LTAT.05.025

Business Process Mining

Lecture 2: Process Performance Measurement and Dashboards

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Structure of the Course

Week 2: Performance Measurement & Dashboards

Automated discovery
Conformance Checking
Performance Mining
What-If Process Mining
Predictive monitoring

Week 4
Week 5
Week 6
Week 7
Week 10

Week 3: Concepts and Capabilities

Week 8: Extract-Transform-Load for Process Mining
Week 9: Declarative Process Mining
Week 11: Process Mining Algorithms
Week 12: Process Mining In Practice
Week 13: Course Recap and Future Trends
How to measure process performance?
Process performance

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

• Faster
• Cheaper
• Better
Process performance

- Time
- Process performance
- Cost
- Quality
*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**
Cycle time efficiency

\[
\text{Cycle Time Efficiency} = \frac{\text{Processing Time}}{\text{Cycle Time}} = \text{Cycle Time Efficiency (CTE)}
\]

Cycle Time Efficiency = 10%

➔ on average 90% of total cycle time is spent on non-value-adding activities
Cost measures

- Cost of value-adding activities
- Cost of non-value-adding activities
- Cost of waste

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
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 relates demand, workload and cycle time

\[ \text{WIP} = \lambda \cdot \text{CT} \]

• WIP = work in progress
• \( \lambda \) = 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.
Little’s law

• We can rearrange Little’s law
  • E.g. to determine the cycle time of the process

\[
CT = \frac{WIP}{\lambda}
\]

Example: if on average there are 50 customers in a restaurant and 25 customers arrive every hour, then the customers spend \(50 / 25 = 2\) hours in the restaurant.
Identifying process performance measures

- Define organizational objectives and KPIs (Balanced Scorecard)
  - Improve customer loyalty (returning customers) by 10%

- For each process, formulate process performance objectives
  - Customer should be served always in a timely manner

- For each objective, identify variable(s) and aggregation method ➔ performance measure
  - Variable: customer served in < 30 min.
  - Aggregation method: percentage
  - Measure: $ST_{30} = \%$ of customers served in < 30 min.

- For each performance measure, define targets
  - $ST_{30} > 99\%$
Process performance reference models

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
What is a Process Performance Dashboard?
Business process monitoring

Enterprise System

Database

Event stream

Event log

Performance Dashboards

Process Mining
Process performance dashboard

Visualization of relevant process performance measures

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 cases
  - 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

<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>
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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 dashboard.
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.
What does a performance dashboard consist of?
A dashboard is a collection of widgets

Each widget displays at least one performance measure
E.g. The average case duration

Four types of widgets:
- Single-dimensional widgets
- Two-dimensional widgets
- Three-dimensional widgets
- N-dimensional widgets (tables)
Process performance dashboard widgets

• Single-dimensional widgets display one variable

• We can group multiple measures in one widget for convenience.
Process performance dashboard widgets

Two-dimensional widgets display two variables:

- Independent variable (x-axis) – variable with respect to which we want to analyze
- Dependent variable (y-axis) – the variable that we wish to analyze

Usually, a two-dimensional widget is a chart

- Bar chart, pie chart, etc.

Types of two-dimensional charts:

- Longitudinal charts: x-axis is time, y-axis is a performance measure
- Cross-sectional chart: x-axis is an attribute (e.g. activity, resource, country), y-axis is a performance measure
- Histogram: x-axis is a performance measure, y-axis is a “count”
Process performance dashboard widgets

Longitudinal chart

Activity instances over time

- From 21.01.2020 03:14:46 to 24.01.2020 00:16:52
- Claims_Management: 190 activities

Work-in-Progress (WIP)

- Active cases over time
Process performance dashboard widgets

Cross-sectional chart

Activities - Total case frequency
Process performance dashboard widgets

Cross-sectional chart

from 10.7 hrs to 2.6 d
Claims_Management: 96
Process performance dashboard widgets

- Three-dimensional widgets display three variables, usually:
  - Two cross-sectional variables
  - A performance measure

- The third dimension can be coded in different ways:
  - Heat map: intensity and/or color
  - Bubble chart: size and/or intensity
  - Scatter plot: useful when the third dimension is Boolean

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Process performance dashboard widgets

- N-dimensional widgets display N dimensions, usually:
  - A cross-sectional variable (e.g. the customer, the case identifier, etc.)
  - Several performance measures

- In general, N-dimensional widgets are tables
Demo Time!
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.
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