

Introduction of Engineering Design Process

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I am the left brain.
I am a scientist. A mathematician.
I love the familiar. I categorize. I am accurate. Linear.
Analytical. Strategic. I am practical.
Always in control. A master of words and language.
Realistic. I calculate equations and play with numbers.
I am order. I am logic.
I know exactly who I am.

I am the left brain.

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I know exactly who I am.

I am the right brain.
I am creativity. I am free spirit. I am passion.
Yearning. Sensuality. I am the sound of roaring laughter.
I am taste. The feeling of sand beneath bare feet.
I am movement. Vivid colors.
I am the urge to paint on an empty canvas.
I am boundless imagination. Art. Poetry. I sense. I feel.
I am everything I wanted to be.

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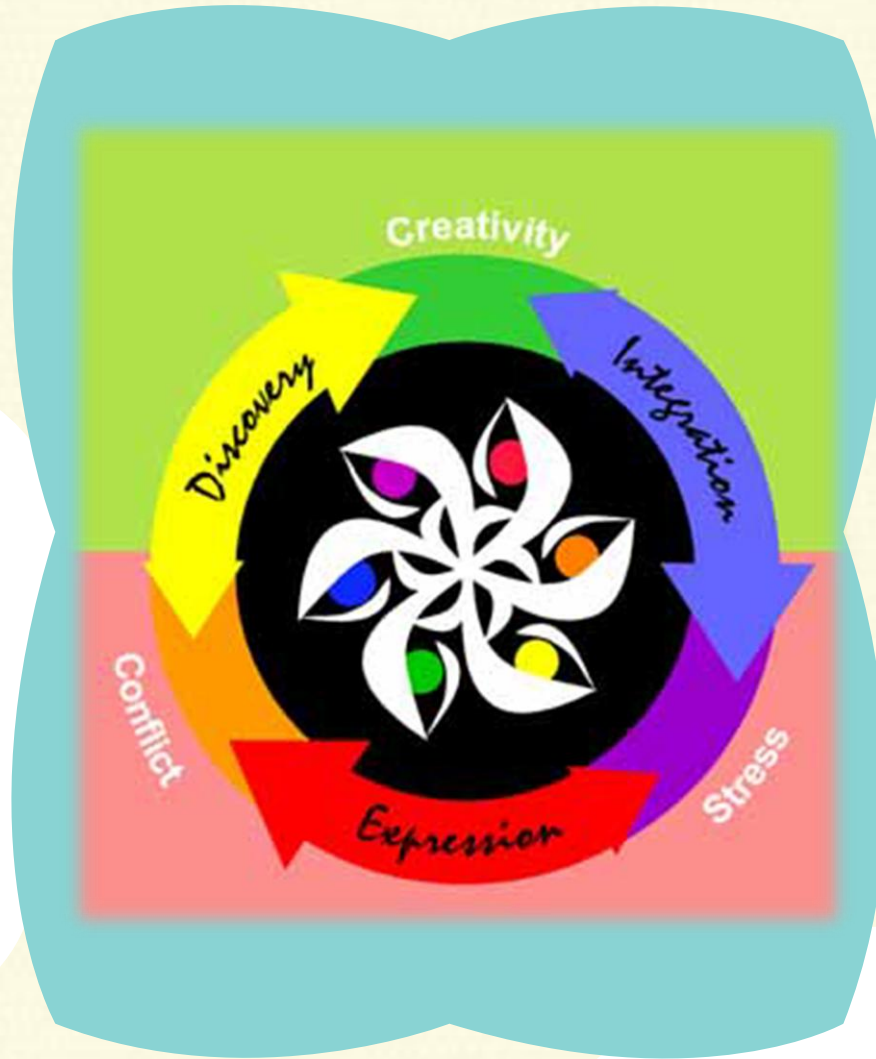
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The Stress – Conflict – Creativity Cycle



- **Stress**, whether positive or negative, provides an indication that limitations are being reached and felt. Stress provides a clear signal of the need for adjustment — of systems, of working models, of the “story” which is driving the scene.
- **Conflict** is an acute derivative of stress. Conflict occurs when two or more differing points of view appear to create limitations upon one another. These points of view may express themselves covertly or overtly, resulting in a competition, or conflict.
- Conflict can become a sticking point. When *expression is conscious, respectful*, and artful, however, conflict can allow the strengths and weaknesses of each point of view to be discovered, leading to an expanded understanding for all.
- New opportunities and changed dynamics become available as a result of this *discovery*.
- Discovery leads naturally to **creativity**. Something new can occur or evolve because of this expanded understanding — leading to a new system, a new working model, or a new “story” — which in turn becomes a new platform for further activity, for *integration*. Discovery leads naturally to **creativity**. Something new can occur or evolve because of this expanded understanding — leading to a new system, a new working model, or a new “story” — which in turn becomes a new platform for further activity, for *integration*.
- *Expression. Discovery. Integration.* These are natural processes that can be hastened, deepened, and otherwise improved through conscious attention.

20 ways to stimulate your own creativity

1. **Keep a notebook and pen with you** at your desk, in your car, everywhere you go so you can always record your ideas as you have them.
2. **Learn to ask more questions.** Ask “What if?” Don’t be afraid to have what seem to be completely crazy ideas. Learn to think beyond what seems obvious.
3. **Daydream.** Learn to use your imagination. You must see it in your mind before it becomes a reality. Become a master at visualization.
4. **Become more spontaneous.** Don’t concern yourself with what others think about your ideas.
5. **Follow your intuition.** Follow that little voice inside; it will never let you down.
6. **Do not compare yourself to others.** This is a quick creativity killer. Be nice to yourself.
7. **Try new things.** Visit a museum, go shopping, a change of scenery will reboot your creative mind.
8. **Brainstorm** with your family or friends.
9. **Read, read and then read some more.** Whether you are reading a book, your tweets, the Internet, just read. Never stop learning.
10. **Take a bubble bath.**
11. **Learn to become comfortable with the silence.** Quiet your mind. Go within, there are nuggets of gold in there if you can quiet your mind and explore yourself. Get in the moment.
12. **Try new foods.** Milk, spinach, salmon, whole grain pasta, tofu and sunflower seeds are all proven to make you feel happier and more creative.
13. **Sleep or lack of it.** It’s funny because it is shown that sleep can recharge your batteries and make you feel more creative, but also hacking your body and not sleeping for extended periods of time can trigger insane amounts of creativity.
14. **Listen to music.**
15. **Physical exercise** definitely stimulates creativity.
16. **Take a walk in nature,** breathe in the fresh air, appreciate and become inspired by nature.
17. **Stop doubting your own ability to be creative.** Believe that you are inherently creative.
18. **If you hit a wall creatively, walk away and do something else for a while, then go back to your project.** When I do this, the answer almost always magically comes to me.
19. **Learn to take more chances,** put yourself out there a bit more, trusting yourself.
20. **Last but certainly not least, fall in love with what you do.** All creative people have this in common. For example, I love to write. I write for the same reason that I breathe, because I have to. It is who I am and I love it. Find your passion and do it. And then, do it some more.

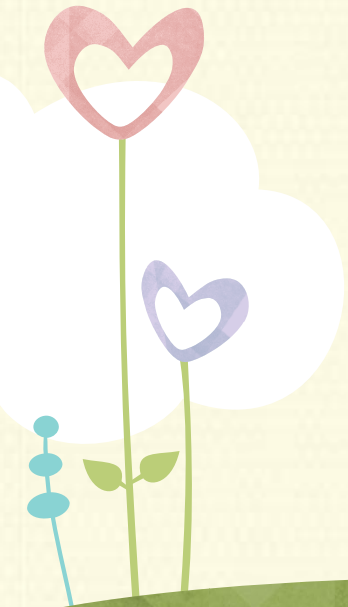
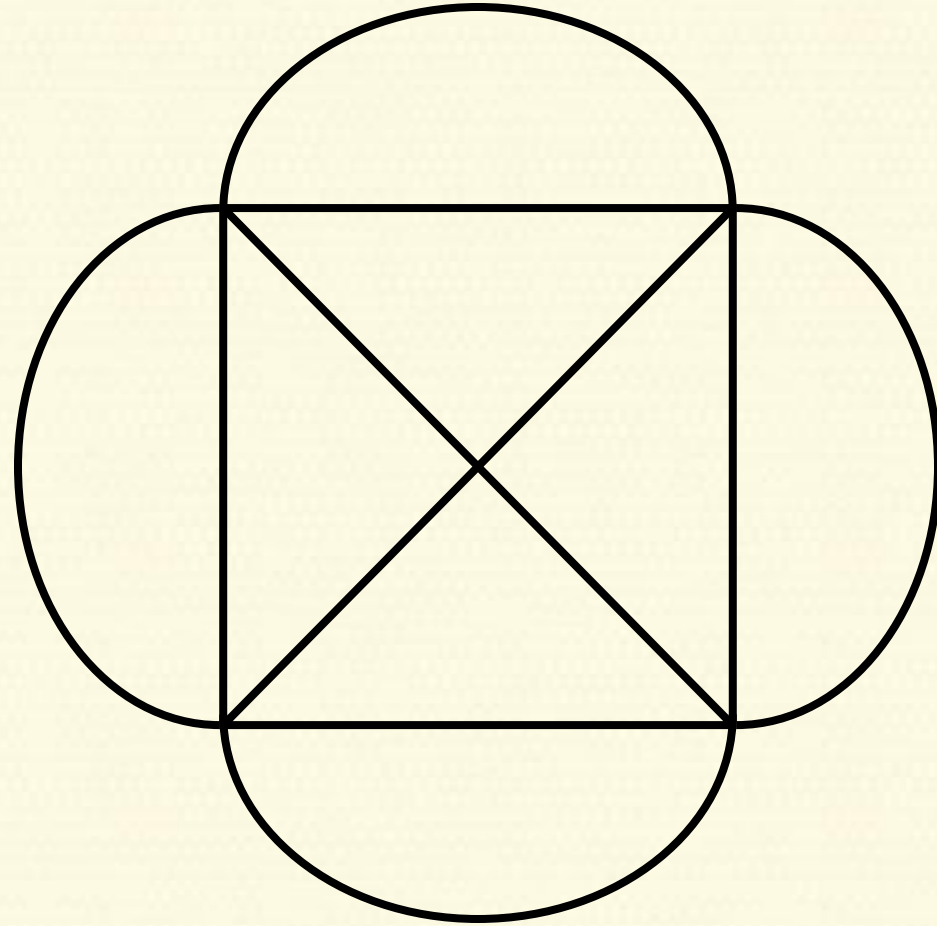
Creativity Test

Prepare :

A piece of paper

A pen / pencil

Make the picture
without removing
your pen/pencil,
and not allowed
to make double
line!





ENGINEERING ?


**KEEP
CALM
I'M
INDUSTRIAL
ENGINEERING**

DESIGN ?

Objectives of study :

- Students understand principles and fundamentals of product design and development.
- Students can explore and identify customer needs to define the value of product design.
- Students can implement product design and development process stages.

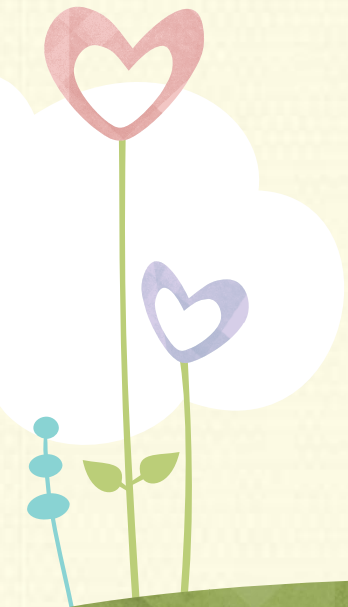
References :

- Yousef Haik & Tamer M. Shahin, Engineering Design Process
- Bernhard E. Bürdek, Design : History, Theory, and Practice of Product Design
- Other books/references

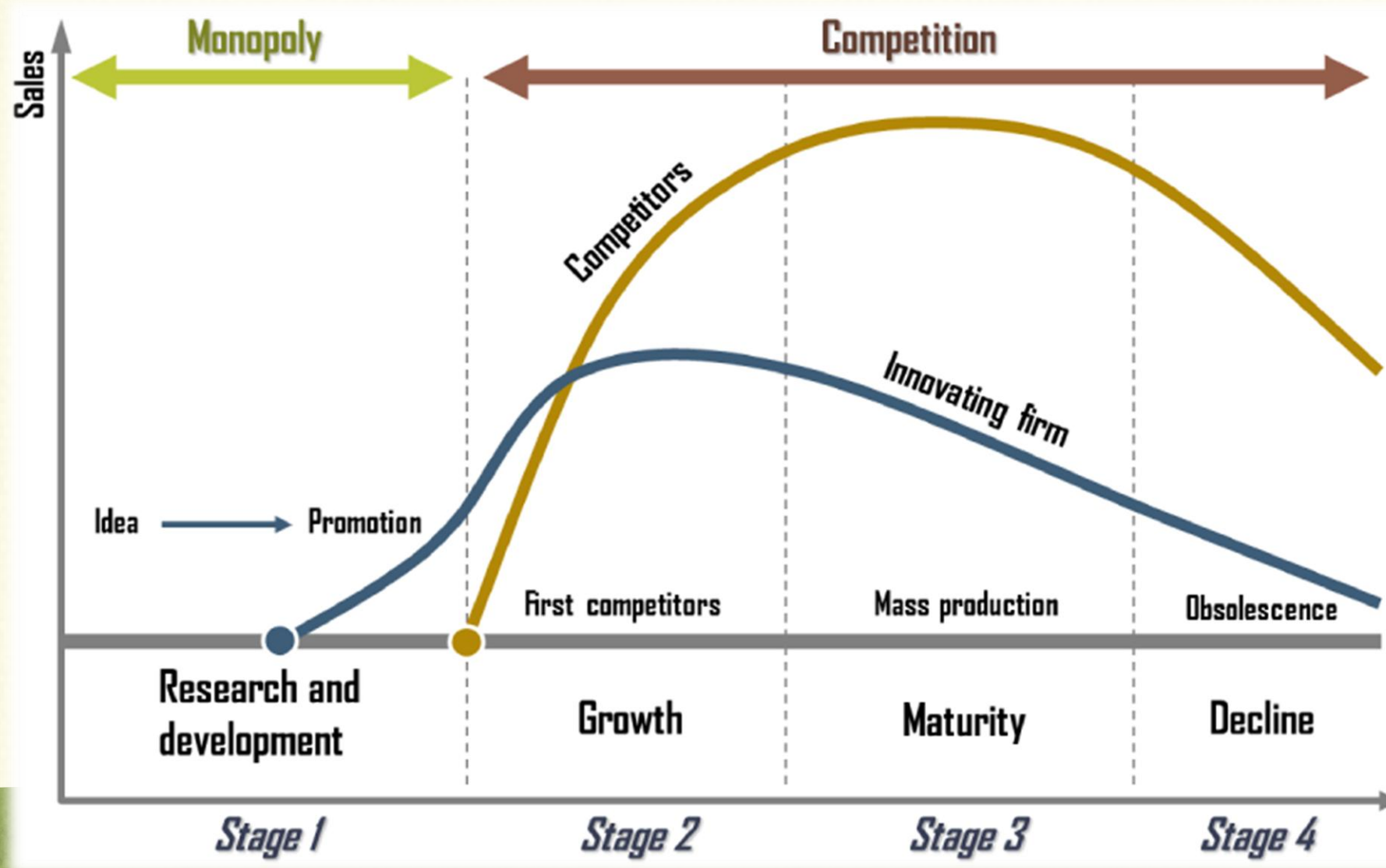


Engineering Design Definition

- The ABET (Accreditation Board for Engineering and Technology) definition states that **engineering design** is the process of devising a system, component, or process to meet desired needs.
 - It is a **decision-making process** (often iterative), in which the basic sciences, mathematics, and engineering sciences are applied to optimally convert resources to meet a stated objective.
 - Among the fundamental elements of the design process is **the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation.**
 - The engineering design component of a curriculum must include most of the following features: **development of creativity, use of open-ended problems, development and use of modern design theory and methodology, formulation of design problem statement and specifications, production processes, concurrent engineering design, and detailed system description.**
 - It is essential to include a **variety of realistic constraints**, such as economic factors, safety, reliability, aesthetics, ethics, and social impact.

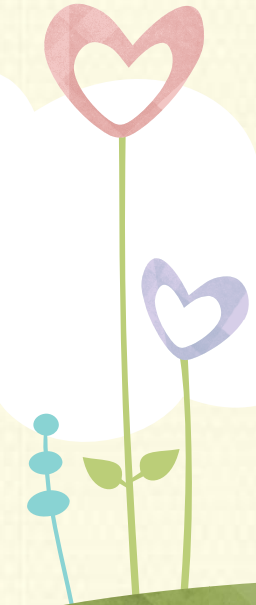


Product Life Cycle

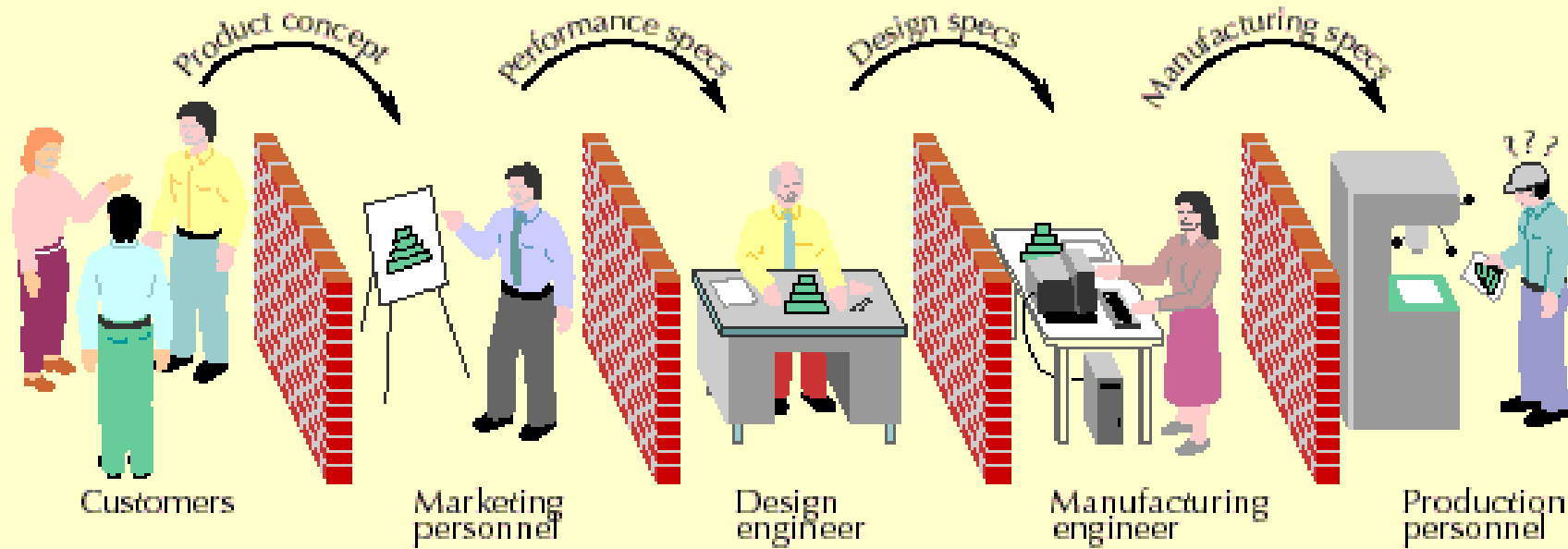


Design Levels

- **Adaptive design:** The designer's work will be concerned with the adaptation of existing designs, only make a minor modification of the product/parts.
- **Development design:** The designer starts from an existing design, but the final outcome may differ markedly from the initial product
- **New design:** Only a small number of designs are new designs. This is possibly the most difficult level in that generating a new concept involves mastering all the previous skills in addition to creativity and imagination, insight, and foresight. For example?



(a) Sequential design: Walls between functional areas



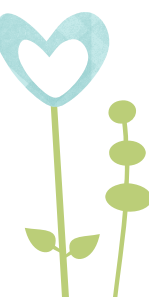
(b) Concurrent design: Walls broken down



One of the first steps in the engineering design process is to have **design meetings**.

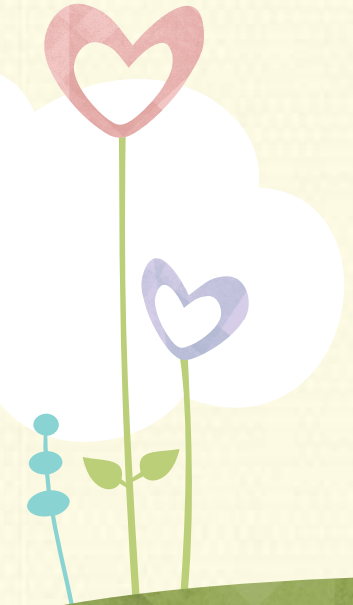
In design meetings, **engineers, technicians, and other staff members come up with solutions to fill specific customer need.**

It's called
**CONCURRENT
ENGINEERING.**



Why engineering design fail?

- ❖ Incorrect or overextended assumptions
- ❖ Poor understanding of the problem to be solved
- ❖ Incorrect design specifications
- ❖ Faulty manufacturing and assembly
- ❖ Error in design calculations
- ❖ Incomplete experimentation and inadequate data collection
- ❖ Errors in drawings
- ❖ Faulty reasoning from good assumptions



Basic Principles of Systematic Design Process



**Engineering
Design Product**

**Industrial
Design Product**

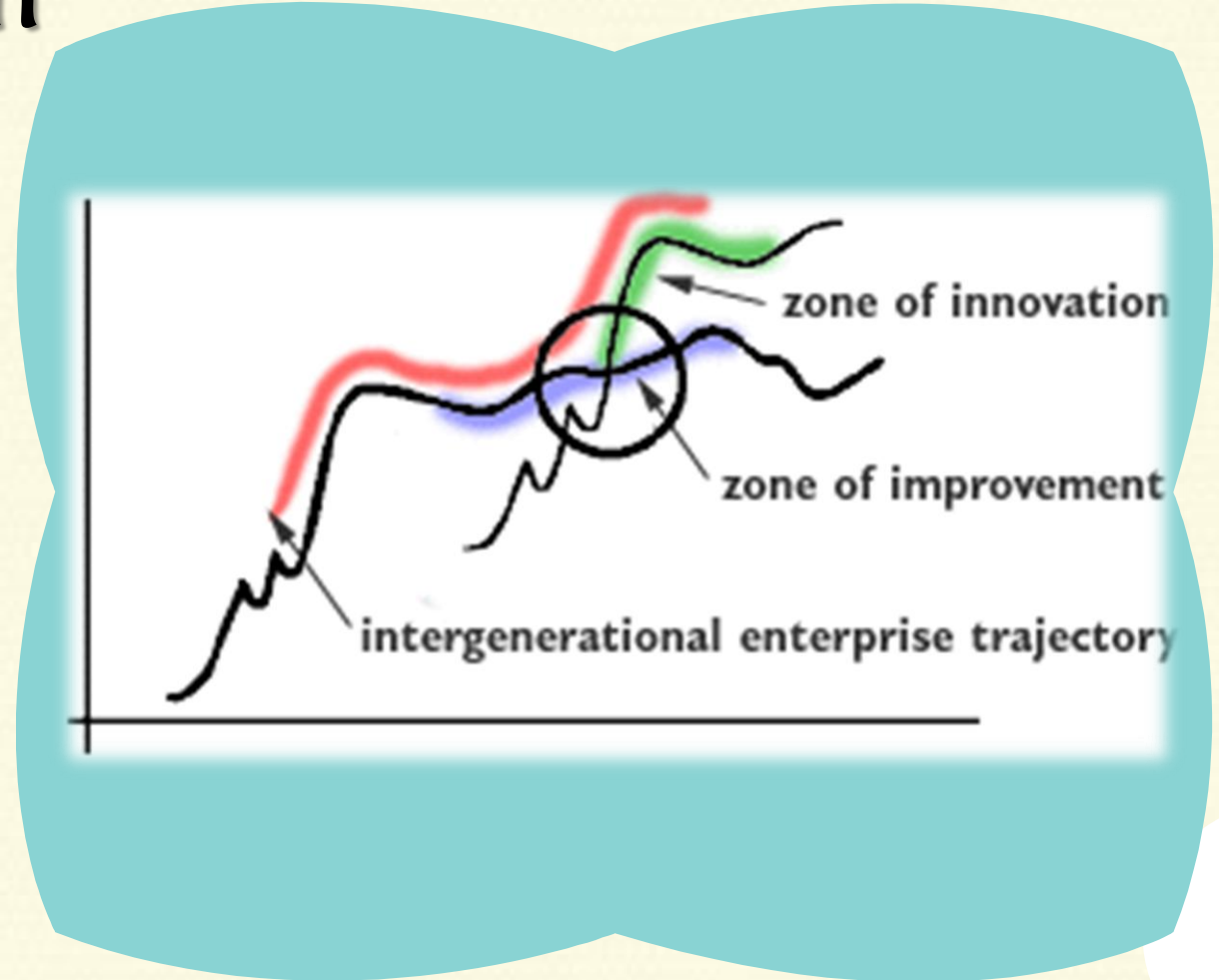
Evolution vs Innovation

Evolutionary/Improvement Change:

A product is allowed to evolve over a period of time with only slight improvement. This is done when there is no competition. The creative capabilities of the designer are limited.

Innovation Change:

Rapid scientific growth and technological discoveries as well as competition among companies for their slice of the market have placed a great deal of emphasis on new products, which draw heavily on innovation. The creative skills and analytical ability of the design engineer play an important role.



Syllabus of Eng Design Process

15% QUIZ 1
15% QUIZ 2
20% TUGAS
15% PRESENTASI
35% UAS

Week	Subject
1	Introduction
2	Essential Transferable Skills
3	Identifying Needs and Gathering Information (Market Research)
4	Customer Requirements
5	Quiz 1 (week 1-4)
6	Establishing Functional Structure
7	Specifications
8	Developing Concepts

Week	Subject
9	Embodiment Design
10	Detailed Design
11	Quiz 2 (week 6-10)
12	Group Presentation
13	Group Presentation
14	Group Presentation
15	Kansei Engineering
16	Improvement vs Innovation

Homework

- Divide the class into 27 groups.
- Read the book titled *Design : History, Theory, and Practice of Product Design* (Bernhard E. Bürdek) and choose a country for your task (it has to be different for each group).
- Make a resume about “History of Design in Company X, Contry Y”, also included with the pictures of its product metamorphosis.

