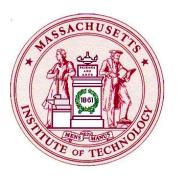
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Systems Ideas in Product Development

Assignment for ESD.83: Research Seminar in Engineering Systems

Prepared by Annalisa L. Weigel 14 November 2000

Outline

- Review several models of PD process in literature
- Examine system aspects of PD
- Non-systems ways of doing PD

Product Development (PD) Definition

PD defined by Ulrich and Eppinger (1995) as "the set of activities beginning with the
perception of a market opportunity and ending in the production, sale and delivery of a
product"

PD Process as described by Anderson

- Reference: Anderson, D.M. (1997) <u>Agile Product Development for Mass Customization</u>. Chicago, Irwin Professional Publishing
- There are a minimum of 5 phases required of PD, as shown in the table below.

Phase	Definition			
1. Product Definition	Product specifications and resource prioritization			
2. Architecture	Simplified concept and optimized architecture including			
	modularity and customization strategies			
3. Design	Product/Process design so thorough that the need for prototype			
	testing and pilot production is minimized or eliminated			
4. Ramp-up	Smooth introduction into production with rapid volume ramp-up			
5. Follow-up	Postmortem to capture lessons learned that can be applied to future			
	projects.			

Table 1. Phases of Product Development by Anderson

PD Process as described by Wheelwright & Clark

- Reference: Wheelwright, S. and K. Clark (1992) <u>Revolutionizing Product Development</u>. New York, The Free Press.
- Diagram below shows a four phase product development cycle mapped to a 36 month calendar, indicating sequential overlaps between the phases and what activities occur in each phase.

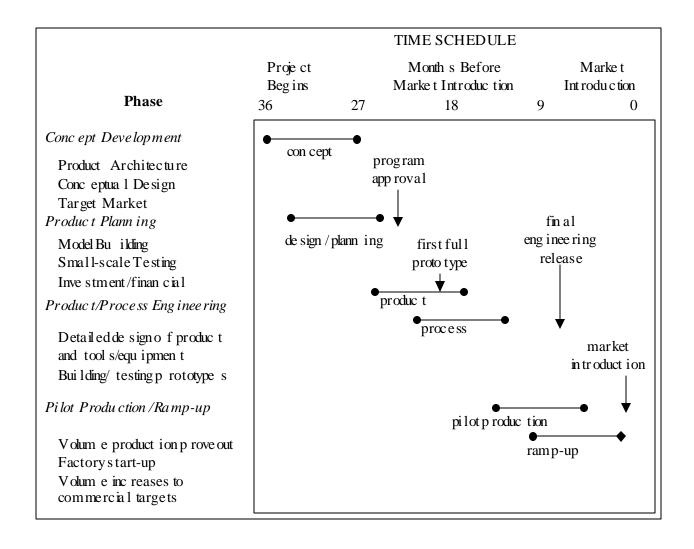


Figure 1. Product Development Process by Wheelwright and Clark.

PD Process as described by Ulrich & Eppinger

- Reference: Ulrich, K. and S. Eppinger (1995) <u>Product Design and Development</u>. New York, McGraw-Hill, Inc.
- Ulrich and Eppinger's generic model of PD contains 5 phases as shown in the diagram below:
 - 1. Concept Development
 - 2. System-Level Design
 - 3. Detail Design
 - 4. Testing and Refinement
 - 5. Production Ramp-up
- Marketing, Design and Manufacturing activities are detailed in each phase

Phase1 Concept De velopment	Phase 2 System-Level Design	Pha se3 De tail De sign	Pha se4 Testing and Refinement	Phase 5 Production Ramp-up
 Marketing Define market seg ments. Identify lead users Identify competitive products. 	Develop plan for product options and extended product family	Deve lop marketing plan	 Develop prom and launch materials Facili tate field testing 	pro duction with key customers
 De sign Investigate concept fe asib ility Develop industrial design concepts Build and test experimental pro totypes 	 Generate alternative pro duct architectur es Define major sub-systems and interfaces. Refine industrial design 	 Define part geometry Choose materials Assign tole rances Complete industrial decontrol documentati 		ance production output at ory
 Manufacturing Estimate manufacturing cost Assess production feasibility 	 Identify suppliers for key components Perform ma kebuy analy sis Define final as sembly scheme 	 Define piece part producti processes Design toolin Design quali assurance processes Begin procurement long-lead tooling 	ramp-up Re fine fabric and assembly Train work f Re fine qualit assurance processes	of entire cation production y system orce
 Other Functions Financ e: Facilitate ec onomic analysis. Le gal: Investigate patent issues. 	 Finance: Facilitate make-buy an aly sis. Service: Ide ntify 		 Deve lop pron and laun ch materials Facilitate field testing 	

Figure 2. Product Development Process by Ulrich and Eppinger.

PD Process as described by Clark & Fujimoto

- Reference: Clark, K. and T. Fujimoto (1991) <u>Product Development Performance</u>. Boston, MA, Harvard Business School Press.
- Clark and Fujimoto model of PD process contains four major developmental stages as shown in the diagram below:

- 1. Concept Generation
- 2. Product Planning
- 3. Product Engineering
- 4. Process Engineering
- Process has loops and other non-linear features



Figure 3. Product Development Process by Clark and Fujimoto.

Systems Aspects of PD

Several systems knowledge domains contribute various concepts to PD:

- Systems Engineering
 - 1. Requirements flowdown
 - 2. Concept generation and evaluation
 - 3. Trades process
- Systems Architecture
 - 1. Top-level systems perspective
 - 2. Interactions with "environment"
- Systems Analysis
 - 1. Market analysis
 - 2. Cost analysis

Non-Systems Ways to do PD

- Have less or no concern for:
 - 1. Interactions
 - 2. Upgrades
 - 3. Changes
 - 4. Maintenance
 - 5. Customer needs
- Don't integrate various parts of PD (marketing, design, manufacturing)
- Take narrow view of the product

Future Research for PD Area

- Reduce PD cycle time
- Effectively integrate PD team organization
- Applying lean principles to PD