RIETI
Research Institute of Economy, Trade & Industry, IAA

# RIETI BBL Seminar Handout

## "Modularity in New Market Formation"

May 30, 2016

Speaker: Ronald Sanchez

# Modularity in New Market Formation

## RIETI Seminar

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## SUMMARY

Research has shown that use of modularity concepts in product and process designs not only ***enables new kinds of organizational capabilities and market strategies,*** but also ***transforms the structures and dynamics of industries*** in ways that can make industries more efficient, adaptable, and capable of rapid growth.

In this seminar we consider the role that ***government policies supporting "modular industries"*** can play in fostering the development of new product markets and the growth of associated industries. We use the case of the rapid rise of the Electric Two-wheeled Vehicle (E2WV) market and industry in China as an illustrative example.

# Outline

- What is *modularity*?
- How does modularity enable *new kinds of firm capabilities and market strategies*?
- How does modularity enable *new kinds of market structures and industry dynamics*?
- How can modularity become an important component of *industrial policies supporting new industries and technological development*?

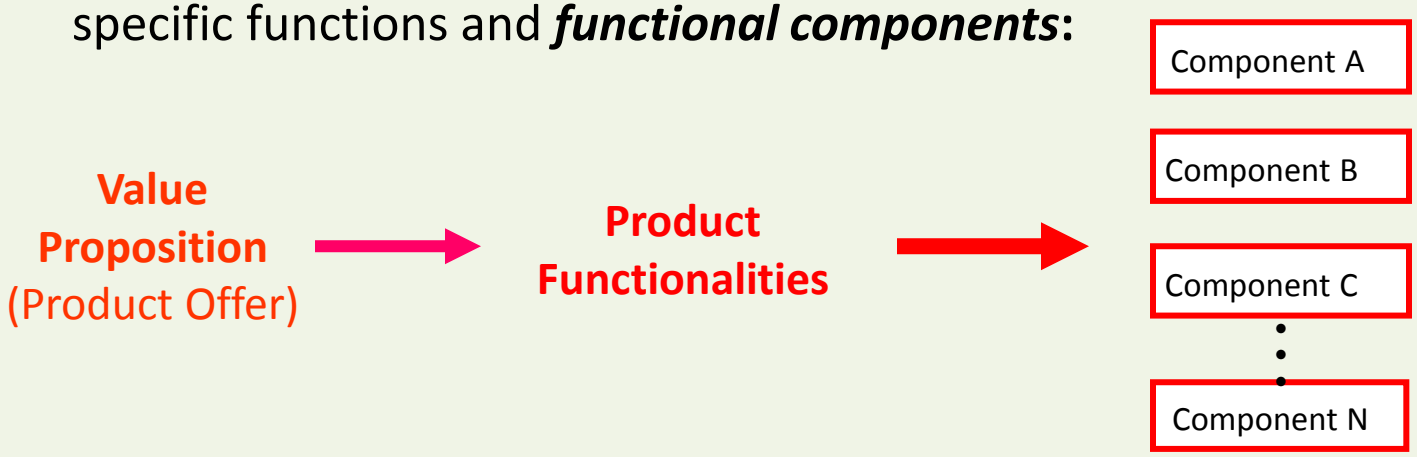
# • What is *modularity*?

***Modularity*** is a special kind of ***product and/or process architecture*** designed to enable rapid configuration of new product and process variations, and rapid technological development of improved and higher-performing product variations.

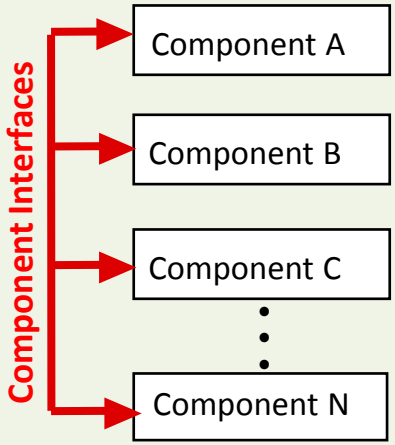
To explain modularity, we first have to define ***product and process architectures***.

## Product Architecture:

1. A decomposition of the overall functionalities of a product into specific functions and ***functional components***:

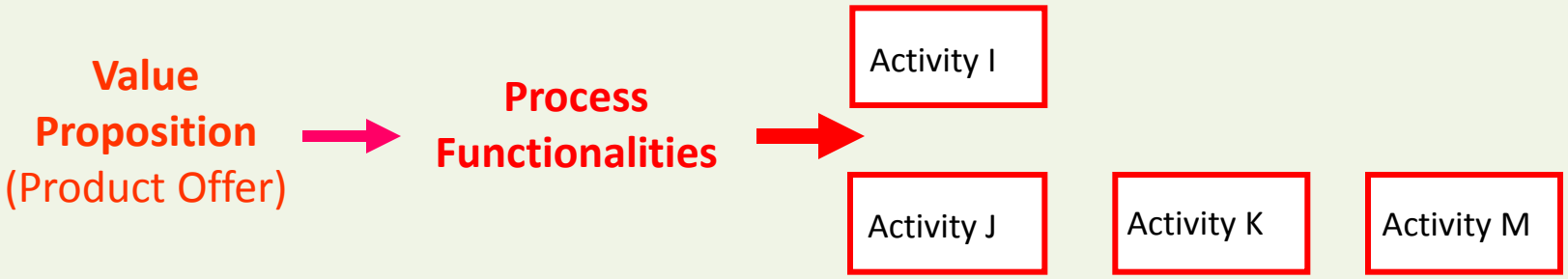



2. The full specification of the ***component interfaces*** – i.e., the inputs and outputs of each component – that define how components *interact* in the *product as a system*:

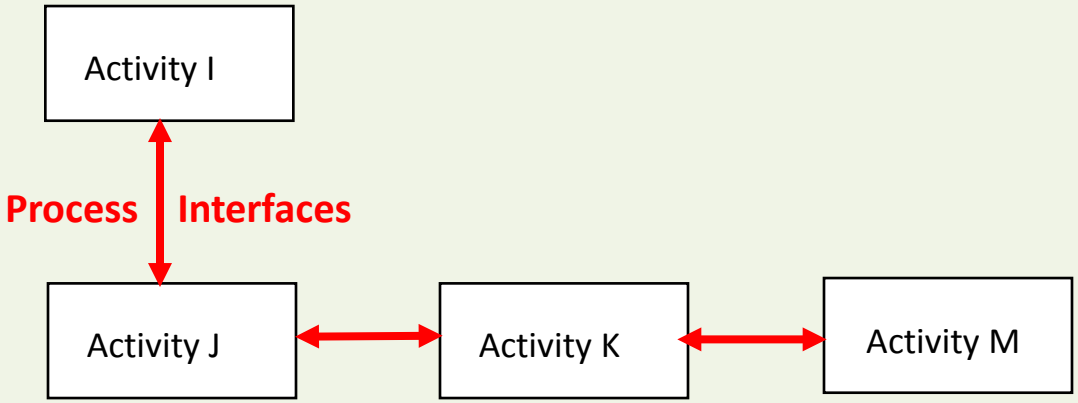


## Process Architecture:

1. A decomposition of the overall functionalities of a process into specific functions and ***functional activities***:




2. The full specification of the ***process activity interfaces*** – i.e., the inputs and outputs of each activity – that define how various process activities *interact* in the *process as a system*:



# • What is *modularity*?

Product and Process Architectures become ***modular*** when

(i) The way the product or process architecture is decomposed into functional components is ***standardized*** – i.e., all product and process variations use the ***same kinds of functional components***.

*and*

(ii) The ***interfaces*** between the functional components are
- specified to allow the ***substitution*** of a range of component variations,
- ***standardized*** (i.e., not allowed to change) for the intended lifetime of the architecture.

- How does modularity enable *new kinds of firm capabilities and market strategies*?

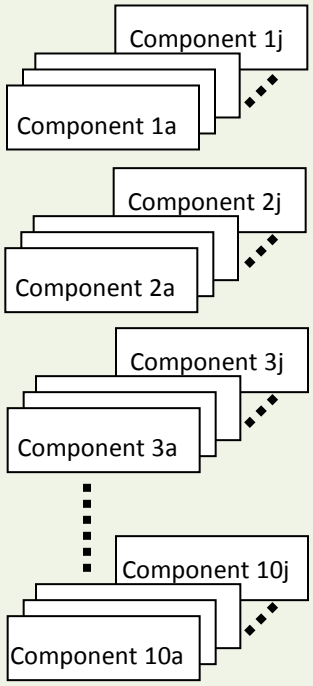
***Modular Product and Process Architectures*** become ***"Strategic Platforms"*** for ***proliferating product variety*** and for ***rapid technological upgrading*** when the product and process architectures are ***strategically partitioned*** to

- Achieve a ***"One-to-One Mapping"*** of specific customer benefits into individual modular components or subsystems

- Technically decouple components to ***"Contain" product variety and technological change*** in individual components

- How does modularity enable *new kinds of firm capabilities and market strategies*?

Consider a modular product architecture composed of 10 standard component types, each of which has 10 different component variations.




This set of

***100 modular components***

can configure

**10,000,000,000 product variations**

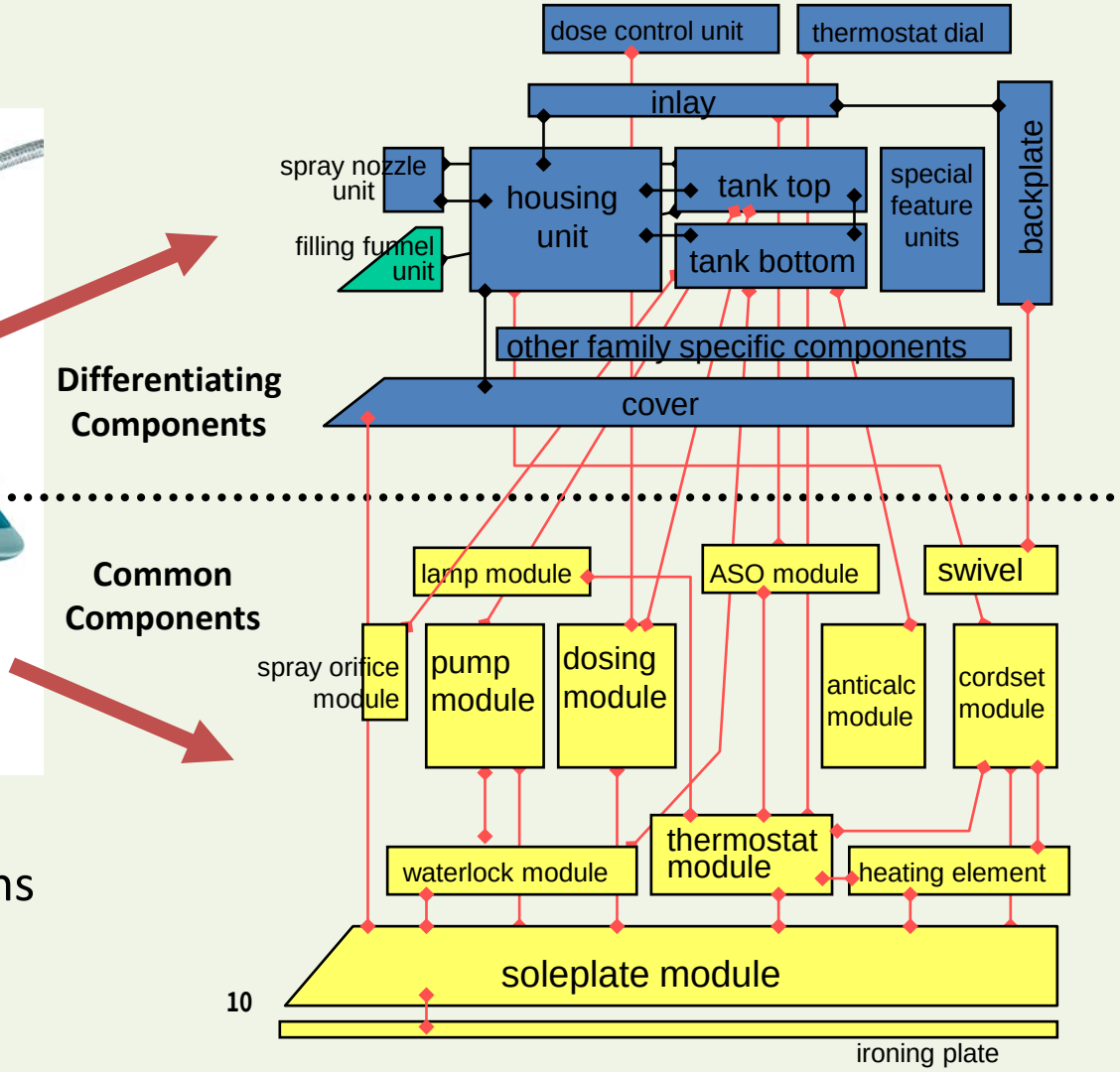
*Example: European Truck Architectures*

• How does modularity enable *new kinds of firm capabilities and market strategies*?

## ***Strategic Partitioning*** of a ***Modular Platform*** into (i) Mass-Produced Common Components and (ii) Differentiating Components enables a broad range of product variety to be produced ***at Low Cost***

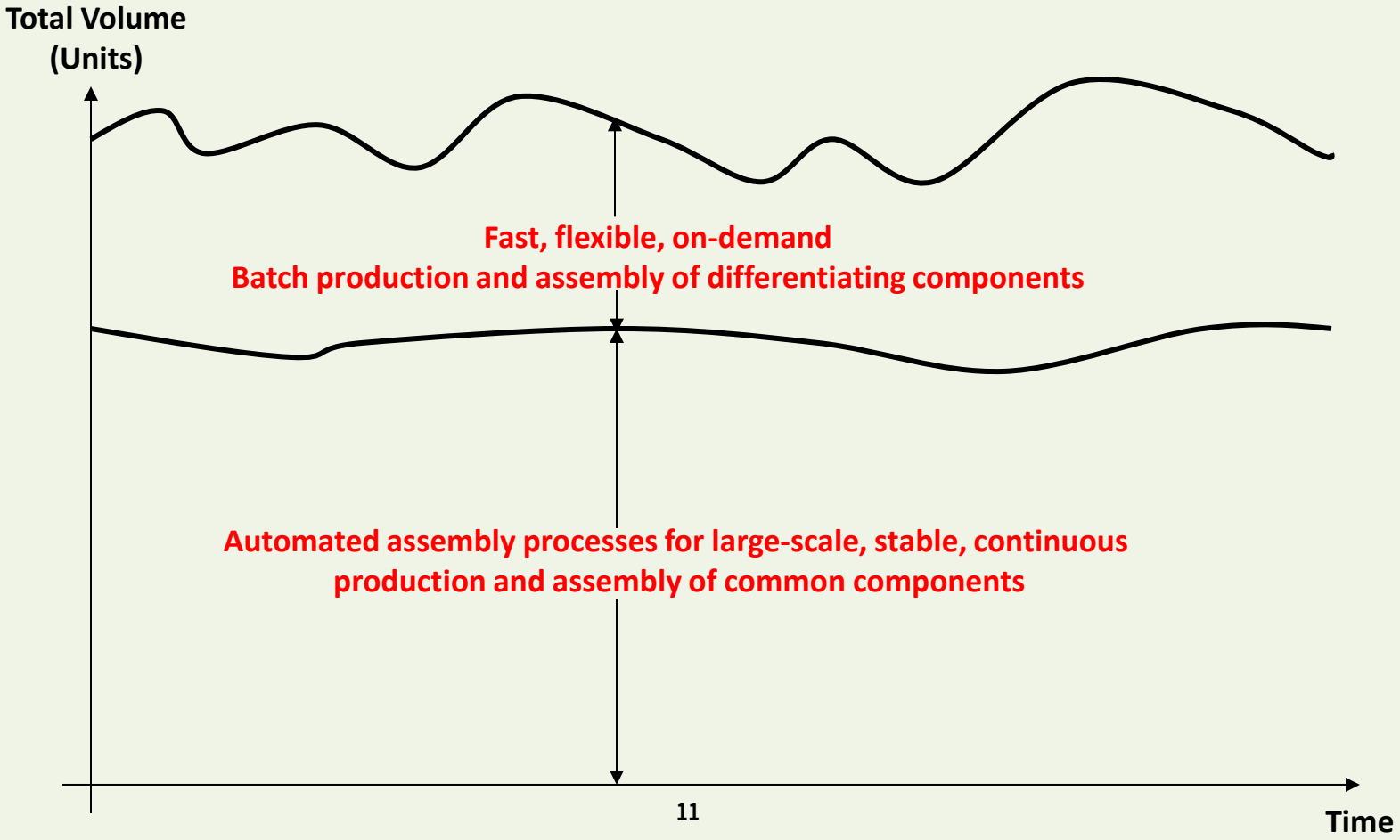

Example:

Philips Elance and Mistral Irons



- How does modularity enable *new kinds of firm capabilities and market strategies*?

# Strategic Partitioning of Modular Platform Architectures Enables Mass-Production of Stable Common Components and Flexible Batch Production and Assembly of Differentiating Components



- How does modularity enable *new kinds of firm capabilities and market strategies*?

## Product Strategy Objectives (Design and Development):

- **Increase product variety** by designing in greater configurability
- **Improve product performance** by designing in rapid technological upgrading
- **Increase speed to market** by adopting the modular development process
- **Reduce design and development costs and time** through disciplined re-use of existing component designs
- **Reduce product costs** through component commonality and design for re-use
- **Improve predictability** of new product introductions

## Process Strategy Objectives (Operations):

- **Reduce production costs** through modular design for assembly
- **Reduce customers' operating costs and complexity** by maintaining commonality of customers' knowledge and skill base

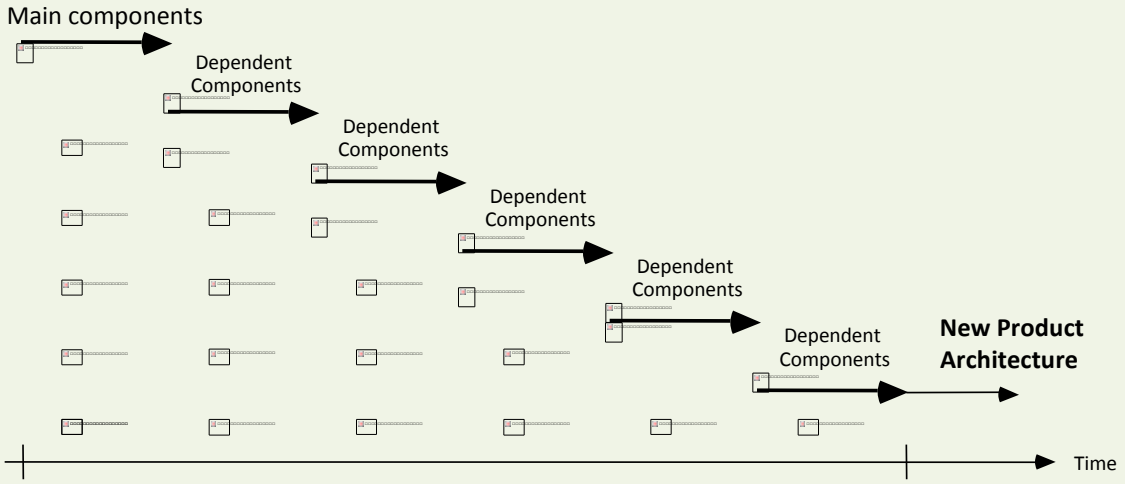
## Management Process Objectives (Organization):

- **Reduce management complexity and costs** by using well specified modular architectures to coordinate development, sourcing, and customer support processes -- both out-sourced and in-sourced

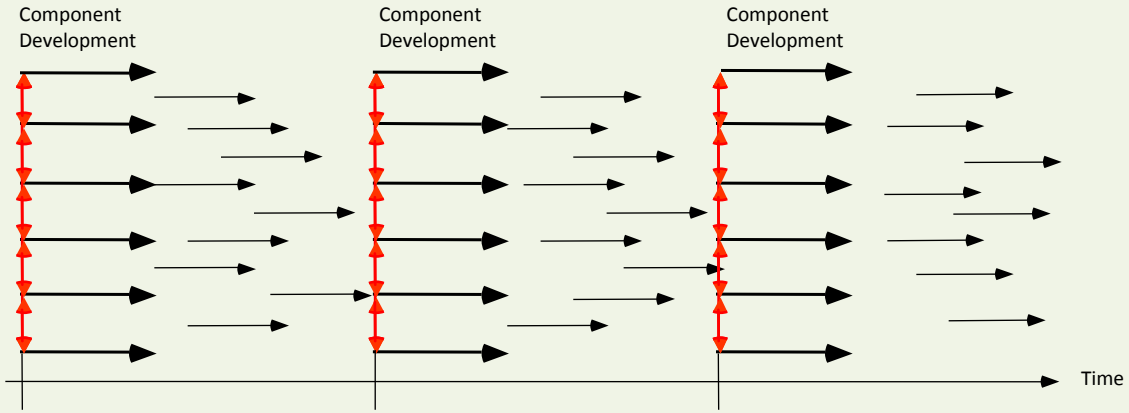
- How does modularity enable *new kinds of firm capabilities and market strategies*?

# Conventional New Product Development versus Modular Development Processes

**Conventional Approach** to Product and Technology Development




**Modular Approach** to Product and Technology Development




**"Decoupled" Technology Development**

Reference: Sanchez and Mahoney (1996), *Strategic Management Journal*.

• How does modularity enable *new kinds of firm capabilities and market strategies*?

# Results of applying Modular Platform Strategy in Philips' Powered Toothbrush Business:

✓ **Product Variations Increased from <100 to 300+**

✓ **48% Reduction in Delivered Cost/Unit**

✓ **Lead Time Reduced from 6 weeks to 5 Days**

✓ **Order Fulfillment Increased from 80% to 99%**

SENSIFLEX 1000 SERIES

HX 1520

HX 1525

SENSIFLEX 2000 SERIES

HX 2520

HX 2540

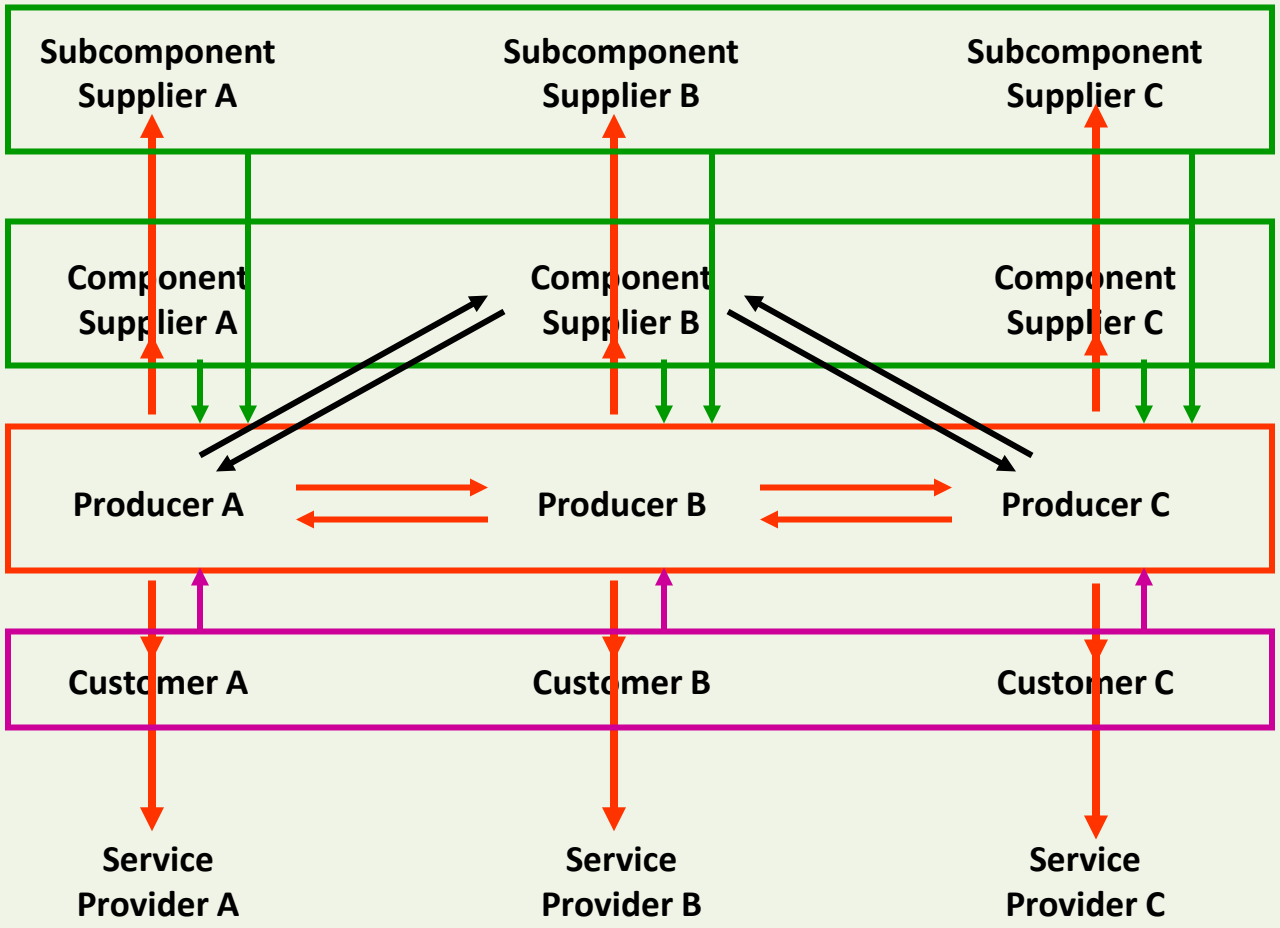
HX 2550

SENSIFLEX DENTAL CENTER

HX 2740

- How does modularity create *new kinds of market structures and industry dynamics*?

## "Modular Industry" Structure and "Coopetition" Dynamics Enabled by Adoption of Standard Modular Platforms



- How can modularity become an important component of *industrial policies supporting new industries and technological development*?

Some "Modular Industry" Benefits that can be Supported by Industrial Policies Promoting Collaboration Among Firms in Establishing Industry-Standard Modular Platforms

- Greatly reduced costs and risks of development and production
- Greater product configurability: More product variety
- More rapid upgrading of product performance through ready incorporation of technologically improved components
- Reduced time to market through concurrent development
- New marketing methods: Real-time market research
- Building long-term customer relationships by "designing in" scalability, upgradeability, extensibility, connectivity
- Reduced costs of complementary goods and services
- Less risk to individual firms at every level of industry structure

- How can modularity become an important component of *industrial policies supporting new industries and technological development*?

## Key Policy Industrial Objectives in Promoting Cooperation Among Firms in Defining Common Architectural Standards

1. Adoption of ***standard way of decomposing product designs*** into functional components: Removes architectural uncertainty that encourages establishment of supplier base

2. Adoption of ***standard types of component interfaces***: Encourages more rapid technological development of components and assures "technical equivalence" of functional components across industry

3. Adoption of ***standard modular interface specifications***: Enables "plug and play" compatibility of standard types of common components in all cooperating firms' product designs

- How can modularity become an important component of *industrial policies supporting new industries and technological development*?

## Lessons from the Electric Two-Wheeled Vehicle (E2WV) Industry in China 1998-2009


**Figure 2: E-Bike and E-Scooter versions of E2WVs**
(Source: Yu, Hang, and Ma 2010)

*Reference:*
R. Sanchez and C.C. Hang (2016), "Modularity in New Market Formation: Lessons for Technology and Economic Policy and Competence-Based Strategic Management," forthcoming in *International Journal of Applied Management Science*.

# Lessons from the Electric Two-Wheeled Vehicle (E2WV) Industry in China 1998-2009

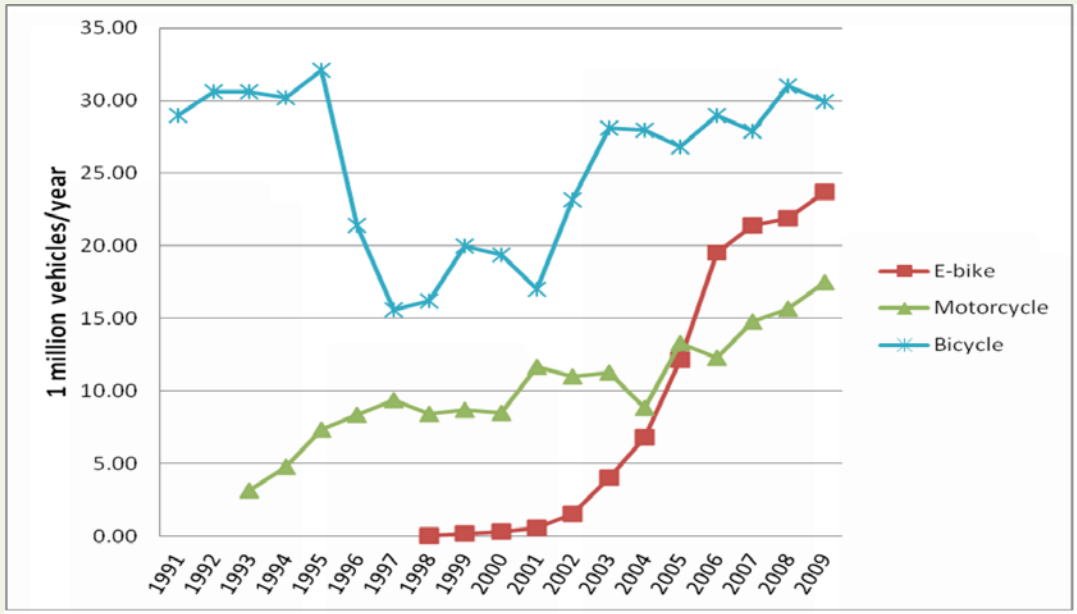



**Figure 1: Sales of Bicycles, G2wVs, and E2WVs in China, 1991-2009**
**Source: Ruan, Hang, Wang, and Ma (2012)**

*Reference:*

R. Sanchez and C.C. Hang (2016), "Modularity in New Market Formation: Lessons for Technology and Economic Policy and Competence-Based Strategic Management," forthcoming in *International Journal of Applied Management Science*.

- How can modularity become an important component of *industrial policies supporting new industries and technological development*?

# Key Policy Initiatives that Resulted in Common Architectural Standards for New E2WV Industry in China, 1998-2009

1. Adoption of ***standard way of decomposing product design*** into functional components: Various government regulations assured that E2WVs would be built on standard pedal-bicycle frames, assuring ready access to and growth of a supplier base -- and "reuse" of "off the shelf" electric motors, sprocket drives, bicycle frames, and other components by new E2WV industry.

2. Adoption of ***standard types of component interfaces***:
   Regulations limiting power of electric motors used on E2WVs effectively standardized existing ways of connecting batteries to motors and motors to chain drives in E2WV industry.

3. Adoption of **standard modular interface specifications**:
   Enabled rapid technological development of higher-performing batteries and controllers as industry-standard common components that could "plug and play" in all product designs in the E2WV industry.

# Thank You!

# Questions and Discussion