0. Introductions and Course Overview

Product Platform and Product Family Design: From Strategy to Implementation

ESD.39s

22 July – 25 July 2013

Olivier de Weck & Tim Simpson
• Location on MIT Campus
  - See next slide
• Classroom 33-116
  - Concept Management Forum
  - Aero Astro Department
• Fire Exits and Alarms
• Medical Assistance
  - MIT Medical 617-253-4481
• Bathrooms
  - Men, Women
• Watch Personal Property
  - Laptops, Wallets …
• Video Taping
  - MIT PE People will come by for testimonials on Wednesday
MIT Campus Orientation

We are here: 33

Student Center (lunch) W20

Main Entrance “Lobby 7”

Killian Court

MIT Medical E23

http://whereis.mit.edu/
Our Motivation (mid 1990s – present)

• … business demands in fast growing high technology industries are short product life cycles, growing demand for product choice and customization, high pressures for globalization and technological innovation, combined with a need to respond to change with stable and long-term, yet flexible and responsive, process capabilities (platforms). Boynton and Victor, 1998

• … in fast “clockspeed” industries modular supply chains with effective architecture (platforms) may exist over a long expanse of geographic distance, diverse cultures, and have autonomous managerial and ownership structures and communication mechanisms. Fine, 1998

• Platform Flexibility: Once-rigid platforms transform into "shared components" that cut costs and boost flexibility. Dan Carney - Society of Automotive Engineers, 2004
Our Motivation (mid 1990s – present)

• Automotive mega-platforms…will double by 2017…“The best of these platforms will enable a very wide variety of vehicle types and sizes, including different vehicle widths as well as different lengths, but while still delivering superb vehicle dynamics”

AEROSPACE FELLOW, MIT

"This course is a must for any professional who is interested in developing an effective product platform or product family. This program quickly lays foundations of system architectures and then gets into the how and why of applying those architecture concepts into a platform, module, or product family. This information also gives tools to the practitioner to develop a commonality plan, along with its rewards and challenges, for implementing for my own use."

CORPORATE DIRECTOR - ENGINEERING IT, HONEYWELL INTERNATIONAL

"Very pertinent to today's business challenges in product development."

SENIOR SOFTWARE ENGINEER, GENERAL DYNAMICS-ADVANCED INFORMATION SYSTEMS

"This program helps you to appreciate another perspective to system designing. Before this program, my initial view of product platform design was based on the relationship of components and their functions. As the program progressed, I learned to realize that commonality can be defined on a number of dimensions, focusing on a number of attributes to meet a number of goals."
Instructor: Olivier L. de Weck

• Email: deweck@mit.edu
• 33-410 and E40-261
Massachusetts Institute of Technology
Cambridge, MA 02139

• Full Professor, dual appointment Department of Aeronautics & Astronautics and the Engineering Systems Division. Previously 6 years experience working on the F/A-18 Military Aircraft program at Boeing (St. Louis). Editor-in-Chief of the journal Systems Engineering.

• Ph.D., AA, MIT, 2001
M.S., AA, MIT, 1999
Dipl. Ing., IE, ETH Zurich, Switzerland, 1993
Instructor: Timothy W. Simpson

• Email: tws8@psu.edu
• 326 Leonhard Building
  Penn State University
  University Park, PA 16802

• Full Professor, joint appointment in Departments of Mechanical & Nuclear Engineering and Industrial & Manufacturing Engineering – and affiliate faculty in Engineering Design and the College of Information Sciences & Technology (joined PSU in 1998)

• Ph.D., ME, Georgia Tech, 1998
  M.S., ME, Georgia Tech, 1995
  B.S., ME, Cornell University, 1994
Course Synopsis

• Over the next four days, we will collectively explore how product architecture and platforms can help a firm deploy and manage a family of products in a competitive manner

  □ Discuss **strategic as well as implementation aspects** of developing and manufacturing a family of product variants derived from a common platform and/or modular architecture

  □ Learn how the reuse of components, processes and design solutions leads to **advantages** in learning curves and economies of scale, which must be carefully balanced against the desire for product customization and competitive pressures

  □ Show how product platforms can be leveraged for **new growth**

  □ Present the latest **theory** as well as a number of **industry case studies**

  □ Discuss recent **strategic issues** such as embedding flexibility in product platforms as well as the effect of platforms on a firm’s cost structure

• This will be accomplished through a combination of lectures, interactive discussions and hands-on activities to engage you, the course participants, in an active learning environment
Learning Objectives

1. Describe the **evolution of industry** from craft manufacturing to mass customization

2. Grasp **fundamental concepts** in product architecting such as customer needs identification, requirements formulation, functional decomposition as well as function-form mapping during conceptual design

3. Understand the **platform concept** and be able to prioritize drivers of modularity and product platform design

4. Enumerate **metrics** for quantifying commonality within a product family

5. Identify major contemporary **methods** and tools for product family and platform design
6. Describe how **optimization** can assist platform and product family design

7. Discuss **strategic issues** such as platform portfolio optimization, embedding flexibility in product platforms and the organizational impact of platforms

8. Leverage platforms for identifying new market and product opportunities to **generate revenue growth**

9. Extract key lessons from **industrial case studies**

10. Participate in **discussions** regarding the challenges that they face in the context of their own product families of industrial and consumer products

11. Point to the latest **published literature** in the field
Materials Provided

• Book
  - Product Platform and Product Family Design: Methods and Applications

• Folders and Notebook
  - Course Agenda, Lecture 0, Roster
  - Daily Feedback forms
  - Take Notes as you see fit in Colored Notebook

• Course Materials uploaded to stellar
  - https://stellar.mit.edu (go to → ESD → Summer 2013 → ESD.39s)
  - Contains all materials as pdf files (Admin, Lectures, Readings)
    - Some ppt files available upon request
  - Feel free to follow along on your laptop during lectures

• Products for Dissection (and tools)
• LEGO® Manufacturing Game
• Directions to Dinner: Brasserie Jo (Tue @ 6:30pm)
<table>
<thead>
<tr>
<th>Team</th>
<th>Location</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team 1</td>
<td>Front Left</td>
<td>Black</td>
</tr>
<tr>
<td>Team 2</td>
<td>Rear Left</td>
<td>Red</td>
</tr>
<tr>
<td>Team 3</td>
<td>Front Right</td>
<td>White/YlW</td>
</tr>
<tr>
<td>Team 4</td>
<td>Rear Right</td>
<td>Blue</td>
</tr>
</tbody>
</table>

- Depending on where you chose to sit you have been automatically assigned to a team.
- Take a look at the color of your folder or notebook
Typical Daily Schedule

Room: 33-116

Daily Schedule:

8:30am - 10:00am - First Session
10:00am - 10:30am - Break – Refreshments w/Coffee
10:30am - 12:00pm - Second Session

12:00pm - 1:00pm - Lunch - on your own

1:00pm - 2:30pm - Third Session
2:30pm - 3:00pm - Break – Refreshments w/Soda
3:00pm - 4:30pm - Fourth Session

4:30pm - 5:00pm – Panel Session and Daily Summary

Need to attend every day to earn Continuing Education Units (CEUs): 2.6
Monday July 22, 2013
Background & Motivation; Platform Definitions & Principles

0. Introductions and Course Overview
1. Background and Motivation
   Industrial Manufacturing Paradigms
   a. Craft Production ( - 1850)
   b. American System of Manufacturing (1850-1900)
   c. Mass Production (1900-1960)
   d. Lean Manufacturing (1960-1990)
   e. Mass Customization (1990 - )

L1. LEGO Game Round 1: Mass Production

2. Fundamental Concepts
   a. Platform Definition and Approaches
   b. Platform Leveraging Strategies
   c. Module- and Scale-based Product Family
   d. Examples
   e. Interpretations, Advantages, Disadvantages

3. Interactive Exercise 1: Product Family Dissection

Panel Session and Wrap-Up

Session numbers correspond to file names on stellar
Tuesday July 23, 2013

Product Architecture and Modularity

4. Product Architecting
   a. Definitions
   b. Methods and Tools
   c. Case Study
   d. Product/System Architecture Framework
   e. Roles and Responsibilities of the Product/System Architect

L2. LEGO Game Round 2: Production with Variety

5. Product Decomposition and Modularity
   a. Product Architecture Decomposition
      • Principles of Decomposition
      • Examples: Automotive, Aerospace, Consumer Products
   b. Modularity and Interfaces
      • Abstraction, Interfaces and Product Complexity
      • Modularity Drivers and Styles of Interconnection
      • Modularity Metrics
      • Modularity vs. Integrality

6. Interactive Exercise 2: Product Decomposition and DSM Mapping

Panel Session and Wrap-Up

Course Participant Dinner at Brasserie Jo @ 6:30pm
Wednesday July 24, 2013
Maps, Metrics, Commonality, and Platforming Architecting

7. Product Platform: Maps & Metrics
   a. Product Family Maps
   b. Defining a Platform Strategy
   c. Platform R&D Metrics
   d. Commonality

Simpson

L3. LEGO Game Round 3: Mass Customization

All

8. Interactive Exercise 3: Commonality Analysis

9. Product Platform Architecting
   a. Single-use Camera Example
   b. Product Platform Planning
   c. Generational Variety Index
   d. Robot Product Family Example
   e. Product Family Optimization via Trade Space Exploration

Simpson

dedeWecK

10. Platforming Software and Services
    Panel Session and Wrap-up
Thursday July 25, 2013

Strategic & Organizational Issues

11. Platform Strategy Selection
   a. Product Families based on Multiple Platforms
   b. Integrated Platform Strategy Model
   c. Optimization Framework: Automotive Case Study

12. Flexible Product Platforms
   a. Motivation for Platform Flexibility
   b. Cousin Parts
   c. Mid/Large Sedan Case Study

13. Organizational Issues
   a. Alignment of Product Architecture and Organization
   b. Time Constants
   c. Divergence and Lifecycle Offsets

Guest Lecture by Dr. Bruce Cameron (MIT System Architecture Lab)

14. Overview of Product Platform Textbook
   a. Chapter Overview
   b. Ties to Course Topics

Team Final Presentations (15 min each)

Final Discussion and Course Diplomas
Product Family Dissection & Analysis

• Working in groups of 5-6 people, you will dissect and analyze a product family using the methods and tools covered in class
Lego® Manufacturing Game

- Play a game assembling small Lego cars
- Maximize profitability under time pressure and competition
- Three rounds
  - Round 1: Mass Production (no variety) – Day 1
  - Round 2: Production with Variety (no platform) – Day 2
  - Round 3: Mass Customization (with platform) – Day 3

- Learning Objectives map to concepts presented in class

Product Family

- Utility Car
- Sports Car
- Family Car
Who Are You?

• Now that you have heard what we intend to offer, we would like to hear from each of you:

  □ Name? Job? What is your role? Why are you here?

  □ List three things you would like to achieve in this course:
    1.
    2.
    3.

  □ What is your biggest concern about taking this course?

* Take a minute to make notes and be ready to share with the rest of the class *