

Problem-Based Interdisciplinary Collaboration

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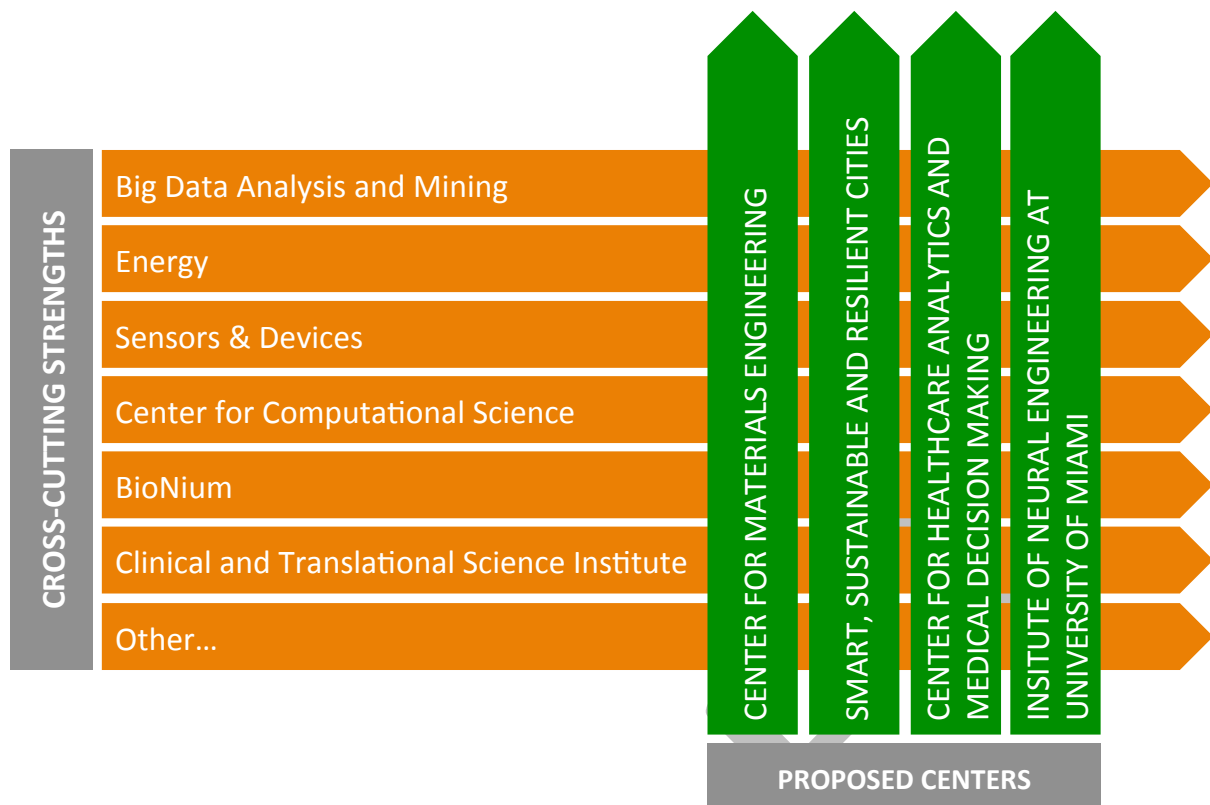
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The charge of this committee is to propose strategies to promote interdisciplinary collaboration within CoE, with other Schools and Colleges at UM and outside, and to identify problem-based cross-disciplinary research areas that can have significant potential societal impact.

Currently, there is minimal interdisciplinary collaboration within CoE and between different colleges/school at UM to address large-scale problems both at the local and global level. Firstly, the committee identified large-scale problems that spanned materials, energy, sustainable cities, rising sea levels, and healthcare. The committee concurred on four themes that represent strong opportunities for problem-based interdisciplinary collaboration across Departments within the College of Engineering and across Schools and Colleges at the University level:

1. Materials Engineering
2. Smart, Sustainable and Resilient City (Smart City)
3. Healthcare Analytics and Medical Decision-Making
4. Neural Engineering

The creation of new centers/institutes along these themes will facilitate interdisciplinary collaboration between Departments of the College of Engineering and between the College of Engineering and Miller School of Medicine (MSoM), College of Arts and Sciences (CAS), RSMAS, Business School, and School of Architecture. The College of Engineering (CoE) will play a central and integral role among each of these centers/institutes. Below we present an outline of the need for each of these Centers/Institutes, existing strengths that can leverage their creation, existing barriers that currently limit the promotion of interdisciplinary collaboration and ideas to address these barriers. All four proposed centers/institutes rely heavily on existing strengths of the Colleges and Schools at the University of Miami, as depicted in the figure below and further explained in the description of the centers.



The 4 proposed centers/institutes are:

1. Center for Materials Engineering

Problem-based need:

- Critical need for breakthroughs on functional materials in varied areas such as renewable energy, aerospace, environment, biomedical, computer, communication, and industrial systems.
- Materials development largely relies on trial-and-error approach. Rationalized design and synthesis of materials best fit to specific applications are needed.
- Recent progress on ab initio quantum simulation demonstrates that new materials/devices/sensors can be designed using ab initio simulation approaches.
- Recent developments on atom-level fabrication can realize the designs by the ab initio methods for specific needs in various applications. Materials and devices with unprecedented functionalities/properties can be created.
- This center will establish a synergy among material synthesis, novel materials research, ab initio simulation, characterization, and testing.

Strengths/Opportunities:

- Expertise among current faculty members in CoE in materials science and engineering
- Existing collaborations with CAS, MSoM, RSMAS
- Leverage existing research facilities including CCS and BioNium
- Fit to MESA

2. Smart, Sustainable and Resilient City (Smart City)

Problem-based need:

- Multiple rapidly growing cities face huge problems including sustainability, sea level rising, coast receding, pollution, energy crisis, water and food shortage, public health emergencies,

infectious disease control, communication and transportation congestion, terrorist's attacks, and natural and non-natural disasters.

Strengths/Opportunities:

- Various efforts have been organized among different units of the UM, including COE, RSMAS, CCS, and Schools of Architecture.
- Some university level collaboration such as CCS's Smart Cities Program and "Resilient Miami" group led by Sonia Chao have been initiated.
- CoE and CCS is discussing big data analytics research for city energy data.
- Some faculties have built personal connections with the local and federal government.

3. Center for Healthcare Analytics and Medical Decision-Making

Problem-based need:

- The increasing availability of large-scale data sets implies the prominent importance of research works that can transform data to insights. The focus can be on generating results from large-scale medical data sets that provide actionable insights. There is a need for visualization, causal inference, survival analysis, drug safety and control, diagnostic tools/sensors, health care data collation frameworks, etc., which are some of the important topics that this center will address.
- Working with large datasets brings new opportunities/challenges that can be better addressed in a collaborative setting. While many research groups are working in this area, no group/center is specialized in BIG Data Analytics and Decision Making Using Data.
- The healthcare industry is in dire need of systematic and sustainable improvements in efficiency, quality, safety and productivity.
- CoE can take the lead to bring together researchers across UM to work more efficiently on the above-mentioned topics and develop more innovative health care related ideas. The center can mainly foster collaboration for grants submission and course development. Also, public health related projects might be considered.

Strengths/Opportunities:

- Many departments can collaborate in this center including COE, Computer Science, Medical School and Sylvester, Nursing, Education, Business, etc.
- Strong ties with industry in South Florida and beyond
- We also don't need much infrastructure to start this center

4. Institute of Neural Engineering at the University of Miami (INEM)

Problem-based need:

- Trauma, injury, diseases, and disorders of the central and peripheral nervous system leads to significant loss in sensory and motor functions.
- Over 2.5+ million individuals affected in US alone
- 6+ billion annual costs incurred in healthcare

Strengths/Opportunities:

- Leverage existing collaboration of CoE with MSOM, including Miami Project to Cure Paralysis, Otolaryngology, Ophthalmology, BioNIUM, etc. to find engineering solutions for clinical problems
- Provides opportunity to establish increased collaborations with CAS Departments, including Psychology, Computer Science, Biology by leveraging the new functional MRI facility and CAS neuroscience initiatives
- CAS and CoE can play a larger collaborative role with MSOM

Ideas that can be converted to opportunities towards facilitating interdisciplinary collaboration within UM:

- Create a culture/environment for cross-flux of ideas and knowledge among students and faculty members.
- Provide seed money for centers for demonstrating the feasibility and initialization and collaborative efforts. Seed money could be used to support the submission of Center/large collaborative proposals
- Promote students from other school to take more engineering courses, this requires developing new courses as well
- Create cross-disciplinary seminar series and networking events in thematic areas that present opportunities for problem-based interdisciplinary collaboration
- Create new team-taught problem-based courses on cross-disciplinary topics
- Create cross-disciplinary MS degrees hosted within institutes, instead of academic departments.
- Provide a meeting space for graduate students to promote interaction of students from different disciplines.
- Create interdisciplinary student projects with students from multiple schools, i.e., Engineering, Business, Law and Sciences.
- Create an office or select a faculty member within each School or College or Institute that serves as a facilitator for interdisciplinary collaborations.

Current barriers/issues impeding interdisciplinary collaboration:

- Working in silos and fragmented collaboration
- Lack of well-organized and coordinated effort towards a bigger problem
- Needs a significant investment on space, facility, and support personnel
- Lack of coordinated effort from the university as a whole to show commitment to the state and federal governments and to funding agencies.
- Lack of a clear mechanism that can facilitate, coordinate, sustain communication among faculty members across schools and outside agencies to coordinate such a large interdisciplinary effort.
- Need to define the relationship between centers/institutes and departments
- Need a mechanism for IDC sharing within a center/institute
- Need a mechanism for IDC sharing among colleges and centers
- Need a mechanism to give credit to junior faculty for interdisciplinary work and participation as key investigators on large proposals in a non-PI role.
- Need a mechanism for tuition sharing for team-taught interdisciplinary courses