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ICT Innovation – Spring 2016
MSc in Computer Science and MEng Telecom. Engineering
EIT Masters ITA, S&P,SDE

Lecture 01 – Product Design and Development
Prof. Fabio Massacci

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Research and Development

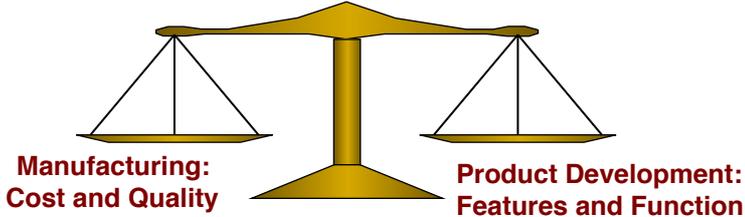
 R	 T	 D
Basic Research	Technology Development	Product Development
<ul style="list-style-type: none">• Discovery process• No set timing• Unpredictable returns• Long term	<ul style="list-style-type: none">• Loosely structured• Difficult to plan• Less predictable• Medium term	<ul style="list-style-type: none">• Structured methods• Planned timing• Predictable outcome• Short term

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What makes a successful product



- **A successful product is based on several features**
 - Features and functions of design process
 - Cost and quality of manufacturing process



- **Features and Functions can be improved by a good product development process that yields “better” products**
 - Beware that an apparently “better” product might not be truly “better” for the intended customer at the end (latent, or marginal feature might take over)

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Example “Marginal feature”



- **SMS intended life**
 - Designed to push configuration information to GSM Phone or pull information from the Network
 - “INFO GPRS” returns the remaining network traffic
 - “SET APN ibox.mycompany.com”
 - 256 characters more than enough for this purpose
- **SMS actual life**
 - Used by phone users to send brief messages
 - A large source of revenues for the telecom operator
- **MMS follow-up**
 - Sending much richer data (photo, video, audio)
 - Why it never took over?

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Why Italians were so fond of SMS?



- **Omnitel**
 - In 1998 ha 6.1M customers
 - My birthday present for my wife at 30 was one of them (and she used a lot of SMS)
- **Sociological explanation? (given in class)**
 - Can't really talk on the phone, calling someone it is hard for some people to talk
 - takes more time writing messages is fast
 - It was new
 - There was internet messages but there was not really internet penetration in Italy
 - It was cheaper than calling
 - Asynchronous communication
 - If what you need to say can fit in to 256 characters there is no need to talk
 - When you want to meet somewhere the sms can be stored and checked later

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Price a family conversation



- **2000 – Fabio and Beatrice have a baby**
 - The kindergarden closes at 16:00
 - Wed 15:15 – Beatrice has an important meeting
 - Thu 19:15 – Beatrice is hungry
- **“Timing exercise” in Class**
- **Acceptable prices for this family conversation**
 - 15:15 – 12 seconds –
 - Value given in class 0.2€ (15) 0.1€ (4) “but could also be” 1€ (4)
 - 19:15 – 13 seconds
 - Value given in class 0.2€, 0.1€

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Why Italians were so fond of SMS?



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- **Omnitel**
 - In 1998 ha 6.1M customers
 - My birthday present for my wife at 30 was one of them (and she used a lot of SMS)
- **The Sociological explanation**
 - Digital natives bla bla, immediate communication but shy of human contacts bla bla, blu blu... can ramble for 50+ slides...
- **Omnitel Tariffs in 1999**
 - From "La Repubblica" 29/January/1999
 - Peak times (8-16): 0.51€/minute (before were 1€/minute)
 - Off peak (22-8): 0.101€/minute
 - SMS costs: 0.086/each
 - Talk 1 minute or 30 second, still pay 1 minute
- **Vodafone (who bought Omnitel) – 2015**
 - Basic: 0.125€/Minute
 - Unlimited Minutes: 34€/Month (actually 4 weeks)
- **What does it mean?**
 - My wife was a young professional, let's take a more middle class role

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Understanding the cost drivers...



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- **Family cost of "Sorry I'm late by 1h." - "Ok, I'll pick the kid at school" in 1999**
 - Talking: 0.5-1€ → SMS: 0.16€
- **Starting salary of Italian High School Teacher with MSc Degree**
 - 42 working weeks out of 52 (4 days a week), 20% taxes.
 - 1999: 10.253,22€
 - 2008-now: 20.973,22€ (plus few euros on performance)
- **Calling for 10' a day, off-peak, for the year**
 - 1999: teach for two weeks
 - now: 4 days
- **Calling for 10' a day, normal hours, for the year**
 - 1999: teach for two months just to pay the phone bill
 - now: 4 days
- **So "minor" features take over...**

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Back to Product Development Lifecycle  UNIVERSITY OF TRENTO

- **Several roles required for the production of a product**
 - General Management
 - Marketing
 - Engineering
 - Manufacturing
 - Quality Assurance
 - Purchasing
 - Customer Services
- **They occurs at most phases of the product development lifecycle**

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Product Lifecycle from Tyco  UNIVERSITY OF TRENTO

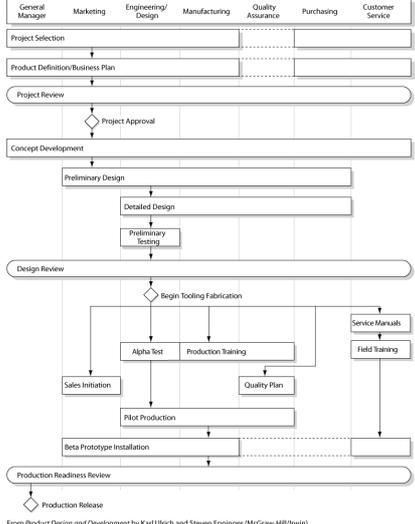
Phase	Key Goals
1. Project Registration	1. Define project and business unit needs
2. Concept Definition	2. Develop project concept and charter
3. Feasibility and Planning	3. Create product description
4. Preliminary Design	4. Create preliminary detailed design
5. Final Design	5. Detail and optimize design
6. Product Verification	6. Demonstrate product performance
7. Process Verification	7. Demonstrate process performance
8. Launch	8. Self-explanatory
9. Post-Launch Assessment	9. Identify lessons learned

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Product Design, Development and Launch



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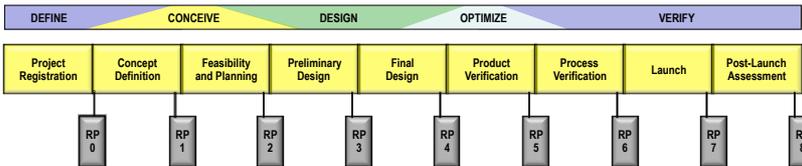
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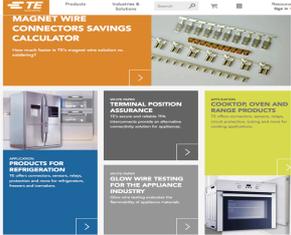
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Tyco (now TE connectivity) Product Lifecycle



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Tyco's Process a bird's eye view

Rally Point Phase	0. Project Registration	1. Concept Definition	2. Feasibility and Planning	3. Preliminary Design	4. Final Design	5. Product Verification	6. Process Verification	7. Launch
Marketing and Sales	XXX	XXX	XX	X		X	XX	XX
Engineering	X	XXX	XXXX	XXX	XXXX	XXX	X	X
Quality Assurance			X		X	X	X	
Manufacturing			XX	XX	X	XX		
Purchasing			XX	X		X		
Legal		X	X	X	X	X		
Financial	X	X	X					

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What Marketing Does?

1. Project Registration
2. Concept Definition
3. Feasibility and Planning
4. Preliminary Design
5. Final Design
6. Product Verification
7. Process Verification
8. Launch
9. Post-Launch Assessment

1. Identify customers and market size, Describe competitive features and benefits, Identify target cost and price
2. Capture voice of the customer, Analyze customer needs, Document customer needs
3. Develop marketing and sales plans, Create phase-in and phase-out plans
4. Review concepts with customer
5. Wait....
6. Initialize field trials
7. Complete field trials, Finalize training plans
8. Finalize pricing and sales forecasts, Complete sales and service training
9. Solicit customer feedback and satisfaction rates, Measure sales vs. forecast, Complete phase-in and phase-out

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What Engineering Does?

<ol style="list-style-type: none"> 1. Project Registration 2. Concept Definition 3. Feasibility and Planning 4. Preliminary Design 5. Final Design 6. Product Verification 7. Process Verification 8. Launch 9. Post-Launch Assessment 	<ol style="list-style-type: none"> 1. Identify project risks 2. Identify critical-to-quality specs, Develop and select concepts, Update project risks 3. Create functional specification and performance metrics, Review concept selection, Define product architecture, Assess technical failures modes 4. Conduct a preliminary design review, Build and test alpha prototypes, Assess product failure modes 5. Freeze hardware and software design, Complete engineering documentation, Draft technical documentation, Secure beta prototypes 6. Finalize design documentation, Complete beta prototype and field testing, Apply for regulatory approvals 7. Obtain regulatory approvals 8. Finalize product metrics
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Marketing vs Engineering

<ol style="list-style-type: none"> 1. Identify customers and market size, Describe competitive features and benefits, Identify target cost and price 2. Capture voice of the customer, Analyze customer needs, Document customer needs 3. Develop marketing and sales plans, Create phase-in and phase-out plans 4. Review concepts with customer 5. ... 6. Initialize field trials 7. Complete field trials, Finalize training plans 8. Finalize pricing and sales forecasts, Complete sales and service training 9. Solicit customer feedback and satisfaction rates, Measure sales vs. forecast, Complete phase-in/out 	<ol style="list-style-type: none"> 1. Identify project risks 2. Identify critical-to-quality specs, Develop and select concepts, Update project risks 3. Create functional specification and performance metrics, Review concept selection, Define product architecture, Assess technical failures modes 4. Conduct a preliminary design review, Build and test alpha prototypes, Assess product failure modes 5. Freeze hardware and software design, Complete engineering documentation, Draft technical documentation, Secure beta prototypes 6. Finalize design documentation, Complete beta prototype and field testing, Apply for regulatory approvals 7. Obtain regulatory approvals 8. Finalize product metrics
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Tyco's Process in one slide

Rally Point Phase	0. Project Registration	1. Concept Definition	2. Feasibility and Planning	3. Preliminary Design	4. Final Design	5. Product Verification	6. Process Verification	7. Launch	8. Post-Launch Assessment
Primary Goal	Define project and business unit needs	Develop project concept and charter	Create product description	Create preliminary detailed design	Detail and optimize design	Demonstrate product performance	Demonstrate process performance	Launch product	Identify lessons learned
Marketing and Sales	Identify customers and market size	Capture voice of the customer	Develop marketing and sales plans	Review concepts with customer		Initialize field trials	Complete field trials	Finalize pricing and sales forecasts	Solicit customer feedback and satisfaction ratings
	Describe competitive features and benefits	Analyze customer needs	Create phase-in and phase-out plans				Finalize training plans	Complete sales and service training	Measure sales vs. forecast
	Identify target cost and price	Document customer needs							Complete phase-in and phase-out
Engineering	Identify project risks	Identify critical-to-quality specs	Create functional specification and performance metrics	Conduct a preliminary design review	Freeze hardware and software design	Finalize design documentation	Obtain regulatory approvals	Finalize product metrics	
		Develop and select concepts	Review concept selection	Build and test alpha prototypes	Complete engineering documentation	Complete beta prototype and field testing			
		Update project risks	Define product architecture	Assess product failure modes	Draft technical documentation	Apply for regulatory approvals			
			Assess technical failures modes	Secure beta prototypes	Test beta prototypes for robustness	Complete quality assurance testing	Conduct process verification testing		
Quality Assurance			Create preliminary test plan						
Manufacturing				Begin manufacturing development	Finalize bill of materials (BOM)	Update manufacturing control plans	Run manufacturing pilots		Register obsolete and scrap products
				Conduct a preliminary manufacturing process review	Develop manufacturing control plans	Finalize manufacturing control plans			
Purchasing				Create a supplier participation matrix	Identify long lead-time items		Verify supply chain readiness		
				Assess suppliers for certification					
Legal		Search patents	Identify trade compliance issues	Identify potential patents	Prepare patent applications	Assure trade compliance			
Financial	Prepare preliminary business case	Refine business case	Complete financial package						Monitor return on investment
Project Management	Identify project timing, resources, and capital	Assess team capabilities/skills	Plan integrated product development schedule	Update RP1-2 deliverables	Update RP1-3 deliverables	Update RP1-4 deliverables	Update RP1-5 deliverables	Finalize all deliverables	Document best practices
	Prepare RP0 checklist & submit for approval	Identify development team members	Assign a project manager	Prepare RP3 checklist & submit for approval	Prepare RP4 checklist & submit for approval	Prepare RP5 checklist & submit for approval	Prepare RP6 checklist & submit for approval	Finalize launch plans and documentation	Prepare RP8 checklist & submit for approval
		Select a Rally Point process variant	Update RP1 deliverables					Update RP1-6 deliverables	
		Prepare RP1 checklist & submit for approval	Prepare RP2 deliverables					Prepare RP7 checklist & submit for approval	

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Is this always true?

- **Does engineering activity stops with product launch?**
- **What happens after launch?**
 - Products can break and needs to be serviced
 - Can argue it is a different function but not always true
- **Depends on Industry**
 - For consumer electronics not really a problem, if it is broken, we essentially replace parts (=re-manufacture a new one)
 - For other industries not so obvious: can't send an X-Ray room or a 50meters tall wind turbine controller to maintenance service in a box
- **If product cannot be "replaced" but must be "serviced", then risk of fragility and cost of maintenance must be factored in the product**
 - Ex-ante (make sure it i serviceable) or ex-post (ask customer to pay hefty maintenance fee) or right licensing (no responsibility)

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Yeah but maintenance doesn't apply to us

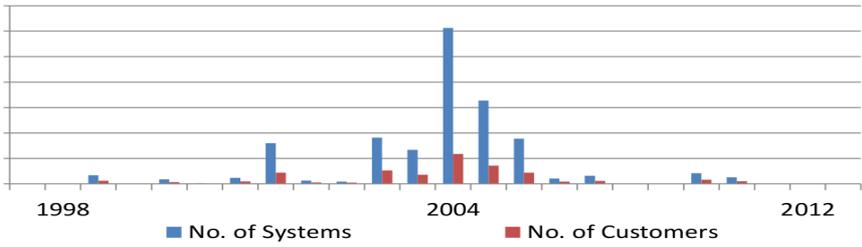
- **For software we don't need "servicing": just update to the new version**
- **Myth driven by browsers or mobile apps**
 - software given to you in change of your personal data
 - without any service level agreement and
 - certainty that updates will break your extensions
- **"Normal" software is very, very, very different**
 - Data is often mission critical and must be migrated
 - Software might be literally on the field in thousands of copies and not reachable
 - Eg car software. Need to recall the car...

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Largest Business Software Producer

- **The company has updated products and yet**
 - Lots of customers are running software that are more than 10years old
- **Updates are costly!**
 - Even if you get a "free update" → data must be migrated
 - Even if all data works → process must be checked that nothing is broken
 - Even if process works → Final users must be re-trained to use new interfaces
 - Even if users can cope → fixing it might break something apparently unrelated
 - See Windows 10 free upgrade that £\$%& all users of the Nvidia Quadro graphic card
- **What happens after the launch is also part of the PD of engineering**



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What if the product is a dud?

- **When would you like to discover it?**
 1. Project Registration
 2. Concept Definition
 3. Feasibility and Planning
 4. Preliminary Design
 5. Final Design
 6. Product Verification
 7. Process Verification
 8. Launch
 9. Post-Launch Assessment
- **Movie Industry: Lone Ranger by Disney Co.**
 - Production (2-7): \$225–250M
 - Launch (8): \$150M
 - Post Launch Assessment (9): \$160–190M Final Losses

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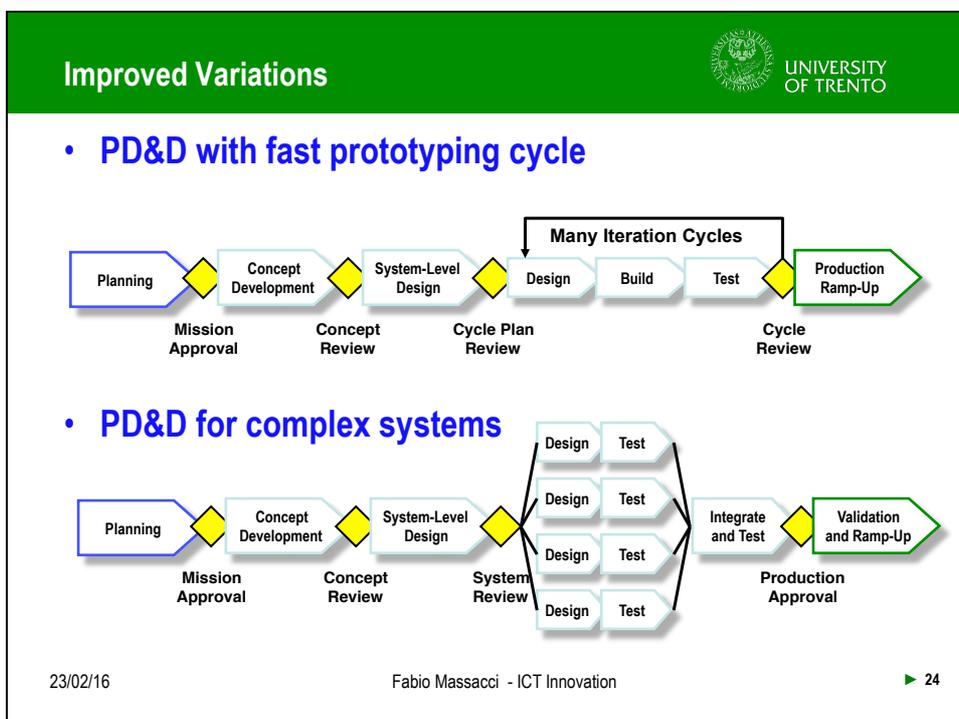
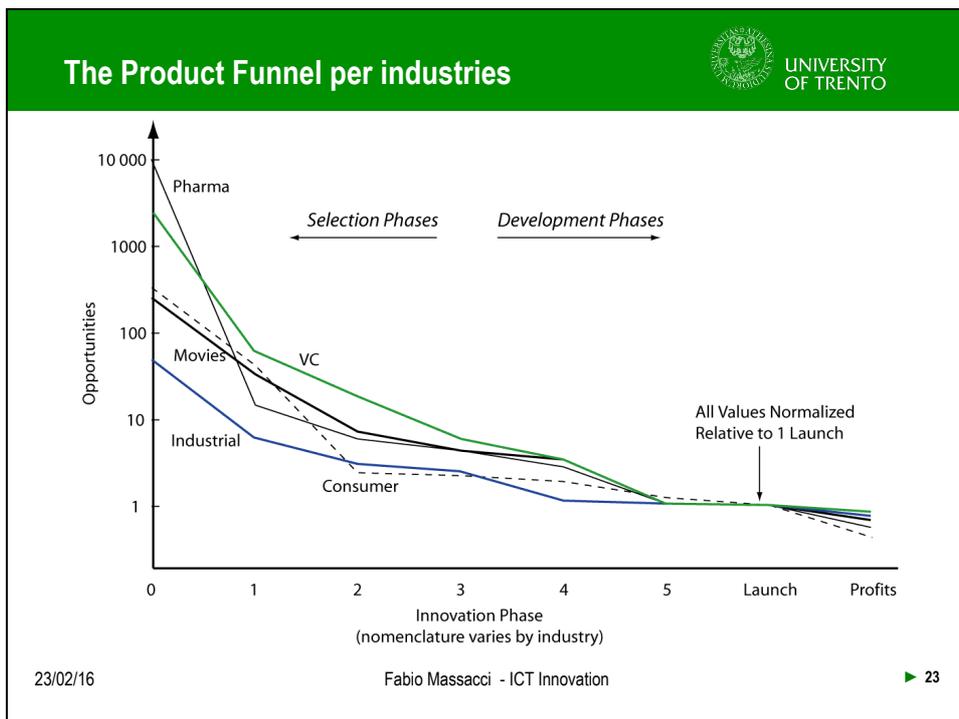

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Ideal PD&D Process

- **Key Idea → Streamline and improve process trying to make (only) successful products emerge at the end**
- **Eliminate**
 - Concepts that look unpromising (business-wise)
 - Concepts that are unwieldy to design
 - Systems that are complex or expensive to build (well as intended)
 - Systems that are difficult to operate (as intended)
- **At all stages “value” based decision must be made based on**
 - Highest paid individual’s opinion or
 - Experiments to check whether intuition is correct → easy for ICT product
 - with 3D printing reasonably easy for small manufactured products



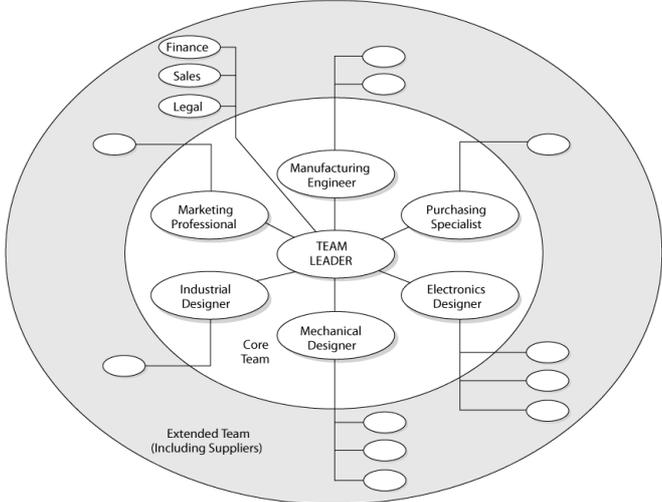
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Ideal PD&D Multi-disciplinary Team



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From *Product Design and Development* by Karl Ulrich and Steven Eppinger (McGraw-Hill/Irwin)

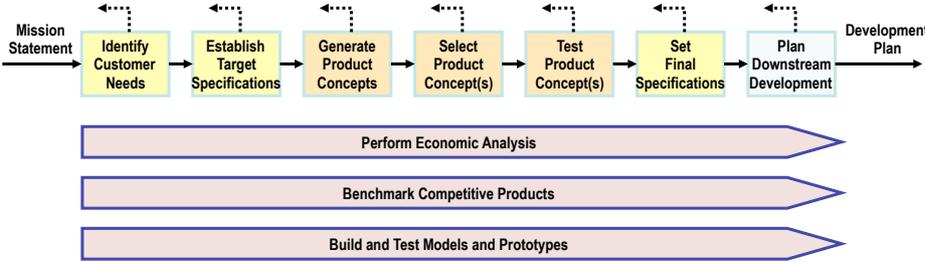
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Concept Development Process



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- **CD is similar to PD&D**
- **Divided in several steps**
 - As PD&D not necessarily sequential → parallel and iterative steps
- **Covered in Chapter 4-8 in the Textbook**
- **Economic Analysis → Business Development Lab Course**



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Case Studies  UNIVERSITY OF TRENTO

- **Winners and Losers**
 - VHS vs Betamax
 - Phonogram vs Gramophone
 - Mac vs PC (but only for for Graphic Designers)
 - iPad vs Windows Tablet (Pen Tablet)
 - Qwerty vs Dvorak
 - 2+ Buttons Mouse vs 1 Button Mouse
- **Each group will have to chose two case studies and present two slide per case study x next Friday**
 - The TAs will not tell you whether you are right or wrong but will challenge your assumptions
- <http://doodle.com/poll/zu6nefewesf3efz2>

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VHS vs Betamax Sample Slides - I  UNIVERSITY OF TRENTO

- **Common Characteristics**
 - If any
- **VHS Unique Characteristics**
 - Key differentiating characteristics (Business, technical, usability, whatever)
 - Bla bla
- **Betamax Unique Characteristics**
 - Key differentiating characteristics (Business, technical, usability, whatever)
 - Bla bla

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VHS vs Betamax Sample Slide - II

- **Why VHS Won?**
 - The reasons for you
 - Bla Bla
 - Bla bla
 - Bla bla
- **Evidence to back your claim**
 - Links, whatever

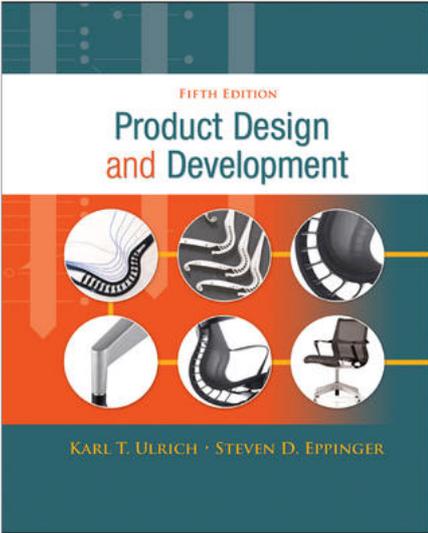
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Textbook

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



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