Soft skill development in engineering education – Active learning in the classroom and beyond
THE ENGINEER OF THE 21st CENTURY

- Engaged in all phases of the lifecycle of a product
- Designs products, processes and systems that incorporate technologies
- Conceives, designs and implements products and processes
- Captures tacit knowledge so that it can be revised and upgraded in the future
- Works in international, sometimes geographically distributed teams
WHAT IS EXPECTED FROM MODERN ENGINEERS?

- Work ethics
- Self-awareness
- Emotion regulation
- Stress management
- Resilience
- Patience
- Perceptiveness
- Communication skills
- Facilitating skills
- Management skills
- Presentation skills
- Negotiation skills
- Networking skills
- Effective teamwork
- Decision-making
- Problem-solving
- Critical thinking
- Lifelong learning
- System-thinking
- Holistic viewpoints
THE ABET CRITERIA

- Requires that all engineering graduates of a baccalaureate program receive at least one year of study in the natural or physical sciences and mathematics, and requires some study within general

- Requires that each student complete a capstone project or design class in their education

- Engineering curricula are somewhat standardized at the bachelor's level, thus ensuring that graduates of any ABET-accredited program have some minimal skill set for entry into the workforce or for future education
shifted the focus away from the inputs (what material is taught) and to the outputs (what students learned)

stresses continuous improvement, and accounts for specific missions and goals of the individual institutions and programs

Enables innovation in engineering programs rather than forcing all programs to conform to a standard, as well as to encourage new assessment processes and program improvements
# The CDIO Approach

## Mission
- Business Strategy
- Technology Strategy
- Customer Needs
- Goals
- Competitors
- Program Plan
- Business Plan

## Conceive
- Conceptual Design
  - Requirements
  - Function
  - Concepts
  - Technology
  - Architecture
  - Platform Plan
  - Market Positioning
  - Regulation
  - Supplier Plan
  - Commitment

## Design
- Preliminary Design
  - Requirements Allocation
  - Model Development
  - System Analysis
  - System Decomposition
  - Interface Specifications
- Detailed Design
  - Element Design
  - Requirements Verification
  - Failure & Contingency Analysis
  - Validated Design

## Implement
- Element Creation
  - Hardware Manufacturing
  - Software Coding
  - Sourcing
  - Element Testing
  - Element Refinement

- Systems’ Integration & Test
  - System Integration
  - System Test
  - Refinement
  - Certification
  - Implementation Ramp-up
  - Delivery

## Operate
- Lifecycle Support
  - Sales & Distribution
  - Operations
  - Logistics
  - Customer Support
  - Maintenance & Repair
  - Recycling
  - Upgrading

## Evolution
- System Improvement
- Product Family Expansion
- Retirement
CDIO STANDARDS

- dual-impact learning experiences that promote deep learning of technical fundamentals and of practical skill sets
- modern pedagogical approaches, innovative teaching methods, and new learning environments to provide real-world learning experiences
- a curriculum organized around mutually supporting technical disciplines with personal and interpersonal skills, and product, process, and system building skills highly interwoven
PEDAGOGICAL FOUNDATION

- Jean Piaget - Constructivism
- Benjamin Bloom - Taxonomy of learning objectives
- Seymour Papert - Constructionism
- David A. Kolb - Experiential learning

Learning is experience. Everything else is just information.
-- Albert Einstein
LEARNING BY DOING MODELLING OF MANUFACTURING PROCESSES

- Simulation of bulk-manufacturing
- Enables natural learning, but without costly consequences
- Based on observations, system re-engineering, individual and team decisions
- Is used in teaching manufacturing, operational research and logistics basics
WAREHOUSING AND ORDER-PICKING SIMULATION
ONLINE “BEER GAME” DISTRIBUTION MANAGEMENT SIMULATION ON TABLETS
INNOVATIVE ANDROID APPS FOR TRAFFIC COUNTING AND DISTRIBUTION OBSERVATIONS
INDUSTRIAL AND ACADEMIC PARTNERS

[Logos of various partners]
SUMMARY

Effective Teamwork
Performance Measurement Cost-Effective Feedback Creative Thinking Ethics
Decision Making Understanding Each Other Hidden Student Potential
Process Re-engineering Controlling View Problem Detection Capacity Utilization
Evaluation Connecting People Quality Management