Process Improvement Based on Causal Networks

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Agenda

1. Causal Networks in Software Engineering
2. The CNPM Approach
3. CNPM Approach Application for CMMI Analysis
4. Conclusion and Future Work
Example: five core metrics by Putnam/Myers

- People with equal level of productivity produce
- Quantity of function (size) of a work product
- Effort
- Reliability
- Time

Expenditure over
1. Causal Networks in Software Engineering

Example: impact trace of SOAP
Example: impact trace of SOAP with causalities

\[ V = \{\text{SOAP\_history, SOAP1.1, SOAP1.2, XML}\} \]

\[ U = \{\text{“Websphere”, “BizTalkServer”, …, “XML RPC”}\} \]

\[ U = \{\text{external\_objects, roles}\} \]
1. Causal Networks in Software Engineering

Causal networks supports:

The consequence of process activities to other ones involving different quality characteristics like correctness, completeness etc.

The repercussion of the chosen approaches for process evaluation and improvement

The overview about strong and weak process connections in order to keep quality improvements

The application of (causal) model-based principles in order to reduce the process complexity and involvements
2. The CNPM Approach

Definition of CNPM

\[ M_{CNPM} = \langle U_{CNPM}, V_{CNPM}, F_{CNPM} \rangle \]

Causal Network based Process Model (CNPM)

SERA 2010
Montreal, May 25, 2010
Reiner R. Dumke, University of Magdeburg
2. The CNPM Approach

Operations

Union/Summarizing

Partitioning

Unified CNPM model $M_3 = f\_join (M_1, M_2)$:

Sub model $M_4 = f\_part (M_3)$:

Sub model $M_5 = f\_part (M_3)$:
2. The CNPM Approach

Restructuring

- Adding/extraction of a function
- Adding/extraction of a role
- Adding/extraction of an input (object)
- Adding/extraction of an output (object)
2. The CNPM Approach

Analysis

- causal coverage analysis
- causal trace analysis
- causal achievement achievement analysis

\[ \text{coverage}_{\text{CNPM function}_y} = \frac{\sum |F_x^{\text{CNPM}}|}{\sum |F_x^{\text{CNPM}}|} \]

\[ F_{\text{CNPM missing function}} = \{ F_x^{\text{CNPM}} \setminus F_y^{\text{CNPM}} : |F_y^{\text{CNPM}}| \leq |F_x^{\text{CNPM}}| \} \]
2. The CNPM Approach

Approach Steps

1. Identifying the different sets of the causal network triple using the (M1) description as the set of (internal/external) objects, functions and roles

2. Using the rules of (M2) in order to construct a high connected process description of the CNPM

3. Applying the CNPM characteristics defined in (M3) in order to identify the functional-based input and output structure including their dependencies

4. Adapting the CNPM analysis methods described in (M4) in order to identify any missing components and to improve the causal-based process description that helps to qualify the software process definition itself.
CMMI process improvement approach

- build the CNPM diagrams
- analysis of these diagrams
- translation into a consistent presentations
CMMI-SP 1.1 – Establish the Strategic Training Needs  (First approach)
A deeper analysis of the objects contained in this network shows, that there is no Task, creating the objects „training needs for roles and skills“ and „training needs for business“.

Furthermore, it can be seen, that the network contains two functions for documenting two different types of training needs.

To create the other specific practices some adaptations of the CMMI-text are necessary.
3. CNPM Approach Application for CMMI Analysis

CMMI-SP 1.1 – Establish the Strategic Training Needs  (correction)
3. CNPM Approach Application for CMMI Analysis

**CMMI-SP 1.4 – Establish training capability**

(adaptation)

- Management
- People
- Training
- Instructors

- Select people for training
- Plan training (incl. resources)
- Conduct training
- Track delivery against plan

- Trained people
- Training plan
- Delivery analysis
### Further Results

<table>
<thead>
<tr>
<th>Output objects without further use</th>
<th>Causal Analysis (SP 2.1, SP 3.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project Planning (SP 1.1, SP 1.2)</td>
</tr>
<tr>
<td>Functions without output objects</td>
<td>Organizational Training (SP 1.4)</td>
</tr>
<tr>
<td></td>
<td>Requirements Development (SP 1.1)</td>
</tr>
<tr>
<td>Use of non defined objects</td>
<td>Project Monitoring and Control (SP 1.1)</td>
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<tr>
<td></td>
<td>Validation (SP 2.1)</td>
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<tr>
<td>Missing (needed) roles</td>
<td>Project Planning (SP 2.5)</td>
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<tr>
<td></td>
<td>Verification (SP 1.2)</td>
</tr>
<tr>
<td>Multiple definition of functions</td>
<td>Quantitative Project Management (SP 1.1)</td>
</tr>
<tr>
<td></td>
<td>Product Integration (SP 1.3)</td>
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</tbody>
</table>
Final evaluation in process:
4. Conclusion and Future Work

- Finalization of the CMMI analysis
- Presentation of the whole causal model
- Considering other process models
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Thanks for your attention!

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