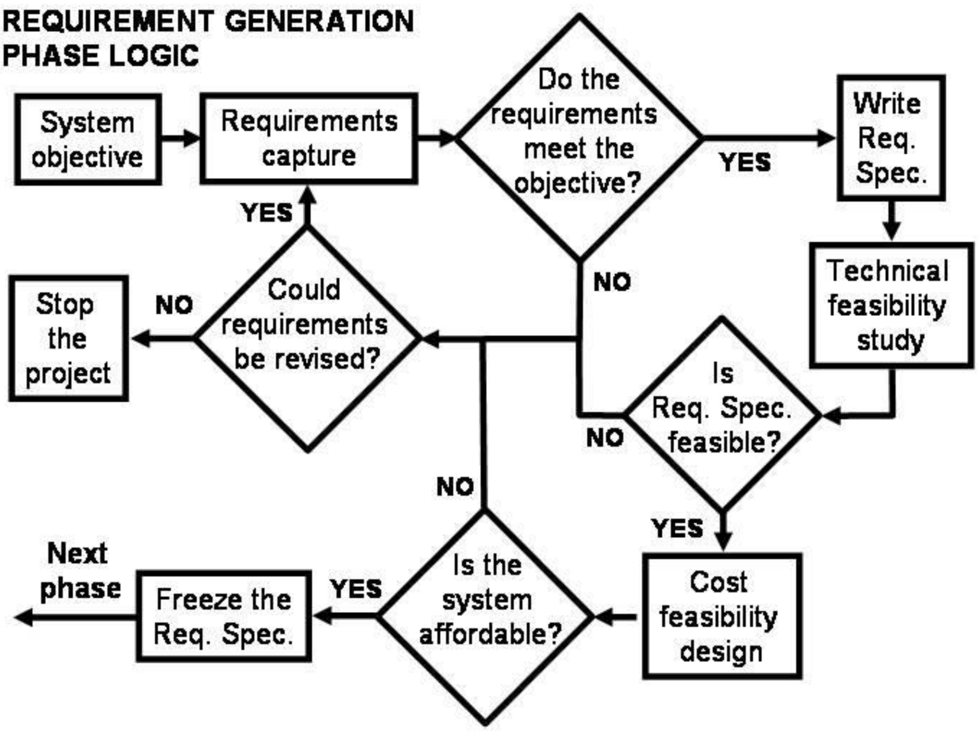
REQUIREMENTS CAPTURE

In the last lecture we looked at what requirements are, and how they are collected into the Requirement Specification.

What we will look at in this lecture is:

- Requirements Capture
- User surveying techniques
- Function Breakdown
- Mission Models
- Fast Prototypes
- Feasibility Designs



STARTING POINT FOR REQUIREMENTS: THE STAKEHOLDERS

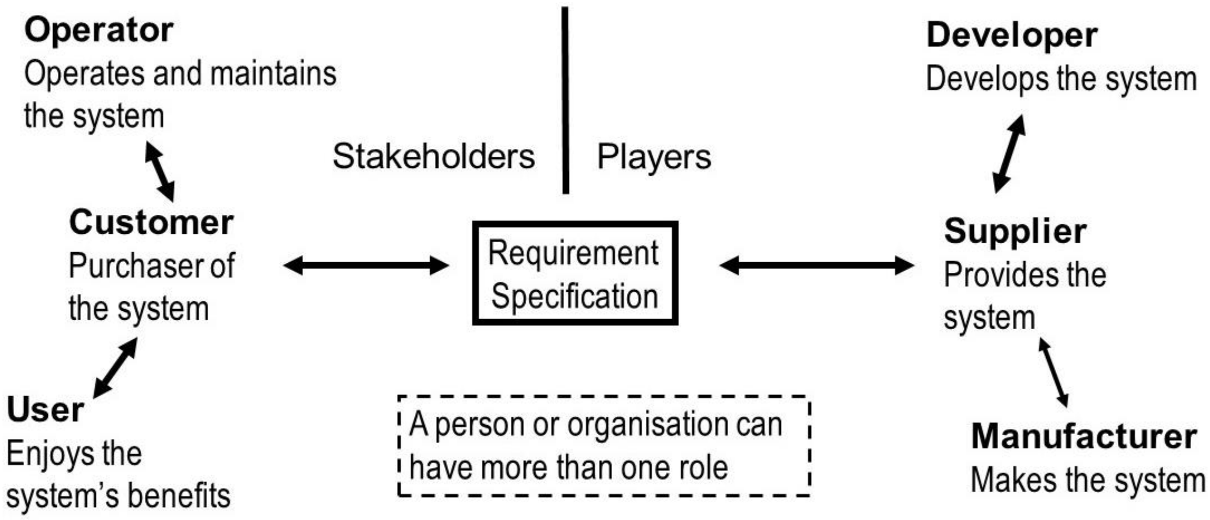
Engineered systems are made by humans, for humans and their success is judged by how well they met the "need" of humans as expressed by the Purpose.

It follows that the humans that interact with the system (the stakeholders) who therefore have an interest in the requirements are the starting point for the requirement capture process.

The processes that are used to consult the stakeholders vary from industry to industry.

PEOPLE INVOLVED IN REQUIREMENT GENERATION

Stakeholder – A person with an interest in the system purpose and therefore can state requirements.



EXAMPLES OF STAKEHOLDERS

ROLE	AIRLINER	CARS	SPACE TELESCOPE
Customer	Airlines	Owner	NASA/ESA
User	Passengers	Driver / passengers	Astronomers
Operator	Pilot / Ground crew	Driver	Hubble centre
Supplier	Prime Contractor	Car dealer	Lockheed
Developer	Prime Contractor	Car manufacturer	Lockheed
Manufacturer	Prime and sub contractor	Car manufacturer and part suppliers	Lockheed and sub-contractors

WHO ARE THE STAKEHOLDERS?

If you follow the definition of stakeholders to its logical conclusion everybody on the planet Earth is a stakeholder in every system. Since it is not very practical to consult everybody, some limits must be placed on which stakeholders are involved in the requirements generation processes.

In fact the requirements from society at large are encode in laws and these form part of the systems constraints. So there is a process for everybody to be involved.

This leaves the question as to which stakeholders need to be involved in the system's more specific requirements.

In most big systems developments there is one or only a few direct customers and they normally have well-structured organisations that mean key stakeholders have a direct input.

However users and operators can be a much larger group (e.g. passengers on civil aircraft) in this case only a sample of stakeholders can be directly involved and then in a way that creates a statistical result.

DIRECT CONTACT METHODS

Contacts with potential system stakeholders (who may be operators of a system that is to be replaced or maybe a new group unfamiliar with the reality of the system).

Structured Methods
Work thorough issues raised by the surveyor

Examples:
- Questionnaires
- Structured Interviews
- Focus groups

Unstructured Methods
More of a two way dialog with the surveyed able to introduce issues.

Examples:
- Unstructured Interviews
- Workshops

STRUCTURED METHODS

The surveying method follows a pre-planned set of questions.

Normally the surveyor has pre-determined areas regarding the system's requirements to which he or she tries to find the answers or opinions of the surveyed. By asking the same questions every time the surveyor:

a) Knows all the points are covered

b) Can get answer from different sources that can then be compared

UNSTRUCTURED METHODS

The surveying method follows a loose agenda and the surveyed can alter that agenda.

In this case normally the surveyor has an objective to find out what is required of the systems but has less pre-determined judgements about what are the important issues. In this case the surveyor gets a greater appreciation of the surveyed viewpoint and is more likely to fill "holes" in his or her understanding

Survey methods do not have to be strictly one or the other – structured and unstructured can be mixed.

SURVEYING STAKEHOLDERS

Some obvious practical advice:

1) Keep a record! Minutes, pro-formas even audio or video recording.

2) Word questions carefully. Leading or closed questions will give you the answer you "load" into them – not the truth. Open questions get to the real issues.
   e.g. "What is the biggest problem when doing this task?"
   Not "Is the VDU position a problem when doing this task?"

3) Check your understanding of the answers by reflecting them back – "Have I got it right, do you mean …"

4) Show the context i.e. show the stakeholders their role and the advantages of the system.

OBSERVATION OF EXISTING PRODUCTS

Where a system is intended as a replacement for an existing system then additional sources of stakeholder requirements can be found. The activity of assessing how well an existing product is meeting its objectives is called "validation" and provides useful input into the requirements capture process.

Examples:

- Customer Feedback (guarantee forms, comment forms)

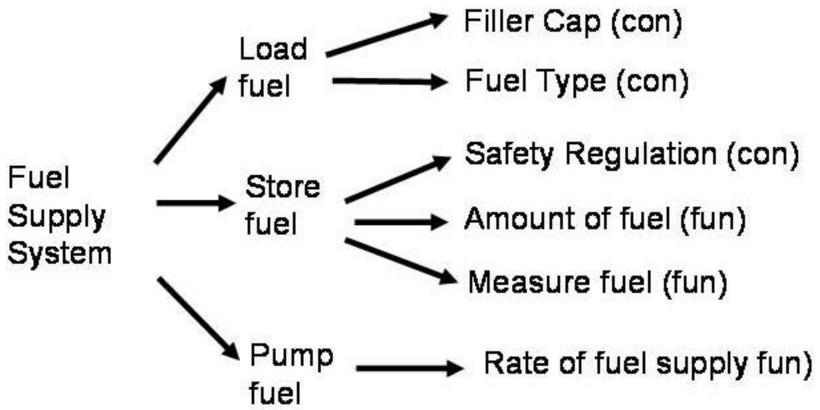
- Observation of Users
  Including - unintended modifications and use
  - formal monitoring systems

- Monitor maintenance activity

- Monitor help desks and problem reports

FUNCTION BREAKDOWN

Function Breakdown is a process of taking high level functions and breaking out the lower level functions. A (very) simple example for a fuel supply system



We are going to cover these in more detail in the diagrams lecture.

MISSION MODELS
(Also called “Operational Scenarios”)

Of the many possible ways of exploring requirements in a "top down" manner one of the most common and successful is through mission models. That is, examine the missions that the system will have to undertake to fulfil the purpose of the system (mission being interpreted broadly).

A mission model is an organised examination of the operational missions (as best they can be defined) that the system is required to do. Missions are often divided into phases - and this should include things like maintenance and servicing. For each phase the study tries to identify the key factors of interest which are:

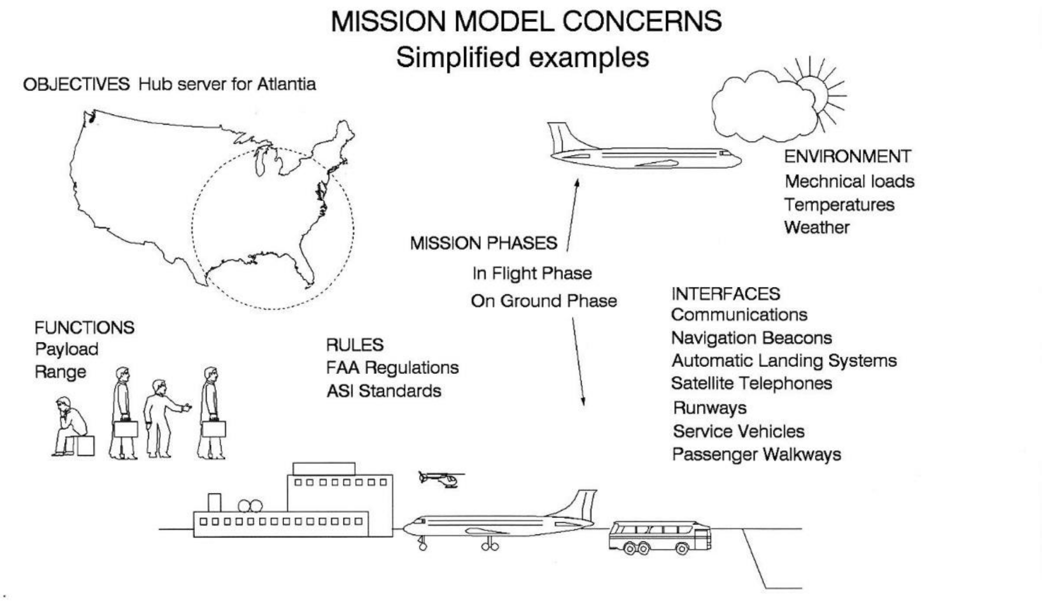
Functions - Things the system will have to do, including performance (with numbers.)

And the **Constraints:**

Interfaces - Things the system will have to interact with - particularly those with a functional role,

Environment - A special type of interface which is not a result of a functional requirement,

Rules - Another special type of interface imposed by human society. laws, engineering standards, codes of practice etc.



FAST PROTOTYPES

A step beyond mission models is to mock up physical replicas or virtual models (maybe from the feasibility designs). Useful way getting “human factors” requirements” This is also very useful for subsystem requirement capture. (A reminder that while generating a system design you are also generating subsystem requirements)

Examples:

- Virtual models introduced into war-gaming
- Concept cars
- Architects CGI videos
- Cockpit mockups

Note: all these have a dual role of requirements capture but also selling the system.

PROFESSIONAL COMPETENCE

Textbooks often given the impression that the formal Requirements Capture techniques will find all the requirements of a system simply by going through the processes mechanistically, without thinking. This is very unlikely in practice the most important factor in getting a comprehensive and workable specification is the expertise of the team doing the work.

A successful Requirements Generation phase depends upon having a thorough knowledge of every aspect of the system and probably has very little to do with the formal processes they use to actually do the work – many successful projects have not even used any of the requirements capture techniques outlined here but still arrived at a good requirement specification.

However the formal techniques do have their place:

They codify and formalise the requirements capture process.
They help stakeholders (especially end user customers) buy into the system.
They help ensure nothing is missed.
They help expand expert knowledge.
They can help identify and deal with changing circumstances.

FEASIBILITY STUDIES

An important part of the requirement definition phase is to ensure that what is being asked is technically feasible and affordable. To do this the most effective technique is to engineer a feasibility design and then cost it.

The objective is to be sure there is a technical approach that will meet the requirements (i.e. what is being asked is possible) and that it can be afforded, and that it is worth doing.

It is NOT to find the best or cheapest solution - that comes later in the system definition. The customer may be pleasantly surprised by the end result of system definition phase - the feasibility study is there to ensure he never gets a nasty surprise.

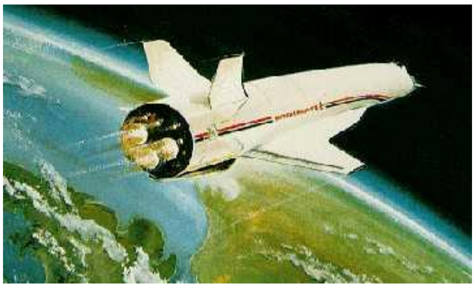
Some tips for a good feasibility design:

- Go for conservative engineering approaches (unless forced otherwise)
  never go for sexy exciting new technology

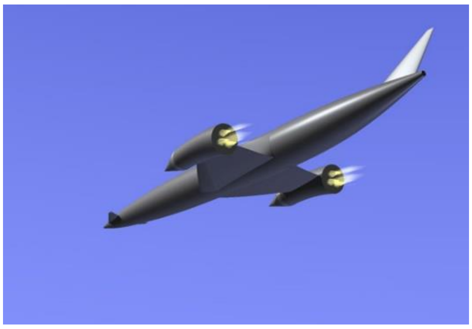
- Stick to meeting the specification
  never add nice to have bits that are not in the requirement specification

- Work downwards on a single design to maximise understanding.
  only do option studies if forced and never do optimisation analysis.

An example of a feasibility design 2 configurations of BAe HOTOL



Two configurations of HOTOL created during the study – both have engines in the back. Although the team soon learnt this was not the best arrangement, it was not thought worth the effort to change the design when the effort could be spent exploring the design issues in more depth



When Reaction Engines Limited revised the design from scratch to create Skylon they moved the engines to the wing tips to solve the problems of a rear engined aircraft

WHAT TO DO WITH FEASIBILITY DESIGNS

The problem with feasibility designs is that they are not optimised, they do not reflect the best available technology, and they are the view of a limited small team. It should always be possible to significantly improve on the feasibility design produced in the Requirement Generation phase. If it isn't - then too much of the wrong sort of work was being done in that phase!

When the Requirement Generation are conducted by the producer there is normally a healthy contempt for the early study work (they know its limitations) and the design team go on to produce their best effort in the system definition phase (helped by the lessons they learnt with the feasibility design).

The problems arise when the customer has done the Requirement Generation work. Normal practice is for the feasibility designs to be made public before bids from contractors are produced for the next (system definition) phase.

The problem with this is that contractors will make their system’s design look like the feasibility design to try and ensure compliance with the requirements because he believes that is what the customer thinks he wants. The contractor tends not to be exploring the best overall solution, which may not look anything like the feasibility design. So my advice is never publish your feasibility designs if you are a customer - it is against your interest.

COSTING

Having established that it is possible to meet the requirements technically the final step is to establish the financial feasibility is it affordable (government) – or can it be sold at a profit (commercial). This is probably the most critical test and the one most difficult to get right.

This has to be done after the technical feasibility work because the feasibility design is the basis for the costing.

There are two ways to cost the feasibility design:

- Bottom up estimating
- Parametric costing (future lecture)