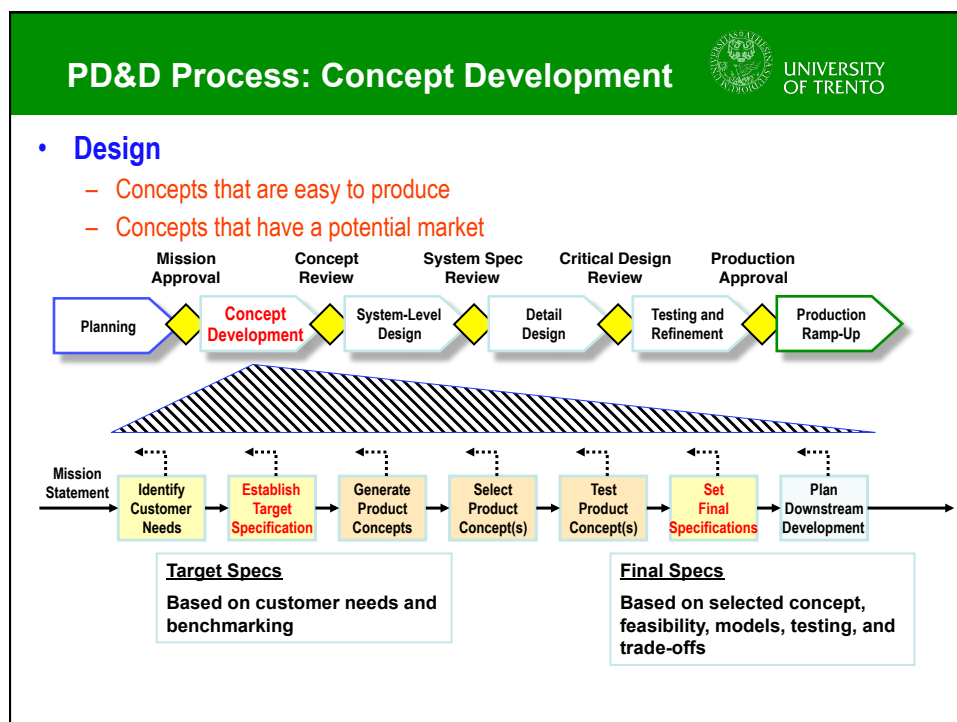UNIVERSITY OF TRENTO

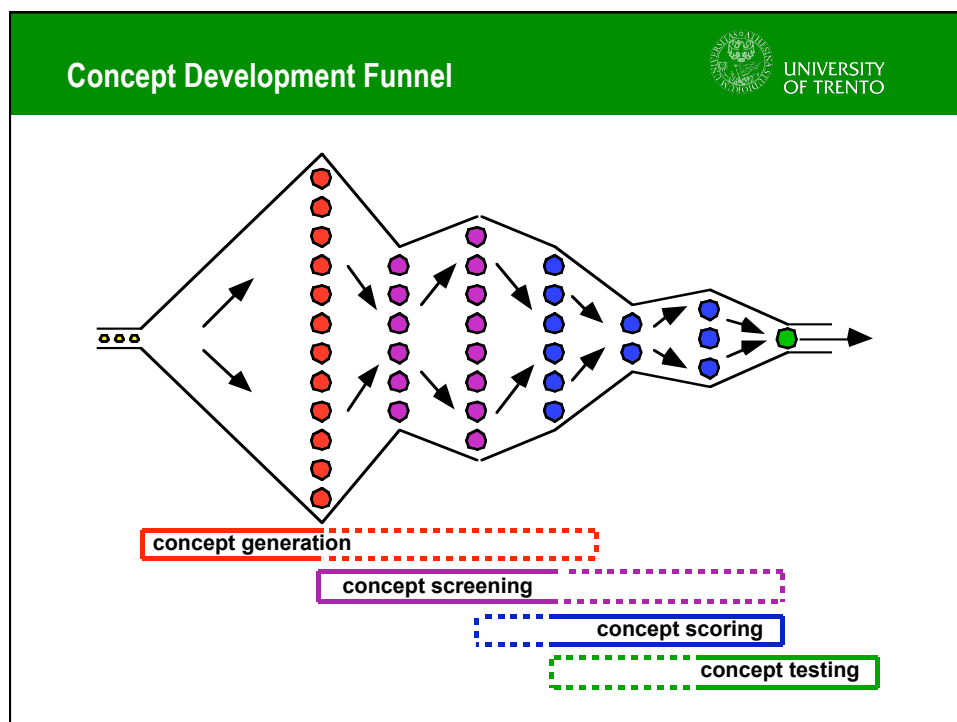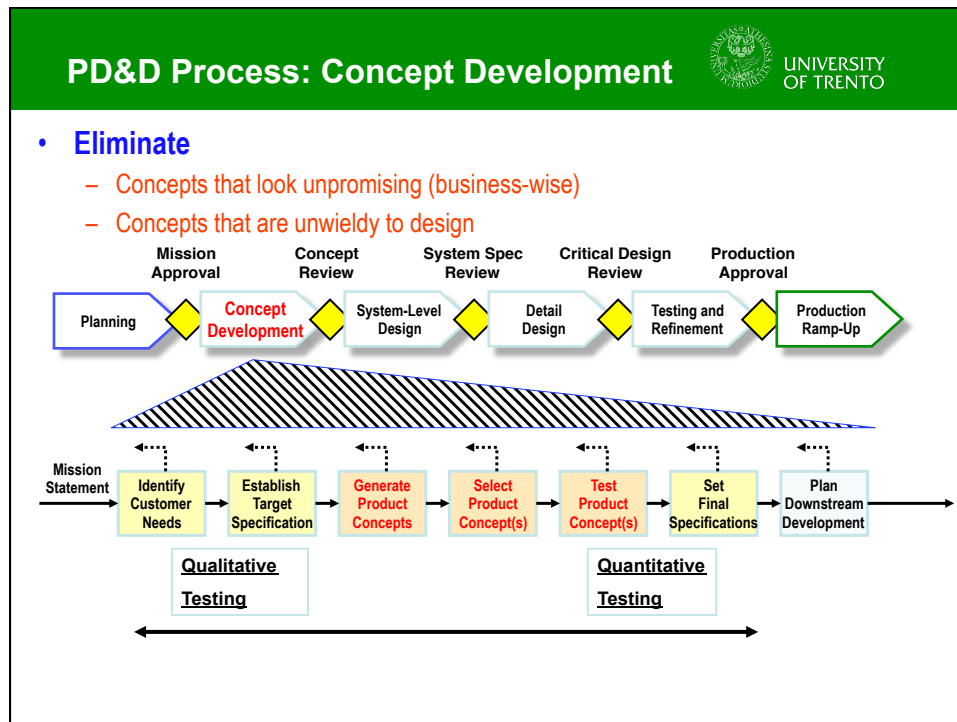# ICT Innovation – Spring 2018
MSc in Computer Science and MEng Telecom. Engineering
EIT Masters ITA, S&P,SDE
Management of Innovation

Lecture 07 – Concept Development – Selection and Testing
Prof. Fabio Massacci

PD&D Process: Concept Development

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- **Design**
  - Concepts that are easy to produce
  - Concepts that have a potential market

Target Specs

Based on customer needs and benchmarking

Final Specs

Based on selected concept, feasibility, models, testing, and trade-offs

PD&D Process: Concept Development

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- **Eliminate**
  - Concepts that look unpromising (business-wise)
  - Concepts that are unwieldy to design

	Mission Approval	Concept Review	System Spec Review	Critical Design Review	Production Approval
Planning	Concept Development	System-Level Design	Detail Design	Testing and Refinement	Production Ramp-Up

Mission Statement → Identify Customer Needs → Establish Target Specification → Generate Product Concepts → Select Product Concept(s) → Test Product Concept(s) → Set Final Specifications → Plan Downstream Development

Qualitative Testing   **Quantitative Testing**

Concept Development Funnel

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concept generation

concept screening

concept scoring

concept testing

Concept Selection Process

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- **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

Concept Selection Example:

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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	−2	0	2	−1	0	
RANK	1	3	7	5	2	6	4	
CONTINUE?	Yes	Yes	No	No	Yes	No	Yes	

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	

Concept Selection Exercise:
Mechanical Pencils

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Mechanical Pencils:
Customer Needs – Students Evaluation in Class

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- **Easy to grip for writing - 3**
  - Comfortable in handling
- **Lightweight - 5**
- **Easy to change - 2**
- **Eraser on the back – 1 (low quality)**
- **Looks beautiful – 2-4 (man-woman difference)**
- **Different colors – Important but hard to rate**
- **Cheap - 5**
- **Button on top or side for the point?**
  - (lead you don't have to change but you consume it)
- **Clip – 4**
- **Easy to operate after dropping - 3**

**Mechanical Pencils:
Customer Needs – Students Evaluation in Class**

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- **Easy to grip for writing - 3**
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- **Easy to operate after dropping - 3**

Pen Criteria

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- **Smoothness of writing --- 7**
- ~~**Ink or gel**~~
- **Easy of handling 8**
- **Fashionable – Instills pride - 2**
- **Writing thickness - 11**
- **Clickable - 1**
- ~~**Long lasting**~~
- **Robustness, Durability 7**
- **Weight – 3**
- ~~**Angle of writing**~~
- ~~**Level of ink visible**~~
- **Ease of manufacturing -→ implies cost (usually)**

Pens for writing

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	InkJoy	SoftFeel	Pilot G-2
Smoothness of writing	+6, +	+5, -7 -	+8, -6 +
Easy to Use	+1, -8 -	+12, -1 +	+12, -1 +
Robust/Durable	+6, -3 +	+8, -12 -	+14, +
Ease of Manufacturing	+16, +	+8, +	-17 -

PLUS	3	2	3
SAME			
MINUS	1	2	1
NET	2	0	0
RANK	1	2	1

Pens for writing (2017)

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	InkJoy	QConnect	SoftFeel	Pilot G-2	Pilot P
Smoothness of writing	+++++	---	-	+++++	-
Easy to Use	+++	----	++++	+++++	-
Robust/Durable	-+-+	----	+++	++++	+
Ease of Manufacturing	++-	+++++	---	------	-

PLUS	12	5	7	14	1
SAME					
MINUS	3	6	4	5	2
NET	+9	-1	+3	+9	-1
RANK					

Pens for writing (2017)

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	InkJoy	Lion	Pilot G-2
Smootness of writing	+6, +	+5, -7 -	+8, -6 +
Easy to Use	+1, -8 -	+12, -1 +	+12, -1 +
Robust/Durable	+6, -3 +	+8, -12 -	+14, +
Ease of Manufacturing	+16, +	+8, +	-17 -

PLUS	3	2	3
SAME			
MINUS	1	2	1
NET	2	0	0
RANK	1	2	1

Remember…

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- **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!**
- **But beware of the best "average" product.**
  - Perform concept selection for each different customer group and compare results.
  - Check sensitivity of selection to relative weightings and ratings

Usage Model is key for concept selection

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- **Recall VHS vs Betamax main issue**
  - Betamax and VHS essentially based on similar technology
  - There is margin for improvement. Which feature to select?
- **Betamax intended usage → live videocamera recording**
  - Small size is best
    - you don't want to carry out heavy and unwieldy cameras
  - Duration not so important
    - you are not going to continuously record live stuff, can change easly tape
- **VHS intented usage → unattended TV recording**
  - Long duration is best
    - you don't want to go back home or wake up in middle of night to change tape
  - Size immaterial
    - recorder is laying together with TV set which is likely much bulkier
- **"Average" concept utterly useless**

Concept Testing is Used for Several Purposes

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- **Ok, you selected a concept, how do you test it?**
  - Ask the customers!
- **What market to be in?**
  - Benchmarking
  - Forecasting demand
- **Which feature exactly?**
  - Selecting among alternative concepts
  - Confirming concept selection decision
  - Soliciting improvement ideas
- **Ready to launch?**
  - Go/no-go decisions

Concept Testing Process

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

emPower Electric Scooter

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- **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

Communicating the Concept

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

Verbal Description

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- **What it is**
  - The product is a lightweight electric scooter that can be easily folded and taken with you inside a building or on public transportation.
- **How it works**
  - 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.
- **Key feature**
  - The scooter can be recharged in about two hours from a standard electric outlet.
- **Key benefit**
  - The scooter is easy to ride and has simple controls — just an accelerator button and a brake.

Various Presentational Formats

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Sketch
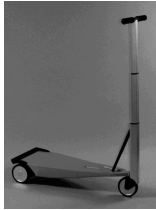
Rendering

Storyboard

3D CAD Model

Appearance Model

Working Prototype

Survey Format

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- **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"

Survey Format   UNIVERSITY OF TRENTO

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

Interpreting the Results:
Forecasting Sales   UNIVERSITY OF TRENTO

- **Q = N x A x P**
- **Q   = sales (annual)**
- **N   = Potential number of (annual) purchases**
- **A   = awareness x availability (fractions)**
- **P   = probability of purchase (surveyed)**
  - C = Conversion Rate "will buy" to "actually buy"
  - F = Fraction of people who answered

  = Cdef x Fdefinitely + Cprob x Fprobably

  "top box"   "second box"

Forecasting Example:

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- **Campus**
  - 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 = 200,000 x 0.2 x [0.4 x 0.3 + 0.2 x 0.2]
- **Total sales: 6400 units/yr**
- **Price point: $795**

- **Factories**
  - 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]
- **Total sales: 6000 units/yr**
- **Price point: $1500**

emPower's Market Decision: Factory Transportation

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You also have to sell it and to make it…

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- **Starting Point**
  - Total sales: 6400 units/yr
  - Price point: $795
- **Price Bites**
  - 40-50% off Resellers
    - Before final price
  - 50% off Distributor
    - Before retailers
    - 25% off before final price
- **Production Costs**
  - Margin:

- **Starting Point**
  - Total sales: 6000 units/yr
  - Price point: $1500
- **Price Bites**
  - 35-45% off Distributors
    - before final price
- **Production Costs**
  - Margin:

Textbook

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Product Design and Development
Karl T. Ulrich and Steven D. Eppinger
5th edition, Irwin McGraw-Hill, 2012

1. Introduction
2. Development Processes and Organizations
3. Opportunity Identification
4. Product Planning
5. Identifying Customer Needs
6. Product Specifications
7. **Concept Generation**
8. **Concept Selection**
9. **Concept Testing**
10. Product Architecture
11. Industrial Design
12. Design for Environment
13. Design for Manufacturing
14. Prototyping
15. Robust Design
16. Patents and Intellectual Property
17. Product Development Economics
18. Managing Projects

FIFTH EDITION

Product Design and Development

KARL T. ULRICH · STEVEN D. EPPINGER