

## Teaching Material

### **Course Announcement: GLOBAL MANUFACTURING**

What should manufacturing enterprises do to succeed in the 21<sup>st</sup> Century? The graduate-level course Global Manufacturing elaborates on this topic. The three main units of manufacturing enterprises —product design, manufacturing, and business model— should be restructured to make them more responsive to market changes. Manufacturing enterprises should deploy globalization strategies that include issues such as fitting the product to the region in which it intends to be sold, selecting the best manufacturing configurations to enhance productivity, and optimizing the location of factories.

### **Class Topics**

#### **Globalization and Manufacturing Paradigms**

Global Integration of Engineering and Business; Customer's Role in Manufacturing Paradigms

#### **Product Invention Strategy**

Technology-Driven Products; Product Development for Globalization – Cultural Fit

#### **Customized, Personalized, Reconfigurable Products**

Design for Mass Customization; Personalized Production; Reconfigurable Products

#### **Mass Production and Lean Production**

Mathematical Model of Mass-Production; The Principles of Lean Production

#### **Analysis of Mass Customization**

Business Strategies of mass Customization; Mathematical model to optimize variants

#### **Traditional Manufacturing Systems**

Comparison Between dedicated lines and flexible manufacturing systems

#### **Economics of Manufacturing Systems**

Life-Cycle Economics; Optimizing manufacturing portfolio; Economics of buffers

#### **Reconfigurable Machines (RM)**

The Rationale for a RM and Prototypes; Reconfigurable Inspection Machines

#### **Reconfigurable Manufacturing Systems (RMS)**

System-Level Design Issues in RMS; System Rapid Ramp-UP

#### **Manufacturing System Configuration Analysis**

Configuration Classification; Comparing RMS with Cell Configurations

Mathematics of RMS Configurations; Impact of Configuration on Performance

#### **Manufacturing Enterprise Business Models**

Business Model Structure; Competitive Advantage; Strategic Resources

Strategies for Global Opportunities

#### **Global Supply-Chain Management**

Economic Order Quantity, Delayed Differentiation, Bullwhip Effect

#### **A Responsive Organizational Structure**

Twenty-First Century Organizational Structure based on Information Transfer

#### **Enterprise Globalization Strategies**

Why Enterprises Become Global; Global Markets; Product Design for Globalization;

Manufacturing Plants – Location and Type; Global Manufacturing Strategies; Strategic Alliances;

**Grading:** 50% team project; 50% home problems, reviews, and class participation.

The team assignment is to start a company to produce a new product that fits mass-customization markets at a global scale. In this project the team should: (1) Describe the product, (2) Design a manufacturing system that produces the product, (3) Elaborate on a business model that will sell and deliver the product, including cost issues.

**Textbook:** *The Global Manufacturing Revolution* by Yoram Koren; John Wiley

In the graduate-level class "Global Manufacturing" we will be using the textbook: *The Global Manufacturing Revolution*. This class will meet twice a week for an hour and a half, over 14 weeks. The course assignments include individual assignments and a team project. The project three goals are: 1. Design of innovative products for mass-customization and personalization. 2. Utilize flexible and reconfigurable manufacturing systems to produce the products. 3. Establish business strategies to sell your new products.

Usually we have in the class 30 to 45 students who are assigned to **nine teams** of three to five students each. Off-campus students who are located at remote sites (in the US, Canada, Mexico and Australia) also participate. Off-campus students are assigned to off-campus teams.

The class schedule is as follows:

| Session # | Chapter Reading | Class Topics   | Home Work                                    |
|-----------|-----------------|--|--|
| 1         | 1               | Course Overview, Requirements & Team Formation<br>Introduction to Global Manufacturing (ch. 1) |  |
| 2         |                 | Mfg. Paradigms & Mfg. Systems (ch. 1)  |  |
| 3         | 2               | Product Invention Strategies – A Global View (ch. 2)   |  |
| 4         | 3               | <i>Customized &amp; Reconfigurable Products (ch. 3)</i>  |  |
| 5         | 4               | Mass Production & Lean Production (ch. 4)  | <b>HW #1</b> (chaps. 1, 2, 3)                |
| 6         | 5               | Analysis of Mass Customization (ch. 5)   |  |
| 7         |                 | <b>Team meetings w/ TAs to discuss product selection</b>                                       | <b>HW #2</b> (chap. 4)                       |
| 8         | 6               | Traditional Manufacturing Systems (ch. 6)  |  |
| 9         | 7               | Economics of Manufacturing Systems (ch. 7)   | <b>HW #3</b> (chap. 5)                       |
| 10        |                 | Economics of Manufacturing Systems (ch. 7)   |  |
| 11        |                 | <b>Product Design Presentations</b> (part 1 of 2) *  | <b>1<sup>st</sup> Review</b> (any chap. 1-7) |
| 12        |                 | <b>Product Design Presentations</b> (part 2 of 2) *  | <i>Course Evaluation</i>                     |
| 13        | 8               | Reconfigurable Machines & Controls (ch. 8)   | <b>Product Report</b>                        |
| 14        |                 | <b>NO CLASS, Term Break</b>  |  |
| 15        |                 | <b>Laboratory Demonstrations – RMT, RIM, RFT</b>   | <b>HW #4</b> (chaps. 6,7)                    |
| 16        | 9               | Reconfigurable Systems (ch. 9)   |  |
| 17        | 10              | System Configuration Analysis (ch. 10)   |  |
| 18        |                 | System Configuration Analysis (ch. 10)   |  |
| 19        | 11              | Business Models for Mfg. Enterprises (ch. 11)  | <b>HW #5</b> (chaps. 9, 10)                  |
| 20        |                 | Supply Chains & Delayed Differentiation (ch. 11)   |  |
| 21        |                 | Friedman's Video or supply chains  | <b>Manufacturing Report</b>                  |
| 22        | 12              | Responsive Organizational Structure (ch. 12)   |  |
| 23        | 13              | Globalization Strategies (ch. 13)  | <b>HW #6</b> (chaps. 11, 12)                 |
| 24        |                 | The Dilemma of Globalization (ch. 13)  |  |
| 25        | 14              | Class Summary  | <b>2<sup>nd</sup> Review</b> (chaps. 8 – 14) |
| 26        |                 | <b>Final Project Presentations (part 1 of 3) **</b>  |  |
| 27        |                 | <b>Final Project Presentations (part 2 of 3) **</b>  |  |
| 28        |                 | <b>Final Project Presentations (part 3 of 3) **</b>  | <b>Essay</b> off-campus students             |

\* 10 min presentation, 5 min. Q&A per team

\*\* 20 min presentation, 10 min. Q&A per team

The submission date of the final report will be announced.

## Course Grade

|  | On-Campus students | Off-Campus students |
|--|--------------------|---------------------|
| <b>Total Team Grade</b>  | <b>50</b>          | <b>50</b>           |
| 1 <sup>st</sup> Report & 1 <sup>st</sup> Presentation (only on-campus students; therefore they have 2 more points) | 12                 | 10                  |
| 2 <sup>nd</sup> Report   | 9                  | 9                   |
| Final Presentation   | 6                  | 6                   |
| Final Report   | 15                 | 15                  |
| Team Effort (grade assigned by team members)   | 8                  | 10                  |
| <b>Total Individual Grade</b>  | <b>50</b>          | <b>50</b>           |
| Six HW Problems (5 pts each)   | 6x5 = 30           | 6x5 = 30            |
| Two Book Chapter Reviews (5 pts each)  | 2x5 = 10           | 2x5 = 10            |
| Class Participation {An essay for off campus students}   | 10                 | 10                  |

**Team Effort:** Each team members confidentially divides the points (8 for on-campus and 10 for off-campus students) between all members; usually all members contribute equally and will receive the full points. If a student contributed less than the average by the judgment of the others, he/she will not have the full 8 (or 10) points. If a member contributed above the average, he/she may receive more than 8 or 10 points. (We give to off-campus students more points because their communication effort is larger.)

**Chapter Reviews:** Submit two chapter reviews. Tell us what you liked and what you did not like in the reviewed chapter. Tell us about your industrial experience that supports or contradicts the theory and claims in this chapter. A typical review will be about one to two pages. 1<sup>st</sup> review – any chapter between 1 through 7; 2<sup>nd</sup> review – any chapter from 8 through 14.

**Essay:** Off-Campus students with industrial experience have to write an Essay that elaborates on their work experience with relationships to the book material (two to three pages). Elaborate on whether your industrial experience supports or contradicts the text. Discuss issues such as: How to link the knowledge of this class to your real work experience. Does the book give you new ways to think about your job, your work matters and concerns? Do you think that the business decisions and global strategies of your company fit the book concepts?

**Class Participation:** The class format includes discussion; we encourage questions, debates and original thoughts about the material. On-Campus students will have 10 points reflecting their oral participation and contribution to the class discussion as well as their class attendance. Please prepare a small “tent” with your name and put it in front of you in the class.

## Class Discussion Topics

We ask the students to read the appropriate chapter before the class and be ready for class discussion on the following topics.

| <i>Session #</i> | <i>Chap. #</i> | <i>Class Discussion Topics</i>   |
|------------------|----------------|--|
| 2                | 1              | <ul style="list-style-type: none"> <li>▪ When should a company use dedicated lines and when use FMS?</li> <li>▪ What is the ideal, still practical sequence of Design-Make-Sell?</li> <li>▪ Will the loop in Fig. 1.14 be closed in the future?</li> <li>▪ Is the speed of responsiveness really important in globalization?</li> </ul>  |
| 3                | 2              | <ul style="list-style-type: none"> <li>▪ Give an example of a possible paradoxical product?</li> <li>▪ Give an example of a possible supplementary function that you suggest to add to an existing product?</li> <li>▪ Should the high-tech capsule be defined as a disruptive technology?</li> <li>▪ Problem 2.4: How would you divide your budget?</li> <li>▪ How would you classify the invention in the picture of Problem 2.5?</li> </ul> |
| 4                | 3              | <ul style="list-style-type: none"> <li>▪ What are the main obstacles in implementing automobile interior design?</li> <li>▪ Discussion on Problems 3.3 and 3.4 – scooters, wheelchairs, bicycles.</li> </ul>   |
| 5                | 4              | <ul style="list-style-type: none"> <li>▪ How does the model in Fig. 1.11 fit the Mass Production paradigm? What was the society need in 1914? What was Ford's business model?</li> <li>▪ Do we have to eliminate all buffers to implement Lean Production?</li> <li>▪ Have you seen examples in which JIT worked or did not work?</li> </ul>   |
| 6                | 5              | <ul style="list-style-type: none"> <li>• Mass Customization, Problem 5.3 – do you agree with Mr. Lutz's comment?</li> </ul>  |
| 7                | 6              | <ul style="list-style-type: none"> <li>• Would you recommend building dedicated transfer lines in the 21<sup>st</sup> Century</li> </ul>   |
| 10               | 8              | <ul style="list-style-type: none"> <li>▪ When would you justify deploying Reconfigurable Machines?</li> </ul>  |
| 16               | 9              | <ul style="list-style-type: none"> <li>▪ Why doesn't industry apply the backwards conveyor in Fig. 9.11?</li> </ul>  |
| 19               | 11             | <ul style="list-style-type: none"> <li>▪ Discussion on Fig. 11.1 – business model. What would you add to Fig. 11.1?</li> <li>▪ Discussion on the questions at the end of each of the two case studies.</li> </ul>  |
| 20               | 11             | <ul style="list-style-type: none"> <li>▪ For the product that you selected as a class project, what are the anticipated issues in building a global supply chain?</li> </ul>   |
| 22               | 12             | <ul style="list-style-type: none"> <li>▪ Do you think that large manufacturing companies should adopt the Army's organizational structure?</li> </ul>  |
| 23               | 13             | <ul style="list-style-type: none"> <li>▪ What are the most compelling reasons to Iscar's global success?</li> <li>▪ What are the issues with Globalization? Who does not benefit?</li> <li>▪ A discussion on Problem 13.1 – dollar-Yuan exchange rate.</li> </ul>  |

Textbook:

**The Global Manufacturing Revolution, by Yoram Koren**

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