Definition of a process?

SPN Diagnosis Process Model

Example: Part 1
Types of processes:
- structured, e.g., manufacturing
- unstructured, e.g., healthcare
- deterministic
- stochastic

Existing Process Modeling Methodologies
- Computer Integrated Manufacturing - Open Systems Architecture (CIM-OSA)
- EXPRESS
- GRAI Method
- Integrated Enterprise Modeling (IEM)
- Problem Statement Language/Problem Statement Analyzer (PSL/PSA)
- Structured Systems Analysis and Design Method (SSADM)
- Object-Oriented modeling methodology for Manufacturing Information Systems (OOMIS)
- MOSYS (Modeling SYstem)
- Petri Nets
- IDEF Methodology
Petri Nets

Petri net (PN): (P, T, IN, OUT, M0)

P = \{p_1, p_2, \ldots, p_m\}: finite set of places
T = \{t_1, t_2, \ldots, t_n\}: finite set of transitions
IN: The mapping from places to transitions
OUT: The mapping from transitions to places
M0: Initial marking

An activity that uses two resources:
(a) PN model,
(b) initial marking,
(c) marking after t_1 has been fired

IDEF Methodology

IDEF = Integrated DEFinition

IDEF Methodologies

IDEF0: modeling a wide variety of systems which use hardware, software, and people to perform activities
IDEF1x: to semantically model the relationships between various pieces of data
IDEF2: to capture the dynamic behavior of a system
IDEF3: created specifically to model the sequence of activities
IDEF5: to model domain ontologies
IDEF6: to define the motives that drive the decision making process

Question:
What is more important the modeling tool itself or the user familiarity with the tool?
**ICOM Example**

Part design Activity 3 - Diameter determination

- **I** = Part length
- **C** = Outcome of the design approval process
- **M** = Designer + CAD system
- **O** = Part diameter

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**Standard Activity Block**

- **I** = Input (I)
- **O** = Output (O)
- **M** = Mechanism (M)
- **C** = Control (C)
Standard Activity Block (cont'd)

Wrong!

Avoid!

Activity 1

Activity 2

OK

Avoid!

Decomposition in IDEF3 methodology
LOGIC JUNCTIONS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>&amp;</td>
<td>Asynchronous = Inputs: All preceding processes must complete. Outputs: All following processes will start.</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>Synchronous = Inputs: All preceding processes must complete simultaneously. Outputs: All following processes will start simultaneously.</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Exclusive OR = Inputs: Exactly one of the preceding processes must complete. Outputs: Exactly one of the following processes will start.</td>
<td></td>
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</tbody>
</table>

IDEF3 process model

Activities: Units of behavior (UOBs)
Links: Relationships between activities which are of three types: precedence links, relational links, and object flow links
Logic JUNCTIONS: AND (‘&’), OR (‘O’), and Exclusive OR (‘X’)

Labeling Process Models

Application area:
- Product development – Design process model
- Manufacturing – Manufacturing process model
- Supply chain – Supply chain (process) model
- Healthcare – Healthcare process model
- xxxx – xxxx process model
**Modeling objective:**
- Value analysis – Value map, value model
- Cost reduction – Lean process model
- Quality/cost – Six sigma modeling
- yyyy – yyyy process model

**Model building approach:**
- Kaizen event – Kaizen (generated) model
- Analyst – Analyst generated model
- Waste walk – Process model
- zzzz – zzzz generated model

**How to Build a Process Model?**
- Left to right
- Right to left
- Top down
- Bottom up
### COMPARISON OF IDEF0 and IDEF3

<table>
<thead>
<tr>
<th>IDEF0</th>
<th>IDEF3</th>
</tr>
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<tbody>
<tr>
<td>FUNCTION</td>
<td>ACTIVITY</td>
</tr>
<tr>
<td>4 ICOMs</td>
<td>3 (4) ICOMs</td>
</tr>
<tr>
<td>NO LOGIC</td>
<td>LOGICAL</td>
</tr>
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<td></td>
<td>CONNECTORS</td>
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### Annotated IDEF3 Model

#### Decision-making logic: Method 1

Data-mining derived knowledge

- If I1 Then O1 and O3
- If I2 Then O2
- If I1 And C1 Then O2 And O3

#### Two approaches to information collection

- Interview Method
- Group Meeting Method
**Interview Method**

Step 1. Domain experts are informed about the process modeling effort and provided with basic training in the methodology.

Step 2. Analyst interviews domain experts and produces a high level process model.

Step 3. Experts fill out the templates.

Step 4. Analyst develops a draft process model.

Step 5. Refinement of the draft model:
   - additional interviews
   - group meetings

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**Group Meeting Method:**

*Model Building Procedure*

Step 1. Define scenario

Step 2. Identify and define appropriate activities

Step 3. Arrange activities in phased sequence

Step 4. Identify and define input and output objects

Step 5. Determine object life cycle states

Step 6. Determine decision points and flow junctions

Step 7. Identify and define activity controls and mechanisms

Step 8. Define notifications and messages.

---

**Template**

![Template Image]

**Which method would you choose**

- Interview
- Group Meeting?

**WHY?**
Characteristics of Methods

Interview Method
• Low cost
• Short time

Group Meeting Method
• Higher cost
• Longer time

Model ownership

Question:
When is it recommended to use the interview method and when the group meeting method?

General Rule for Method Selection

Interview Method → Simple Processes

Group Meeting Method → Complex Processes

Process Model Development

- Project Management Swim Lane
- Engineering Design Swim Lane
- Systems Support Swim Lane

Swim Lane Approach
Other Tools and Techniques

- Waste walk – application of lean manufacturing approaches to process improvement
- Spaghetti analysis – application DSM and systems decomposition concepts (this class) and flow analysis techniques (56:166 Production Systems)
- Information wheel – DSM concept
- Kaizen approach – corresponds to team-based process modeling

Comparison of Techniques

Relationship between the number of domain experts participating in the process modeling effort and the cost and/or reliability of the information collected.

<table>
<thead>
<tr>
<th>Number of domain experts</th>
<th>Cost of information</th>
<th>Reliability of information</th>
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MODEL BUILDING CASE STUDY

IDEF3 process model at level 1

Premount process model (level 2)

"CHECK WORK"
SUMMARY

• Understanding how to use a technique is often more important than the technique itself
• An important attribute of a modeling technique is its extendibility
• IDEF0 and IDEF3 are perhaps the simplest to use and the easiest to extend
• The most frequently recognized shortcoming of process modeling may be the lack of use and/or incomplete analysis of models