What is Engineering Mind-set thinking?

Engineering Mind-set Thinking is a way of thinking that combines the problem solving/design process with the life-skills that fosters dealing with others as in a team. It provides the culture, language, tools and values of engineering without the high level knowledge of math and science (Content Knowledge). Mastering this way of thinking is important for all students, regardless of their career objectives.

You can integrate Engineering mind-set thinking into an existing curriculum by including project-based, experiential focus on all social skills that connect people & society to create a better design and problem-solving solution. It's the culture & tools for thinking. A way of thinking a culture for an entire organization.

The process is not only about solving problems but also about interfacing with people and the community to background information about the problem . In the business world this means having empathy with your customer. The mindset is breaking the problem into manageable chucks to better understand the problem, taking a system view (inputs & outputs) of the problem and seeing the right issues are addressed for the needs of the community.   It's being a leader of your learning environment and taking ownership and responsibility of the project, you are working on. Engineering mindset also means seeing problems as opportunities and the fun in solving those problems.

"As important as content knowledge is, along with the skills to apply it, something else is at least as important today: the set of attitudes, behaviors and motivations that enable knowledgeable graduates to work with others,": "There is an urgent need for substantial improvement in the engineering graduates' competencies in ethical behavior and trustworthiness, teamwork and consensus building, effective communication and persuasion, entrepreneurial mindset, creativity and design thinking, empathy and social responsibility, interdisciplinary thinking and global awareness and perception," said President Rick Miller of Olin College.

Culture (See Appendix for elements of the culture)

"Engineers are optimistic. They are accustomed to facing problems and solving them. This optimism contrasts with the culture of criticism one often finds in some other professions.
For example, lawyers are trained to imagine the worst possible outcomes and protect against them. Engineer-Designers are trained to imagine the best possible outcome that one might be
able to create with a novel artifact. It is no surprise that these two groups of professionals often find themselves in a clash of cultures".
DESIGN creation of artifacts in society, Karl T. Ulrich

Elements of Engineering Mind-set

Culture:

- **Values/ norms/ communities**
- **Negotiations**
- **Decision making**
- **Collaboration**
- **Excellence**

Project Formation:

- **Creative and Critical thinking**
- **System view**
- **Questioning**
- **Customer needs**
- **Financial controls**

Planning and Scheduling

- **Time management**
- **Measurements/ Feedback**
- **Quality systems**
- **Leadership**

Problem Solving / Process

- **Innovation**
- **Risk taking**
- **Prototyping and iteration**
- **Entrepreneurship**

Public reporting

- **Reflection**
- **Testing idea**
- **Presenting**

Attitude

- **Being Positive**
- **Being Flexible**
- **Doing your best**
- **Being a leader when necessary**

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Engineering is **ACADEMIC GLUE** – it binds complex concepts to real-world experiences and leads to learning that sticks with students

Engineering is **CREATIVITY** – it brings out the best ideas from the students

Engineering is **GROUP WORK** – students learn to communicate and work together while they solve community, educational or world problems

Engineering is **EVERYWHERE** – students learn that engineers have designed, created or modified nearly everything they touch, wear, see and hear in their daily lives

The Engineering Mind-set process involves interfacing with many sets of people and listening to their requirement.   It's a circular process that continuously gets better.

Our focus is to have students take ownership and responsibility for their learning and use measurements in combination with a quality focus to strive for continuous improvements. Developing a thought process that fosters an ability to continue to have a system and reflective view of the learning process. Engineering mind-set begins with an understanding "that all problems are opportunities and the bigger the problem, the bigger the opportunity" (Vinod Khosla) to learn and be a creative problem solver.

The process of learning uses the system view of creating goals, setting milestones to develop a plan that tracks, using feedback to measure, the best possible outcome. Its creating a language and diagrams to represent the problem for communication to others. A culture with others will include such values as; Trust. Empathy, Curiosity, Kindness and Honesty. We will work collaborative with others to make each other successful as individuals.

The outlook of this approach is that of Bernard Gordon who states that a "Real Engineer" outlook is not just with the technical items but to make society better by using social skills to create a community to enhance the Engineering Mind-set.

 We will spend more time training to be open-minded and learning to update our beliefs in response to new data. We will practice adjusting after our mistakes, and we will invest more in the skills traditionally associated with emotional intelligence.   Ed Hess JUNE 19, 2017

  Few people complete a formal education in engineering (B.S. degree through a Ph.D. degree) but Guru Madhavan (Think like an engineer) is convinced that almost anyone can develop an engineer's mind-set, one that could create a significant competitive advantage for them. "Engineers help create "solution spaces" -- suites of possibilities that offer new choices, conveniences, and comforts -- that redefine our standard of living." They have developed a mind-set that guides and informs those efforts.

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Emotional Intelligence Domains and Competencies

SELF-AWARENESS	SELF-MANAGEMENT	SOCIAL AWARENESS	RELATIONSHIP MANAGEMENT
Emotional self-awareness	Emotional self-control	Empathy	Influence
	Adaptability		Coach and mentor
	Achievement orientation	Organizational awareness	Conflict management
			Teamwork
	Positive outlook		Inspirational leadership

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Practical engineering-needs:

- Teamwork
- Problem Solving
- Communication
- Ethics
- Lifelong Learning

http://hplengr.engr.wisc.edu/resources.ht

Howard Gardner has much of value to say about multiple intelligences that have almost unlimited applications in what are often viewed as separate and [begin italics] unrelated [end italics] arts and sciences. Guru Mudhavan agrees with Gardner: **"The engineering mind-set can be applied successfully in every walk of life because its core elements (structure, constraints, trade-offs) and its basic concepts (including recombination, optimization, efficiency, and prototyping, are equally effective in finding solutions to non-engineering challenges**.

Obviously, the engineer's mind-set can help to create "suites of possibilities that offer new choices, conveniences, and comforts -- that redefine our standard of living." It can guide and inform those efforts. But there is a higher purpose to which Guru Madhavan refers when **suggesting that everyone is an engineer** "at some point in the way we design our destinies. That's why it's the responsibility of not only engineers, but just about everyone to share the future course of engineering, which is entering an era of new eclecticism. With a shared vision, we can create better solution spaces, convert random motions into progress, and improve societal muscle strength to address the complexities of today and tomorrow."

 We live in a world that increasingly requires what psychologist Howard Gardner calls searchlight intelligence. That is, the ability to connect the dots between people and ideas, where others see no possible connection. An informed perspective is more important than ever to anticipate what comes next and succeed in emerging futures. … ***The best leaders are constant learners*** … HBR

Education is not the learning of facts but the training of the mind to think – Albert Einstein:

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Appendix:

Values:

Trust	Teamwork	Kindness	Curiosity
Empathy	Self-control	Honesty	Pattern-Finding
Code of Ethics	Leadership		

Norms:

- **Break** problems into small parts
- **Focus** on the Gap between customers need and the present condition
- **Observation** *Learning to look through the eyes of a designer (**Engineering Lens**)*
- **Understanding** the needs of your customer/ community
- **Research** *Using objects, primary source documents, maps and other materials*
- **Creative Solutions** *Through the process of making something- a model, an object or a poster*
- **Planning & Commitment:** *Insure that schedules and deliverables are set to meet the customers' needs*
- **Presentation and Reflection** *Includes a verbal presentation by the designers followed by analysis and evaluation which helps to improve the design*

Adapted from Cooper-Hewitt

Language words used:

Function	Input / Output	Design parameters	Scaling
Testing	Reviews	Dynamic / Static process	Feedback
Reflection	Requirements	Design	Leadership
Management	Artifacts	Customer, Client,	Deliverables
Skills	Measurements	Planning	

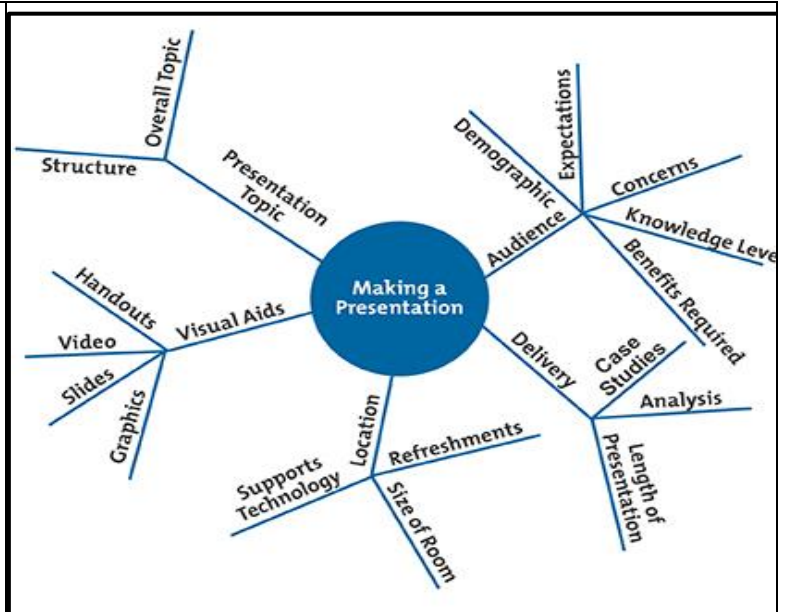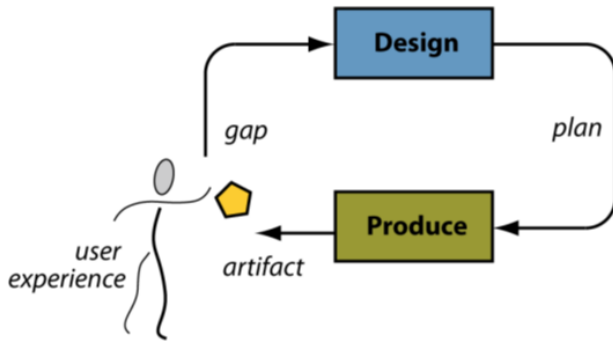**Drawing:** https://www.wisc-online.com/learn/career-clusters/stem/eng20004/pictorial-drawings

Functional	Schematic	Part-drawing	Block-diagram
Mind-map			

Information sharing …   Mind-mapping:

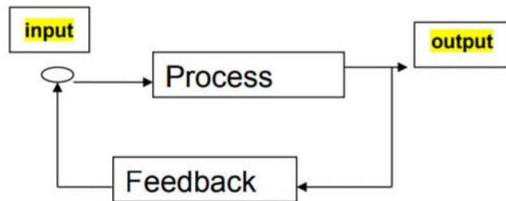## DESIGN creation of artifacts in society, …Karl T. Ulrich

Process feedback

Input: complete, count, define, describe, identify, list, match, observe, recit
Process: evaluate, judge, predict, infer, analyze, reason, explain, distinguish
Output: complete, imagine, predict,
Feedback: speculate, if/then, forecast, idealize, hypothesize, judge

Important places:
http://www.idesignthinking.com/main.html
http://theengineeringmindset.com/
https://www.farnamstreetblog.com/best-articles/

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