From Scientific Process Management to Process Science: Towards an empirical research agenda for Business Process Management

Jan Mendling
Your take-aways

1. BPM requires a stronger grounding in the scientific method
2. BPM requires a broader uptake of experiments
3. Resulting insights will build the foundations of
   ▪ Process science in research and the
   ▪ Scientific process management in practice
"To take an example, the trade of a pin-maker: But in the way in which this business is now carried on, it is divided into a number of branches:

- One man draws out the wire; another straights it;
- a third cuts it; a fourth points it; a fifth grinds it at the top for receiving the head; to make the head requires three operations; to put it on is a peculiar business;
- to whiten the pins is another; to put them into the paper; and the important business of making a pin is, in this manner, divided into about eighteen distinct operations."

Smith 1776
Division of Labour

Icons designed by Freepik
Task and Coordination Efficiency

Task Efficiency

Draw out wire → Straight wire → Cut wire → Point wire → Grind wire

Make head → Put head on → Whiten the pin → Put pin in paper

Coordination Efficiency
What is more important?

**Task Efficiency**

**Coordination Efficiency**

Flow-Time Efficiency of Business Processes in Practice

Minimal Working Time / (Working Time + Waiting Time)

- Auto manufacturing: 5.60%
- Hospital: 3.75%
- Commercial bank: 2.36%
- Consumer packaging: 0.14%
- Life insurance: 0.16%

Blackburn 1992
Processes, People and Systems

ERP

A → B → C

Workflow

A → B → C

Crowdsourcing

A → B → C
BPM Lifecycle

Dumas et al. 2013
Papers at BPM Conference

Recker/Mendling, BISE 2016
<table>
<thead>
<tr>
<th>Year</th>
<th>Artifact</th>
<th>Formal Concepts</th>
<th>Algorithm</th>
<th>Theory</th>
<th>Hypothesis</th>
<th>Ind. Variables</th>
<th>Dep. Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>15</td>
<td>12</td>
<td>1</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>18</td>
<td>11</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>35</td>
<td>16</td>
<td>9</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2006</td>
<td>33</td>
<td>16</td>
<td>11</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>27</td>
<td>12</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2008</td>
<td>23</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2009</td>
<td>17</td>
<td>8</td>
<td>9</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2010</td>
<td>20</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2011</td>
<td>23</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>21</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>14</td>
<td>5</td>
<td>8</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>246</td>
<td>101</td>
<td>64</td>
<td>59</td>
<td>8</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>
Findings on State of the Field

Formal Science well established and well understood
Findings on State of the Field

- Make more use of established empirical methods including experiments, surveys and
- Put more emphasis on theory building
- Use more systematic literature reviews
Findings on State of the Field

- Consider Methods like Action Research and Case Studies
- Evaluate with Design Hypotheses and Benchmark Data
- Adopt algorithm engineering
The scientist’s objective is to find the truth about the physical world.
Deductive logic can be used to derive at the consequences or predictions of competing hypotheses.

Inductive logic can be used to compare the various hypotheses’ predictions against the data to determine which hypothesis is true or most likely to be true.
Scientific Method Revisited

Efficient experimental designs and data analyses are the means for answering questions posed to nature.

Data is of value for discriminating between competing hypotheses.
Where is causality in BPM?

1. What is a desirable outcome?
2. What is a potentially strong factor?

significant and good effect size
Process Modeling Experiments

Subjects

Model

Tasks

Technique

Theory

Figure 2: Norman’s [28] theory of action as applied to IS modeling.

Independent variables (factors with treatment) -> dependent variables (response variables)
Is BPMN better than YAWL?
How to check if BPMN is better?

Subjects

Model

Task

Technique

->

Outcome

Fig. 2 Norman’s [28] theory of action as applied to IS modeling.
Symbol Set is the Factor

<table>
<thead>
<tr>
<th></th>
<th>R_{UML}</th>
<th>R_{BPMN}</th>
<th>R_{EPC}</th>
<th>R_{YAWL}</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AND</strong></td>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
<td><img src="image3" alt="Diagram" /></td>
<td><img src="image4" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Outer Shape</strong></td>
<td>narrow rectangle (bar)</td>
<td>symmetric diamond-shape</td>
<td>circle</td>
<td>rectangle</td>
</tr>
<tr>
<td><strong>Inner Shape</strong></td>
<td><img src="image5" alt="Diagram" /></td>
<td>internal marker (“+”)</td>
<td>logical marker for ‘and’ (“∧”)</td>
<td>left- and right-sided open triangle</td>
</tr>
<tr>
<td><strong>XOR</strong></td>
<td><img src="image6" alt="Diagram" /></td>
<td><img src="image7" alt="Diagram" /></td>
<td><img src="image8" alt="Diagram" /></td>
<td><img src="image9" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Outer Shape</strong></td>
<td>diamond-shape without internal marker</td>
<td>symmetric diamond-shape</td>
<td>circle</td>
<td>rectangle</td>
</tr>
<tr>
<td><strong>Inner Shape</strong></td>
<td><img src="image10" alt="Diagram" /></td>
<td><img src="image11" alt="Diagram" /></td>
<td><img src="image12" alt="Diagram" /></td>
<td><img src="image13" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Figl et al, DSS 2013
Need to understand redesign
Scientific Management

Basic principles

1. Scientifically analyse and define each element of work
2. Train and teach workers according to the identified rules
3. Assure that work is conducted according to the rules
4. Divide work equally such that management is responsible for planning and worker for performing

Taylor 1911
Scientific Management

Basic principles
1. Scientifically analyse and define each element of work
2. Train and teach workers according to the identified rules
3. Assure that work is conducted according to the rules
4. Divide work equally such that management is responsible for planning and worker for performing

Shortcomings
- Less emphasis on the coordination of activities, but on their isolated analysis
- No development of a theory of process improvement
How we do redesign

- Customer Heuristics
- Operations Heuristics
- Behaviour Heuristics
- Organization Structure Heuristics
- Organization Population Heuristics
- Information & Technology Heuristics
- Environment Heuristics

Dumas et al. 2013
Redesign Heuristics: Behaviour Example

• Parallelism:
  “Consider whether activities may be executed in parallel”
How we should do redesign

Weber/Mendling, 2015
"Improved" credit application

Customer Satisfaction

<table>
<thead>
<tr>
<th></th>
<th>Half day Checking</th>
<th>Full week Checking</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Satisfaction</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Customer Satisfaction

<table>
<thead>
<tr>
<th></th>
<th>Half day Checking</th>
<th>Full week Checking</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accept</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reject</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Improving Microsoft’s Help Website with A/B Testing

Kohavi, 2009

~ 33%  ~ 33%  ~ 33%
How to integrate this into BPMS

Weber/Mendling, 2015
We need to understand:

- Factors that make a process better
- Measures of desirable outcomes
- Taxonomies for both
- Theories that explain effects
- Insights into effect sizes
- Concepts to implement systems accordingly
Implications for practice: Scientific Process Management

We need to provide:

- Systems for conducting process experiments
- Reusable best practice processes
- Analytics for identifying factors
1. BPM requires a stronger grounding in the scientific method
2. BPM requires a broader uptake of experiments
3. Resulting insights will build the foundations of
   - Process science in research and the
   - Scientific process management in practice
4. Read more in
References

- Frederick W. Taylor: The principles of scientific management (1911)