



CSILLA FEJES

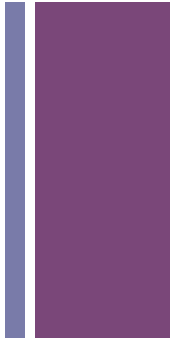
TECHNICAL UNIVERSITY OF
CARTAGENA, SPAIN

DOCTORAL SCHOOL OF
ECONOMY, MANAGEMENT
AND LAW SCIENCES

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



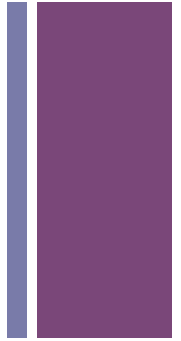
WHAT IS EXPECTED FROM MODERN ENGINEERS?



- 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
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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



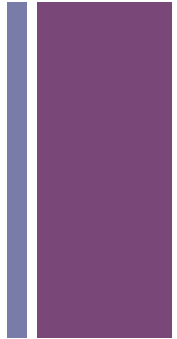
ENGINEERING CRITERIA 2000



- 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



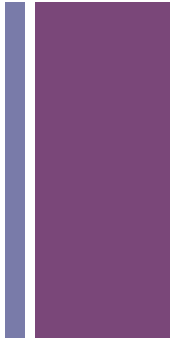
THE CDIO APPROACH



Conceive		Design		Implement		Operate	
Mission	Conceptual Design	Preliminary Design	Detailed Design	Element Creation	Systems' Integration & Test	Lifecycle Support	Evolution
<ul style="list-style-type: none">• Business Strategy• Technology Strategy• Customer Needs• Goals• Competitors• Program Plan• Business Plan	<ul style="list-style-type: none">• Requirements• Function• Concepts• Technology• Architecture• Platform Plan• Market Positioning• Regulation• Supplier Plan• Commitment	<ul style="list-style-type: none">• Requirements Allocation• Model Development• System Analysis• System Decomposition• Interface Specifications	<ul style="list-style-type: none">• Element Design• Requirements Verification• Failure & Contingency Analysis• Validated Design	<ul style="list-style-type: none">• Hardware Manufacturing• Software Coding• Sourcing• Element Testing• Element Refinement	<ul style="list-style-type: none">• System Integration• System Test• Refinement• Certification• Implementation Ramp-up• Delivery	<ul style="list-style-type: none">• Sales & Distribution• Operations• Logistics• Customer Support• Maintenance & Repair• Recycling• Upgrading	<ul style="list-style-type: none">• 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



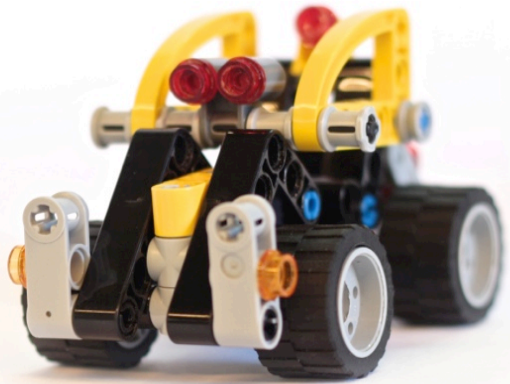
- J e a n P I A G E T - Constructivism
- S e y m o u r P A P E R T - Constructionism
- B e n j a m i n B L O O M - Taxonomy of learning objectives
- D a v i d A. K O L B – Experiential learning

*Learning is experience.
Everything else is just information.*
-- Albert Einstein

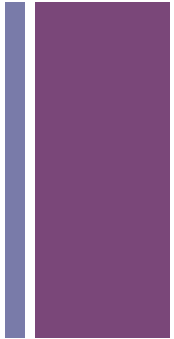




LEARNING BY DOING MODELLING OF MANUFACTURING PROCESSES

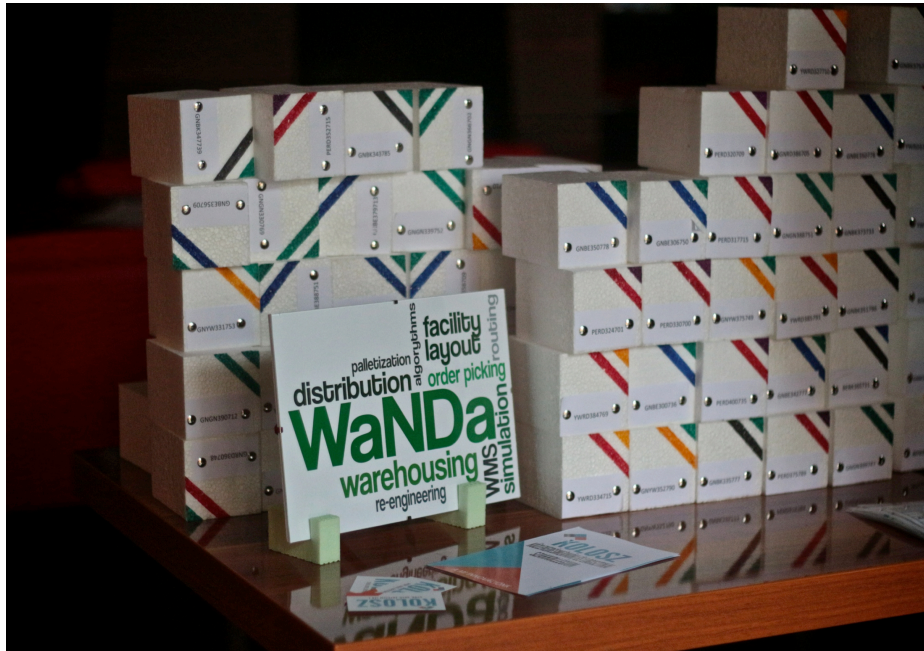


- Simulation of bulk-manufacturing
- Enables natural learning, but without costly consequences
- Based on observations, system re-engineering, individual and team decisions
- Is used in teaching manufacturing, operational research and logistics basics



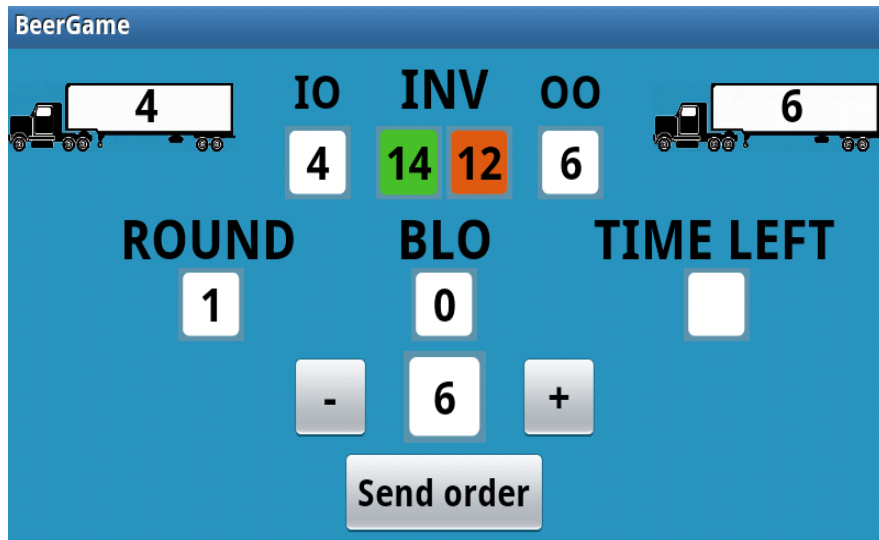
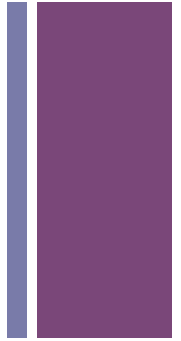


WAREHOUSING AND ORDER-PICKING SIMULATION





ONLINE "BEER GAME" DISTRIBUTION MANAGEMENT SIMULATION ON TABLETS





INNOVATIVE ANDROID APPS FOR TRAFFIC COUNTING AND DISTRIBUTION OBSERVATIONS





INDUSTRIAL AND ACADEMIC PARTNERS

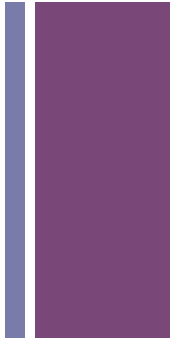


Universidad
Politécnica
de Cartagena





SUMMARY



EFFECTIVE TEAMWORK

PERFORMANCE MEASUREMENT COST-EFFECTIVE
FEEDBACK CREATIVE THINKING ETHICS
DECISION MAKING UNDERSTANDING EACH OTHER
HIDDEN STUDENT POTENTIAL CONTROLLING VIEW
PROCESS RE-ENGINEERING PROBLEM DETECTION
EVALUATION CAPACITY UTILIZATION
CONNECTING PEOPLE QUALITY MANAGEMENT