Hofstra University Center for Innovation: Motivation and Description

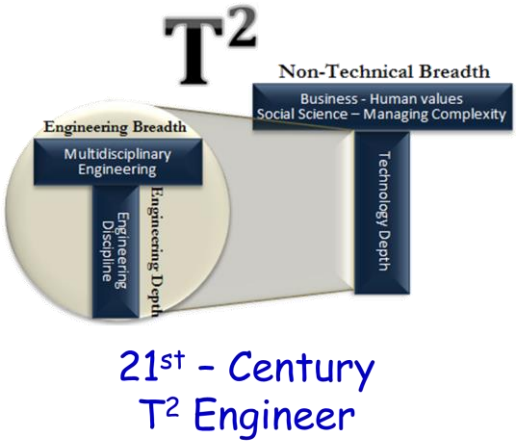
There are fundamental questions that this document addresses:

1. What is innovation and what are the main obstacles to innovation?
2. What is mechatronics and how does mechatronics enhance innovation?
3. What is the Hofstra University Center for Innovation and how will it become successful?

The Center for Innovation will enable the Hofstra School of Engineering and Applied Science to become a national model for innovation and transformational engineering education.

What Is Innovation and What Are The Main Obstacles to Innovation?

It is widely recognized that the future of the U.S. and indeed our everyday lives are increasingly dependent on scientific and technical innovation. The urgent problems society faces are multidisciplinary, complex, and ever changing. The innovation shortfall of the past decade is real and there have been far too few commercial innovations that can transform lives and solve urgent human problems. Perhaps as a result or as a cause of this shortfall, basic STEM (science, technology, engineering, and mathematics) skills are viewed as separate commodities which can be outsourced. Other countries have a competitive advantage in low-cost manufacturing and services, with excellent commodity engineers, scientists, and mathematicians available at a fraction of the cost of their U.S. counterparts. To be competitive, U.S. engineers, scientists, and mathematicians must provide high value by being innovative, which includes being immediate, integrative, conceptual, and multidisciplinary. In addition, innovation is local – you don't import it and you don't export it! You create it! Innovative solutions require a new way of thinking, communicating, and doing; they must be human-centered, technologically feasible, commercially viable and sustainable, usable from a complexity view, and sustainable in a global sense (top figure right). The 21st-century engineer is a critical-thinking, multidisciplinary problem solver and is effectively characterized as a T^2 engineer (bottom figure right).



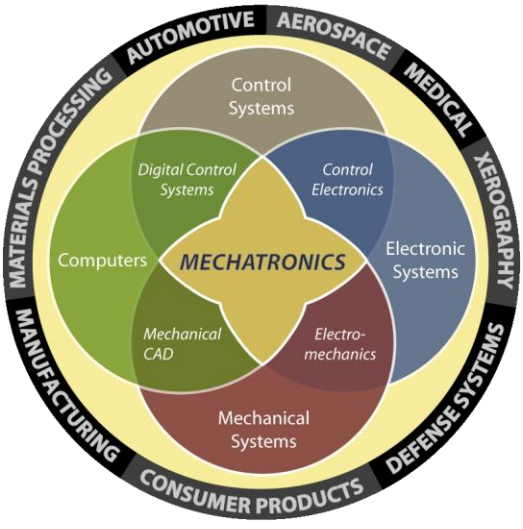
There are two main impediments to innovation in both engineering education and engineering practice: silos and comfort zones. First, the silo structure in both academia and industry does not enhance innovation. Silos promote narrowly-focused group-think, complacency, and mediocrity. Silos occur at all levels, e.g., within a department, among departments, among schools at a university, among divisions in a company. The silo mentality inhibits multidisciplinary

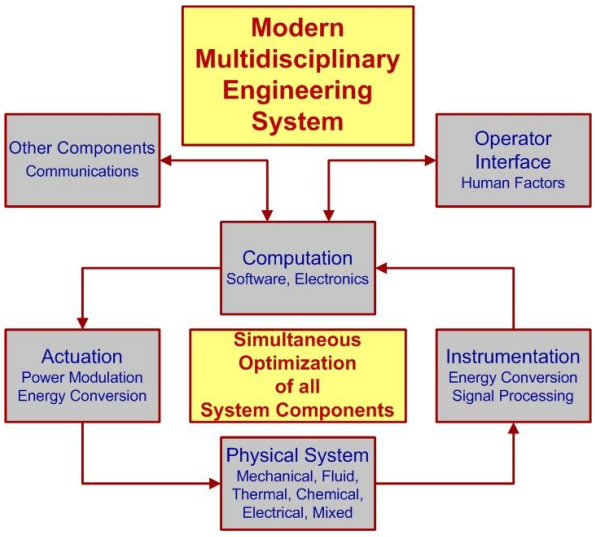
collaboration and fails to recognize that collaboration enhances, not diminishes, all we do. Collaboration is not a zero-sum game; everyone wins! The silo problem starts with administrators who are old-school managers rather than leaders, with no understanding of the real-world present or vision for the future. This view then propagates down through the ranks. Second, there is a failure of faculty and practicing engineers to get out of their comfort zones, become immersed in real-world problem solving, and respond to the challenges of both teaching and practicing multidisciplinary engineering problem solving in a discovery learning mode. Knowledge needs to be unbundled and rebundled in both engineering education and engineering practice to give it balance between theory and practice and relevance to the solution of the multidisciplinary problems society faces.

What Is Mechatronics And How Does Mechatronics Enhance Innovation?

Mechatronics (figure below left) is the *synergistic integration* of physical systems, electronics, controls, and computers through the design process, from the very start of the design process, thus enabling complex decision making. Integration is the key element in mechatronic design as complexity has been transferred from the mechanical domain to the electronic and computer software domains. Mechatronics is an evolutionary design development that demands horizontal integration among the various engineering disciplines as well as vertical integration between design and manufacturing. It is technology integration to achieve optimal system functionality and is the best practice for synthesis by engineers driven by the needs of industry and human beings.

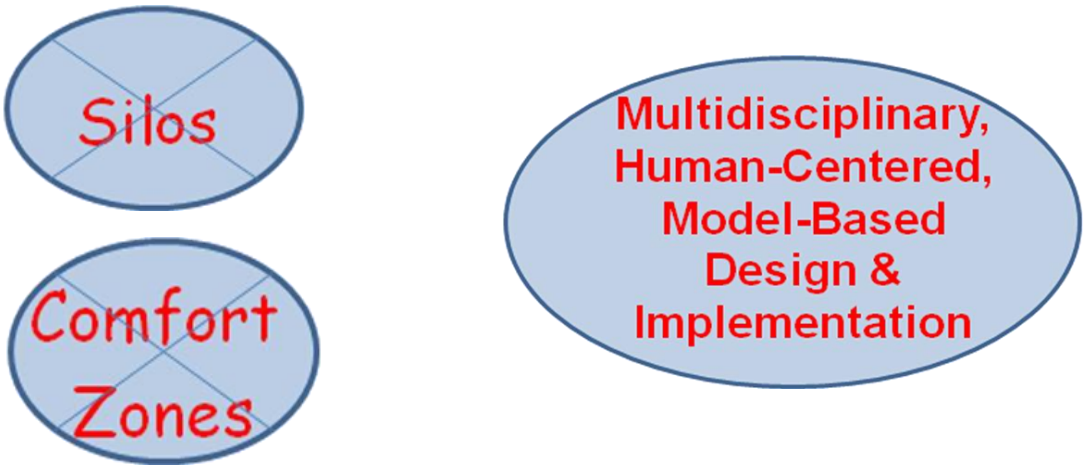
In a modern multidisciplinary engineering system (figure below right), performance, reliability, low cost, robustness, efficiency, and sustainability are absolutely essential. All components must be simultaneously integrated and optimized from the start of the design process.





Two elements are essential in modern engineering practice: human-centered design and model-based design. Human-centered design requires interdisciplinary collaboration, an iterative process with frequent prototyping, and engagement with real people. Also, in evaluating concepts, a modeling-and-analysis approach must replace any design-build-and-test approach, but this modeling is multidisciplinary and crosses domain boundaries. Mechatronics is multidisciplinary system problem solving and is a vital element to the transformation of both engineering education and engineering practice to achieve innovation.

What is the Hofstra University Center for Innovation and How Will It Become Successful?



Ultimately, the Center for Innovation will be a place where where education, government, and industry leaders can collaborate to address specific societal problems, develop broad new solutions, and create best practices that help re-shape U.S. industry and education as we know it today. It will be a place where the main obstacles to innovation are removed. Silos and comfort zones do not exist.

Initially, with the completion of the modernization of the School of Engineering and Applied Science (SEAS) and the investment of millions of dollars in new laboratories and facilities, the center will focus on innovation and building closer ties with business, corporations, and industry. This is a win-win situation, as all parties benefit: Hofstra's reputation will be enhanced locally and nationally, both in academic and business circles, as a leader in innovation; faculty and students will participate in solving urgent problems confronting industry and society and our curricula will reflect this participation; internship, cooperative, and employment opportunities will abound for our students; and long-lasting partnerships between Hofstra University and the business / industrial community will be created.

Dr. Kevin Craig, who is experienced in creating and working with centers of innovation at RPI (Troy, NY) and Marquette University (Milwaukee, WI), is building on this experience and leading the Center for Innovation. Initially, Dr. Craig will meet with industry/business leaders and establish an understanding of their needs. He has already initiated projects with The Feinstein Institute for Medical Research, Festo, and Rockwell Automation. He will identify the resources of the center in terms of faculty and facilities. From this effort, contracts with

business and industry will result for innovative projects and collaborations. It is envisioned that industry will contract with the center for projects of less than a year's duration, initially in the $25,000 – $50,000 range. Faculty and/or consultants will be employed to solve the proposed problems. They will be compensated based on their effort, as determined in the contract and in consultation with center's director, Dr. Craig.

There are two elements that are essential for this to be viable and sustainable, and, above all, game changing. They are: (1) No intellectual property rights will be claimed by the faculty / consultants or university; all intellectual property will be held by the contracting company, and (2) the overhead cost will be low, 25% (less than half of what is normal at a university), and all overhead will be used to support engineering labs and facilities. In addition, if there are no Hofstra faculty qualified and available to work on projects, the center can employ consultants with requisite expertise. This ensures that the team assembled to solve a problem will be the best available, made up of experienced professors, engineers, designers, and scientists.

An added feature of the Center for Innovation is professional distance education in Mechatronics. A Certificate in Mechatronics for Practicing Engineers is currently being developed. This certificate program is an on-line program for practicing engineers who want to raise their skill level to compete in the global economy and for companies who want to empower their engineers so as to achieve a real competitive advantage in the global economy. Traditional engineering skills and information are commodities today. This program is designed to exceed fundamental skills, with an integration of rigorous theory and best industry practice, to enhance engineering practice for those presently working in the trenches to solve society's most urgent problems. Model-based design, grounded in mathematics and physics, is the key. Twelve one-credit / one-month modules, taken in a specific order, will cover the essential areas of mechatronic system design.

- Physical and Mathematical Modeling
- Electrical Systems
- Mechanical Systems
- Electromechanical Systems
- Fluid Systems
- Thermal Systems
- Computer Simulation
- Measurement Systems
- Sensors for Mechatronics
- Actuators for Mechatronics
- Control System Fundamentals
- Control System Design & Digital Implementation