Towards Integrated Product and Package Development

Caroline Bramklev

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Agenda

- Introduction
- The research approach
- Results
- On a proposal for a generic package development process
- A proposal for an Integrated Product and Package Development process
- Conclusions
Introduction
Background

- Global enterprises (incl. global supplier networks)
- Global consumer networks

- Increased need of packages for internal and external distribution of raw materials, parts, subsystems and final products.

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Background
- The product-package lifecycle

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Background - The integration concept
Background

Paper: “Packaging Logistics in Product Development”

Integration of Packaging Logistics in each of the phases

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Research questions

1. Is there industrial support for the establishment of an integrated product and package development process?

2. How can an integrated development process for product and package development be accomplished?
Research objective

“Contribute to efficient and effective resource utilisation in global enterprises by providing an overall procedure model for integrating product and package development.”

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Research sub-objectives

1. Establish the current status regarding the proposed integration concept (for product and package development) in theory.
2. Establish the support for the proposed integration concept in the product manufacturing industry.
3. Propose an updated package development process well adapted for integration into the product development process.
4. Provide a first version of a generic and operational integrated product and package development process.

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The research approach
Sub-objective 1

*Establish the current status regarding the proposed integration concept (for product and package development) in theory.*

**Method**

- Literature review
  - Product development
  - Logistics
Sub-objective 2

Establish the support for the proposed integration concept in the product manufacturing industry.

Method

- Sample survey
  - Swedish industry
    - 20 mechanical companies
    - 20 pharmaceutical companies
    - 20 food companies
Sub-objective 3

Propose an updated package development process well adapted for integration into the product development process.

Method

• Multiple case study
  – Pilot case study
    • Package manufacturer
  – Multiple cases
    • In 5 package manufacturing companies
Sub-objective 4

Provide a first version of a generic and operational integrated product and package development process.

Method

- Literature review
  - Concept of integration
- Synthesis of previous results
  - Sample surveys
  - Cases
- Multiple case study
  - 2 concept cases
  - 4 Product-Package-System (PPS) concept evaluations
The research process

**RQ 1:** Is there industrial support for the establishment of an integrated product and package development process?

**RQ 2:** How can an integrated development process for product and package development be accomplished?

<table>
<thead>
<tr>
<th>Empirical data</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey I</td>
<td>Review of related work</td>
</tr>
<tr>
<td>Survey II</td>
<td>Review of mechanical product development area</td>
</tr>
<tr>
<td>Survey III</td>
<td>Review of pharmaceutical product development area</td>
</tr>
<tr>
<td></td>
<td>Review of food product development area</td>
</tr>
<tr>
<td></td>
<td>Review I of package development area</td>
</tr>
<tr>
<td>Pilot case study</td>
<td>Review II of package development area</td>
</tr>
<tr>
<td>Multiple case study</td>
<td>Conceptual review on the integration phenomena in product development</td>
</tr>
<tr>
<td>Multiple case study</td>
<td>Synthesis study</td>
</tr>
<tr>
<td>Synthesis study</td>
<td>Future research</td>
</tr>
</tbody>
</table>

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Results
Is there interest in integrating product and package development?

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Is it possible to exclude the package?

- Mechanical: 10.00% Yes, 90.00% No
- Pharmaceutical: 100.00% Yes
- Food: 15.00% Yes, 85.00% No

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It is possible to reduce costs through package design.
## Costs and distribution

<table>
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<tr>
<th></th>
<th>GAMMAL</th>
<th>NY</th>
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</thead>
<tbody>
<tr>
<td>Kvantitet Pallar</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Pallar / Container</td>
<td>42</td>
<td>21</td>
</tr>
<tr>
<td>=</td>
<td>350,0%</td>
<td>-50,0%</td>
</tr>
<tr>
<td>Produkter / Container</td>
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<td>378</td>
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<tr>
<td>Pallar / År</td>
<td>32500</td>
<td>7222</td>
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<tr>
<td>=</td>
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<tr>
<td>Containrar / År</td>
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<td>=</td>
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<td>-429,9</td>
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<td>Savings Pallets Sek</td>
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<tr>
<td>Savings/year Sek</td>
<td></td>
<td></td>
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<tr>
<td>Savings Handling Sek</td>
<td>2 300 277</td>
<td>= 8 495 739</td>
</tr>
<tr>
<td>Savings/year Total Sek</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Savings:** 8 495 739 SEK / year

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Current package development as observed in the package manufacturing industry

Caroline Bramklev
Department of Design Science
Findings from the analysis of the package development processes – in theory

- Discrepency between empirical data and literature descriptions

  – see table 1, appended paper IV

Caroline Bramklev
Department of Design Science
On a proposal for a generic package development process

Caroline Bramklev
Division of Packaging Logistics
The package development process – in theory (see table 1, appended paper IV)

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Is the process decomposed into distinguishable development phases?</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Are the development phases decomposed of the problem(s) defining into interrelated development activities?</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
</tr>
<tr>
<td>Are decision gates introduced in the process model?</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
<td>No</td>
<td>Yes, partly</td>
<td>Yes</td>
<td>Yes, partly</td>
</tr>
<tr>
<td>Are methods available for solving/handling of the problem(s) defining the development activities?</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
<td>No</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
<td>Yes, partly</td>
</tr>
<tr>
<td>Are tools provided for solving/handling of the problem(s) defining the development activities?</td>
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<td>Yes, partly</td>
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<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Does the author(s) claim the process to be generic?</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Does the model provide recommendations for the organisation of responsibilities between the product manufacturing company and the package manufacturing company?</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Does the model provide recommendations for the establishment of goals between the product manufacturing industry and the package manufacturing industry?</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Does the process model enclose a description of its theoretical origin? (Based on: Best practice (Bp), creative problem solving (PS) or other theoretical source (O))</td>
<td>PS</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>PS</td>
</tr>
<tr>
<td>Does the author(s) claim the process be implemented (I) or based practical cases (PC)</td>
<td>-</td>
<td>PC</td>
<td>-</td>
<td>-</td>
<td>PC</td>
<td>-</td>
</tr>
</tbody>
</table>
The proposal for a generic Package Development Process

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A proposal for an Integrated Product and Package Development process

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The reference model of the product development process
(Ulrich and Eppinger, 2007)

The generic product development process

Phase 0: Planning
- Corporate strategy
- Assessment of technology
- Market objectives

Project mission statement

Phase 1: Concept development
- Needs of target market
- Choose alternative product concepts

Phase 2: System-level Design
- Product architecture
- Subsystems lay-out
- Preliminary process flow diagram for assembly process

Phase 3: Detail Design
- Complete specification of product parts
- Process plans and tooling

Phase 4: Testing and refinement
- Prototype
- Production needs

Phase 5: Production Ramp-up
- Production system

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On the constitutive structure of a product development process

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The process integration concept

Development phase level

Development activity level

Development subprocess level

Development task level

THE PRODUCT DEVELOPMENT PROCESS

THE PACKAGE DEVELOPMENT PROCESS

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A first proposal for an Integrated Product and Package Development (IPPkgD) Process
The model

1. Heavy loads were found during the handling and transportation of the product, which resulted in severe damage. The initial action was launched within the Detailed Design phase by redesigning parts of the product (increasing load resistance) on the development task level. By utilizing the detailed information on the actual loads and other design parameters, it was possible to redefine the package system within the development activity Specify package system, which in turn resulted in a new package system.

2. In order to minimize the volume of the product during distribution, the need for a redesign of the existing product became a necessity. By redefining the product within the development activity subprocess Define product architecture, 6 different assembly alternatives were created. These were used in turn to redefine the package system within the development activity Specify package system, thus providing the required flexibility accommodating a more compact product package system.

3. During the transportation of the product static electricity was generated, which was harmful to the product. In the development activity subprocess Conduct the analysis the reason why the static electricity occurred was established, indicating two possible modes of action regarding the package. In the first of these, denoted 3A, a change of package material was an option. This action requires a redefinition of the material in the development activity Establish design specification. The second option, if 3A failed, was to create a new package concept. This is initiated within the development activity Establish package concept specification.

4. A number of observations made during the studies in industry pointed unambiguously to the need to coordinate the product and package specifications on a regular basis. This was identified as integrating the product development activity Set final specifications and the package development activity Analyse request/mission statement.

5. From the surveys in industry it was observed that a coordination of product and package idea is necessary. This is obtained by integrating the product development activity Identify opportunities with the package development activity Analyse request/mission statement.

6. In a research project aiming at developing analysis techniques for an increased use of computer-based analysis tools in optimization of the structural response of the PPS, statically as well as dynamically, the Finite Element Method was selected as the predominant tool. The result is obtained by integrating Structural analysis on the development task level for the product within the development phase Detailed Design, and for the package on the development task level within the development phase Package Design.

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Conclusions
Conclusions

• There is an industrial support for integrating product and package development.
• No previous such concept was found in the literature, but support of the concept was found in the food and pharmaceutical product development literature.
Conclusions

• A new updated generic package development process was developed adapted for integration to the product development process no such process was found in the literature.
  – This process model is partly verified based on interviews with representatives of the package manufacturing industry.
Conclusions

• A first version of an Integrated Product and Package Development (IPPkgD) Process is provided.
  – After adding additional integration problems this model will be verified in industrial practice.
Thank you!

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Background to presentation: results and data published in