Competitive Sustainable Manufacturing

**Personalized Production Paradigm**

Exactly the product needed …

… Exactly when needed

Yoram Koren

Manufacturing Paradigms

Our society experienced three manufacturing paradigms:

- **Craft Production**
- **Mass Production**
- **Mass Customization**

and more recently the emerging paradigm of **Personalized Production**

The personalized production paradigm can sustain a strong auto industry in the US and Europe, and create new Small Business industries

Product-Process-Business

Manufacturing enterprises contain three main elements:

- **Product**
- **Process**
- **Business**

And three main corresponding actions:

- **Design** the product
- **Make** the product
- **Sell** the product

**Competitive Sustainable Manufacturing**

1. **How can the US and Europe sustain manufacturing jobs?**
   Products in which short delivery time is critical will be produced domestically

2. **How can we create new Small Business (SB) mfg. industries?**
   Products of **large-variety & small-volume** to be produced by domestic SB

3. **How can the US and Europe sustain a strong auto industry?**
   A new direction to the auto industry, of which domestic manufacturing is advantageous because it requires a short delivery time

   We will show that a new paradigm of personalized design of automobile interiors responds to these issues

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#2
What are the Possible Sequences?

There are only three possible sequences!
And each sequence defines a paradigm

Three Paradigms

Is it possible to define a new paradigm?

Two Phases in Personalized Kitchens

A. Modules are designed by the manufacturer

P. The personalized kitchen is designed by the customer

Product Design Phases in the personalization paradigm

The product design in the personalization paradigm has two phases:

- An initial phase, Design (A), in which the product architecture is designed, and the range of modules is established.
  This design phase is a strategic decision done by the manufacturer.
- The personalized design phase, Design (P), in which the final tailored-design takes place with close interaction with the customer.
Mass Customization & Personalization

The manufacturer designs the options.

- Design
  - Product Options
  - Design
    - Architecture and Modules
  - Personalized Design
    - Customer Involved
  - Make
    - One Option
  - Make
    - One Unique Product

Push-Pull Model

- Customer involved
  - The customer designs the option.

Paradigm Transition

- Push
- Pull

- Mass Customization: Design, Sell, Make
- Personalized Production: Design, Sell, Make
- Mass Production: Design, Sell, Make

Paradigm Changes

- The opening of the moving assembly line by Henry Ford in 1913 in Dearborn, Michigan, started the mass production paradigm.

Mass Production of Automobiles

- In 1955, seven (7) million vehicles were sold in the U.S. Ford, GM and Chrysler accounted for 95% of sales. Eight (8) models accounted for 80% of all cars sold.

The auto industry is still using the serial moving assembly line, 100 years after its invention.
Changeable Automobile Interior

Customer’s Fit Into His Car Interior

Customers’ Wishes of Their Automobile Interior

- Dog bed
- GPS
- File cabinet
- Additional storage area
- Air bags inside the safety belt
- Folding table
- TV
- Refrigerator
**Personalized Car Interior – System Concept**

Database of Interior Components

- File cabinet
- Computer station
- Weight storage
- Microwave
- Refrigerator
- Bed
- Folding table
- Dog basket
- Clothing-racks
- Portable-potty for kids

**Small Business Industry for Car Modules**

Should be Open-Architecture standards for
- Mechanical
- Electrical
- Information

Module interfaces are designed according to the open-architecture standards

**Challenge #1: Creating New CAD Technologies**

INTERACTIVE DESIGN DOMAIN SYSTEM

- Anthropometry
- Interative Visualization

INTERACTIVE VISUALIZATION

- Realistic Imaging
- 3D Immersive Environment
- Interactive Environment

FEEDBACK
- Psychology
- Physiology
- Aesthetic
- Design Conflicts
- Safety
- Mfg. Constraints

**Paradigm Transitions Over Time**

Serial Assembly Line

- Invented in 1913

**Challenge #2: Reconfigurable, Non-Serial Assembly system**

Optimal Manufacturing System

- Serial Assembly Line
  - Invented in 1913

General-Purpose Machine Tools
The Number of Possible Configurations

Configurations of assembly systems with 5 stations. In practice there may be over 50 stations.

**Challenge:** How to design a configuration which is not a serial line.

Reconfigurable Manufacturing System - Example

A RMS is a system designed at the outset for rapid changes in structure, in order to quickly adjust production capacity and functionality when needed.

A Reconfigurable Assembly System – an Example

Ford's serial assembly line that was invented in 1913, should be substituted.

Example: Reconfigurable Assembly System

Another example of assembly system of personalized automobile interiors.

This layout resembles the layout of a reconfigurable shoe factory in Italy.
Reconfigurable Shoe Factory

Example of the shoe factory in Vigevano, Italy
Fast delivery of personalized shoes

Personalized Production –
A Competitive Sustainable Manufacturing

Summary

Personalized Products – the buyers are actively involved in the design of their products

Two engineering challenges to make the personalized paradigm a reality

**Challenge #1: Creating New CAD Technologies**

Exactly the product needed …

Exactly when needed

**Challenge #2: Reconfigurable Assembly System**