Capability, Architecture, and Industrial Competitiveness
- Implication to Vietnam-Japan Cooperation -

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Takahiro Fujimoto

Professor, Faculty of Economics, University of Tokyo
Executive Director, Manufacturing Management Research Center
Senior Research Associate, Harvard Business School
Manufacturing Management Research Center, University of Tokyo (2003 -)

Manufacturing Management Research Center
THE UNIVERSITY OF TOKYO
8F 3-34-3 Hongo, Bunkyo-ku, Tokyo, 113-0033, Japan
Tel: +81-3-5842-5501 Fax: +81-3-5842-5536
E-mail: info@mmrc.e.u-tokyo.ac.jp
Framework: Design Information View

Key Concept: Design Information = Value

A firm’s products and processes are artifacts that have been designed.

Manufacturing is essentially creation and transmission of design information to customers.

A firm’s manufacturing (monozukuri) capability is its distinctive ability to handle flow of design information toward customers.

Product-process architecture is designers’ basic way of thinking when creating design information for the product and processes.

“Design” is the common denominator for these analyses.
Design Information View: Interdisciplinary Background

Technology and Operations Management (Innovation Management)

Evolutionary Theory of Firms

Resource-Capability View of the Firm in Strategic Management

Product-Process Architecture in Engineering

Combining Design Concept in Engineering and Trade-Industry Policy

Fit between Organizational Capability and Architecture

- Design-Based Comparative Advantage

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1 Performance Measurement -- A Multi-Layer Approach

2 Organizational Capability -- A Design Information View

3 Product-Process Architecture

4 Capability-Architecture Fit -- Explaining Competitiveness
1 Measuring and Analyzing Industrial Performance -- From Competitiveness to Profitability

**Figure 12** Capability, Competitiveness, and Profitability

- **Organizational Capability**
  - organizational routine
  - Arena of Capability-building Competition

- **Productive Performance**
  - productivity
  - lead time
  - conformance quality etc.

- **Market Performance**
  - price
delivery
perceived quality etc.

- **Profit Performance**

Other factors of environments and strategy

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Example: Productive Performance of Japanese Auto Firms

Adjusted Engineering Hours (Product engineering)

Adjustment method:
(1) # of body types=2, (2) New design ratio=0.7, (3) Suppliers’ contribution=0.3, (4) Product class=compact/sub-compact
The Architecture - Capability Framework

1. Performance Measurement -- A Multi-Layer Approach

2. Organizational Capability -- A Design Information View

3. Product-Process Architecture

4. Capability-Architecture Fit -- Explaining Competitiveness
2 Toyota’s Manufacturing Capability as Effective Information-Processing

Toyota’s manufacturing capability -

Dense and accurate design information transmission by Teamwork of multi-skilled workers (stable employment).

(1) Higher Productivity and Shorter Throughput Time (TPS)

Mudais unnecessary non-transmission time, which includes inventory, over-production, and defects on the information receiver side.

(2) Higher Manufacturing Quality (Lower Defect Rate) (TQM)

Building-in quality: Errors of information transmission are avoided in the first place (vs. inspection).

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(1) Higher Productivity and Shorter Throughput Time

Organizational Capability Regarding Productivity and Throughput Time (Toyota)
The Architecture - Capability Framework

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4 Capability-Architecture Fit -- Explaining Competitiveness
3 Architectural Thinking and Industrial Classification

Supplementary industry classifications
-- based on product-process architecture

*Product architecture*,
Basic way of thinking of engineers
when they design **functions** and **structures** of a new product
Basic Classifications of Product-Process Architecture

**Modular architecture**

*one-to-one correspondence*

between functional and structural elements

- Computing
- Projection
- Printing

---

**Integral architecture**

*many-to-many correspondence*

between the functional and structural elements

- Handling
- Ride
- Fuel Efficiency

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**Open architecture**: “mix and match” of component designs across firm

**Closed architecture**: mix and match only within a firm

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Three Basic Types of Product Architecture

- **Closed-integral**
- **Open-modular**

![Diagram showing three basic types of product architecture: Closed-Integral, Open-Matrix, and Closed-Modular.](image)
Closed-Integral Architecture (Car)

Modular Integral

Small cars

Compact consumer electronics

Internet

Bicycle

LEGO (building-block toy)

Motorcycle

Machine tools

Figure 6  Basic Types of Product Architecture

Open

Game software

Mainframe computer

Personal computer (PC)

PC software

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### Open-Modular Architecture (PC)

<table>
<thead>
<tr>
<th>Modular</th>
<th>Closed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Cars</td>
<td>Compact Consumer Electronics</td>
</tr>
<tr>
<td>Internet</td>
<td>Bicycle</td>
</tr>
<tr>
<td>LEGO (Building-Block Toy)</td>
<td>Motorcycle</td>
</tr>
<tr>
<td>Machine Tools</td>
<td>Game Software</td>
</tr>
<tr>
<td>Mainframe Computer</td>
<td>Personal Computer (PC)</td>
</tr>
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</tbody>
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Figure 6: Basic Types of Product Architecture

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Closed-Modular Architecture (Mainframe Computer)
The Architecture - Capability Framework

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4 Capability-Architecture Fit --- Explaining Competitiveness

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4 Hypothesis: Capability-Architecture Fit at National Level

A group of firms in the same country or region, facing similar environmental constraints, national-regional institutions, demand patterns or other forces specific to a particular geographical area may develop similar types of organizational capabilities.

Products with the architecture which fits this organizational capability tend to demonstrate competitive advantage (if not profitability).

History matters.
Ratio of Export and Integral Architecture Index Scatter chart
(Regression Equation Number 1 assembly products 52sample)
Predictions on Architecture-based Comparative Advantage

**Japanese firms -- integration capability**
More competitive in products with *closed-integral architecture.*
Based on *integration-based manufacturing capability*

**Chinese firms -- mobilization capability**
More competitive in labor-intensive products
With *open-modular (or quasi-open) architecture*

**Korean (large) firms -- concentration capability**
More competitive in capital-intensive products
With *modular architecture* (moving toward *integral*?)

**ASEAN firms -- labor-retaining capability??**
More competitive in labor-intensive products
With *closed-integral architecture?*

**U.S. firms -- conceptualization capability**
More competitive in knowledge-intensive products
With *open-modular architecture*

**European firms -- expression capability**
More competitive in *closed-integral products*
Based on *brand-design-marketing capability*

--- What about Vietnam??
Architectural Geopolitics:
A Prediction in the Pacific Region

Integral Axis

Modular Axis

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Potentials of Manufacturing in Vietnam

Excellent quality of **Workers and Engineers**. Tenacious, Low Turn-Over, Low Wage

Can Firms Hire High-quality **Multi-skilled Workers** at 100 Dollar per Month?  
--- Difficult in Southern China, but Possible in Vietnam

Growing Number of Vietnamese Production and Design Facilities  
by Prominent Japanese Firms (Toyota, Denso, Canon, Honda…)  

**Toyota Motor Vietnam** --- Good operation with 10K units per years.  
Skilled stamping and welding workforce

**Denso Manufacturing Vietnam** --- Amazingly Low Turn-Over of CAD operators  
(College Graduates)

**Canon Vietnam** --- Rapidly Shifting Production Capacities from China to Vietnam

**Consumers Tend to Appreciate Sophisticated Goods with Integral Architecture**  
(Vietnamese Motorcycles vs. Chinese Motorcycles)

**Vietnamese Manufacturing Culture Emphasizing Cleanliness and Concentration ---**  
Good fit with the Japanese Manufacturing Philosophy

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Implication to Vietnam-Japan Relations: Multi-Skilled Human Resource is Key

Strength/Attractiveness

1. **High Quality Multi-Skilled Workforce** – Concentration, Tenacity, Low Turn-Over
2. **Education system**: High-school (worker) and college graduates (engineers)
3. **Similarity in Manufacturing Culture** – Steady Improvement, Trust, Cleanliness

Weakness/Problems seen by Japanese firms

1. **Infrastructure (transportation)** – Danang–Burma, Hanoi-China Highway?
2. **Supplier Base is Still Underdeveloped (vs. Thailand)**
3. **Government Policies Are Sometimes Unpredictable/Unstable to Firms**

Possibility of Cooperation

1. **Systematic Training for Multi-Skilled Workers** --- ODA should focus on this.
2. **Improvement of Infrastructure** (Vietnam-China-Thailand-India Corridor?)

Differentiation from China in **Organizational Capability** and **Product Architecture** is key.

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Implications to Industrial Policies

The post-war Japanese industrial policy tended to be oriented to “full set” industrial development.

But this policy often meant protective industrial policies.

It has become unrealistic to maintain the full-set industrial policy.

The government has to infuse strategic thinking into its industrial policy by discerning strength and weakness of the Japanese firms. Capability-architecture framework may help this initiative.

Industrial policy-makers need to select sectors with good capability-architecture fit, identify best-practice firms in such sectors, establish alignment between the industrial policy and the firms’ best-practice, and stimulate capability-building competition (not only price competition).

That is, shift to “front-runner-oriented industrial policy”

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Conclusion

Design-Information View of Manufacturing (Monozukuri)

Competitiveness at Surface and Deep Levels

Capability-Building Competition

Integration-Based Organizational Capability (Teamwork of Multi-Skilled Workers)

Product Architecture – Modular and Integral, Open and Closed

Capability-Architecture Fit Leads to Comparative Advantages

Geopolitical Hypotheses of Design-Based Comparative Advantage in Asia

Front-Runner-Oriented Policies for Industrial Promotion

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Reference


