Organizing and Managing Modular Strategies and Development Processes

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Some perspectives:

• Achieving the full benefits obtainable from modular product strategies requires *new kinds of organization designs* and adoption of new *modular management processes*.

• Implementing modular organization designs and modular management processes requires *systemic change* in the ways organizations work and the ways managers manage.

• Most organizations using modularity *have not undergone* the systemic organizational and management changes needed to achieve the full benefits of modular product strategies.

• The biggest impediments to achieving the full benefits of modular strategies are
  -- *Lack of real understanding* of modularity strategies
  -- *Lack of leadership* in making systemic changes to traditional organization designs and management processes

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Key Questions Addressed in this Presentation

I. What are the essential features of well-functioning modular strategies and development processes?

II. What are the most common failures of firms to implement effective modular strategies and development processes?

III. What level of modularity maturity is your organization?
I. What are the essential features of well-functioning modular strategies and development processes?

1. All managers and developers correctly understand what modularity means and how modularity strategies work.
2. All managers and developers correctly understand the “New Rules and New Roles” of modular development processes.
3. Modular development processes start only when new product specifications and technology choices have been frozen.
4. The first steps in the modular development process are strategic partitioning and strategic specification of interfaces.
5. Strategic-level managers are directly involved in decisions of strategic partitioning and standardizing interfaces.
6. The modular development process is disciplined and adheres to the “New Rules” for developing modular products.
7. Organizational learning about product performance is captured in improved component designs and interface specifications.
I. *Essential features* of modular strategies and development processes

(1) All managers and developers correctly understand *what modularity means* and *how modularity strategies work*.

Example:

European auto manufacturer *versus* Philips Oral Health Care
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

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I. Essential features of modular strategies and development processes

Product Architecture:

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

   Value Proposition (Product Offer) → Product Functionalities

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:
I. **Essential features** of modular strategies and development processes

**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:
1. **Essential features** of modular strategies and development processes

Product and Process Architectures may have *two levels of modularity:*

**Technical Modularity:**
The *interfaces* between components are
- specified to allow the *substitution* of a range of component variations
- *standardized* (i.e., not allowed to change) for some period of time

**Strategic Modularity:**
Product and process *architectures* are *strategically partitioned* to
- Achieve a *“One-to-One Mapping”* of specific customer benefits into individual modular components or subsystems
- Interfaces are specified to technically decouple components to *“Contain” product variety and technological change* in individual components

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I. **Essential features** of modular strategies and development processes

Coordinated “Platform” of Modular Product and Process Architectures

(Source: Sanchez 1999)
I. **Essential features** of modular strategies and development processes

(2) All managers and developers correctly understand the **“New Rules and New Roles”** of modular development processes.

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“Fast-Cycle” Modular Development Process

(Adapted from Sanchez and Mahoney 1996)
I. Essential features of modular strategies and development processes

Stages in New Product Development

Traditional Product Development:

R+D → Proof of Concept → New Product Development

Modular Architecture Development:

R+D → Proof of Concept → Technology Development → Proof of Component → Architecture Configuration

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I. What are the *essential features* of well-functioning modular strategies and development processes?

(3) Modular development processes start only when *new product specifications and technology choices have been frozen.*
I. What are the *essential features* of well-functioning modular strategies and development processes?

(4) The first steps in the modular development process are *strategic partitioning and strategic specification of interfaces.*
I. Essential features of modular strategies and development processes

Example of Strategic Partitioning of a Modular Architecture into Differentiating Components and Stable Components, with “One to One Mapping” of functions into single components
I. **Essential features** of modular strategies and development processes

**Strategic Partitioning** can be motivated by a number of **Strategic Objectives**:

**Product Strategy Objectives (Design Issues):**

- 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 development costs and time through disciplined design for re-use and redundancy design methods
- Reduce product costs through component commonality and design for re-use
- Improve predictability of new product introductions

**Process Strategy Objectives (Operational Issues):**

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

**Management Strategy Objectives (Organizational Issues):**

- 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
I. *Essential features* of modular strategies and development processes

**Strategic Partitioning of Architecture**

To Enable **Mass-Production of Stable Set of Common Components**

And **Flexible Batch Production and Assembly of Differentiating Components**
I. **Essential features** of modular strategies and development processes

<table>
<thead>
<tr>
<th>Type of Interface</th>
<th>What the Interface Specification Defines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attachment interface</td>
<td>Defines how one component will physically attach to another component</td>
</tr>
<tr>
<td>Spatial interface</td>
<td>Defines the physical space a component will occupy in a system design</td>
</tr>
<tr>
<td>Transfer interfaces</td>
<td>Defines the input(s) that a component will transform into some kind of output(s)</td>
</tr>
<tr>
<td>Control and communication interface</td>
<td>Defines how one component will exchange signals with another component (used to monitor and control the behaviors of components in a system design)</td>
</tr>
<tr>
<td>User interfaces</td>
<td>(a) Defines the intended ways in which a user will interact with a component in a system design; (b) Defines how a component will interact with the user's &quot;macro-system&quot; context</td>
</tr>
<tr>
<td>Environmental interfaces</td>
<td>(a) Defines how a component is expected to interact with the ambient environment of the system design; (b) Defines how the functioning of one component affects the functioning of other components in the system design.</td>
</tr>
</tbody>
</table>

**Types of Interfaces to be defined and specified in an architecture**
(source: Sanchez 1999)
I. What are the *essential features* of well-functioning modular strategies and development processes?

(5) *Strategic-level managers are directly involved* in decisions of strategic partitioning and standardizing interfaces.
I. **Essential features** of modular strategies and development processes

**Conventional Product Development Process**
- Senior Management Involved Only in Defining Desired Product Attributes
- Heavy Middle Management Involvement To Adjudicate “Interface Issues” During Conventional Development Processes

**Modular Architecture Development Process**
- Strategic Managers Directly Involved in Specifying Interfaces in Modular Product Architecture to Support Modular Product Strategy
- Minimal Middle Management Involvement During Concurrent Development of Components

Senior Management Inputs Required in Conventional vs. Modular Development

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I. **Essential features** of modular strategies and development processes

(6) The modular development process is *disciplined* and adheres to the “New Rules” for developing modular products.

1. All design decisions -- especially those affecting *interfaces* between components -- must be consistent with the modular product strategy.

2. Once a product architecture is adopted, *interface specifications* may not be changed or modified without management approval of a change in the product architecture.

3. Desired strategic variety and change must be accomplished with the fewest possible changes to existing components -- the principle of “containment of change.”

4. Re-use of existing or “off-the-shelf” components in new or revised product designs is *mandatory* unless a convincing business case can be made to justify design of a new component or part.

5. Only *proven component designs* may be used in new architectures.
I. **Essential features** of modular strategies and development processes

(7) **Organizational learning** about product performance is captured in improved component designs and interface specifications.

Four Kinds of Knowledge Embedded in Modular Architectures

1. Knowledge of how a given product functionality may be decomposed into specific functional components in product and process designs

2. Knowledge of how product and process components function and can be designed

3. Knowledge of how functional components of various types interact in product architectures and in process architectures

4. Knowledge of how each product component interacts with each process component
I. **Essential features** of modular strategies and development processes

**Knowledge Architecture:**

An organization’s understanding of

- How to *decompose functionalities* into functional components or activities
- How its product (process) *components function*
- How its product (process) *components interact*
- How its *product and process architectures interact*

<table>
<thead>
<tr>
<th>Process Architecture</th>
<th>Product Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process I</td>
<td>Component A</td>
</tr>
<tr>
<td>Process J</td>
<td>Component B</td>
</tr>
<tr>
<td>Process K</td>
<td>Component C</td>
</tr>
<tr>
<td>Process M</td>
<td>Component N</td>
</tr>
</tbody>
</table>

Interactions of Product and Process Architectures

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II. What are the most common *failures* of firms to implement effective modular strategies and development processes?

(1) Failure simply to understand what modularity means

(2) Failure to adopt “New Rules and New Roles” of modular organization design and management processes

(3) Failure to partition modular architectures strategically.

(4) Failure to fully specify and freeze interface specifications before beginning development processes.

(5) Failure to adhere to specified interfaces during development

(6) Failure to capture learning in improved component designs and interface specifications
III. What level of *modularity maturity* is your organization?

**Six Stages of Modularity Evolution**

1. **Cost rationalization** through standardized components and processes

2. **Configurability** as enabler/driver of product strategy

3. **Speed-to-market** as source of competitive advantage

4. Architectures used as framework for *knowledge management and organizational learning*

5. Architectures seen as way to *integrate technology, marketing, and business strategy*

6. Modular architectures used in structured way to *define, create, and manage firm’s competences*
### III. What level of *modularity maturity* is your organization?

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Management Understanding</th>
<th>Design and Development Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td><strong>Modularity as framework for identifying and developing new strategic competences</strong></td>
<td>Architectural management function directly involved in identifying goals for strategic competence development</td>
</tr>
<tr>
<td>6</td>
<td><strong>Modularity as framework for strategic integration</strong></td>
<td>Architectural management function directly involved in setting market, technology, and business strategies</td>
</tr>
<tr>
<td>5</td>
<td><strong>Modularity as framework for knowledge management</strong></td>
<td>New architectural knowledge created in development is captured in improved interface specifications</td>
</tr>
<tr>
<td>4</td>
<td><strong>Modularity seen as means to reduce time to market</strong></td>
<td>Modular development process based on “new rules and new roles” enables concurrent component development</td>
</tr>
<tr>
<td>3</td>
<td><strong>Modularity seen as means to increase product variety</strong></td>
<td>Strategic partitioning to decouple stable from variable components to enable configuration of product variations</td>
</tr>
<tr>
<td>2</td>
<td><strong>Modularity seen as means to reduce product costs</strong></td>
<td>Early form of modular development process seeks to use common components and re-usable components</td>
</tr>
<tr>
<td>1</td>
<td><strong>Modularity seen only as engineering issue</strong></td>
<td>Conventional development process uses technical modularity to reduce design time and cost</td>
</tr>
<tr>
<td>0</td>
<td>Unaware of modularity</td>
<td>Conventional development process with no systematic use of modularity</td>
</tr>
</tbody>
</table>

**Modularity Maturity Model**
Systematic Use of Architectural Framework at Automatix, Inc.

**New Product Ideas**
*(functions, features, performance, cost)*

**Product Component Managers:**
Can we leverage this product from existing product architectures?

If YES

**Product and Process Component Managers:**
Can we leverage this product by using new component variations in existing product and process architectures?

If YES

**“Wish List” Committee:**
Is this a product opportunity that warrants investing in creating a new process capability?

If YES and < "X" $

**Executive Committee:**
Should we create a new product and/or process architecture?

If YES and > "X" $

If NO

Leverage new product from existing components

Leverage new product using new product components using existing product and process architectures

Leverage new product using new components in both product and process architectures

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Thank You!

Questions or Comments?