Understanding Execution Deviations in the O2C Process at Woodcorp

From Planned Process to Actual Execution

Fictitious Company: Woodcorp
Course: Process Mining (DIS 26a.1), BSc. Data and Information Science
Tool: Celonis (Process Mining)
Project Type: Academic Project
Team: K
Team Members:
Jan Lucas Krings (11158700)
Henri Mörsheim (11158679)
University: TH Köln
Date: January 2026

Woodcorp’s operating model structurally amplifies O2C execution deviations

Evidence from Order-to-Cash execution data (≈20k orders)

Company Overview

- German mid-sized industrial manufacturer
- Make-to-order with limited finished-goods buffers
- €210.1M total revenue
- ~19,953 sales orders

Top customers generate a significant share of revenue.

- Brand AG (€19.5M), Götz (€17.0M), Jürgens (€12.4M)

Product Catalog

Product Type	Description	Typical Use Case	Operational Characteristics
Pallets	Standardized wooden pallets	Transport, storage, logistics	High volume, lower unit price, tolerance-sensitive
Crates	Custom wooden crates	Industrial goods, heavy equipment	Make-to-order, higher variability, higher unit price

Operational Footprint

- Multi-plant production network
- Mixed automation levels
- Multiple external logistics providers

This setup **increases coordination effort after order release**
(**order release** = the point in the Order-to-Cash process where a confirmed sales order is handed over to production and logistics for execution)

WoodCorp
Paletten & Kisten

Why This Matters

Structural characteristics of Woodcorp’s operating model systematically **amplify post-release deviations in the Order-to-Cash process**, directly impacting service reliability for key customers.

WoodCorp
Paletten & Kisten

O2C Execution Deviations Undermine Planning Stability and Require Targeted Management Action

Executive Objective

The objective of this analysis is to support operational decision-making by:

- Creating transparency on **actual O2C execution behavior**
- Identifying **systematic execution gaps** with operational impact
- Translating insights into **prioritized management actions**

Executive Focus

- Decision support for operations and process owners
- No tool demonstration or technical deep dive

Key Stakeholders

Primary Audience
O2C Process Owner – end-to-end accountability for execution performance

Relevance for the O2C Process Owner

- End-to-end visibility into execution deviations
- Clear linkage between execution behavior and planning instability
- Fact-based foundation for targeted management action

Why This Matters

Without a fact-based understanding of execution behavior, **improvement initiatives risk addressing symptoms rather than root causes.**

Enhancement Cycle Phase: *Identify Execution Gaps*
(Problem Context & Objective Definition)

WoodCorp
Paletten & Kisten

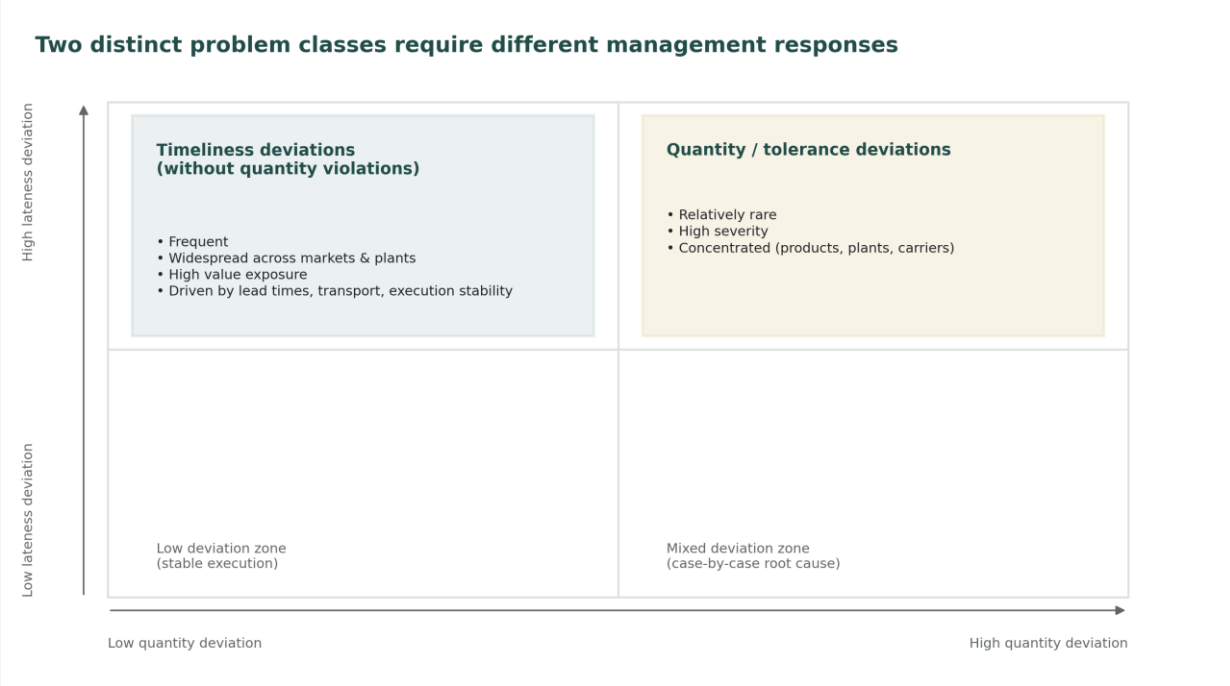
Operational Issue Requires Two Different Management Responses

Observed Core Patterns

Our analysis reveals **systematic execution gaps in the O2C process**. **Operational Issues are not driven by a single root cause**, but by **distinct execution patterns** with different operational and value impacts.

Key observations:

- **Quantity tolerance violations** are associated with **concentrated, high-severity cases**, rather than broad lateness.
- A **substantial share of late deliveries** occurs at **low or moderate quantity-violation rates**.
- **Value exposure is primarily driven by late deliveries without quantity violations**.



How to read:
The chart plots **quantity tolerance deviations (x-axis)** against **delivery lateness (y-axis)**. It distinguishes **systemic lateness issues** from **concentrated, high-severity quantity violations**, indicating that different deviation patterns require **different management responses**.

Analytical Approach

Process Mining Enhancement Cycle

The analysis follows the Enhancement Cycle to identify, quantify, and analyze execution gaps in the O2C process, derive differentiated improvement actions, and define KPIs for sustainable control and monitoring.

Why This Matters

These patterns imply that improving O2C performance requires differentiated, problem-specific management actions rather than broad process changes.

Enhancement Cycle Phase: *Identify Execution Gaps*

WoodCorp
Paletten & Kisten

Execution Deviations After Order Release Drive ~4 Days of Delay

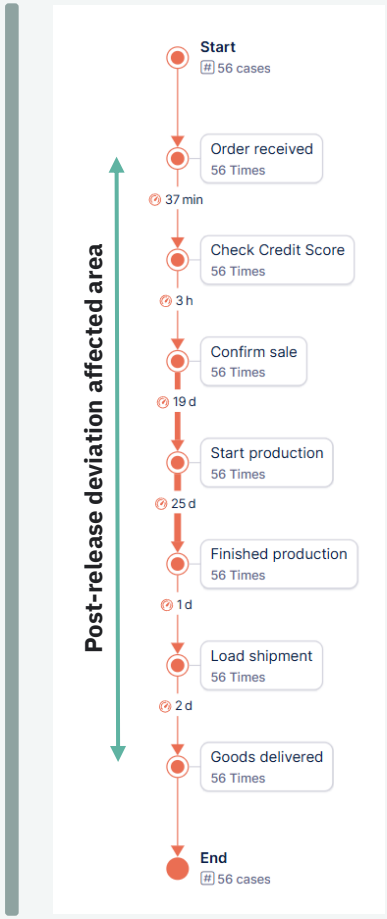
Happy Path – Analytical Reference

The Happy Path represents the **intended best-case execution flow** of the Order-to-Cash (O2C) process **without rework or change loops**.

It is used **exclusively as an analytical baseline** to **identify, compare, and quantify execution deviations** and to **derive targeted improvement actions**.

Why This Matters

Orders following the exact Happy Path are ~4 days faster, showing that delays are **primarily associated with post-release deviations from the Happy Path.**



Happy Path

(based on internal business sorting logic):

1. Order received
2. Check credit score
3. Confirm sale
4. Start production
5. Finished production
6. Load shipment
7. Goods delivered

Quantitative reference:

- All orders contain these core activities
- Typical Order process variations (top 30) with post-release deviations:
  → ***Median throughput time: 45.6 days***
- Orders that follow the exact Happy Path:
  → **Median throughput time: 41.5 days**

The Happy Path is intentionally rare and serves as a performance benchmark, not as a realistic target state.

Share of orders following exact Happy Path: <1%

Enhancement Cycle Phase: *Identify Execution Gaps (Process Discovery & Transparency)*

A Small Number of Post-Release Rework Patterns Drives Most O2C Delays

Execution Gaps Identified

Late Quantity Changes After Load Shipment

- Execution Gap

Occur **after physical execution has started**

- Affect a **small but highly impacted subset of orders**
- Trigger **rework after shipment**, causing disproportionate delays

Interpretation:
Late order changes introduce operational rework beyond the controllable execution window.

Repeated Production Start Date Changes after Production Start

- Planning / Coordination Gap

- Occur in the **vast majority of orders**
- Low impact per case, but **systematic and recurring**
- Primary driver of **planning instability**, not physical failure

Interpretation:
Frequent replanning erodes schedule reliability across the network.

Credit Blocks With Downstream Rework

- Control / Compliance Gap

Affect a **relevant majority of cases (~10%)**

- Create significant cycle time increases once triggered

Interpretation:
Payment-related controls introduce downstream process friction beyond order release.

Sales price rework after Sale confirmation

- Commercial / Policy Gap

Affect a **relevant minority of cases**

- Affect a **relevant majority of cases (~13%)**
- Create significant cycle time increases once triggered

Interpretation:
Sales prices are renegotiated and reprocessed after order receipt and sale confirmation, causing additional approval steps, rework loops, and execution delays in O2C.

Timestamp inconsistencies

- Data / Technical Artifact

- Timestamps do not reliably reflect business execution order
- Root cause: **technical logging effects** (e.g., retrospective reporting)

Analytical handling:

- Process order defined by business logic (sorting column)
- plausible Timestamps used for **durations only**

Why This Matters

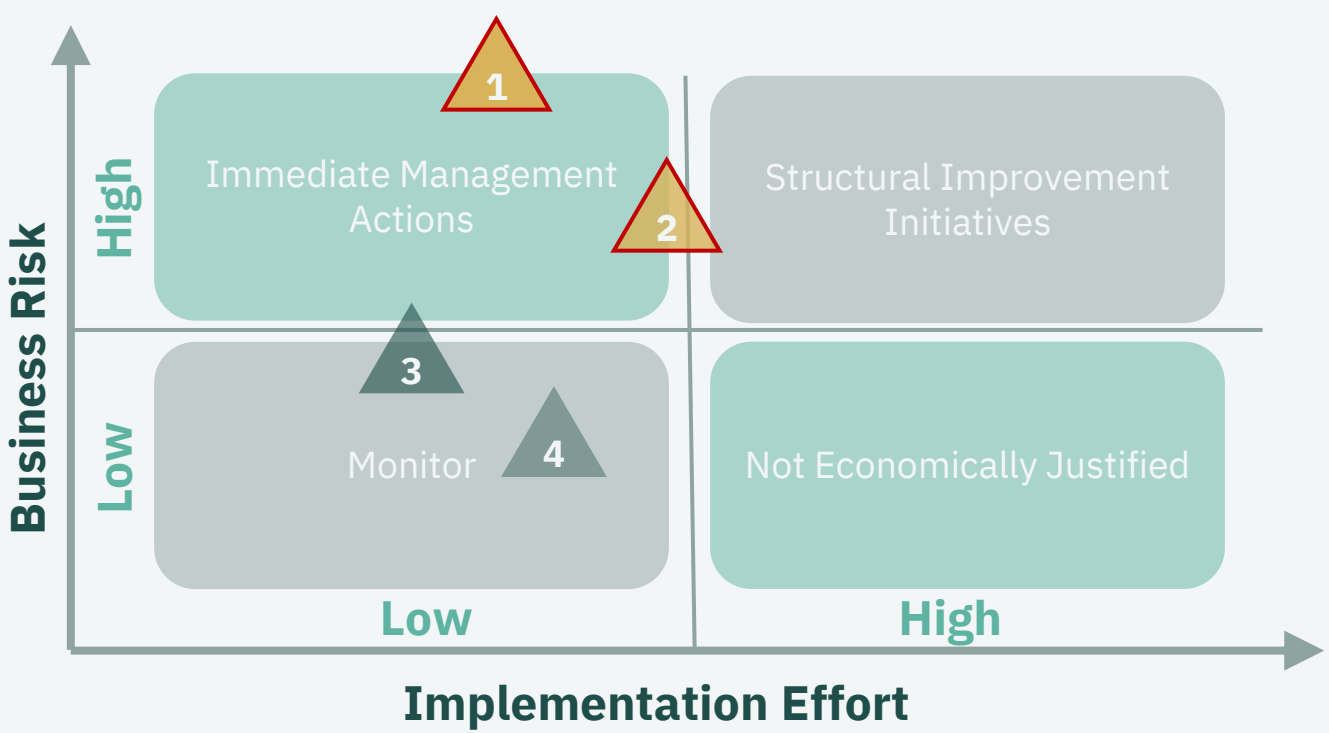
A small number of recurring execution gaps explains a large share of cycle time variance and planning effort, making them **high-leverage targets for management action and improvement potential**.

Enhancement Cycle Phase: *Quantify Execution Gaps*

WoodCorp
Paletten & Kisten

Two Post-Release Execution Gaps Require Immediate Management Attention

Rank (Importance)	Gap	Per Case	% of Orders	Δ Cycle TPT vs. Happy Path median of 41.5d	Business Risk
1	**Post-loading quantity correction**	1-13 1 2 3	27.9% 12.5% 11% 3.6%	**+11 d** **+8.9 d** **+10.9 d** **+10.5 d**	**VERY HIGH**
2	**Credit order block**	1	10%	**+19.5 d**	**VERY HIGH**
3	**Post-confirm sale price rework**	1-9 1 2 3	13% 6.4% 5.5% 0.8%	**+19.9d** **+19.9d** **+16.5d** **+32.8d**	**HIGH**
4	**Repeated Production Re-Scheduling After P-Start**	1-9 1 2 3	48.2% 38.3% 7.5% 2%	**-13.5 d** **-16.5 d** **+5.5 d** **+11.5 d**	**MEDIUM**



How to read:
Top-left gaps require immediate management action, while others are monitored or addressed structurally based on effort–impact trade-off.

Execution gaps are ranked by **frequency, delay impact (Δ TPT vs. Happy Path), and business risk**.
The matrix positions gaps by **business risk (Y-axis)** and **implementation effort (X-axis)**; numbers refer to the ranked gaps.

Combining lateness, quantity deviations, value exposure, and frequency enables impact based prioritization

Analytical Approach

We focus on attributes that jointly explain operational risk and business impact:

Delivery timeliness
Identifies systemic execution instability and planning reliability issues.
Quantity tolerance deviations
Indicates late order changes and post-release rework beyond the controllable execution window.
Value exposure
Ensures management focus on deviations with material business impact.
Frequency across orders
Distinguishes isolated exceptions from recurring execution gaps.

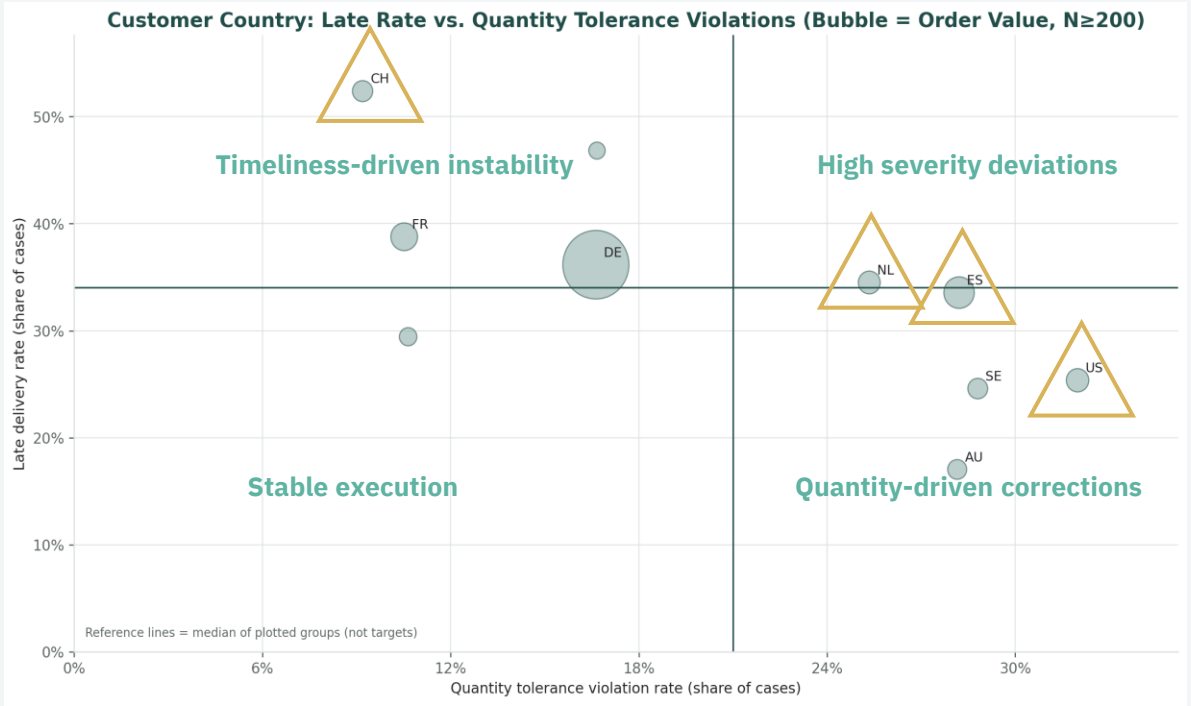
These attributes allow us to separate stable execution from high-impact deviation patterns and prioritize management action.

Assessment Priority Example: Customer Country

- **CH**: extreme late-rate outlier → timeliness-driven execution instability
- **NL / ES**: elevated late rates with high value exposure → economically relevant patterns
- **US**: high quantity deviation + delay exposure → post-release quantity corrections

(DE/FR appear sizeable mainly due to baseline volume; they are treated as reference segments)

Identified Assessment Priority Markets



How to read:
X = Qty deviation rate, Y = Late rate, Bubble = value exposure;
lines = median of plotted segments

Enhancement Cycle Phase: *Analyze Drivers*

WoodCorp
Paletten & Kisten

Post loading quantity corrections affect few orders but drive disproportionate delay and value exposure

GAP DEFINITION: Quantity is changed ***after*** shipment was loaded.

Urgency

- affects ~28% of processes
- represents ~46% of ordered value
- Difference in median TPT: **+ 11 days**
- Hits high-value orders harder

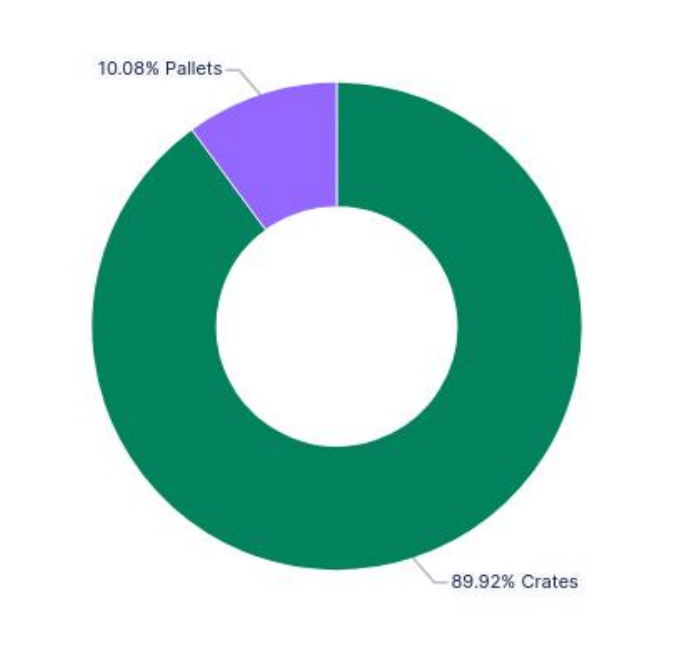
Factory

- Mostly in **Essen (63,61%)**
- **Bonn** is also overrepresented **(10,77% vs. 5,84%)**

Customer

- **Brand AG** is overrepresented **(20,63%)**

Product type distribution of post-loading quantity corrections



How to read: Post-loading quantity corrections mainly affect crate production and the transportation customer segment.

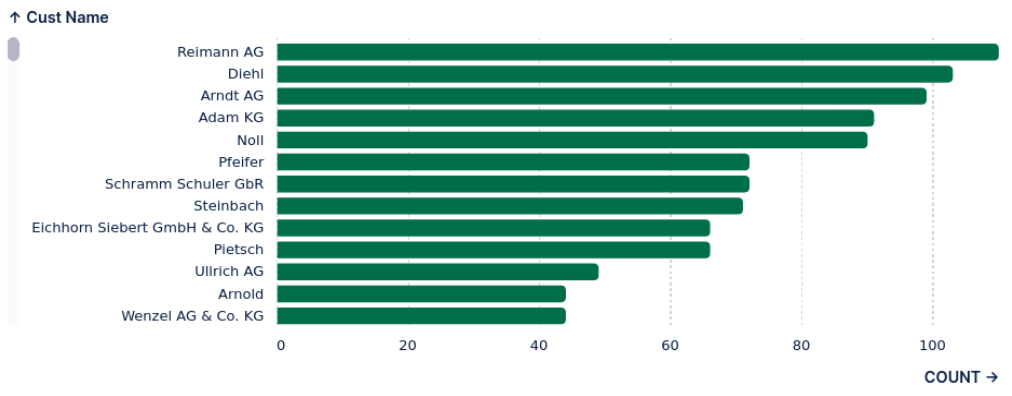
Key Message

This execution gap is very impactful and mostly rooted in high value orders, concentrated on both particular customers and factories.

Credit blocks create severe delays for a relevant share of orders but lack a single dominant root cause

GAP DEFINITION: Credit order is being blocked ***at least once***.

Customer distribution for orders with credit order blocks



How to read: Customer impact is broadly distributed with no dominant customer segment.

Urgency

- Affects **~10,05%** of all processes
- Difference in median TPT: **+ 19,5 days**

Customer Country

Nothing unusual, except for some slight overrepresentations **(France, Netherlands)**. Generally everything outside the EU is slightly overrepresented.

Key Message

This execution gap is impactful but lacks a clear root cause.

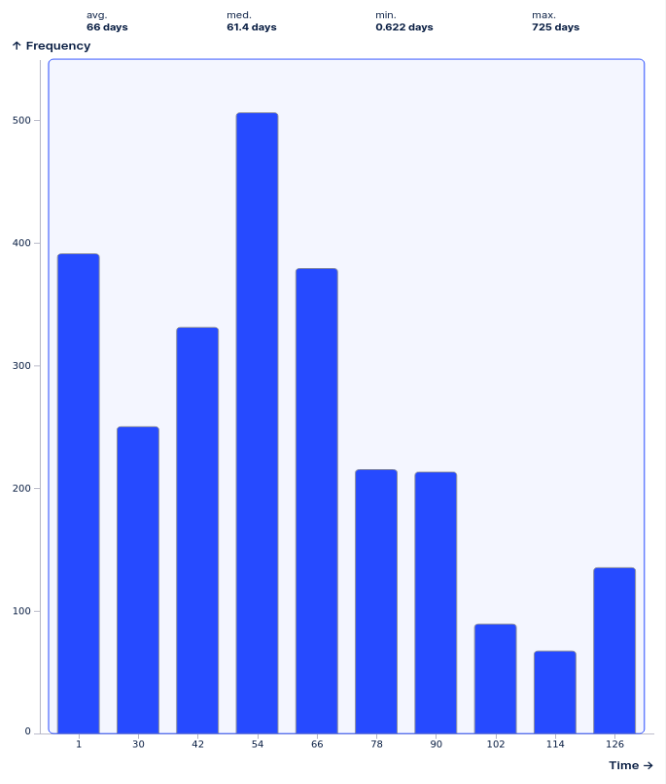
The broad customer distribution points to a systemic issue affecting smaller or infrequent buyers.

Price changes after sale confirmation introduce significant rework and increase throughput time

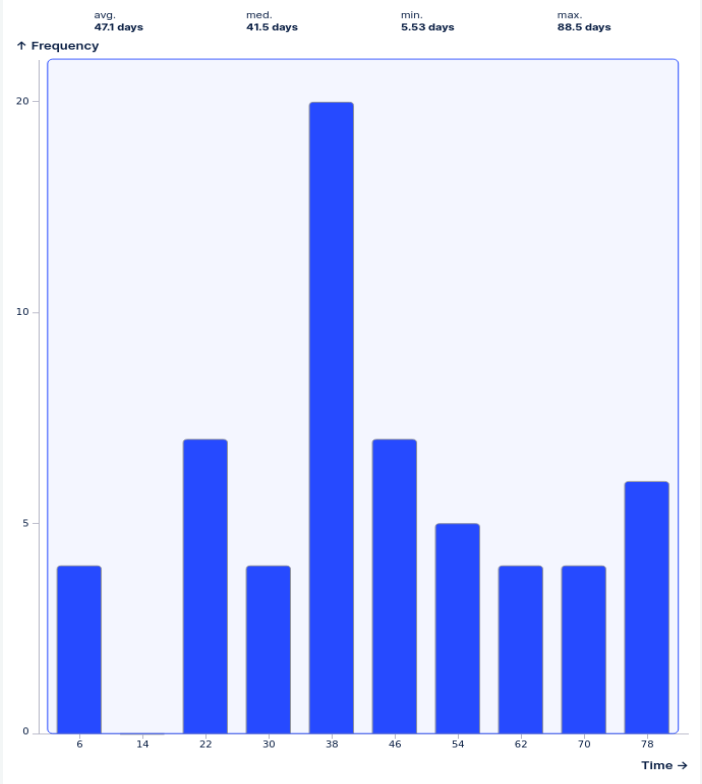
GAP DEFINITION: Price is changed any time ***after*** sale confirmation.

Throughput time distribution with and without post-confirmation price changes

Orders with post-confirmation price changes



Happy Path



Urgency

- Affects **~13%** of all processes
- Difference in median TPT: **~20d**

Key Message

The lack of a dominant driver indicates a systemic issue.

Enhancement Cycle Phase: *Analyze Drivers*

WoodCorp
Paletten & Kisten

Repeated production rescheduling is a systemic planning issue rather than an isolated execution failure

GAP DEFINITION: Production start date is changed ***after*** start of production.

Urgency

- Affects **~48,3%** of all processes

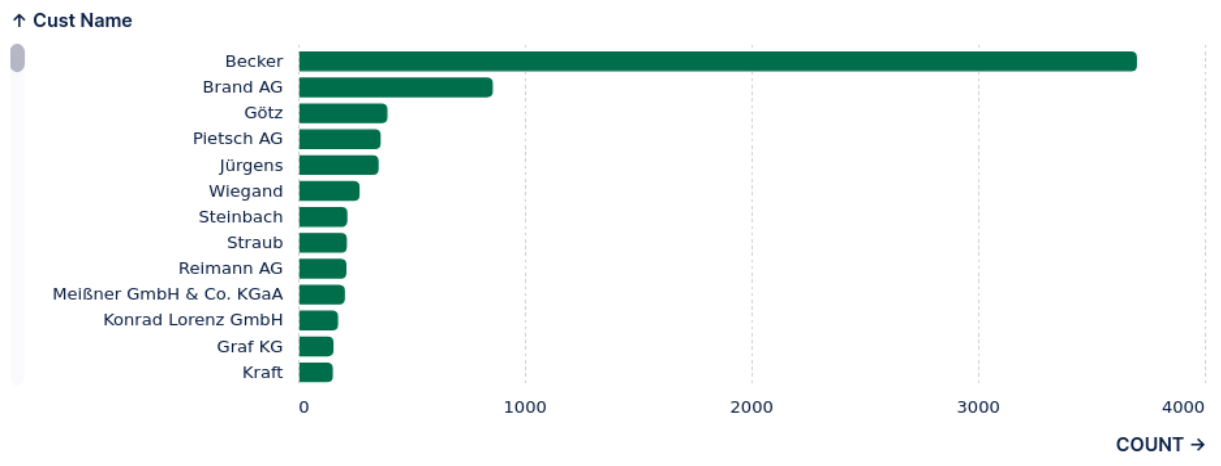
Factory

Relatively stable across all factories, nothing unusual.

Key Message

This execution gap affects nearly half of all processes and reflects a systemic planning issue rather than isolated execution failures.

Customer distribution for orders with repeated production rescheduling



How to read: Each bar represents the number of orders with repeated production rescheduling per customer

Enhancement Cycle Phase: *Analyze Drivers*

WoodCorp
Paletten & Kisten

Targeted Management Actions

Identified Gap	Gap Category	Management Action	Action Type	Business Impact	Implementation Effort	Control KPI
Late quantity changes after load shipment	Execution Gap	**Audit and standardize loading procedures at Essen and Bonn**: Implement digital checklists or barcode scanning for quantity verification pre-loading; train staff on error-prone steps	**IMMEDIATE**	**HIGH**	**LOW**	% qty changes post-shipment
Credit blocks with downstream rework	Control / Compliance Gap	**Implement tiered credit policies**: Auto-approve low-value orders (<€5k) for established EU customers; require pre-checks only for new/non-EU buyers.	**IMMEDIATE**	**HIGH**	**MEDIUM - HIGH**	% of orders blocked by credit checks
Sales price rework after confirmation	Commercial / Policy Gap	**Increase transparency on post-confirmation price changes and monitor their frequency and impact.** Introduce a **soft price-change governance** (e.g. justification requirement and managerial approval after sale confirmation). Evaluate the need for a formal price-change freeze only if rework remains frequent or value-relevant.	**MONITOR**	**(HIGH)**	**LOW - MEDIUM**	% prices changes post sale conformation
Repeated production start date changes after production start	Planning & Coordination Gap	**Increase transparency on post-start production re-scheduling and monitor its frequency and drivers.** Introduce a **formal change governance after production start** (e.g. justification and approval requirement). Escalate to a strict change-freeze or penalty-based policy only if re-scheduling remains frequent and destabilizes planning reliability.	**MONITOR**	**MEDIUM**	**MEDIUM**	% production start date changes after start production
Timestamp inconsistencies	Data / Technical Artifact	**Handle timestamp inconsistencies analytically rather than operationally.** Use business-based sorting logic and plausibility checks for analysis. Document data quality limitations and flag standardized event logging as a future IT enablement topic, **not as a current improvement initiative.**	**AVOID**	**LOW**	**MEDIUM**	*Data Quality checks*

How to read:
The table links identified O2C execution gaps to issue based categories, prioritized management actions, and control KPIs based on impact and implementation effort.

Key Message
Targeted actions aligned to specific execution gap types deliver higher impact than broad, undifferentiated process changes.

Enhancement Cycle Phase: *Devise & Prioritize Improvements (with Control KPIs)*

WoodCorp
Paletten & Kisten

Key Takeaway for Management

Execution variability is not a data problem.
It is a governance problem.

Thank you

Woodcorp – Order-to-Cash Process Analysis
Academic project · DIS26a1 (Process Mining) · TH Köln
· Tools: Celonis (process mining platform), Python
· Team: Jan Krings & Henri Moersheim

Fictitious company · Data synthesized

Documentation & Reproducibility

- Detailed analysis, methodology and assumptions documented on the project repository
- Data quality checks and sequence validation implemented in Python scripts
- All analyses are fully reproducible based on the provided repository structure: https://github.com/mmoershe/dis26a1_process_mining

Celonis Dashboard:
https://academic-celonis-0fm1g1.eu-2.celonis.cloud/package-manager/ui/studio/ui/spaces/44f58993-390a-49ba-bb45-913a7efb1513/packages/6031c063-b7d6-4ba8-80fd-33937b708a93/nodes/cb811a3e-2d40-4441-b944-abe40f31dc83?activeTabs=dd3867aa_e9a4_498f_89d0_8ed80f1cd164-view:b05c11e2-e496-4643-8292-065003342a70