

- We need a few focus areas:
  - Important projects that have national impact
  - Exciting multi-investigator efforts which will help us attract and retain great people
  - Excitement and sense of purpose to secure University support and alumni giving
  - Sustainable through major external funding from entities that need to support this work

- It has worked for CS
- It is working for BME
- It can work for EE/ESE
# EE Fellows

<table>
<thead>
<tr>
<th>IEEE</th>
<th>AIMBE</th>
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<tbody>
<tr>
<td>Mark Franklin</td>
<td>Martin Arthur</td>
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<td>Donald Snyder</td>
<td>American Physical Society</td>
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<td>Barry Spielman</td>
<td>Marcel Muller</td>
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<td>William Pickard</td>
<td>Barbara Schrauner</td>
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<td>Marcel Muller</td>
<td>National Academy of Engineering</td>
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<tr>
<td>Charles Wolfe</td>
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## WU IEEE Fellows

### EE
- Mark Franklin
- Donald Snyder
- Barry Spielman
- Marcel Muller
- William Pickard
- Charles Wolfe

### NON-EE
- Chris Byrnes
- Bijoy Ghosh
- Alberto Isidori
- Jim Miller
- T.J. Tarn
- Jon Turner
- Jerry Cox
- John Zaborzsky
Ad Hoc Comm. Recommendations

- Re-establish a culture of excellence.
  - renewed emphasis on research
  - new departmental leadership
  - faculty turnover and renewal

- Reorganize to leverage existing strengths.
  - CoE to CS to enable CoE to thrive, while reducing department’s undergraduate teaching responsibilities
    - strongly supported by CoE faculty
  - combine forces with SSM to form Department of Electrical and Systems Engineering

- Maintain high caliber undergraduate program.
  - focus on quality more than quantity
  - strengthen connection to research
ESE Research Focus Areas

- Imaging Science and Engineering
  » investigate fundamental principles with broad uses
  » applications in medicine, defense, vision and security

- Systems, Signals, Control, and Optimization
  » world leadership in nonlinear systems
  » robust systems, signal modeling and analysis, game theory
  » applications in control, tracking, dynamic vision

- Information Sciences and Enabling Technologies
  » communication theory and systems, information theory
  » information storage and magnetics, signal processors

- Security Technologies
  » new initiative under way to establish Security Center and compete for NSF ERC funding
  » home, homeland, information, and infrastructure security
Imaging Science and Engineering

• Interdisciplinary field in which Washington University is a leader

• Medical imaging. CT, MRI, Optical Imaging.
  - Integrated CT-PET, micro-CT, micro-PET, micro-MR, and micro-optical imaging.
  - NIBIB.

• Remote sensing and military imaging. Infrared, radar, laser radar, multispectral and hyperspectral imaging sensors.
  - Earth sensing, for environmental and military purposes.
  - Object recognition and parameter estimation. Merging with geographic information systems (topographic data, multiple sensor data, vegetation information).

• Industrial imaging. Computer vision in industrial settings, in manufacturing and robotic applications, and in security systems.
  - Vision for automotive and transportation systems: optical cameras, radar sensors, infrared sensors, and laser radar sensors.
  - Object and face recognition.
  - Biometric systems: fingerprints, retinal scans, hand scans, face images, and ultimately DNA.
Ad Hoc Committee on ESE

- Discuss Issues in SSM-EE Merger
  » Assess Strengths (Essentially done)
  » Assess Opportunities (In progress)

- Future Needs and Opportunities
  » Identify Scope: 20 Faculty in steady state
  » Obtain assurances from Dean
    - Faculty Slots
    - Space
    - Resources in general

- Decide whether to merge

- Map out merger strategy
  » Faculty
  » Chair
  » Undergraduate and graduate education
  » Research organization
  » Target late August 2002