Modularization Benefits
A LEGO Story made Tangible

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Aalborg University, Denmark

Empirical Background

• 50+ organizations
• 100+ projects
• Focus: products, production setup, +
• Extent: products and production structures, organizational setup, change management
• Duration: month to several years
Modularization Benefits

VW's platforms to perform?

15 October 2015 | Ian Henry

The OEM has introduced four vehicle platforms to maximise global production efficiency. But will internal efficiency? AMI looks at the steps taken so far, the benefits still to come, and asks if the strategy will work.

Automotive Manufacturing Solutions
October 15 2015
Modularization Benefits

Modularization Benefits

Modularization Benefits

Supporting Theory
Modularization Benefits
Supporting Theory

Market Sales → Total Benefits → Manufacturing Costs

Competitiveness = ?

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Supporting Theory

Market Sales → Total Benefits → Manufacturing Costs

Competitiveness = ?
### Modularization Benefits

#### Supporting Theory

**Effectiveness**
Doing the right things

**Competitiveness**
\[ \frac{\Sigma \text{Value}}{\Sigma \text{Cost}} \]

- **Market Sales**
- **Efficiency**
  Doing things right
- **Total Benefits**
- **Manufacturing Costs**

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#### Modularization Benefits

Supporting Theory

**Product innovation**

<table>
<thead>
<tr>
<th>Stage 1 - Fluid</th>
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<tbody>
<tr>
<td>- Exploration</td>
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<td>- Uncertainty</td>
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<td>- Flexibility</td>
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**Emphasis of innovation**

[Image: Abernathy & Utterback Pattern of Industrial Innovation Technology Review, 1978]
Modularization Benefits
Supporting Theory

Abernathy & Utterback
Pattern of Industrial Innovation
Technology Review, 1978
Modularization Benefits
Supporting Theory

Abernathy & Utterback
Pattern of Industrial Innovation
Technology Review, 1978

Modularization Benefits
Supporting Theory
Modularization Benefits
Supporting Theory

Stage 1 - Fluid
- Exploration
- Uncertainty
- Flexibility

Stage 2 - Transitional
- Dominant design

Stage 3 - Specific
- Standardization
- Integration

Emphasis of innovation
Product innovation
Process innovation
Modularization Benefits

Supporting Theory

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<th>Stage 2 - Transitional</th>
<th>Stage 3 - Specific</th>
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<tr>
<td>Exploration</td>
<td>Dominant design</td>
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Modularization Benefits
Supporting Theory

Ron Sanchez
Modular Architectures
Int. J. Technology Management, 2000

Modularization Benefits
Supporting Theory

Product Architecture

Process Architecture
Moulding
Process Interfaces
Decoration
Assembly
Packing

Interactions of Product and Process Architectures

Stage 1 - Fluid
- Exploration
- Uncertainty
- Flexibility

Stage 2 - Transitional
- Dominant design

Stage 3 - Specific
- Standardization
- Integration

Emphasis of innovation
Product innovation
Process innovation
Modularization Benefits
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Market
Variety, Brand, Configuration

Product
Structure Specifications

Process
Technology Capability

Supply Chain
Time, Space, Availability

Hansen & Sun
Complexity in Managing Modularization
IEEE Computer Society, 2011
Modularization Benefits
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Modularization Drivers

Development & Design
- Carry Over
- Technical Update
- Styling

Manufacturing and Logistics
- Process & Organisation
- Supplier Availability
- Gradual Completion

Hansen & Sun
Complexity in Managing Modularization
IEEE Computer Society, 2011

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Modularization Effects

Cost, Quality, Complexity
- Direct Cost

Capital Binding
- Stocks, Finished Goods, Machinery, Tools, Knowledge

Lead Time
- Development, Production, Logistics

Hansen & Sun
Complexity in Managing Modularization
IEEE Computer Society, 2011
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Modularization Benefit Matrix

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<td>Development</td>
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Hansen & Sun
Complexity in Managing Modularization
IEEE Computer Society, 2011

Modularization Benefits
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Modularization Benefits
Modularization Simulator

Hansen & Persson
Engineering Case Method Applied in
Teaching Modularization Management
Design Society, 2016
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Modularization Simulator

Modularization Benefits
Modularization Simulator

10,000,000 minifigures
16 variants
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Modularization Simulator

Need: 100 mill parts

Need: 127 mill parts

Consider new production challenges when scaling the production to produce Series 1. The 16 different figures are to be produced in a total of 10 mill units. How many new moulds are needed?
Modularization Benefits

Modularization Simulator

How many new moulds?
38 new moulds
Investment: 1,520,000 €

The competitors are ready!
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Modularization Simulator

Consider new production challenges when preparing the production to produce Series 2. The 16 different figures are to be produced in a total of 15 mill units. How many new moulds are needed?
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The LEGO Story
Modularization Benefits
The LEGO Story

You must be able to spell
A-R-C-H-I-T-E-C-T-U-R-E
before you can say
PLATFORM

Hansen & Sun
 Complexity in Managing Modularization
 IEEE Computer Society, 2011
Modularization Benefits
The LEGO Story

Hansen & Sun
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The LEGO Story

Level of ambition

Hansen & Sun
Complexity in Managing Modularization
IEEE Computer Society, 2011
Thanks!