Machine Elements and Manufacturing Engineering joint project, Y2, spring 2002

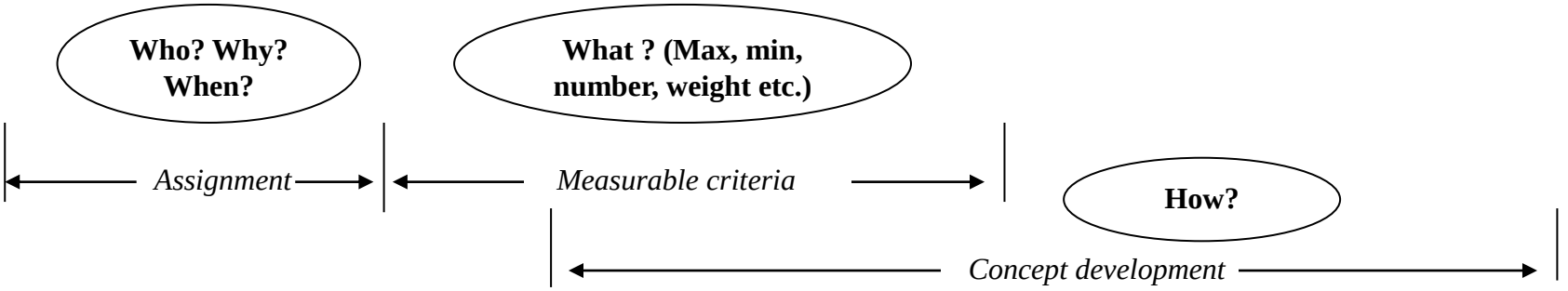
Introducing a Design-build experience

Overall project aims

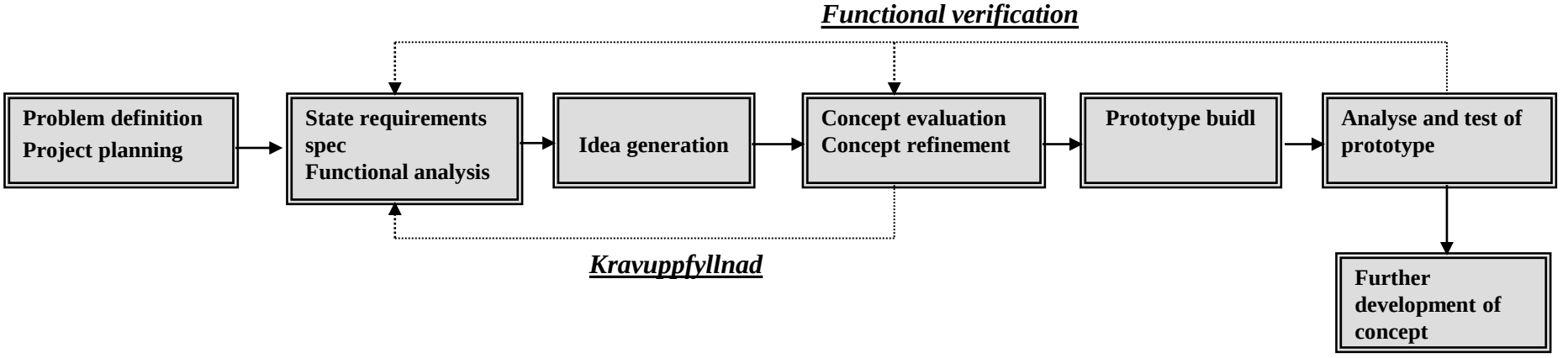
- Practice collaboration and project management (Concurrent engineering)
- Apply theory from courses in Machine Elements and Manufacturing Engineering
- Gain insight and understanding on how to use design and analysis methods throughout the product realization process
- Practice oral and written communication skills
- Utilize projects from industry

The Design Process

The purpose



The process

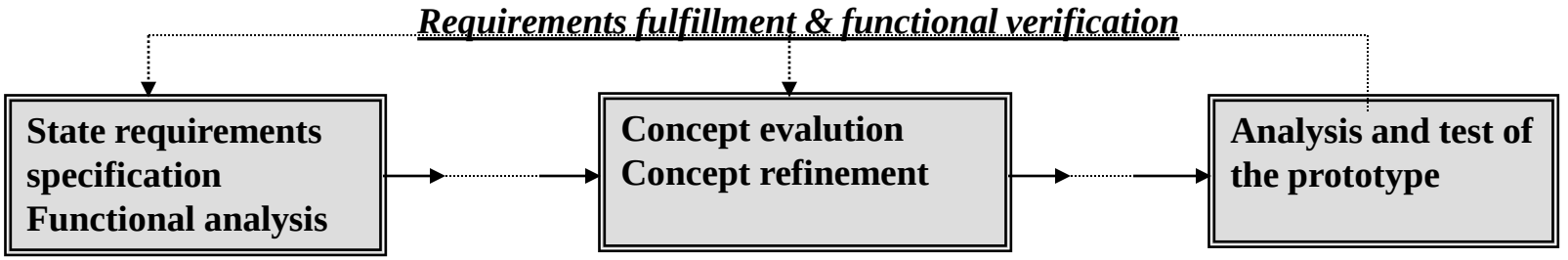


Scope

	Activity	Method/Tool	Purpose/aim	Tutoring
1	**Problem definition**	Handouts	Define project purpose and aims	
2	**Project planning**	Gantt chart	Identify project steps, time and resource planning	
3	**Requirement specification**	Freddy Olssons matrix Checklist - Pugh's Design Core Information search	Measurable criteria	**1**
4	**Functional analysis**	Blackbox	Identify main function and subfunctions	
5	**Idea generation**	Brainstorming	Find/create solutions for subfunctions	
6	**Idea selection**	Handouts	Reject solutions that cannot be realized or that are not safe	
7	**Idea systematization**	Classification scheme	Create additional solutions	**2**
8	**Combination of partial solutions**	Morfological matrix	Document sub-solutions and combine these into system solution	
9	**Further development of selected concepts**	Handouts	Develop the concepts to a similar degree of detail	
10	**Evaluation 1**	Pugh's relative decision matrix	Identify strengths and weaknesses wrt the criteria	
11	**Concept refinement**	Handouts	Improve concepts wrt minus (-) scores	
12	**Evaluation 2**	Pugh's relative decision matrix (choose new reference)	Select 3-4 concepts for futher development	
13	**Prototype manufacturing**	Select one concept for prototype manufacturing	ProE CAD modelling Manufacture one prototype variant	**4**
14	**Analysis of prototype**	Handouts	Analyse function and requirements fulfillment	
15	**Sel of manufacturing process, cost estimation**	SWIFT	Redesign concepts for manufacturing	**6**
16	**Evaluation 3**	Concept scoring + Kesselring	Selection of final concept	
17	**Further development of the selected concept**	Handouts	Detaila dimensions, tolerances, materials selection etc.	**7**
18	**Documentation and presentation**	Handouts, course memo	Dokumentation of working process and final design	**8**

Prototype build - purpose

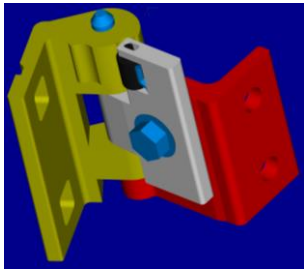
- Physical/geometric verification of the concept solution
- Verify requirements fulfillment
- Functional analysis
- DFM – DFA
- Form – Aestethics - Feel
- Identify weaknesses/improvements



Prototype

Select concept for prototype manufacturing

Koncept / Kriterie	1	2	3	4	5	6	7	8	9
A	+	0	+	**R**	+	-	+	-	+
B	0	-	0	**E**	-	-	0	+	-
C	+	+	0	**F**	0	+	0	+	-
D	-	-	-	**E**	0	-	0	-	-
E	+	+	-	**R**	+	-	+	-	+
F	+	0	+	**E**	+	0	0	0	0
∑ +	4	2	2	**N**	3	1	2	2	2
∑ -	1	2	2	**S**	1	4	0	3	3
∑ 0	1	2	2	6	2	1	4	1	1
Tot. ∑	3	0	0	0	2	-3	2	-1	-1
Placering	1	3	3	3	2	5	2	4	4



CAD modeling (ProE)

Manufacturing

SLA, SLS (CARAN)

Analysis

Function and requirements fulfillment

Project assignment

- All projects were from industry
  - Added realism and motivation

- Passenger car handle (Volvo Car Corp)
- Fan valve for airfreight container (Envirotainer)
- Adjustable bracket for radio link antenna (Viking Microwave)

Adjustable bracket for radio link antenna

Results from prototype manufacturing

- Total 71 pcs

- SLA & SLS

”Full” prototypes were built by adding standard parts

Project work, spring 2002

Reflections

- Positive reactions from the students
  - ”it’s was fun with physical feedback”
  - ”realistic and meaningful - motivating”
  - ”oops … it didn’t work ….”
  - ”the physical prototype made it easier to find weaknesses and come up with improvements”
  - ”deeper understanding of the function”,
- Teacher:
  - more motivated students
  - industry relevance, deadlines, milestones, deliverables
  - more work
  - reasonable cost (5 700 USD for 71 “prototypes”)

Future

- Plan to run the project with similar scope next year
- Improved student design-build facilities through the prototyping lab
- Continued collaboration with CARAN
- Carefully selected project assignments