LTAT.05.015

Business Process Mining

Lecture 2: Process Performance Measurement and Dashboards

Marlon Dumas

Professor of Information Systems @ University of Tartu
Co-founder @ Apromore
Course Outline

Introduction

Process performance measurement & dashboards

Process mining

- Automated process discovery
- Conformance checking
- Performance mining
- Variant analysis

Simulation and “what-if” process mining

Data extraction & preparation for process mining

Predictive process monitoring

Business case analysis & project management for process mining

Trends: prescriptive monitoring, causal process mining, robotic process mining
Process performance

If you had to choose between two services, you would typically choose the one that is:

• Faster
• Cheaper
• Better
Process performance

- Time
- Quality
- Cost
Time measures

- **Processing time**
- **Waiting time**
- **Time taken by value-adding activities**
- **Time taken by non-value-adding activities**
- **Time between start and completion of a process instance**
Cycle time efficiency

\[
\text{Processing Time} \div \text{Cycle Time} = \text{Cycle Time Efficiency (CTE)}
\]
Cost measures

- Processing cost
- Cost of value-adding activities
- Cost of a process instance
- Cost of waste
- Cost of non-value-adding activities

Per-Instance Cost

Cost of value-adding activities + Cost of non-value-adding activities = Per-Instance Cost
Typical components of cost

Material cost

- Cost of tangible or intangible resources used per process instance

Resource cost

- Cost of person-hours employed per process instance
Resource utilization

Resource utilization = 60%
⇒ on average resources are idle 40% of their allocated time
Resource utilization vs. waiting time

Typically, when resource utilization > 90% → Waiting time increases steeply
Quality

Product quality

- Defect rate

Delivery quality

- On-time delivery rate
- Cycle time variance

Customer satisfaction

- Customer feedback score
- Net Promoter Score (NPS)
Other process performance measures

• Measuring demand (for the process)
  • Case arrival rate (written $\lambda$): number of new cases created per time unit
  • An alternative measure is the case inter-arrival time (the average time between two new consecutive cases)
  • Example: number of new purchase orders created per day

• Measuring workload
  • Work-in-Process: (average) number of cases that are active, meaning that have started but not completed
  • Example: number of purchase orders that have been received and not yet fulfilled
Little’s law

• Little’s law is a fundamental law of systems that involve jobs waiting for resources (like business processes).
• It relates demand, workload and cycle time

\[ WIP = \lambda \cdot CT \]

• WIP = work in process
• \( \lambda \) = arrival rate (number of new cases per time unit)
• CT = cycle time

• Example: if we receive 10 customer claims per hour and it takes us 2 hours to solve a claim, then the number of claims that are “pending” is \( 10 \times 2 = 20 \) unresolved claims.
For each performance measure, define targets

\[ ST_{30} > 99\% \]
Balanced scorecard

Financial

Customer

Internal business process

Innovation & learning

Cost measures

Quality & time measures

Technology leadership, Staff satisfaction

Quality & time measures
Supply Chain Operations Reference Model (SCOR)
- Performance measures for supply chain management processes

American Productivity and Quality Council (APQC)
- Performance measures and benchmarks for processes in the Process Classification Framework (PCF)

IT Infrastructure Library (ITIL)
- Performance measures for IT service management processes
Business Process Monitoring

Enterprise System → Database

Event stream → Event log

Performance Dashboards

Process Mining
Types of process dashboards

- Operational dashboards (runtime)
- Tactical dashboards (historical)
- Strategic dashboards (historical)
Operational process dashboards

• Aimed at process workers & operational managers
• Emphasis on monitoring (detect-and-respond), e.g.:
  - Work-in-progress
  - Problematic cases – e.g. overdue/at risk
  - Resource load
Tactical dashboards

• Aimed at process owners / managers
• Emphasis on analysis and management
  • E.g. detecting bottlenecks
• Typical process performance indicators
  • Cycle times
  • Error rates
  • Resource utilization
Tactical Performance Dashboard
@ Australian Insurer
Strategic dashboards

• Aimed at executives & managers
• Emphasis on linking process performance to strategic objectives
# Strategic Performance Dashboard
@ Australian Utilities Provider

<table>
<thead>
<tr>
<th>Key Performance</th>
<th>Manage Unplanned Outages</th>
<th>Manage Emergencies &amp; Disasters</th>
<th>Manage Work Programming &amp; Resourcing</th>
<th>Manage Procurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Satisfaction</td>
<td>0.5</td>
<td>0.55</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td>Customer Complaint</td>
<td>0.6</td>
<td>-</td>
<td>-</td>
<td>0.5</td>
</tr>
<tr>
<td>Customer Feedback</td>
<td>0.4</td>
<td>-</td>
<td>-</td>
<td>0.8</td>
</tr>
<tr>
<td>Connection Less Than Agreed Time</td>
<td>0.3</td>
<td>0.6</td>
<td>0.7</td>
<td>-</td>
</tr>
</tbody>
</table>
Process: Manage Procurement 0.67

Process: Manage Emergencies & Disasters 0.58

Process: Manage Unplanned Outages

Overall Process Performance 0.54

1st Layer Key Result Area
- Financial: 0.5
- People: 0.4
- Customer Excellence: 0.65
- Operational Excellence: 0.5
- Risk Management: 0.8
- Health & Safety: 0.4

2nd Layer Key Performance
- Customer Complaint: 0.6
- Customer Satisfaction: 0.7

3rd & 4th Layer Process Performance Measures
- Customer Rating (%): 0.7
- Customer Loyalty Index: 0.6
- Average Time Spent on Plan: 0.8
- Satisfied Customer Index: 0.4
- Market Share (%): 0.8
Designing Process Performance Dashboard

1. Identify a user or users and define a clear question or set of questions that users will answer with this question.
2. Identify the type of dashboard elements based on the insights required to answer the question.
3. Identify a type of visualization (e.g., type of chart) for the element.
4. Determine x-axis (independent variable): longitudinal time, cross-sectional (attribute).
5. Determine y-axis (dependent variable): performance measure or attribute and the aggregation function.
Process performance dashboard elements

**Indicator:** Card displaying a process performance measure

- Example: cycle time (average, median, max, min, etc.)

**Trend chart:** A longitudinal performance chart that traces a performance measure over time

- Chart displaying the number of active cases (WIP) over time

**Performance distribution chart:** A histogram displaying the performance of the process across different components

- Histogram of total effort (total processing time) spent per resource

**Cross-sectional chart:** A chart that traces a performance measure across different segments (e.g. business units, countries, activity, etc.)

- Chart displaying the cycle time of the process per country

**Detailed Tables**

- Tables providing detailed performance statistics per case, per activity, etc.
Tools for performance dashboarding

Operational-Tactical – Business Activity Monitoring (BAM)
- Axway AMPLIFY
- VITRIA Operational Process Intelligence
- Oracle BAM
- SAP Operational Process Intelligence (OPI)
- webMethods Optimize for Process

Tactical
- Business Intelligence (BI) tools: PowerBI, Qlikview, Tableau…
- Process Mining (dashboard modules): Apromore, Celonis, QPR, …

Strategic Level – Balanced Scorecard tools
- BSC Designer Online, Quickscore, Sisense, etc.
Quick Demo

Performance dashboards in Apromore
cole nussbaumer knaflic

storytelling with data

a data visualization guide for business professionals

WILEY