

**MKT 1821**

Introduction to  
Mechatronics Engineering

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# Engineer

Designs and manufactures

- materials,
- machines, devices,
- buildings and
- systems.

Pays attention to

- **Feasibility**
- **Reliability**
- **Cost**

Three  
Pillars of  
Engineering



Aerodynamic flutter

# Reliability

The primary causes of engineering disasters are usually considered to be

- human factors (including both 'ethical' failure and accidents)
- design flaws (many of which are also the result of unethical practices)
- materials failures
- extreme conditions or environments, and, most commonly and importantly
- combinations of these reasons

# Reliability

A study conducted at the Swiss federal Institute of technology in Zurich analyzed 800 cases of structural failure in which 504 people were killed, 592 people injured, and millions of dollars of damage incurred. When engineers were at fault, the researchers classified the causes of failure as follows:

- Insufficient knowledge ..... 36%
- Underestimation of influence ..... 16%
- Ignorance, carelessness, negligence ..... 14%
- Forgetfulness, error ..... 13%
- Relying upon others without sufficient control ..... 9%
- Objectively unknown situation ..... 7%
- Imprecise definition of responsibilities ..... 1%
- Choice of bad quality ..... 1%
- Other ..... 3%



# Reliability

Matousek shows that the following errors underlying the failures could have been detected in time:

- **32%** by a careful review of the documents by the next person in the process,
- **55%** by additional checks, if one had adopted the right strategies.
- In the first case the importance of good cooperation between all those involved in the construction phase
- In the second the need for well-planned quality assurance procedures.

Finally, Matousek concluded that **13%** of all errors could not possibly have been detected in advance.

# Feasibility

Technical Feasibility

Operational Feasibility

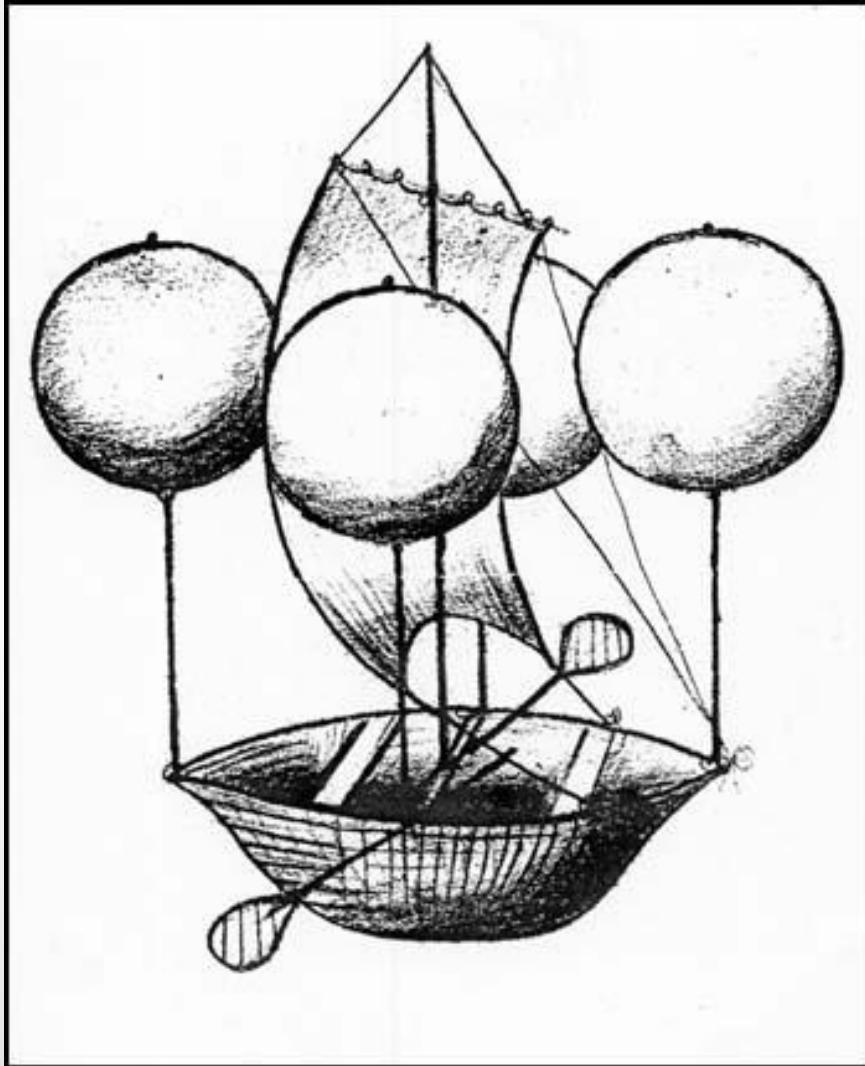
Economic Feasibility

# Feasibility

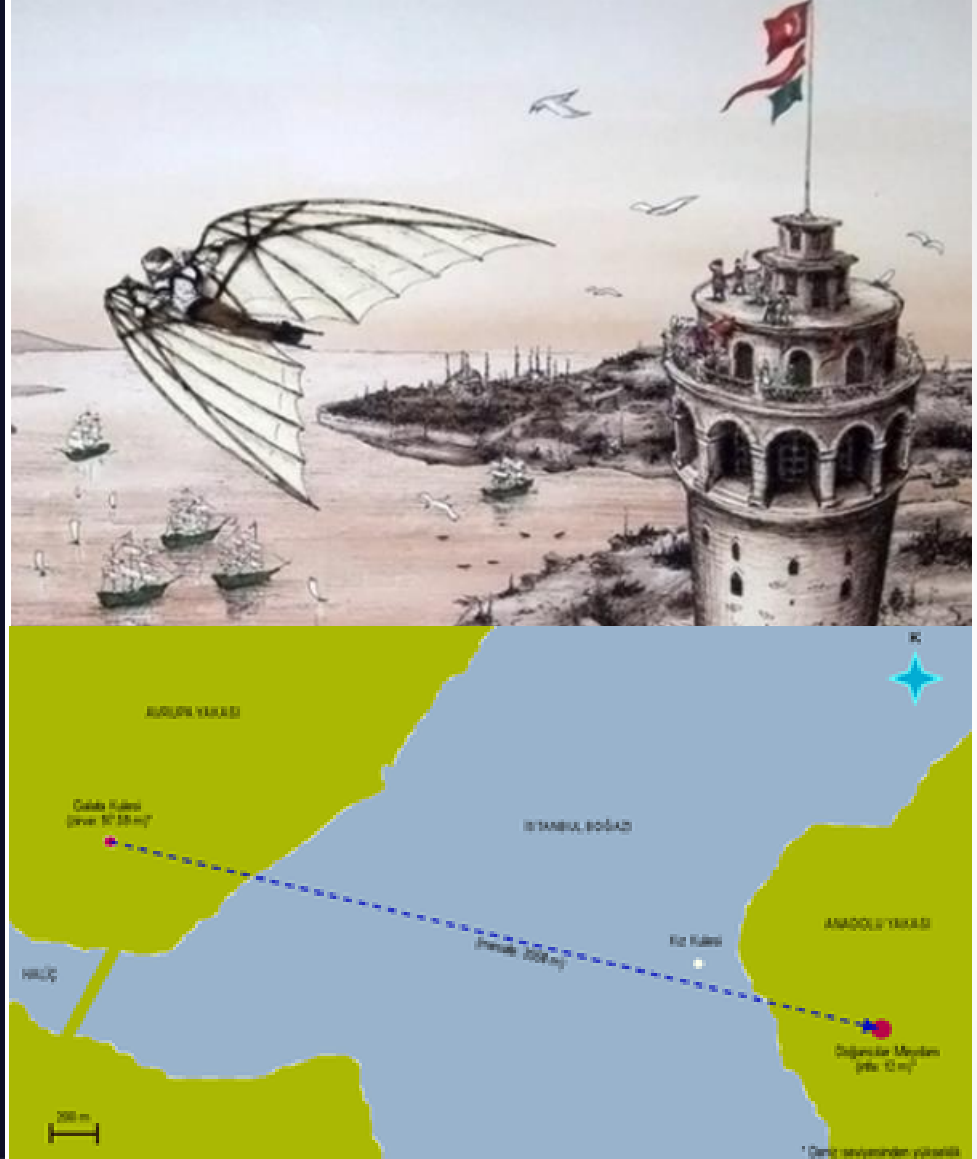
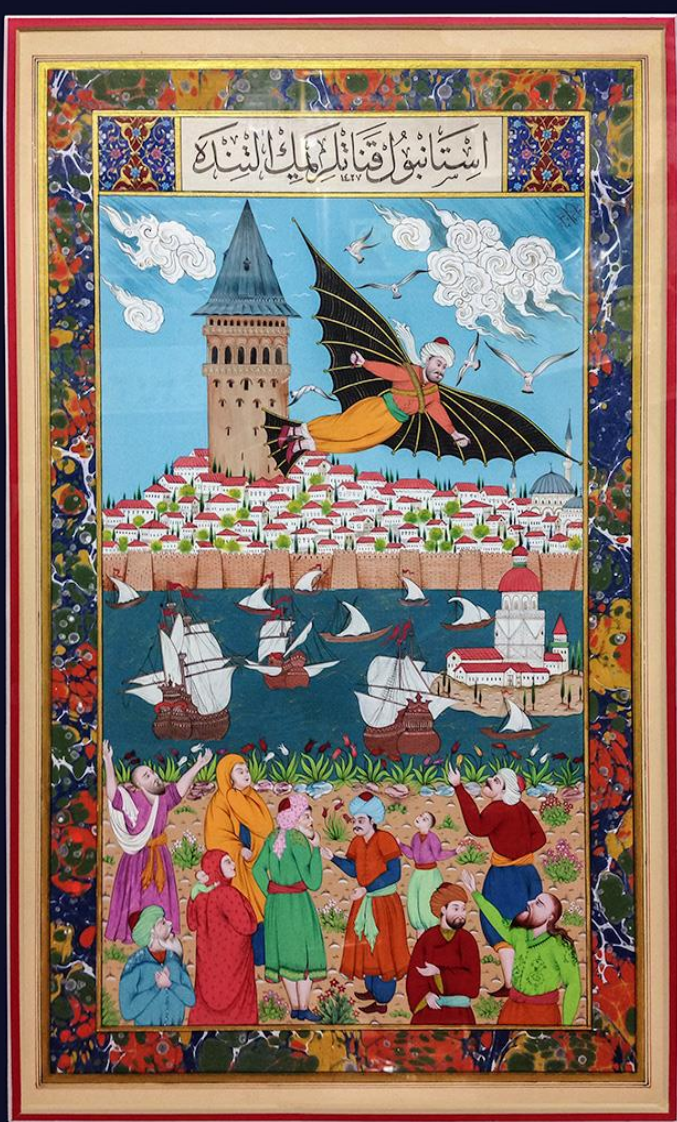
Design  Achievement

Design  Failure

# Feasibility



One of the first vessels ever seriously designed to travel the air of which we possess any really authentic record was that projected in 1670 by Francis Lana, a Jesuit; it consisted of a wicker boat or basket, to be lifted into the air by four spherical balloons, each 25 feet in diameter, made of sheet copper  $\frac{1}{200}$  of an inch thick, each enclosing a vacuum; and to be propelled by a sail and oars. This project never came to anything, because it is obvious that even if it were possible to construct such balloons, they would collapse directly an attempt was made to exhaust the air contained in them.



the first appropriate flight with artificial wings in the history of aviation.  
 in the year 1638  
 He flew like a bird softly until Uskudar  
 3358 metre



# Feasibility

*Solar power airliner??  
Today????*



Pathfinder Plus



## **The Solar Impulse**

has proved its flight in darkness and the cells stored enough energy between its take off at 7 a.m. and nightfall the next night to get through the whole night at a maximum altitude of 28,000 feet.

26 hours, 10 minutes and 19 seconds.

*“The pioneer is not always the one who succeeds, but the one who is not scared to fail.”*

# Cost

## Engineering and economics are inseparable.

A **fixed cost** is constant, independent of the output or activity level.

A **variable cost** does depend on the output or activity level. The raw material cost for a production facility is a variable cost because it varies directly with the level of production.

The **total cost** to provide a product or service over some period of time or production volume is the total fixed cost plus the total variable cost,

# Cost

A **marginal cost** is the variable cost associated with one additional unit of output or activity.

If the total cost of 3 units is 1550, and the total cost of 4 units is 1900. The marginal cost of the 4th unit is 350.

- Investment Cost
- Financial Cost
- Operational Cost
- Total investment Cost



# Cost

## **What Is a Feasibility Study?**

A feasibility study is an analysis that takes all of a project's relevant factors into account—including economic, technical, legal, and scheduling considerations—to ascertain the likelihood of completing the project successfully.

Project managers use feasibility studies to discern the pros and cons of undertaking a project before they invest a lot of time and money into it.

### **The goals of feasibility studies are as follows:**

- To understand thoroughly all aspects of a project, concept, or plan
- To become aware of any potential problems that could occur while implementing the project
- To determine if, after considering all significant factors, the project is viable—that is, worth undertaking

# Engineering

The application of science to the optimum conversion of the resources of nature to the uses of humankind.

The creative application of;

- “scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination or
- to construct or operate the same with full cognizance of their design or
- to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property.

[Britannica]

# IMAGINation EnginEERING

## Imagineering



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Nathan Myhrvold

For a long time we've sought a word to describe what we all work at hard here at Alcoa.

It takes a very special word to describe making aluminum cheap, making it versatile, finding totally new places to use it, and then helping people use it where they should. In war times it takes a very special word indeed to describe, also, the ingenuity and daring that can make, almost overnight, three and four and five times as much aluminum as was ever made before, and make it cheaper than ever.

IMAGINEERING is the word. What aluminum did for civilians, what aluminum is doing for our armed forces,

what aluminum will do in the future, all come out of that one word.

Imagineering is letting your imagination soar, and then engineering it down to earth. At Alcoa we have engineers with almost every kind of diploma, scientists with almost every "key" we know. Yet whatever career they follow with us, their real field is Imagineering. They work at it hard. They get results. The importance of aluminum is their own doing.

We at Alcoa would like nothing better than that our company be known everywhere as the place they do Imagineering.

ONE PAGE FROM THE AUTOBIOGRAPHY OF  
**ALCOA ALUMINUM**

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

## Good Engineers ?

- Good engineers firmly grasp the fundamental principles of engineering, which they can use to solve many different problems.
- Good engineers are analytical, detail oriented, and creative.
- Good engineers have a desire to be lifelong learners. For example, they take continuing education classes, seminars, and workshops to stay abreast of innovations and new technologies. This is particularly important in today's world because the rapid changes in technology will require you as an engineer to keep pace with new technologies.

- Good engineers, regardless of their area of specialization, have a core knowledge that can be applied to many areas.
- Good engineers have communication skills that equip them to work well with their colleagues and to convey their expertise to a wide range of clients.
- Good engineers have time-management skills that enable them to work productively and efficiently.

- Good engineers have good “people skills” that allow them to interact and communicate effectively with various people in their organization.
- Engineers are required to write reports. These reports might be lengthy, detailed technical reports containing graphs, charts, and engineering drawings, or they may take the form of brief memoranda or executive summaries.
- Engineers are good at using computers in many different ways to model and analyze various practical problems.

- Good engineers actively participate in local and national discipline-specific organizations by attending seminars, workshops, and meetings. Many even make presentations at professional meetings.
- Engineers generally work in a team environment where they consult each other to solve complex problems. They divide up the task into smaller, manageable problems among themselves.

## Basic Skills for Engineers?



# Business Skills



## ***Action oriented***

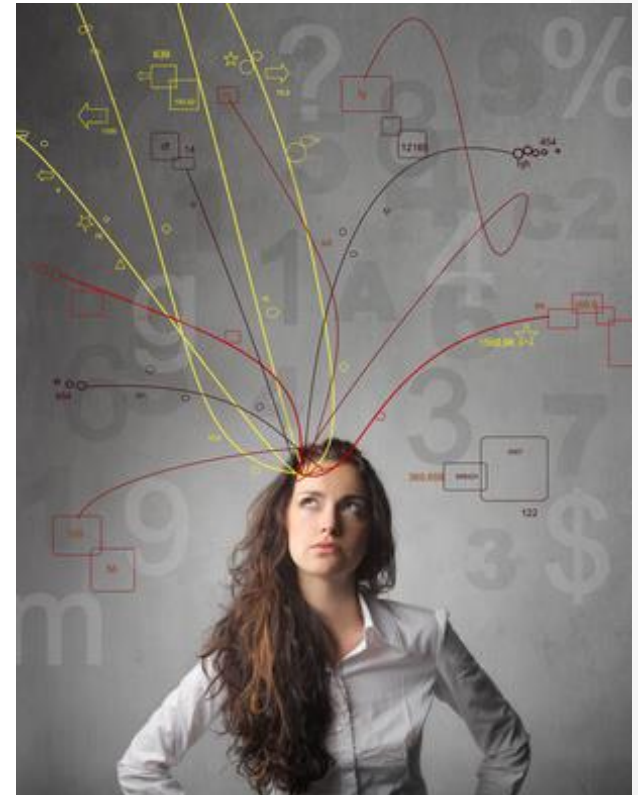
Able to recognize when action is required. Will take control of the situation and implement or propose a course of action. Able to respond quickly and acting fast. Does not wait to be prompted.



# *Analytical*

Able to acquire information and identify missing information.

Able to look logically at a technical situation to solve problems and create new and innovative solutions.



## ***Attention to detail***

Able to produce accurate work, even when under pressure. For critical information checks the accuracy of information before using it or passing on to others.



## ***Commitment to excellence***

Has a passion for succeeding in assigned tasks and to produce work of the highest quality. Will adjust working time to meet the demands of the business. Meets own commitments and ensure the completion of own tasks. Is responsible and can be relied upon.



## ***Communicate effectively***

Able to communicate effectively face to face, on the phone, in writing and via presentations, Knows when to abstract complex technical concepts and describe in terms meaningful and relevant to technical and business managers and to other non-technical people. Also knows how to obtain the maximum understanding from other people. Is able to build a network of contacts that can provide information and assistance. Able to be active listeners to quality needs.



## ***Customer orientation***

Is focused on what is best for the customer, always meets customer needs, consistent with business profitability, drive actions and decisions.







## *Decision making*

The ability to make timely decisions based on the adequate but often incomplete information



## ***Flexibility and self learning***



The knowledge and service based industry today is one of the fastest changing industries of all time. This makes it both an exhilarating and demanding environment to work. Products that everyone was using two years ago are replaced with alternative products. Ways of working that are common today will disappear tomorrow. To survive, and enjoy the experience, you will have a flexibility attitude, be willing to acquire and learn new skills, new knowledge and new ways of working. Sometimes this will be achieved by formal education and sometimes by selfstudy and research.

## *Information handling*



With email, the World Wide Web and company Internets the volume of information available significantly exceeds anyone persons capability to absorb it.

Information handling skills are therefore needed to identify what is important and what is urgent and to be able to categorize information for easy retrieval.



Getting information off the  
Internet is like taking a  
drink from a fire hydrant.

Mitchell Kapor

## *Innovative*

The ability to create images and visions to help explain concepts and put ideas across in exciting and thought provoking ways in order to achieve quantum leaps as well as incremental improvements



# *Leadership*

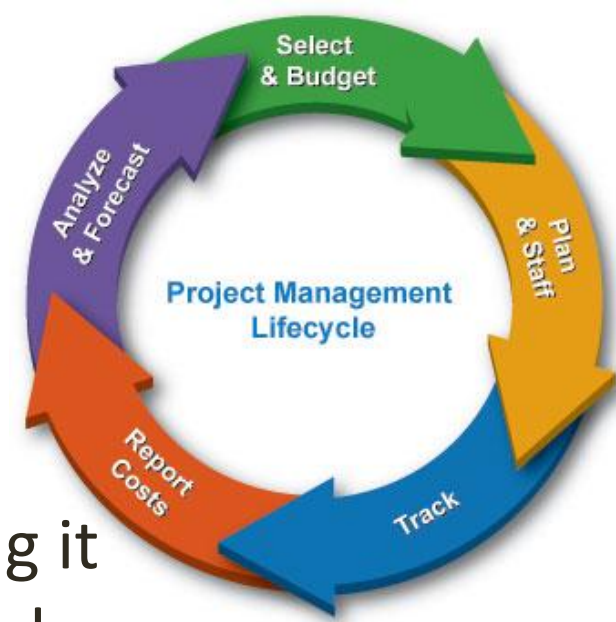
At the personal level capable of making decisions and recognizing and managing conflict situations. Able to command the support of a team and carry out their decisions to completion. Willing to challenge existing processes and proposals. Able to create and sell a vision of the future which others are keen to follow.





## *Manage projects*

When given a task is able to determine and document the best approach and the time required carrying it out. Approaches the task in an organized and professional way and highlights revisions to the plan in timely manner, based on the work already done and new factors. Ensures that the work is carried out in a way that conforms to the rules of the organization. Delivers on time and works equally effectively on multiple tasks when necessary.



## ***Negotiation***

Can communicate with the others to come up with a course of action, which meets the needs, and objectives of all parties.

Not concerned with winning an argument for its own sake but producing a solution, which meets the needs of the situation and the individuals, involved.



## *Persuasiveness*



Able to convince others of the effectiveness of the proposals presented in a friendly and constructive way.

Demonstrates other necessary attributes simultaneously (e.g. teamwork)



## ***Problem solving***

When given a task is able to determine and document the best approach and the time required carrying it out.

Approaches the task in an organized and professional way and highlights revisions to the plan in timely manner, based on the work already done and new factors.

Ensures that the work is carried out in a way that conforms to the rules of the organization. Delivers on time and works equally effectively on multiple tasks when necessary.



## *Professional attitude*

Approaches tasks and colleagues in a responsible and professional manner demonstrating facts which are considered appropriate to the situation and job. Understands what is required in this respect and is able to modify attitudes to meet varying situations. can be relied upon to produce quality results efficiently

that bring credit to themselves their team and their company.

Takes ownership and responsibility for work items and is tenacious in work through or around problems.

Works efficiently and effectively to produce a quality result.





## ***Relationships***

Most of the jobs in the new knowledge and service based industry require an ability to work effectively with our people. You will have good communication skills, be able to listen effectively to others and be confident in seeking advice when appropriate. You will quickly develop networks and share information and ideas.



## *Strategy and planning*

Able to take a broad and long-term view of what needs to be done in a particular situation and translate it into detailed actions.





## ***Teamwork***

Demonstrates a strong desire to see the team achieve its agreed goals. Prepared to support team members and team decisions at expense of own goals.

Recognized the value of having diverse attitude, skills, experiences and views and prepared to ensure they are harnessed when appropriate.



## ***Technical orientation***

Is excited by finding out how things work.

Applies technical understanding to solve business problems.

Willing and excited by performing technical and analytical tasks.

## *Think globally*

Able to understand and operate upon a global company without boundaries, acting still locally. Prepared to support global needs and decisions at expense of own goals.



You will quickly develop a network of contacts and be ready to share information and ideas in order to move fast forward.



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