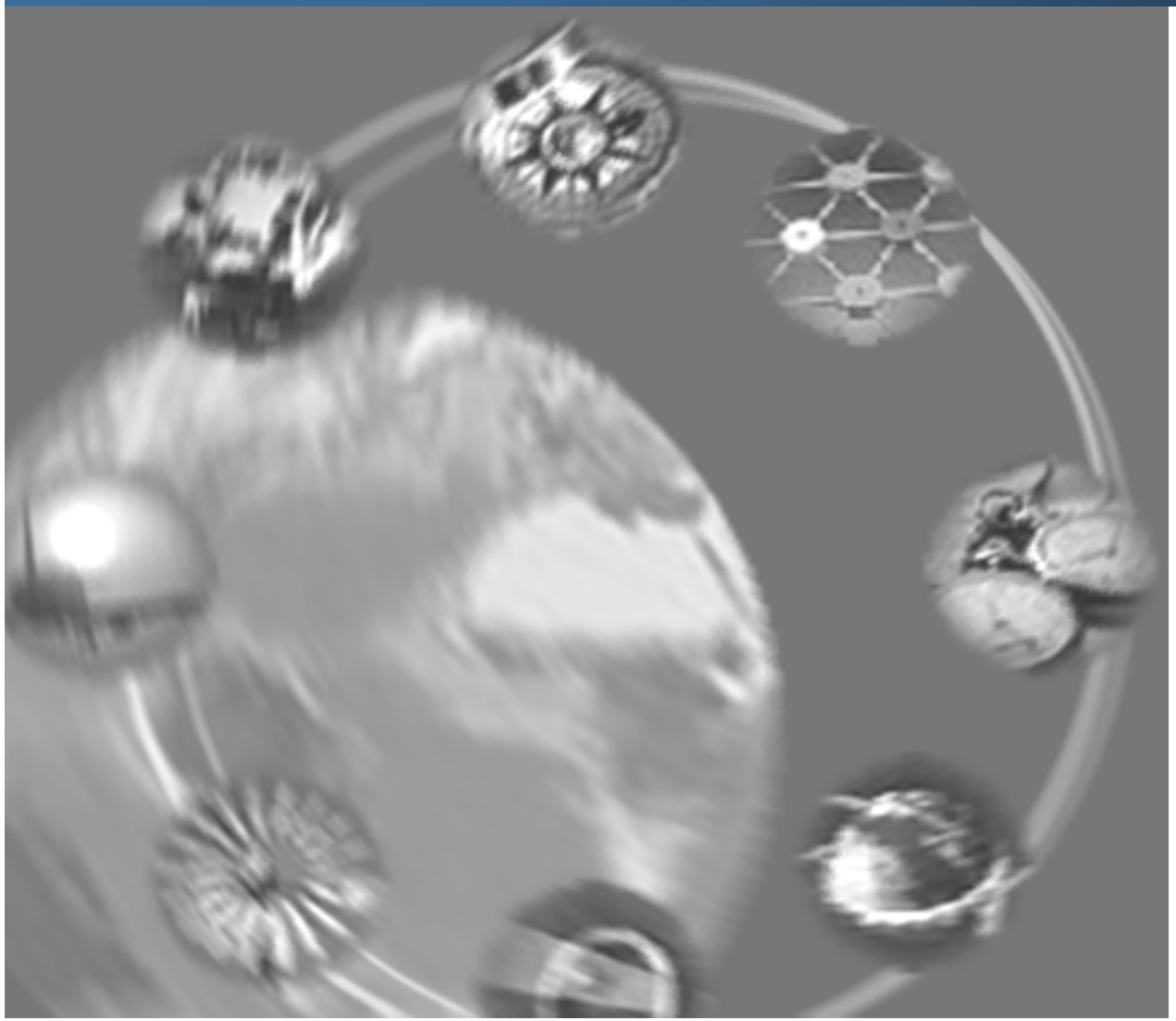
Concept Selection &Test

4013.315 Architectural Engineering System Design

May 13th , 2009



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Concept Selection

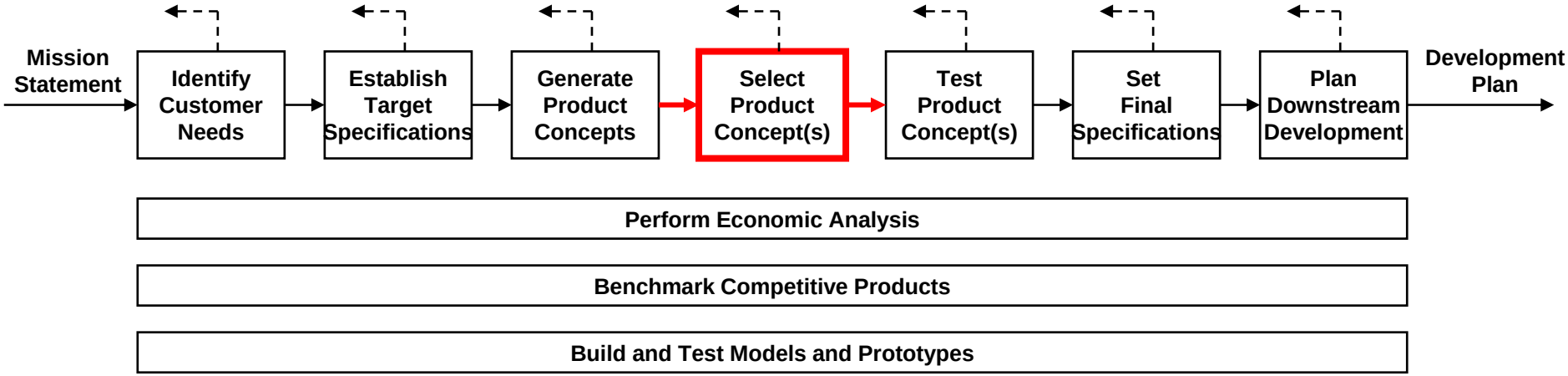
Teaching materials to accompany:

Product Design and Development
Chapter 7

Karl T. Ulrich and Steven D. Eppinger
2nd Edition, Irwin McGraw-Hill, 2000.

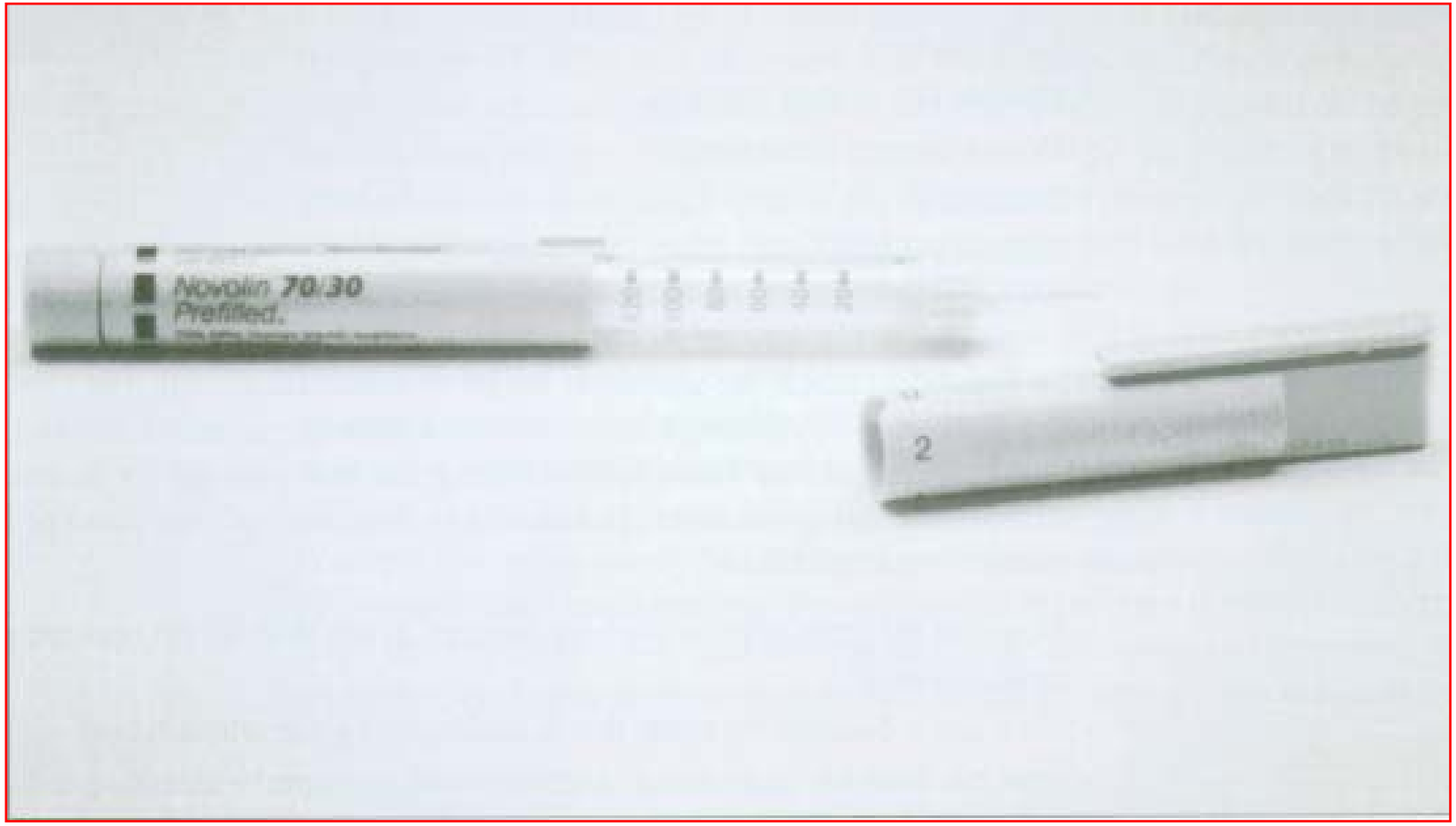
- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York, 2000.

Concept Development Process



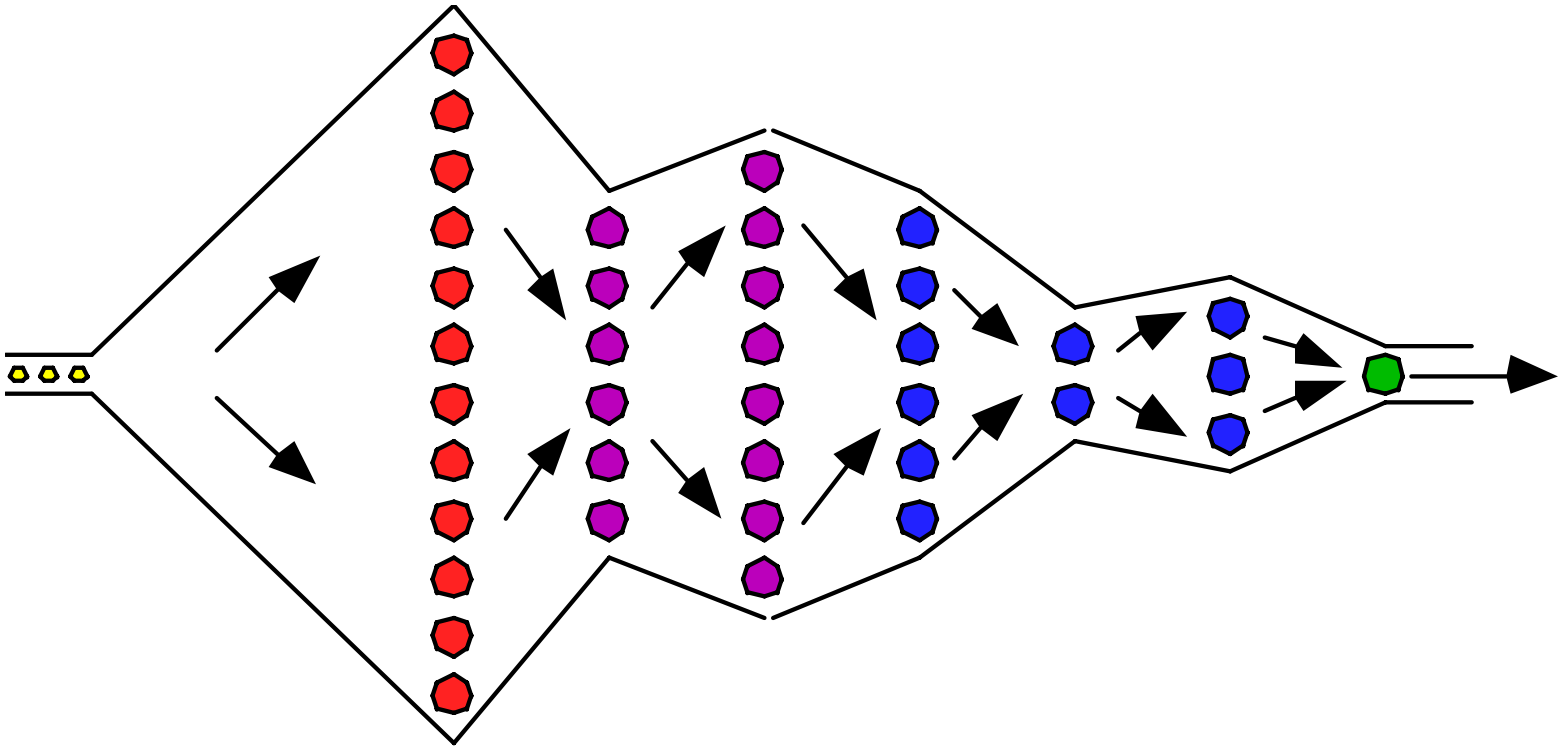
- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York, 2000.

Concept Selection Example: Reusable Syringe



- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York, 2000.

Concept Development Funnel



- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York, 2000.

Concept Selection Process

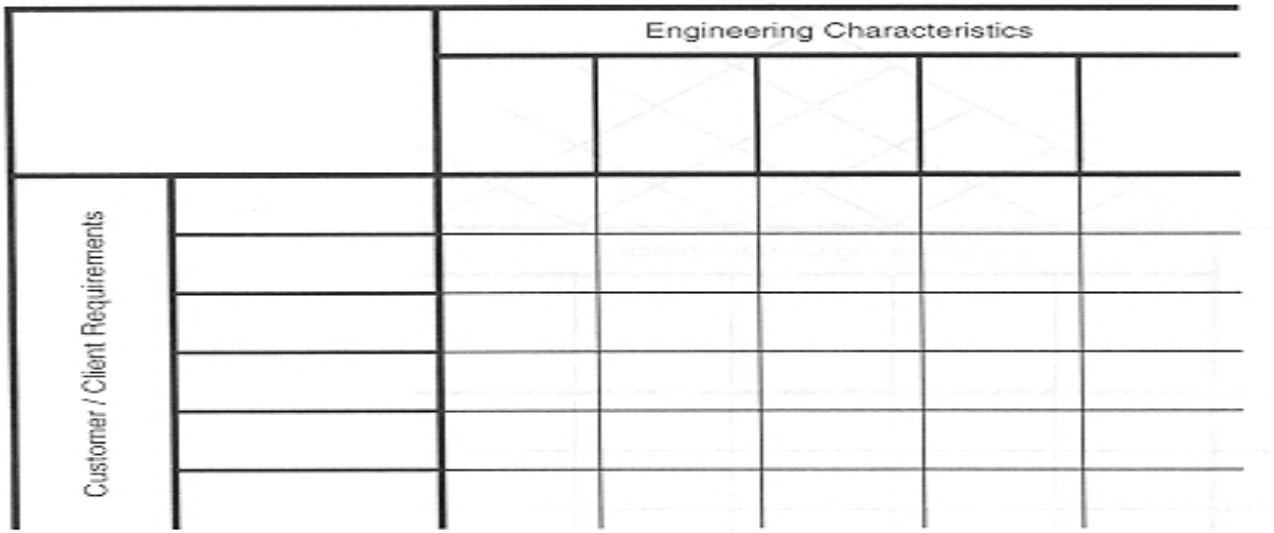
- Prepare the Matrix
  - Criteria
  - Reference Concept
  - Weightings
- Rate Concepts
  - Scale (+ – 0) or (1–5)
  - Compare to Reference Concept or Values
- Rank Concepts
  - Sum Weighted Scores
- Combine and Improve
  - Remove Bad Features
  - Combine Good Qualities
- Select Best Concept
  - May Be More than One
  - Beware of Average Concepts
- Reflect on the Process
  - Continuous Improvement

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

Pugh Chart

Method for concept selection

- **What design concepts would have useful functions**
- **Helps list advantages and disadvantages of certain designs**

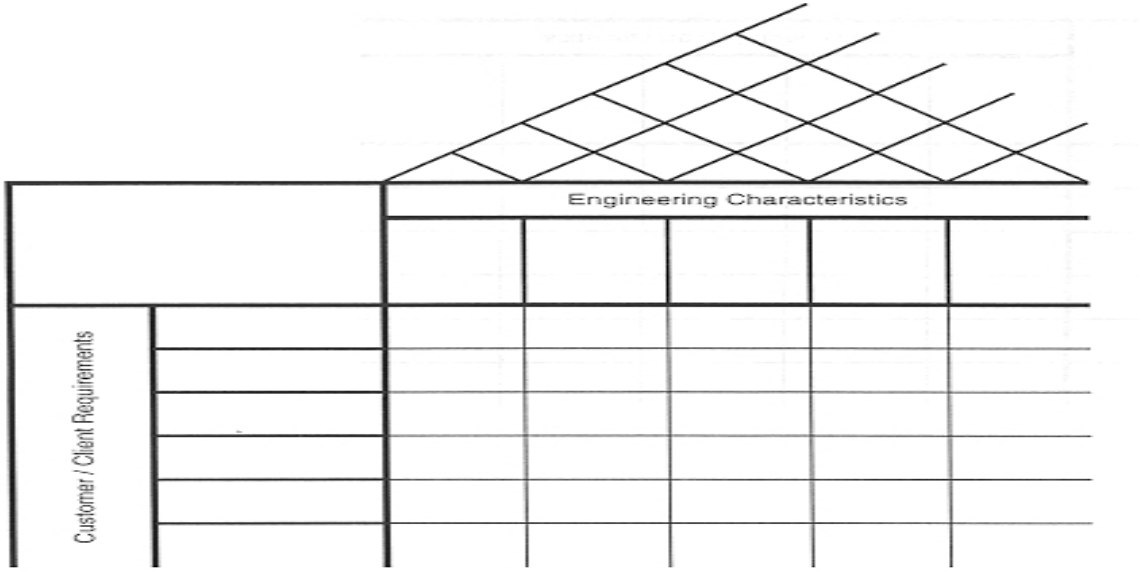


- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York, 2000.

House of Quality

A design tool that enables engineers and management to relate the attributes to the engineering characteristics.

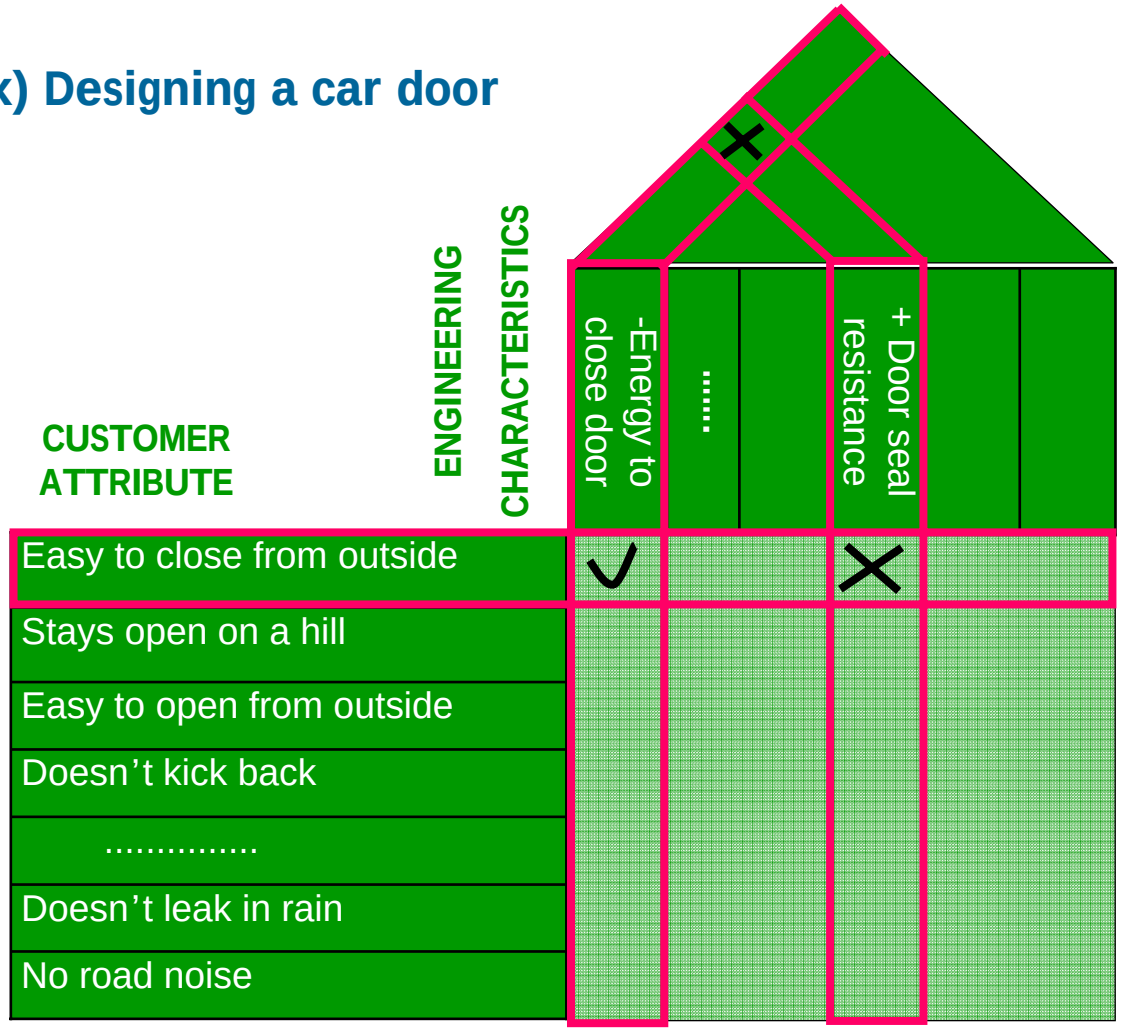
- Attributes - a customer might associate with a quality product
- Engineering characteristics - responsible for such attributes



- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

House of Quality

Ex) Designing a car door



√: Strong positive

×:Strong negative

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

-Harvard business review-

Screening Matrix - Concept selection process

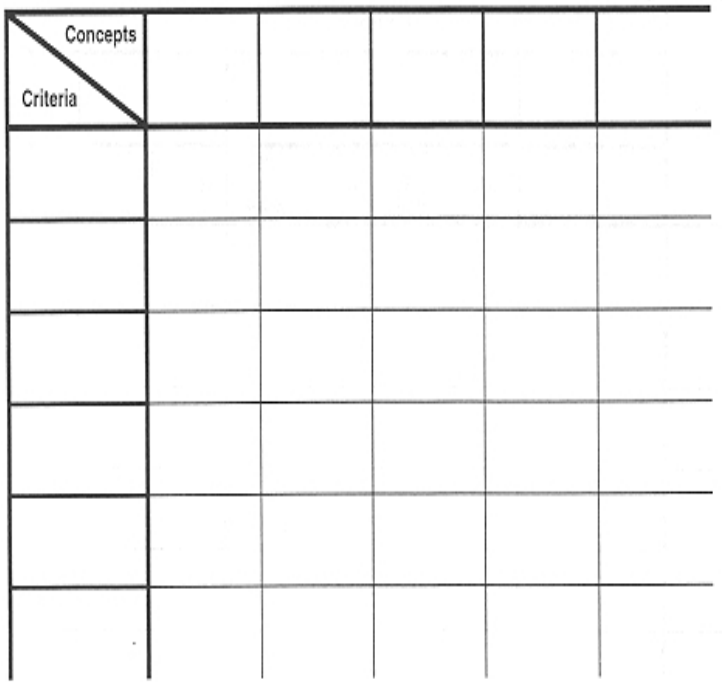
Preparing the selection matrix

- List the **project concepts** as **rows** of the matrix
- List the **selection criteria** as **columns** of the matrix (Pick criteria based on customer needs, or enterprise needs)

Rating the concepts

- Place a relative score of (+), (0), or (-) in each box by making a comparison with the reference concept

Sums up the pluses and minuses for each concept, and then rank orders the concepts



http://www.foundationcoalition.org/resources/first-year/asu/course-materials/concept-selection.html

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Screening Matrix - Example

Where to go for a lunch (I'm in 35 dong)

Concepts

Criteria	3rd Cafeteria (공대 식당 3층)	3rd Cafeteria (공대 식당 4층)	Snack Bar (공대)	Restaurant Jahayoen	Dong-won hall
Distant	1	1	1	0	-1
Cost	0	-1	1	0	0
Taste	0	1	0	0	1
Quality	1	1	-1	1	1
Wating time	-1	-1	1	-1	-1
Buffet side dishes	1	1	0	0	0
Menu	0	1	0	0	1
Interior	1	1	0	1	1
Total	3	4	2	1	2

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Example: Concept Screening

	CONCEPT VARIANTS							
SELECTION CRITERIA	A	B	C	D	E	F	G	REF.
Ease of Handling	0	0	–	0	0	–	–	0
Ease of Use	0	–	–	0	0	+	0	0
Number Readability	0	0	+	0	+	0	+	0
Dose Metering	+	+	+	+	+	0	+	0
Load Handling	0	0	0	0	0	+	0	0
Manufacturing Ease	+	–	–	0	0	–	0	0
Portability	+	+	–	–	0	–	–	0
PLUSES	3	2	2	1	2	2	2	
SAMES	4	3	1	5	5	2	3	
MINUSES	0	2	4	1	0	3	2	
NET	3	0	?	0	2	?	0	
RANK	1	3	7	5	2	6	4	
CONTINUE?	Yes	Yes	No	No	Yes	No	Yes	

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York, 2000.

Scoring Matrix - Example

Where to go for a lunch ?

	Rating	3rd Cafeteria (공대 식당 3층)	3rd Cafeteria (공대 식당 4층)	Snack Bar (공대)	Restaurant Jahayoen	Dong-won hall
Distant	1	1*1=1	1*1=1	1*1=1	0*1=0	-1*1=-1
Cost	5	0*5=0	-1*5=-5	1*5=5	0*5=0	0*5=0
Taste	2	0*2=0	1*2=2	0*2=0	0*2=0	1*2=2
Quality	1	1*1=1	1*1=1	-1*1=-1	1*1=1	1*1=1
Waiting time	1	-1*1=-1	-1*1=-1	1*1=1	-1*1=-1	-1*1=-1
Buffet	2	1*2=2	1*2=2	0*2=0	0*2=0	0*2=0
side dishes	1					
Menu	1	0*1=0	1*1=1	0*1=0	0*1=0	1*1=1
Interior		1*1=1	1*1=1	0*1=0	1*1=1	1*1=1
Total		4	4	6	1	1

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Scoring Matrix - Concept Scoring process

More detailed than the screening matrix

- List the remaining project concepts as columns of the matrix
- Split the concept columns into two - one for rating and another for weighted scoring
- List the selection criteria as rows of the matrix - **add weights to the criteria**

Criteria	Weight	Concepts								
		Rating	Rating x Weight	Rating	Rating x Weight	Rating	Rating x Weight	Rating	Rating x Weight	

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

http://www.foundationcoalition.org/resources/first-year/asu/course-materials/concept-selection.html

Rating the concepts

- Place a numerical score of 1, 2, 3, 4, or 5 in each box by making a comparison with the reference concept
- Multiplies the criteria weight by the relative performance rating for each component, and then ranks the concepts by total score.

Selects one or two concepts

Criteria	Weight	Concepts								
		Rating	Rating x Weight	Rating	Rating x Weight	Rating	Rating x Weight	Rating	Rating x Weight	
Total Score										

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

http://www.foundationcoalition.org/resources/first-year/asu/course-materials/concept-selection.html

Example: Concept Scoring

		Concepts							
		A (reference) Master Cylinder		**DF Lever Stop**		**E Swash Ring**		**G+ Dial Screw+**	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Ease of Handling	5%	**3**	0.15	3	0.15	4	0.2	4	0.2
Ease of Use	15%	**3**	0.45	4	0.6	4	0.6	3	0.45
Readability of Settings	10%	2	0.2	**3**	0.3	5	0.5	5	0.5
Dose Metering Accuracy	25%	**3**	0.75	3	0.75	2	0.5	3	0.75
Durability	15%	2	0.3	5	0.75	4	0.6	**3**	0.45
Ease of Manufacture	20%	**3**	0.6	3	0.6	2	0.4	2	0.4
Portability	10%	**3**	0.3	3	0.3	3	0.3	3	0.3
	Total Score	2.75		3.45		3.10		3.05	
	Rank	4		1		2		3	
	Continue?	No		Develop		No		No	

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Remember…

The goal of concept selection is not to

- Select the best concept.

The goal of concept selection is to

- Develop the best concept.

So remember to combine and refine the concepts to develop better ones!

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York, 2000.

Caveats

- Beware of the best "average" product.
- Perform concept selection for each different customer group and compare results.
- Check sensitivity of selection to the importance weightings and ratings.
- The selection process is at least as important in building consensus and fostering discussion as in selecting a good concept.
- Concept selection is iterative and convergent.

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

Concept Selection Exercise

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

1. Mission statement

2. Customer needs

3. Criteria for evaluating the products

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

4. Reference concept

5. Weightings

6. Group evaluation with respect to each criterion

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

Concept Testing

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

Concept Testing is Used for Several Purposes

- Go/no-go decisions
- What market to be in?
- Selecting among alternative concepts
- Confirming concept selection decision
- Benchmarking
- Soliciting improvement ideas
- Forecasting demand
- Ready to launch?

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

Concept Testing Process

- Define the purpose of the test
- Choose a survey population
- Choose a survey format
- Communicate the concept
- Measure customer response
- Interpret the results
- Reflect on the results and the process

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

Concept Testing Example: emPower Electric Scooter

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Scooter Example

- Purpose of concept test:
  - What market to be in?
- Sample population:
  - College students who live 1-3 miles from campus
  - Factory transportation
- Survey format:
  - Face-to-face interviews

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

Communicating the Concept

- Verbal description
- Sketch
- Photograph or rendering
- Storyboard
- Video
- Simulation
- Interactive multimedia
- Physical appearance model
- Working prototype

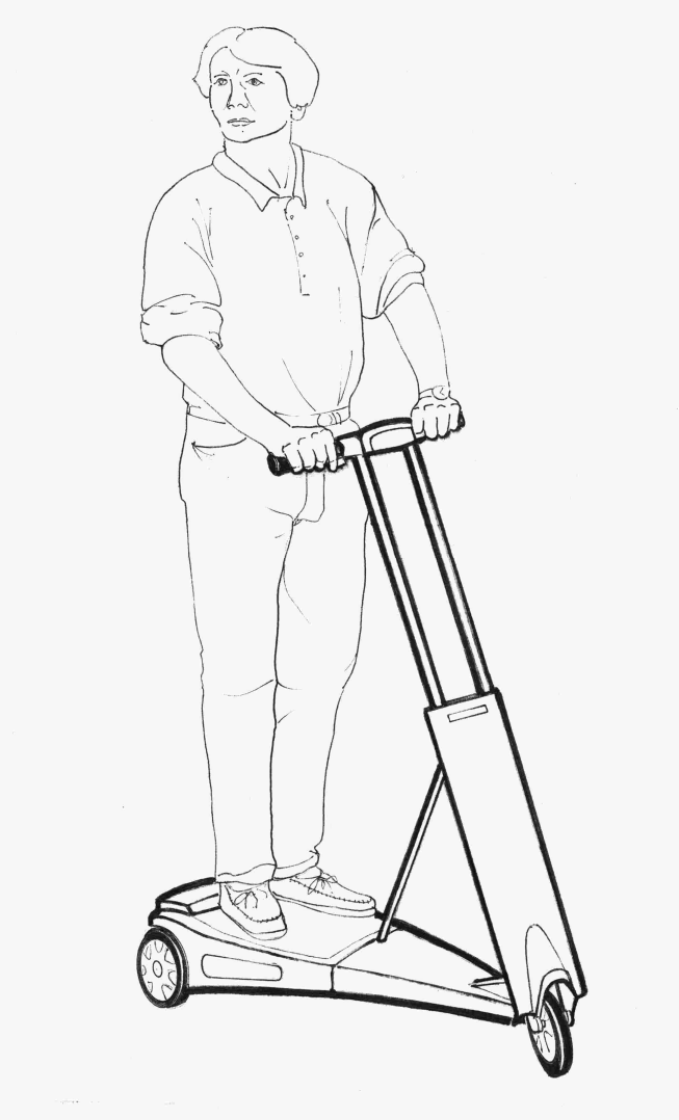
- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

Verbal Description

- The product is a lightweight electric scooter that can be easily folded and taken with you inside a building or on public transportation.
- The scooter weighs about 25 pounds. It travels at speeds of up to 15 miles per hour and can go about 12 miles on a single charge.
- The scooter can be recharged in about two hours from a standard electric outlet.
- The scooter is easy to ride and has simple controls — just an accelerator button and a brake.

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York, 2000.

Sketch



- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York, 2000.

Rendering

- Karl T. Ulrich and S
  Second Edition, Mc
  2000.

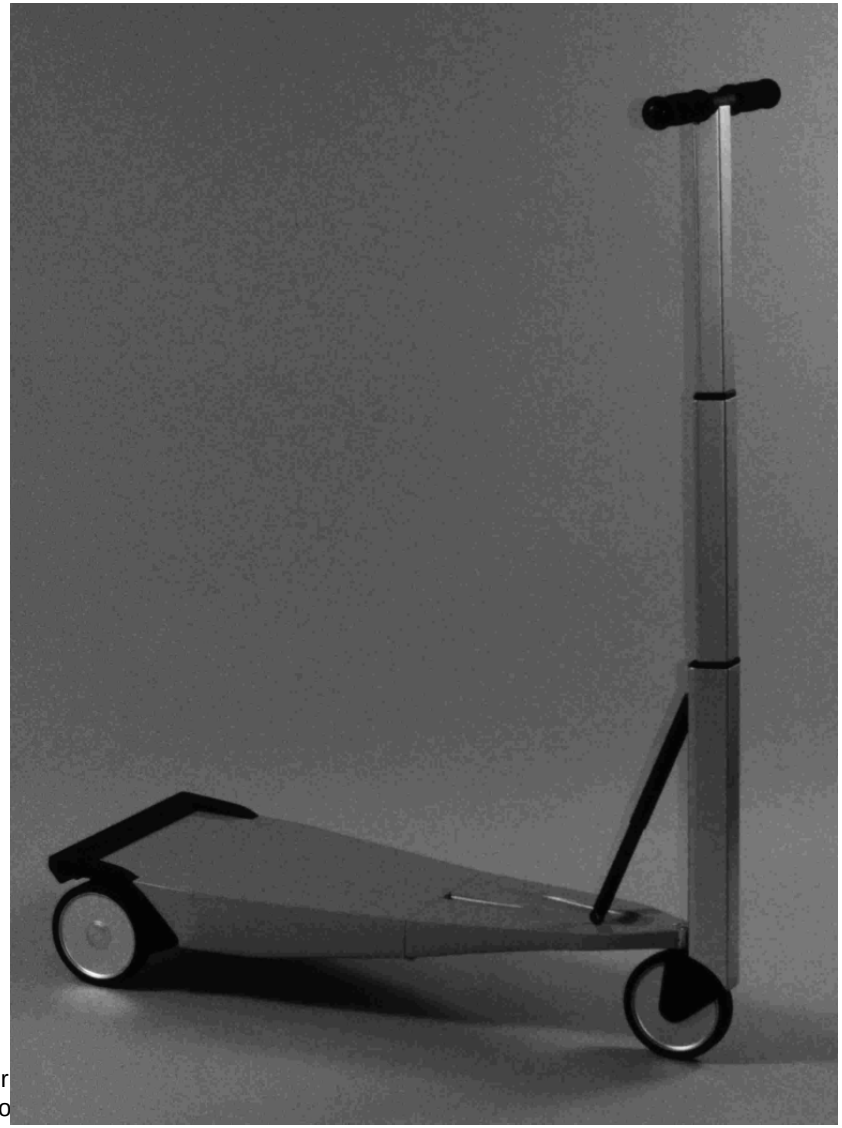
Storyboard

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

3D Solid CAD Model

- Karl T. Ulrich and Steven D. Eppinge
  Second Edition, McGraw-Hill, New Y
  2000.

Appearance Model



- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New Yo
  2000.

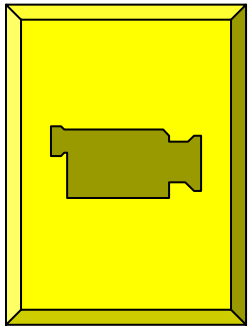
Working Prototype

- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New Yo
  2000.

Beta Prototype

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Video
Animation
Interactive Multimedia
Live Demonstration



- Karl T. Ulrich and Steven D. Eppinger
  Second Edition, McGraw-Hill, New York,
  2000.

Survey Format

- **PART 1, Qualification**
  - How far do you live from campus?
    - <If not 1-3 miles, thank the customer and end interview.>
  - How do you currently get to campus from home?
  - How do you currently get around campus?
- **PART 2, Product Description**
  - <Present the concept description.>

- **PART 3, Purchase Intent**
  - If the product were priced according to your expectations, how likely would you be to purchase the scooter within the next year?

I would **definitely not purchase** the scooter.

I would **probably not purchase** the scooter.

I **might or might not purchase** the scooter.

I would **probably purchase** the scooter.

I would **definitely purchase** the scooter.

"second box"

"top box"

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Survey Format

- **PART 4, Comments**
  - What would you expect the price of the scooter to be?
  - What concerns do you have about the product concept?
  - Can you make any suggestions for improving the product concept?
- **Thank you.**

- Karl T. Ulrich and Steven D. Eppinger
Second Edition, McGraw-Hill, New York, 2000.

Interpreting the Results: Forecasting Sales

$$Q = N \times A \times P$$

- Q = sales (annual)
- N = number of (annual) purchases
- A = awareness x availability (fractions)
- P = probability of purchase (surveyed)

$$= C_{def} \times F_{def} + C_{prob} \times F_{prob}$$

"top box" "second box"

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Forecasting Example: College Student Market

- N = off-campus grad students (200,000)
- A = 0.2 (realistic) to 0.8 (every bike shop)
- P = 0.4 x *top-box* + 0.2 x *second-box*
- Q =

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Forecasting Example: Factory Transport Market

- N = current bicycle and scooter sales to factories (150,000)
- A = 0.25 (single distributor's share)
- P = 0.4 x *top-box* + 0.2 x *second-box*
- Q = 150,000 x 0.25 x [0.4 x 0.3 + 0.2 x 0.2]
  = 6000 units/yr

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

emPower's Market Decision: Factory Transportation

Production Product

- Karl T. Ulrich and Steven D. Eppinger Second Edition, McGraw-Hill, New York, 2000.

Architectural

Engineering Systems Design