MTAT.03.231
Business Process Management

Lecture 5
Qualitative Process Analysis

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Process Analysis

Process identification

Process architecture

Process discovery

Conformance and performance insights

As-is process model

Process analysis

Insights on weaknesses and their impact

Process monitoring and controlling

Executable process model

Process implementation

Process redesign

To-be process model
Process Analysis Techniques

Qualitative analysis
• Value-Added & Waste Analysis
• Root-Cause Analysis
• Pareto Analysis
• Issue Register

Quantitative Analysis
1. Introduction
2. Process Identification
3. Essential Process Modeling
4. Advanced Process Modeling
5. Process Discovery
6. **Qualitative Process Analysis**
7. Quantitative Process Analysis
8. Process Redesign
9. Process Automation
10. Process Intelligence
Qualitative analysis

Value-Added & Waste Analysis

Issue Register & Pareto Charts

Root-Cause Analysis
Value-added analysis

1. Decorticate the process into steps
   • Steps performed before a task
   • The task itself, possibly decomposed into smaller steps
   • Steps performed after a task, in preparation for the next task

2. Classify each step
   • Value-adding (VA)
   • Business value-adding (BVA)
   • Non-value-adding (NVA)
Value-adding activities

Produce value or satisfaction to the customer

Criteria

• Is the customer willing to pay for this step?
• Would the customer agree that this step is necessary to achieve their goals?
• If the step is removed, would the customer perceive that the end product or service is less valuable?

Examples

• Order-to-cash process: Confirm delivery date, Deliver products
• University admission process: Assess application, Notify admission outcome
Business value-adding activities

Necessary or useful for the business to operate

Criteria

• Is this step required in order to collect revenue, to improve or grow the business?
• Would the business (potentially) suffer in the long-term if this step was removed?
• Does it reduce risk of business losses?
• Is this step required in order to comply with regulatory requirements?

Example

• Order-to-cash process: Check purchase order, Check customer’s credit worthiness, Issue invoice, Collect payment, Collect customer feedback
• University admission process: Verify completeness of application, Check validity of degrees, Check validity of language test results
Non-value-adding activities

Everything else besides VA and BVA. Activities the customer would be unwilling to pay for

Includes

1. Handovers, context switches
2. Waiting times, delays
3. Rework or defect correction

Examples

- Order-to-cash process: Forward PO to warehouse, Re-send confirmation, Receive rejected products
- University admission process: Forward applications to committee, Receive admission results from committee
Extract of Equipment Rental Process

- Fill request (VA)
- Send request to clerk (NVA)
- Check equipment availability (VA) – 1st time
- Record recommended equipment (BVA)
- Forward request to works engineer (NVA)
- Open and read request (NVA)
- Select suitable equipment (VA) – 1st time
- Produce PO (BVA)
- Submit PO to supplier (VA)
- Open and examine request (BVA)
- Communicate issues (BVA)
- Forward request back to clerk (NVA)
## Equipment Rental Process – VA Analysis

<table>
<thead>
<tr>
<th>Step</th>
<th>Performer</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill request</td>
<td>Site engineer</td>
<td>VA</td>
</tr>
<tr>
<td>Send request to clerk</td>
<td>Site engineer</td>
<td>NVA</td>
</tr>
<tr>
<td>Open and read request</td>
<td>Clerk</td>
<td>NVA</td>
</tr>
<tr>
<td>Select suitable equipment</td>
<td>Clerk</td>
<td>VA</td>
</tr>
<tr>
<td>Check equipment availability</td>
<td>Clerk</td>
<td>VA</td>
</tr>
<tr>
<td>Record recommended equipment &amp; supplier</td>
<td>Clerk</td>
<td>BVA</td>
</tr>
<tr>
<td>Forward request to works engineer</td>
<td>Clerk</td>
<td>NVA</td>
</tr>
<tr>
<td>Open and examine request</td>
<td>Works engineer</td>
<td>BVA</td>
</tr>
<tr>
<td>Communicate issues</td>
<td>Works engineer</td>
<td>BVA</td>
</tr>
<tr>
<td>Forward request back to clerk</td>
<td>Works engineer</td>
<td>NVA</td>
</tr>
<tr>
<td>Produce PO</td>
<td>Clerk</td>
<td>BVA</td>
</tr>
<tr>
<td>Send PO to supplier</td>
<td>Clerk</td>
<td>VA</td>
</tr>
</tbody>
</table>
Waste analysis

“All we are doing is looking at the time line, from the moment the customer gives us an order to the point when we collect the cash. And we are reducing the time line by reducing the non-value-adding wastes”

Taiichi Ohno, Toyota
Seven sources of waste

- **Move**
  - Transportation
  - Motion

- **Hold**
  - Inventory
  - Waiting

- **Over-do**
  - Defects
  - Over-Processing
  - Over-Production
Move
Transportation

Send or receive materials or documents (incl. electronic) taken as input or output by the process activities

Example

University admission process: to apply for admission at a university, students fill in an online form. When a student submits the online form, a PDF document is generated. The student is requested to download it, sign it, and send it by post together with the required documents:

1. Certified copies of degree and academic transcripts
2. Results of language test
3. CV

When the documents arrive at the admissions office, an officer checks their completeness. If a document is missing, an e-mail is sent to the student. The student has to send the missing documents by e-mail or post depending on document type.
Motion

• Motion of resources internally within the process
• Common in manufacturing processes, less common in service processes

Examples

• Vehicle inspection process: a process worker moves with the inspection forms from one inspection base to another; in some cases inspection equipment also needs to be moved around
• Application-to-approval process: a process worker moves around the organization to collect signatures
Hold
Inventory

• Materials inventory
• Work-in-process (WIP)

Examples

• **Vehicle inspection process**: when a vehicle does not pass the first inspection, it is sent back for adjustments and left in a pending status. At a given point in time, about 100 vehicles are in the “pending” status across all inspection stations.

• **University admission process**: About 3000 applications are handled concurrently.
Waiting

• Task waiting for materials or input data
• Task waiting for a resource
• Resource waiting for work (resource idleness)

Examples

• **Vehicle inspection process**: A technician at a base of the inspection station waiting for the next vehicle
• **Application-to-Approval process**: Request waiting for approver
• **University admission process**: Incomplete application waiting for additional documents; batch of applications waiting for committee to meet
Over-do
Defects

• Correcting or compensating for a defect or error
• Rework loops

Examples

• Vehicle inspection process: A vehicle needs to come back to a station due to an omission
• Travel approval process: Request sent back to requestor for revision
• University admission process: Application sent back to applicant for modification; request needs to be re-assessed later due to incomplete information
Over-processing

• Tasks performed unnecessarily given the outcome of the process
• Unnecessary perfectionism

Examples
• **Vehicle inspection process**: technicians take time to measure vehicle emissions with higher accuracy than required, only to find that the vehicle clearly does not fulfill the required emission levels
• **Travel approval process**: 10% of approvals are trivially rejected at the end of the process due to lack of budget
• **University admission process**: Officers spend time verifying the authenticity of degrees, transcripts and language test results. In 1% of cases, these verifications uncover issues. Verified applications are sent to the admissions committee. The admission committee accepts 20% of the applications it receives
Over-production

• Unnecessary process instances are performed, producing outcomes that do not add value upon completion

Examples

• Quote-to-cash process: In 50% of cases, issued quotes do not lead to an order
• Travel approval process: In 5% of cases, travel requests are approved but the travel is cancelled
• University admission process: About 3000 applications are submitted, but only 600 are considered eligible after assessment
Equipment rental process: wastes

1. New Equipment Needed
   - Submit equipment rental request
   - Send request to clerk (Transportation)
   - Forward request to works engineer (Transportation)
   - Select suitable equipment
   - Check availability
   - Create PO

Defect:
- Not available
- Rejected (Transportation)
- Over-processing

Send request back to clerk (Transportation)
Equipment rental process: wastes

Transportation
- Site engineer sends request to clerk
- Clerk forwards to works engineer
- Works engineer sends back to clerk

Inventory
- Equipment kept longer than needed

Waiting
- Waiting for availability of works engineer to approve
Equipment rental process: wastes

**Defect**
- Selected equipment not available, alternative equipment sought
- Incorrect equipment delivered and returned to supplier

**Over-processing**
- Clerk finds available equipment and rental request is rejected by works engineer
- Rental requests being approved and then canceled by site engineer because no longer needed

**Over-production**
- Equipment being rented and not used at all by site engineer
- Equipment returned by site engineer because is incorrect
Issue register

Purpose: to maintain, organize and prioritize perceived weaknesses of the process (issues)

Sources of issues:
- Input to a BPM project
- Collected as part of ongoing process improvement actions
- Collected during process discovery (modelling)
- Value-added/waste analysis
Issue register structure

Can take the form of a table with:

- Issue identifier
- Short name
- Description
- Assumptions
- Impact: Qualitative and Quantitative
- Possible improvement actions

Larger process improvement projects may require issue trackers
**Issue name**
- Equipment kept longer than needed

**Description**
- Site engineers keep rented equipment longer than needed by asking for deadline extensions to the supplier

**Assumptions**
- 3000 pieces of equipment rented p.a.
  - In 10% of cases, equipment is kept two days more than needed
  - Average rental cost is 100 per day

**Quantitative impact**
- \[0.1 \times 3000 \times 2 \times 100 = 60,000\] p.a
## Issue Register Example

### Equipment rental process

<table>
<thead>
<tr>
<th>Name</th>
<th>Explanation</th>
<th>Assumptions</th>
<th>Qualitative Impact</th>
<th>Quantitative Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment kept longer than needed</td>
<td>Site engineers keep equipment longer than needed via deadline extensions</td>
<td>3000 pieces of equipment rented p.a. In 10% of cases, equipment kept two days longer than needed. Rental cost is 100 per day</td>
<td>Disrupted schedules. Employees stress and frustration</td>
<td>$0.1 \times 3000 \times 2 \times \text{EUR} 100 = \text{EUR} 60000 \text{ p.a.}$</td>
</tr>
<tr>
<td>Wrong equipment delivered</td>
<td>Site engineers reject delivered equipment due to non-conformance to their specifications</td>
<td>3000 pieces of equipment rented p.a. 5% of them are rejected due to an internal mistake For each equipment rejected due to an internal mistake, BuildIT is billed EUR 100.</td>
<td></td>
<td>$3000 \times 0.05 \times \text{EUR} 100 = \text{EUR} 15000 \text{ p.a.}$</td>
</tr>
<tr>
<td>Late payment fees</td>
<td>Late payment fees incurred because invoices are not paid by their due date</td>
<td>3000 pieces of equipment rented p.a. Average rental time is 4 days. Rental cost is EUR 100 per day. Each rental leads to one invoice. About 10% of invoices are paid late. Penalty for late payment is 2%.</td>
<td>Poor reputation with suppliers</td>
<td>$0.1 \times 3000 \times 4 \times \text{EUR} 100 \times 0.02 = \text{EUR} 2400 \text{ p.a.}$</td>
</tr>
</tbody>
</table>
Pareto chart

• Useful to prioritize a collection of issues
• Bar chart where the height of the bar denotes the impact of each issue
• Bars sorted by impact
• Superposed curve of cumulative percentage impact
Pareto chart example
Two-Dimensional Prioritization: PICK Chart

![Diagram showing a two-dimensional prioritization chart with axes for High and Low Payoff, and Implement and Challenge quadrants. The chart is divided into quadrants: Easy, Difficulty, and Hard for the X-axis, and Possible and Kill for the Y-axis. Data points are scattered across the chart to represent different priorities.]
Root-cause analysis

Factors

Why-why diagram

Issue

Cause-effect diagram
Why-why diagram

Five levels of nesting - “Five Why’s”
Why-why diagram example

Site engineer keeps equipment longer than needed

Site engineer fears equipment will not be available later when needed

Time between request and delivery too long

Excessive time spent in finding suitable equipment and approving the request

Time spent waiting for works engineer to check request

Time spent by clerk contacting possibly multiple suppliers sequentially
Cause-effect (Fishbone) diagram

Causal Factors

- Measurement
  - Primary
    - Secondary
      - Primary
    - Primary

- Material
  - Primary
    - Secondary
      - Primary
    - Primary

- Machine
  - Primary
    - Secondary
      - Primary
    - Primary

- Milieu
  - Primary
    - Secondary
      - Primary
    - Primary

- Man
  - Primary
    - Secondary
      - Primary
    - Primary

- Method
  - Primary
    - Secondary
      - Primary
    - Primary

Issue
Categories of causes: Six Ms

1. **Machine**: factors stemming from technology used
   - Lack of suitable functionality in the supporting software applications
   - Poor User Interface (UI) design
   - Lack of integration between systems

2. **Method**: factors stemming from the way the process is designed, understood or performed
   - Unclear assignments of responsibilities
   - Unclear instructions
   - Insufficient training
   - Lack of timely communication

3. **Material**: factors stemming from input materials or data
   - Missing, incorrect or outdated data
Categories of causes: Six Ms

4. **Man**: factors stemming from wrong assessments or incorrect performance of steps attributable to:
   - Lack of training and clear instructions
   - Lack of motivation
   - Too high demands towards process workers

5. **Measurement**: factors stemming from reliance on:
   - Inaccurate estimations
   - Miscalculations

6. **Milieu**: factors outside the scope of the process
   - Delays caused because of unresponsive external actors
   - Sudden increases of workload due to special circumstances
Cause-effect diagram example

**Causal Factors**

- **Measurement**
  - Clerk selected equipment with incorrect specs
  - Inaccurate equipment description in provider's catalogue

- **Material**
  - Incomplete or inaccurate requirements from site engineer
  - Clerk misunderstood site engineer's requirement

- **Machine**
  - Clerk is entirely responsible for equipment selection
  - Site engineer does not validate the choice of equipment

**Issue**

- The system does not keep the site engineer informed
- Equipment rejected at delivery
Summary

1. Segregate value-adding, business value-adding and non-value-adding steps
2. Identify waste
3. Collect and systematically organize issues, assess their impact
4. Analyze root causes of issues