MTAT.03.231
Business Process Management

Lecture 4 – Qualitative Process Analysis

Marlon Dumas

marlon.dumas @t ut . ee
Process Analysis
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

• 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

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

• Produces 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
- Includes:
  - Handovers, context switches
  - Waiting times, delays
  - Rework or defect correction
- Examples
  - Order-to-cash: Forward PO to warehouse, Re-send confirmation, Receive rejected products
  - University admission: Forward applications to committee, Receive admission results from committee
Extract of Equipment Rental Process

- **Fill request (VA)**
- **Send request to clerk (NVA)**

- **Open and read request (NVA)**
- **Select suitable equipment (VA) – 1st time**
- **Check equipment availability (VA) – 1st time**
- **Record recommended equipment (BVA)**
- **Forward request to works engineer (NVA)**

- **Open and examine request (BVA)**
- **Communicate issues (BVA)**
- **Forward request back to clerk (NVA)**

- **Select suitable equipment (VA) – 1st time**
- **Check availability**
- **Create PO (BVA)**
- **Submit PO to supplier (VA)**
- **Produce PO (BVA)**
- **Review rental request**

- **X (Available)**
- **X (Rejected)**

- Ste Eng.

- Clerk

- BuildIT
## 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
Seven sources of waste

Move
- Unnecessary Transportation
- Motion

Hold
- Inventory
- Waiting (and idleness)

Over-do
- Defects
- Over-Processing
- Over-Production
Move
Unnecessary transportation

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

Example:
• 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 to 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 business 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
• Approval process, a process workers 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

- 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
- 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
- Rework loops

Examples
- Vehicle inspection: A vehicle needs to come back to a station due to an omission
- Travel approval: Request sent back to requestor for revision
- University admission: 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: 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: 10% of approvals are trivially rejected at the end of the process due to lack of budget
- University admission: 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
- Order-to-cash: In 50% of cases, issued quotes do not lead to an order
- Travel approval: In 5% of cases, travel requests are approved but the travel is cancelled
- University admission: About 3000 applications are submitted, but only 800 are considered eligible after assessment
Equipment rental process: wastes

1. **Site Eng.**
   - New Equipment Needed
     - Submit equipment rental request

2. **Clerk**
   - Open and read request (Handover → transportation)
   - Select suitable equipment
   - Check availability
   - Defect
     - Not available
   - Create PO
   - PO Created

3. **Works Eng.**
   - Forward request to works engineer (Transp.)
   - Review rental request
   - Approved
   - Reject
   - Request Rejected

4. **Send request to clerk (Transp.)**
   - Forward request back to clerk (Transp.)
Equipment rental process: wastes

**Transportation**
- Site engineer sends request to clerk
- Clerk forwards to works engineer
- Works engineer send 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 because equipment not needed
  - Rental requests being approved and then canceled by site engineer

- **Over-production**
  - Equipment being rented and not used at all
Issue register

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

• Sources of issues:
  • Input to a process modelling 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 example

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
<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</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</td>
<td>0.1 × 3000 × 2 × 100 = 60,000 p.a.</td>
<td></td>
</tr>
<tr>
<td>than needed</td>
<td></td>
<td>longer than needed via deadline extensions. Rental cost is 100 per day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rejected equipment</td>
<td>Site engineers reject delivered equipment due to non-conformance to their</td>
<td>3000 pieces of equipment rented p.a. 5% of them are rejected due to an internal</td>
<td>Disrupted schedules. Employee stress and frustration</td>
<td>3000 × 0.05 × 100 = 15,000 p.a.</td>
</tr>
<tr>
<td></td>
<td>specifications</td>
<td>mistake For each equipment rejected due to an internal mistake, BuildIT is</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>billed 100.</td>
<td></td>
<td></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</td>
<td>Poor reputation with suppliers</td>
<td>0.1 × 3000 × 4 × 100 × 0.02 =</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cost is 100 per day. Each rental leads to one invoice. About 10% of invoices</td>
<td></td>
<td>2400 p.a.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>are paid late. Penalty for late payment is 2%.</td>
<td></td>
<td></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
Why-why diagram

Issue

Contributing Factor

Contributing Factor

Contributing Factor

Contributing Factor

Contributing Factor

...
Why-why diagram example

Site engineers keep equipment longer, why?

• Site engineer fears that equipment will not be available later when needed, why?
  
  • time between request and delivery too long, why?
    
    • excessive time spent in finding suitable equipment and approving the request, why?
      
      • time spent by clerk contacting possibly multiple suppliers sequentially;
      
      • time spent waiting for works engineer to check the requests;
Cause-effect (Fishbone) diagram
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
- **Material**
  - Inaccurate equipment description in provider's catalogue
- **Machine**
  - The system does not keep the site engineer informed
- **Milieu**
  - Incomplete or inaccurate requirements from site engineer
- **Man**
  - Clerk misunderstood site engineer's requirement
- **Method**
  - Clerk is entirely responsible for equipment selection
  - Site engineer does not validate the choice of equipment

**Issue**
- 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