PROCESS MINING APPLICATIONS AND USE CASES

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- **Education:**
  - *B.Sc.* Information Technology, Iran
  - *M.Sc.* Electronic Commerce, Iran
  - *M.Sc.* Business Informatics (Data and Web Science), University of Mannheim
  - *Doctoral student*, University of Mannheim
- **Industry experience:**
  - Information Technology associate (in Iran)
  - Big-Data software engineer at Celonis
- **Research interests:**
  - [Predictive] Process Mining, Visual Analytics, Business Intelligence, Business value generation with process mining

University of Mannheim is located in the heart of Europe and has a strong focus on business administration

University of Mannheim

- Founded in 1907
- 12,000 students
- 5 faculties with **focus on social science and business research**
- **Strong connections to industry** as well as international university landscape

Business School

- 44 professors & 80 honorary professors / adjunct faculty
- 150+ doctoral students
- **36 chairs in 7 different areas**, including:
  - **Information systems**
  - **Operations management**
- First German university with **triple crown accreditation** (AACSB, EQUIS & AMBA)
- **Only German faculty among top 100 global business schools** in terms of publications in high-ranked journals[1]

1 UT Dallas ranking of business schools by publications in 24 leading journals, 2014-2011 https://jindal.utdallas.edu/the-utd-top-100-business-school-research-rankings/

University of Mannheim is one of the leading institutions for business education

The Business School of the University of Mannheim is **one of the leading institutions for business research and education in Europe**. It stands for excellent research, strong internationality, and a distinct practice focus.

German university ranking 2019 (*Wirtschaftswoche*[1])

Management / Business Administration		
1	**Mannheim**	**29.5%**
2	Cologne	21.5%
3	Munich, LMU	20.3%
4	Frankfurt a. M., Goethe	16.2%
5	Münster	15.9%
6	Oestrich-Winkel, EBS	15.2%
7	Berlin, Humboldt	15.1%
8	Vallendar, WHU	14.8%
9	Frankfurt, School of Finance & Management	13.6%
10	Hohenheim	13.3%

Economics		
1	Munich, LMU	18.6%
2	**Mannheim**	**17.5%**
3	Cologne	16.8%
4	Frankfurt a. M., Goethe	15.3%
5	Berlin, Free	15.1%
6	Berlin, Humboldt	14.8%
7	Bonn	12.8%
8	Heidelberg	10.8%
8	Göttingen	10.8%
10	Tübingen + Hannover	10.3%

1 Important ranking in Germany. Based on a survey among corporate HR executives (2019-05-03). The *Financial Times* "Masters in Management" ranking lists Mannheim at place 14 worldwide and as the best business school in Germany (http://rankings.ft.com/businessschoolrankings/masters-in-management-2018).

Agenda


01 What is a process?
02 Petri Nets and BPMN recap
03 Basics of Process Mining
04 Types and Perspectives
05 Use Cases
06 Q&A

Wiliam Edwards Deming
Leading Management Thinker
in the Field of Quality (1900-1993)

"If you can't describe what you are doing as a **process**, you don't know what you're doing."

اگر نمی‌توانید کاری که انجام می‌دهید را **فرایند**وار توضیح دهید، نمی‌دانید چه‌کار می‌کنید!

TO-BE vs. AS-IS PROCESSES

Reality:
As-Is Processes (De-Facto)

vs.

Expectations:
To-Be Processes (De-Jure)

TO-BE vs. AS-IS PROCESSES

Reality:
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TO-BE vs. AS-IS PROCESSES

Reality:
As-Is Processes (De-Facto)

vs.

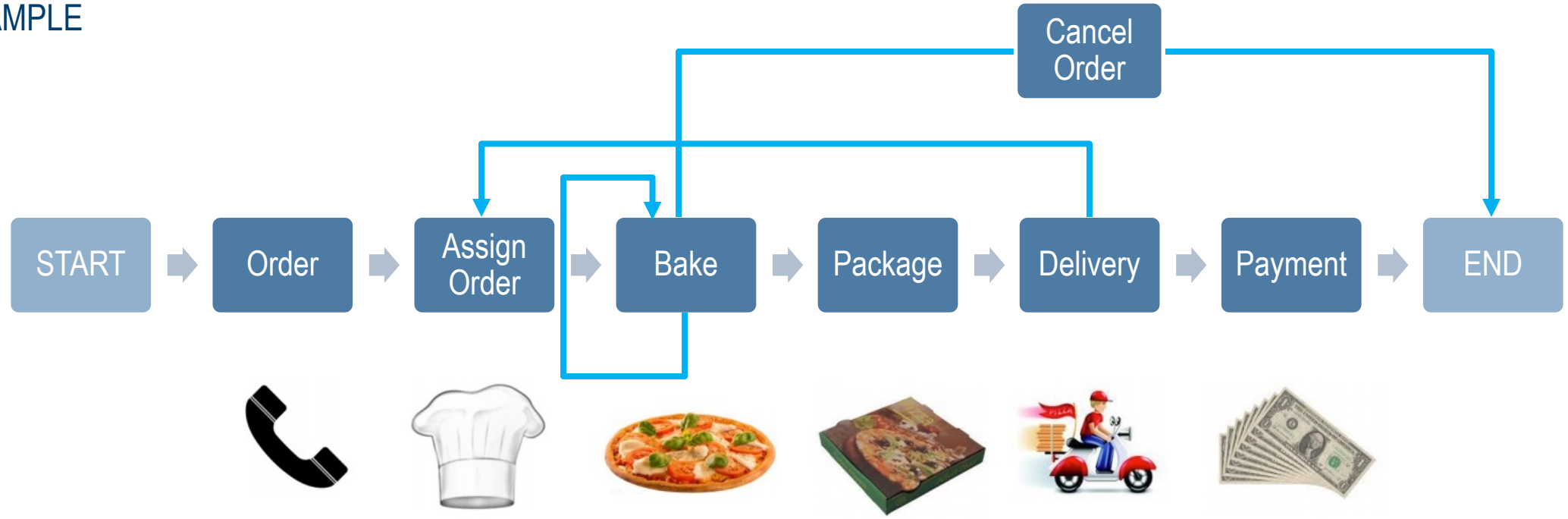
Expectations:
To-Be Processes (De-Jure)

WHAT IS A PROCESS?

- DEFINITION

  A business process or business method is a collection of related, structured activities or tasks that in a specific sequence produces a service or product (serves a particular business goal).

- EXAMPLE



Prof.dr.ir. Wil van der Aalst
Father of Process Mining!

> **“The idea of process mining is to discover, monitor and improve real processes (i.e., not assumed processes) by extracting knowledge from event logs readily available in today's (information) systems.”**

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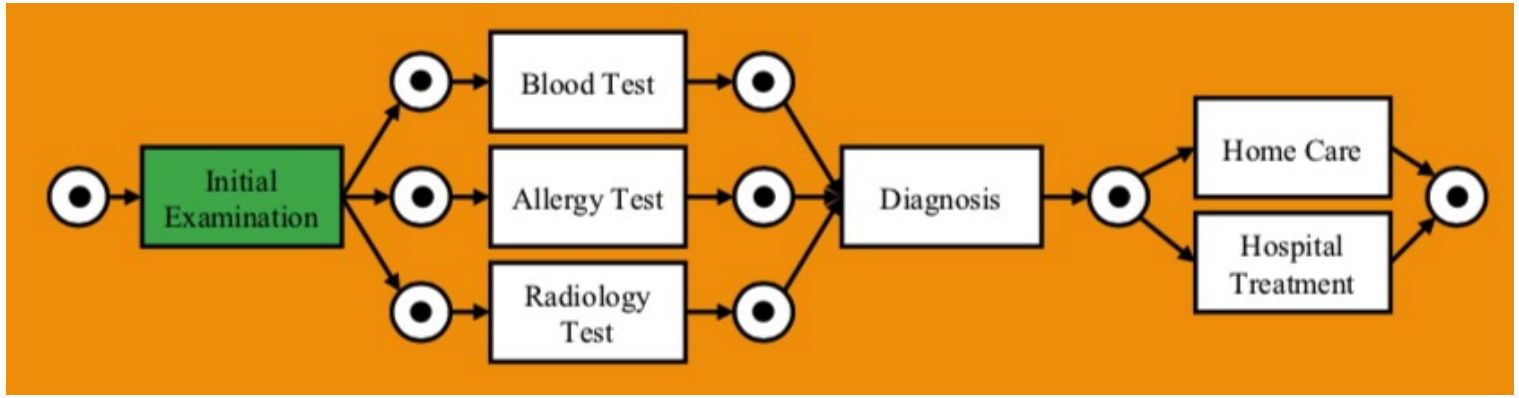
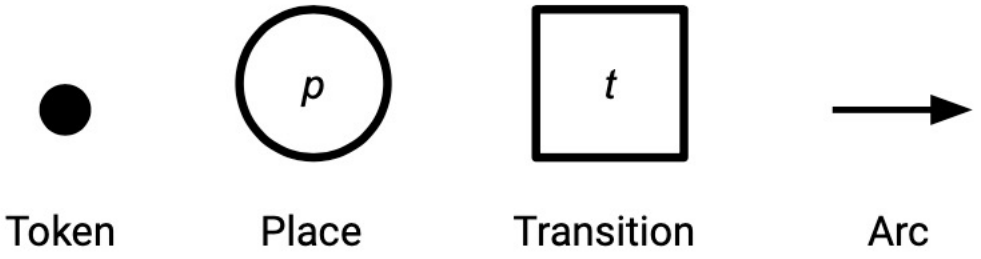
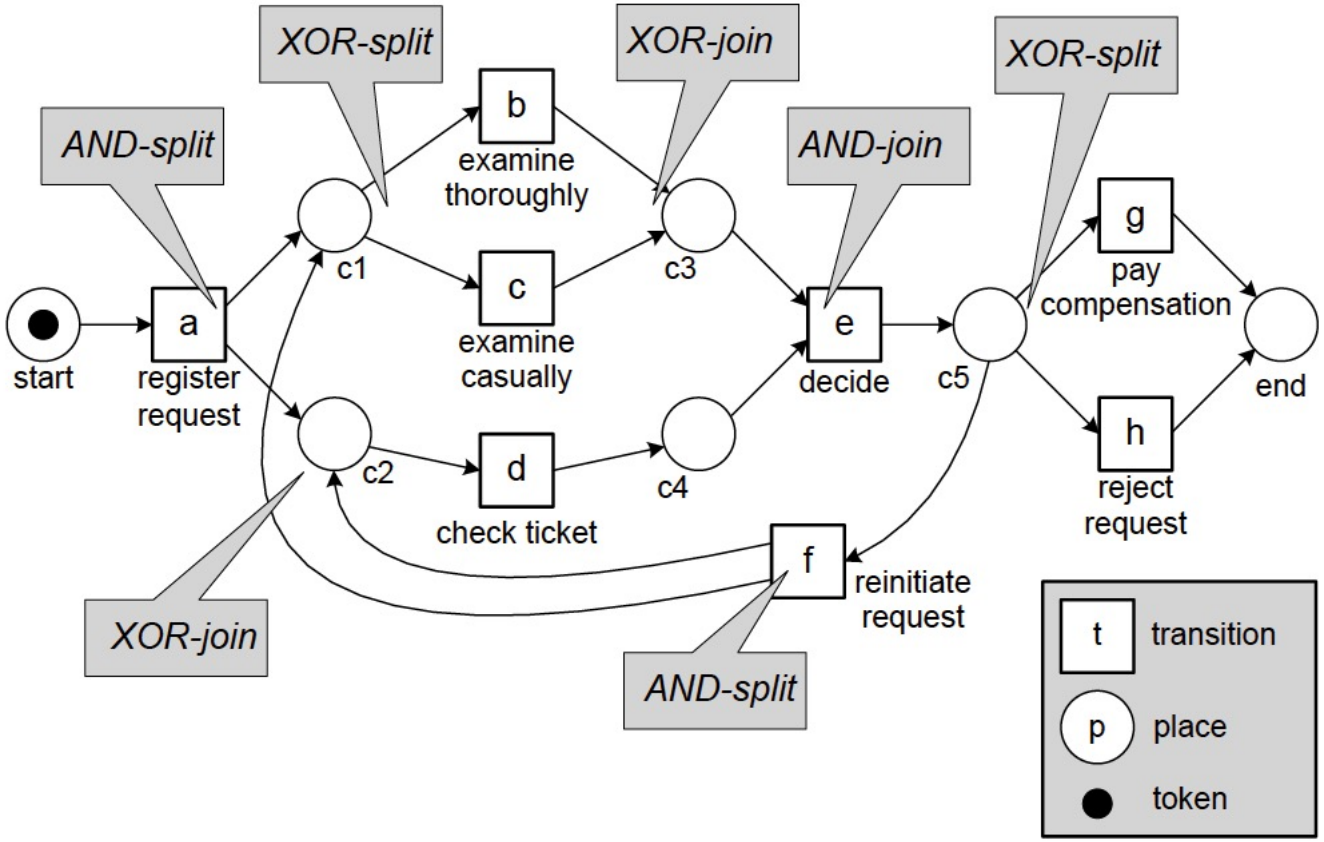
PETRI NETS, RECAP



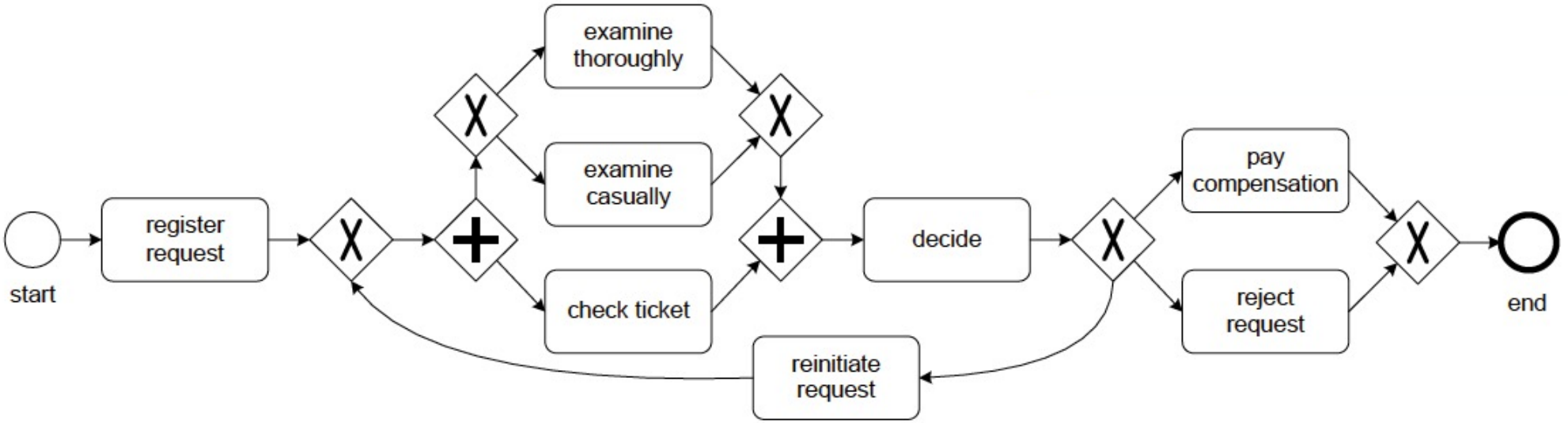
Initial Examination
Allergy Test
Blood Test
Radiology Test
Diagnosis
Home Care



PETRI NETS, RECAP



BPMN – BUSINESS PROCESS MODEL AND NOTATION



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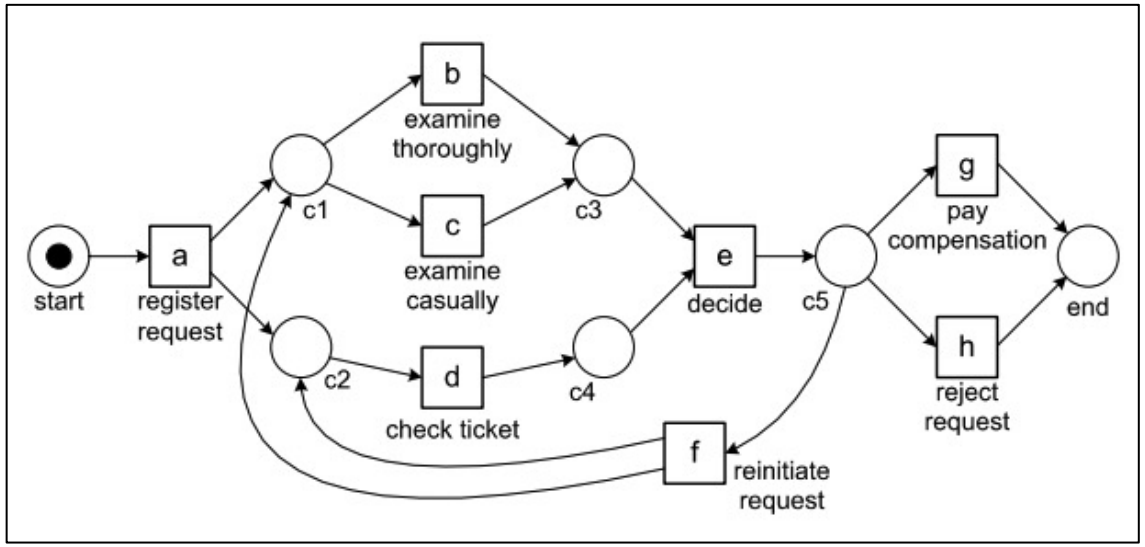
PROCESS MINING EVENTLOG

case id	event id	properties				
		timestamp	activity	resource	cost	...
1	35654423	30-12-2010:11.02	register request	Pete	50	...
	35654424	31-12-2010:10.06	examine thoroughly	Sue	400	...
	35654425	05-01-2011:15.12	check ticket	Mike	100	...
	35654426	06-01-2011:11.18	decide	Sara	200	...
	35654427	07-01-2011:14.24	reject request	Pete	200	...
2	35654483	30-12-2010:11.32	register request	Mike	50	...
	35654485	30-12-2010:12.12	check ticket	Mike	100	...
	35654487	30-12-2010:14.16	examine casually	Pete	400	...
	35654488	05-01-2011:11.22	decide	Sara	200	...
	35654489	08-01-2011:12.05	pay compensation	Ellen	200	...
3	35654521	30-12-2010:14.32	register request	Pete	50	...
	35654522	30-12-2010:15.06	examine casually	Mike	400	...
	35654524	30-12-2010:16.34	check ticket	Ellen	100	...
	35654525	06-01-2011:09.18	decide	Sara	200	...
	35654526	06-01-2011:12.18	reinitiate request	Sara	200	...
	35654527	06-01-2011:13.06	examine thoroughly	Sean	400	...
	35654530	08-01-2011:11.43	check ticket	Pete	100	...
	35654531	09-01-2011:09.55	decide	Sara	200	...
	35654533	15-01-2011:10.45	pay compensation	Ellen	200	...
4	35654641	06-01-2011:15.02	register request	Pete	50	...
	35654643	07-01-2011:12.06	check ticket	Mike	100	...
	35654644	08-01-2011:14.43	examine thoroughly	Sean	400	...
	35654645	09-01-2011:12.02	decide	Sara	200	...
	35654647	12-01-2011:15.44	reject request	Ellen	200	...
...	...	...	...	...	...	...

- **A process consists of CASES**
- **A case consists of EVENTS, relating to exactly one case**
- **Events within a case are ORDERed**
- **Events can have ATTRIBUTES (time, cost, resource, activity)**

PROCESS MODEL DISCOVERY

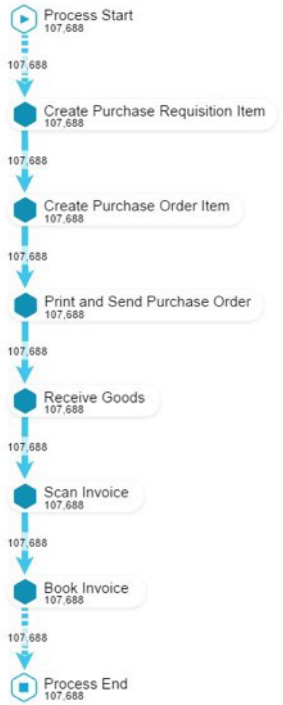
Case id	Trace
1	$\langle a, b, d, e, h \rangle$
2	$\langle a, d, c, e, g \rangle$
3	$\langle a, c, d, e, f, b, d, e, g \rangle$
4	$\langle a, d, b, e, h \rangle$
5	$\langle a, c, d, e, f, d, c, e, f, c, d, e, h \rangle$
6	$\langle a, c, d, e, g \rangle$
...	...



Explore the as-is process and understand the variant explorer

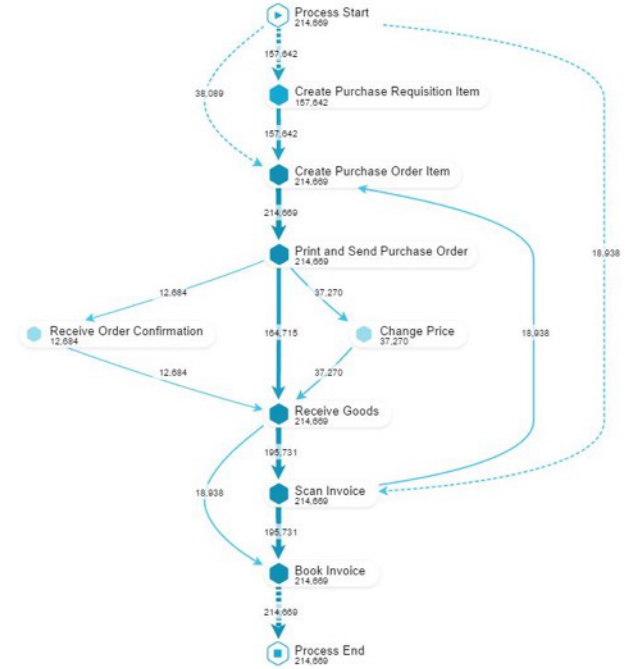
1 See the 'happy paths'

The level of detail of the process can be **easily adjusted**. The number of variants displayed can be reduced in order to show only the **core process**.



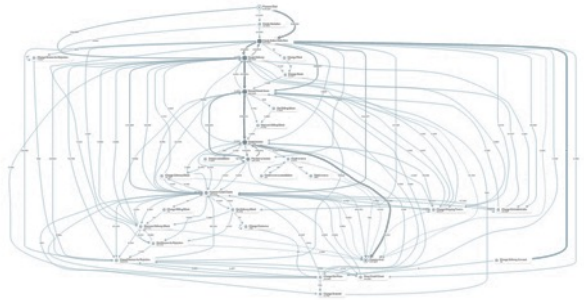
2 Explore deviations

Increasing the number of variants, i.e., the level of detail, the process will reveal **less common paths and activities**. Spot **deviations** and **inefficient loops**.



3 Get the big picture

Going full-throttle on the process by increasing to **100% data coverage**. Nothing escapes the watchful eye – especially if this augmented with **drill-down functionalities** to spot long-runners, unusual process paths, etc.



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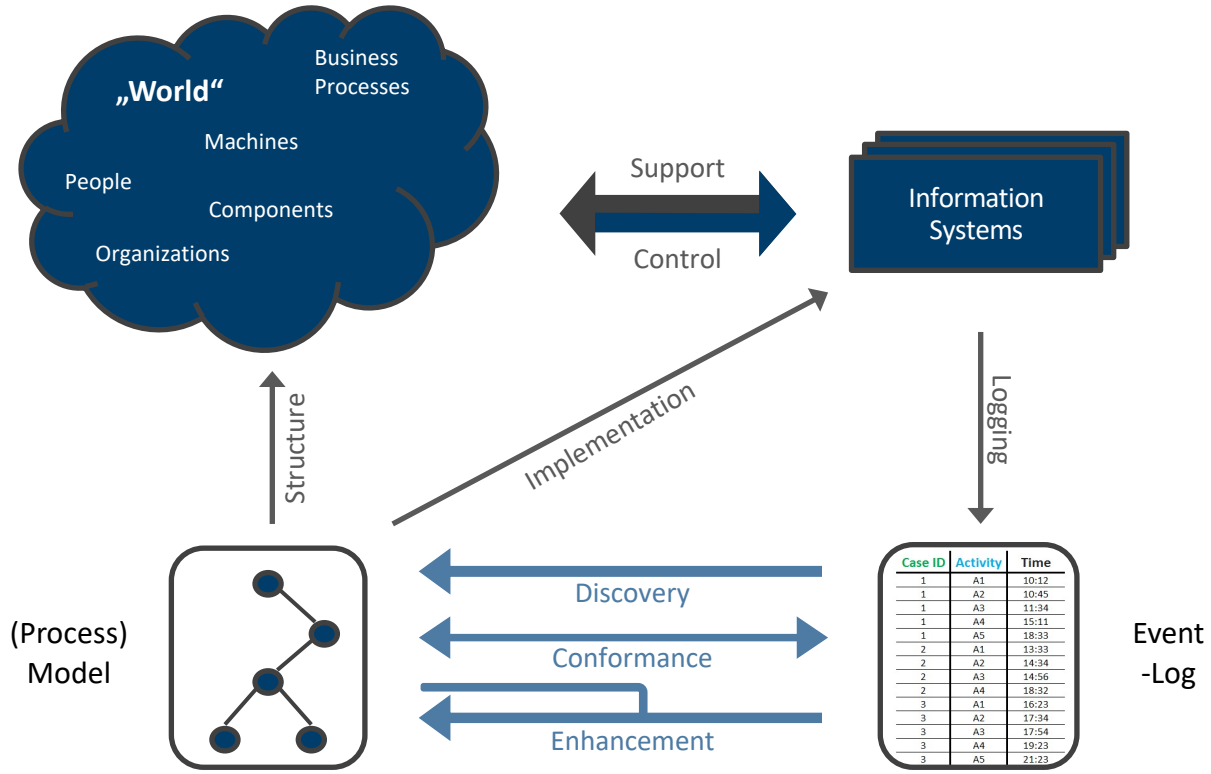
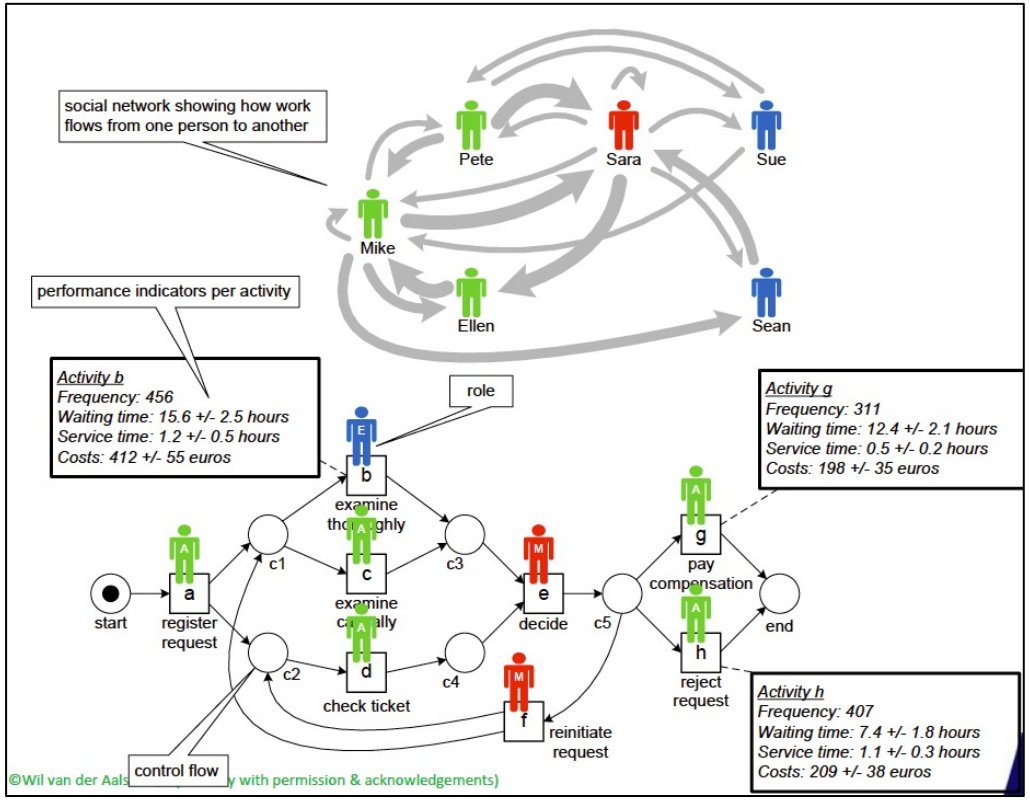
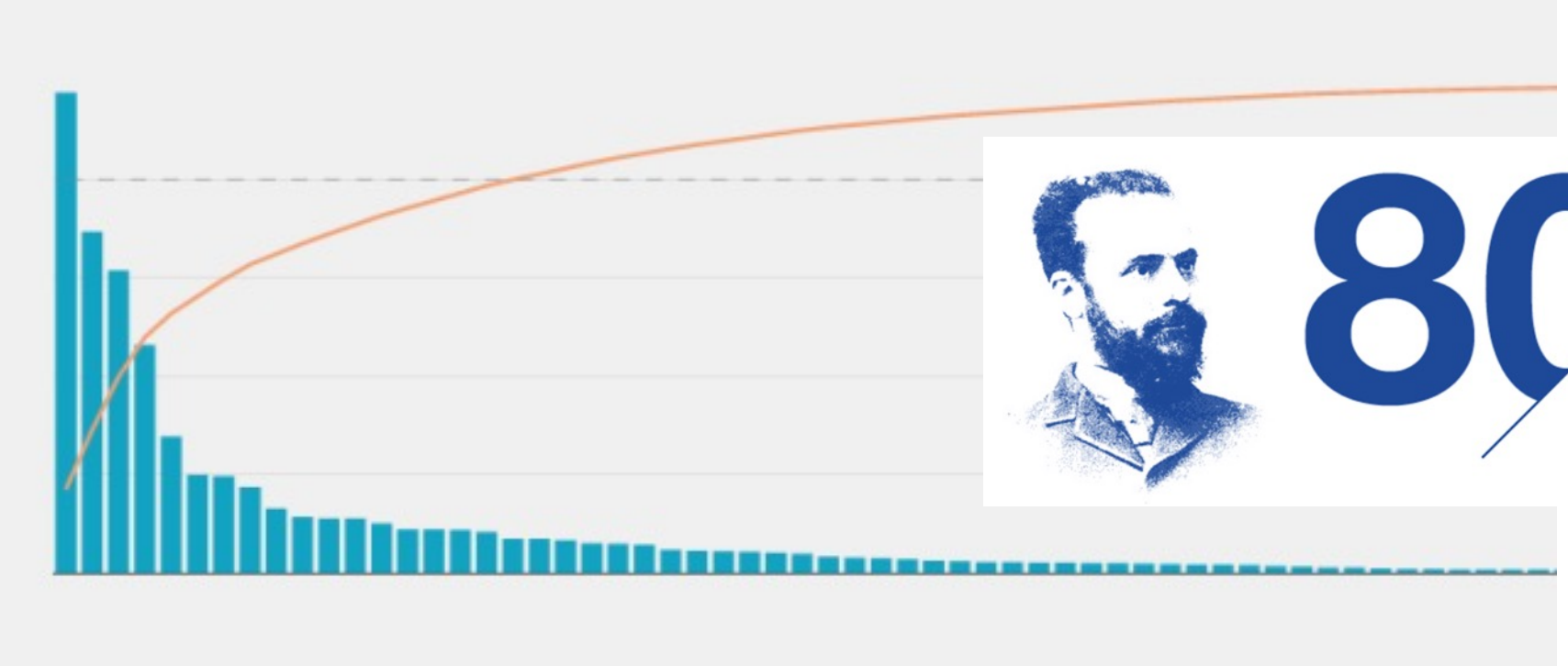
PROCESS MINING TYPES AND PERSPECTIVES





PARETO APPLIES HERE, TOO

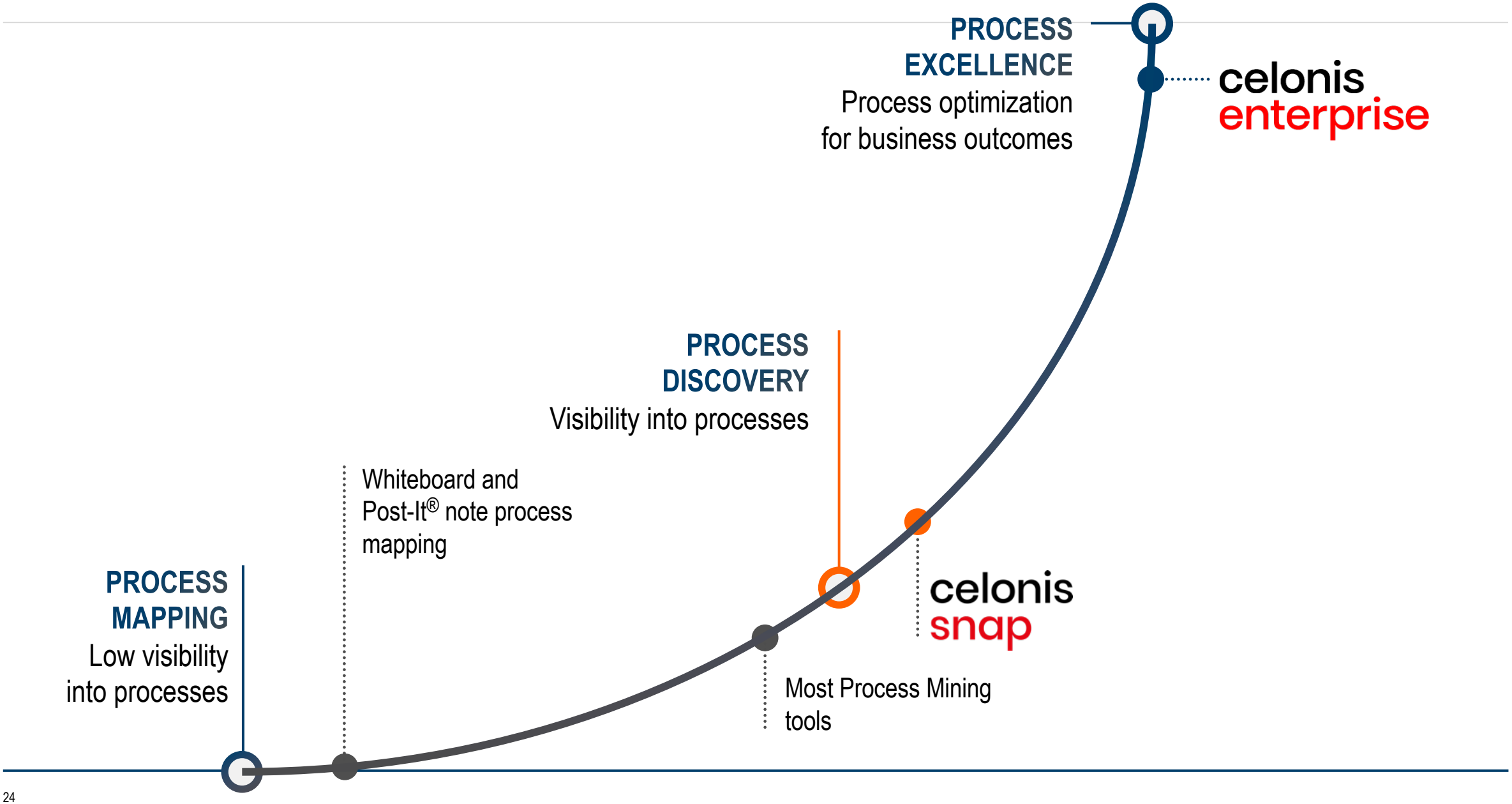
A few process variants are explaining majority of the entire processes!



PARETO APPLIES HERE, TOO

ocesses!

PROCESS EXCELLENCE MATURITY CURVE



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IMPACT OF **PROCESS MINING** ON THE PURCHASE-TO PAY-PROCESS

-25%

SAVE COSTS

Uncover hidden inefficiencies, deviations and bottlenecks to reduce process cost by 25%

+37%

INCREASE SPEED

Using the fastest process paths and targeted optimization speeds up throughput times by up to 37%

+30%

BOOST EFFICIENCY

Improved automatization and e-business rates, and avoiding manual rework increases efficiency by over 30%

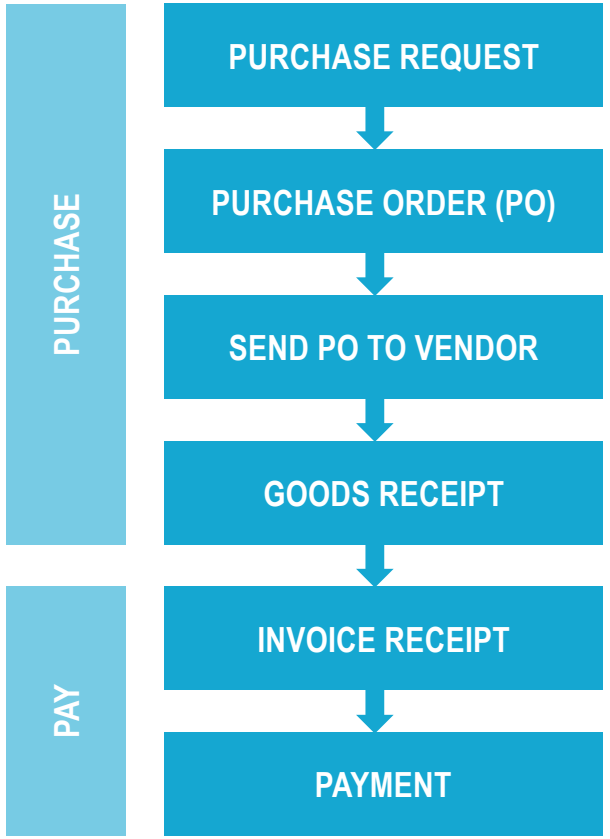
100%

ENSURE QUALITY

High precision in planning and delivery, fewer incidents and clear responsibilities increase customer satisfaction significantly.

Purchase-to-Pay (P2P)

- Core business process
- High number of transactions
- Complexity:
  Requests, approvals, timelines
- Various departments involved:
  Procurement, Accounting,
  Warehousing,…



HOW IT WORKS

STEP 1

Find out how your process is executed in reality.

STEP 2

Identify and eliminate weak spots. Use proactive insights to prioritize actions leading to process improvement.

STEP 3

Find your „happy path“ and ensure continuous process efficiency, compliance, and quality.

EXAMPLE

PROCESS DISCOVERY & KPIs

- CYCLE TIMES
- AUTOMATION RATES
- ON TIME DELIVERY
- CONTRACT USAGE RATIO

INTELLIGENT ROOT CAUSE ANALYSES

- DISCOUNT LOSSES
- MANUAL REWORK
- DELIVERY RELIABILITY
- MAVERICK BUYING

celonis

Let's find

$10,000,000

trapped in your business.

ANALYSIS

How often do document changes occur during the purchasing process?

Please note: all screenshots used are merely exemplary and have not been taken from real customer data. Hence, they do not correspond with the calculations made in this business case.

MEASURES & POTENTIALS

Using Celonis, often occurring changes and their **root causes could be identified and analyzed.** In comparable use cases, manual effort could be **reduced by up to 40%.**

OVERALL POTENTIAL

RESULTS:

Duration of manual change: **20 min.**
Occurrences per year: **199,752**
Potential for optimization: **40 %**

BEFORE:

199,752 *20 min. = 3,995,040 min.= **66,584**

SAVINGS:

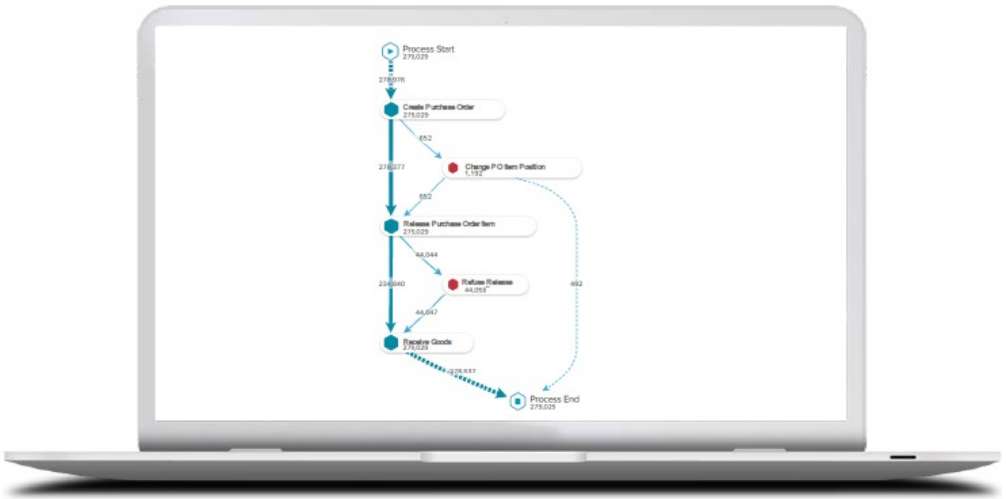
66,584 h * 40% = 26,633 h/Year
= 14 FTE = 999,676 €/Year

*1 FTE = 5 Days/Week * 8h * (52-5) Weeks/Year = 1880 Hours/Year = 70.000€*

1 m € SAVINGS

ANALYSIS

How often do rework activities occur during the purchasing process?



Please note: all screenshots used are merely exemplary and have not been taken from real customer data. Hence, they do not correspond with the calculations made in this business case.

MEASURES & POTENTIALS

Rework activities slowed down the process and led to significant manual effort. With Celonis, often occurring **rework activities could be identified** and **reduced by up to 50%.**

OVERALL POTENTIAL

EFFORT OF REWORK ACTIVITIES:

Activity	#	Time	Sum
Change Price	152,092	15 min	2,280,000 min
Block Purchase Order	52,148	25 min	1,303,700 min
Delete Purchase Order	25,920	25min	648,000 min
Refuse Purchase Order	26,064	30min	781,920 min

SAVINGS:

5,013,620 Min * 50% = 47,780 h/Year

= 22.2 FTE =1,555,644€/Year

*1 FTE = 5 Days/Week * 8h * (52-5) Weeks/Year = 1880 Hours/Year = 70.000€*

1.6 m € SAVINGS

ANALYSIS

How high are automation rates of process activities and can they be improved further?

Please note: all screenshots used are merely exemplary and have not been taken from real customer data. Hence, they do not correspond with the calculations made in this business case.

MEASURES & POTENTIALS

By improving the automation rate of certain activities, the efficiency of the purchasing process could be improved.

In particular, the automation rates of the following activities could be optimized (amongst others):

Purchase Requisition Creation | Purchase Order Creation | Goods Receipt | Payment Block Removal | Purchase Order Approval

OVERALL POTENTIAL

RESULTS:

Cases per year:	**1,116,080**
Potential for automation:	**62%**
Time saved per case:	**10 Min.**

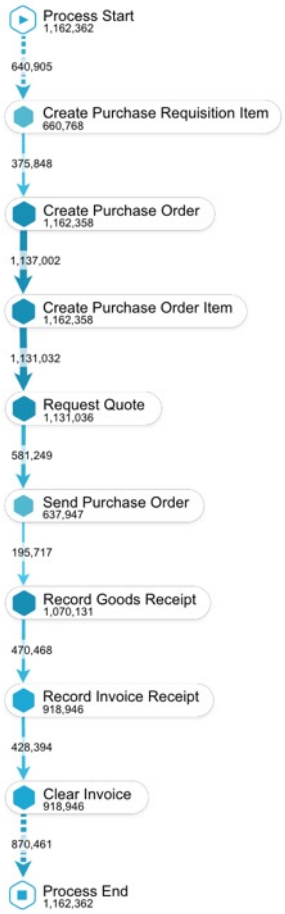
SAVINGS:

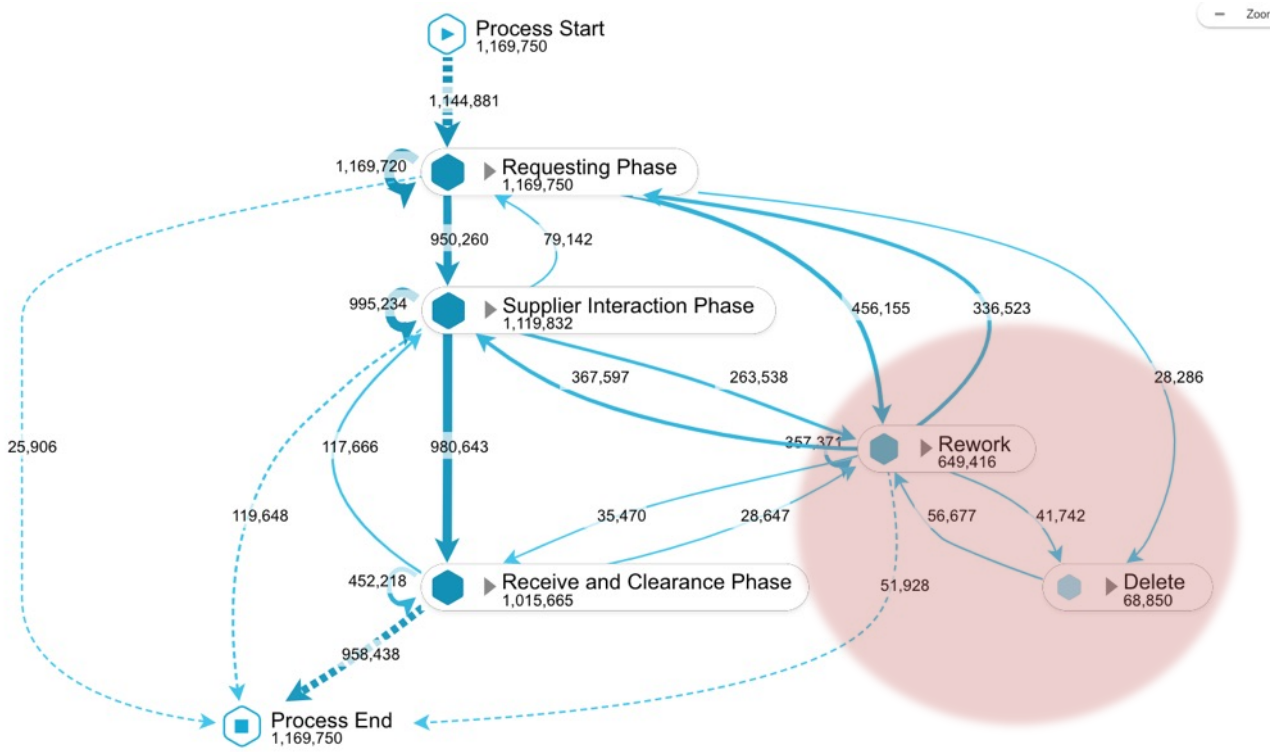
1,116,080 * 60% * 10 Min = 111,608 h/Year
= 59.3 FTE/Year = 4,155,617 €/Year

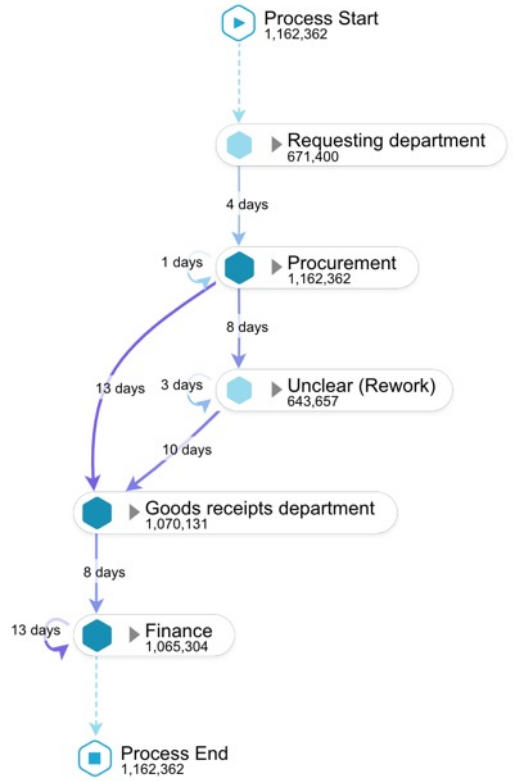
*1 FTE = 5 Days/Week * 8h * (52-5) Weeks/Year = 1880 Hours/Year = 70.000€*

4.1 m € SAVINGS

Process Inefficiency







How to Identify Process Inefficiencies?

CATEGORIES

1. PROCESS STEP

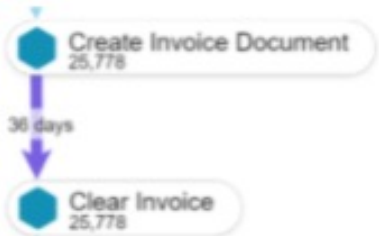
A Process Step is a) **occurring**, b) **missing** or c) **repeated**.

2. SEQUENCE

Process steps are executed in the **wrong order**.

3. THROUGHPUT TIME

The throughput time between process steps is **too high or too low**.



4. AUTOMATION

The automation rate for process steps or entire cases is **too low**.

5. PROCESS SPECIFIC

KPIs that **don't fit** any other category and are only applicable to some processes.

TOOLS

- Process Explorer (Frequency)
- Selection Views (Activity, Rework)
- Conformance Checker

- Conformance Checker
- Process Explorer (Frequency)
- Selection Views (Flow)

- Throughput Time Search
- Process Explorer (Time)
- Selection Views (Time)

- Process Explorer (Automation)
- Histogram (Automation)

- Custom Components (Content Store)

Always prioritize significant Opportunities by briefly evaluating findings for **impact of the inefficiency** (includes frequency) and **effort needed to realize the opportunity.** When evaluating the impact, also consider when in the process the inefficiency occurs.

Find Drivers for Inefficiencies

Consider absolute frequency to analyze where your inefficiency appears most and consider relative frequency to search for possible drivers.

Find Drivers in the Process

Process Explorer

Work with the Process Explorer to discover other inefficiencies driving yours.

Find Drivers in the Attributes

Drilldown Table

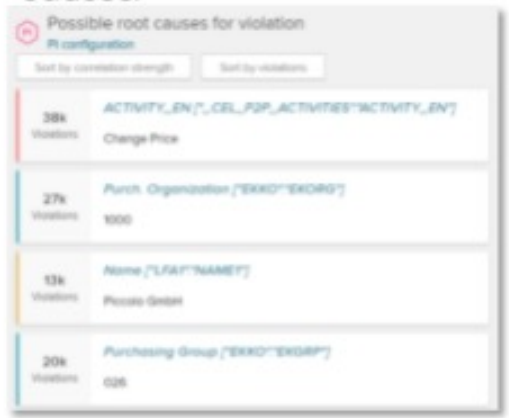
Search for drivers in different dimensions using the Drilldown Table.

Column Chart

Search for significant developments over time.

Conformance Checker (automated)

Use the Root Cause Analysis in the Conformance Checker to automatically derive possible causes.



Optional

Drill Down to a document level and look at specific Documents in Celonis (Case Explorer) or the Source System.

OPTIMIZE WORKING CAPITAL

Improve payment terms:
Identify unfavorable payment terms with negative effect on working capital

Reduce inventory cost:
Analyze root causes for violations and reduce inventory whenever possible

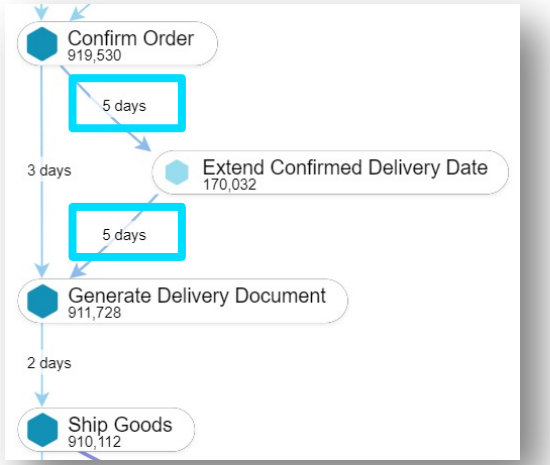
Reduce Internal Cycle Times:
Make sure invoices are created with no delay to collect money earlier

Others:
…

Selected Customers applying Celonis in Sales

ExxonMobil, SIEMENS, BMW, Roche, zalando, KOCH INDUSTRIES INC, CHART, Mexichem, vodafone, uniper, Henkel, B|BRAUN, MARS, swisscom, AIRBUS, GE, ABB, Dow, BOSCH, L'ORÉAL, BD, Bonfiglioli, 3M, Honeywell

Case Study – Speed up Cycle Times



Slow cycle times occur all the time and slow order confirmations, delayed goods issue or delayed invoicing massively impact cash collection. With the Intelligent Business Cloud, it is easy to identify reasons for long-runners, use the Action Engine to take immediate action and positively impact working capital.

Cycle Times by Sales Order Amount

Sales Order Amount	# Sales …	Net Order Value	Cycle Time (…	Total Cycle Ti…
a) 0 - 100€	537,217	16,270,972 €	36 Hours	790 Hours
b) 100 - 500€	291,276	67,827,039 €	37 Hours	792 Hours
c) 500 - 1.000€	31,282	21,518,000 €	29 Hours	790 Hours
d) 1.000 - 10.000€	15,486	35,796,525 €	38 Hours	796 Hours
e) > 10.000€	406	1,396,954 €	44 Hours	794 Hours

OPTIMIZE WORKING CAPITAL: REDUCE LATE PAYMENTS

1 Identify: See where payment delays occur

Process Analytics

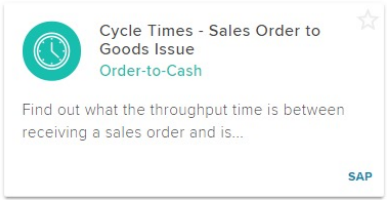
Late payments delay cash collection and impact working capital, for instance:

- Slow invoicing
- Unfavorable payment terms
- Bad payment morale

Example above:
500,000 orders take more than 14 days between creation and shipping

2 Analyze: Understand root causes for late payments

Intelligent App Store



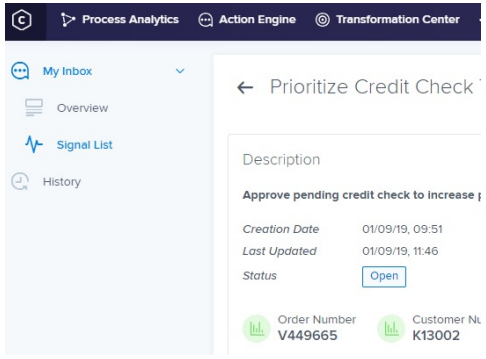
Intelligent Apps help you to determine

- Which customers are responsible for delays
- Where payment terms need to adjusted

Example above: Certain customers are responsible for a majority of late payments.

3 Operationalize: Proactively reduce throughput times

Action Engine



Action Engine Skills help you to proactively avoid late payments:

- Ensure quick invoicing
- Automated dunning
- Etc.

Example above: The skill automates the dunning process dependent on payment terms.

4 Improve: Measure results & sustain

Transformation Center

The Transformation Center helps you to measure & document success stories.

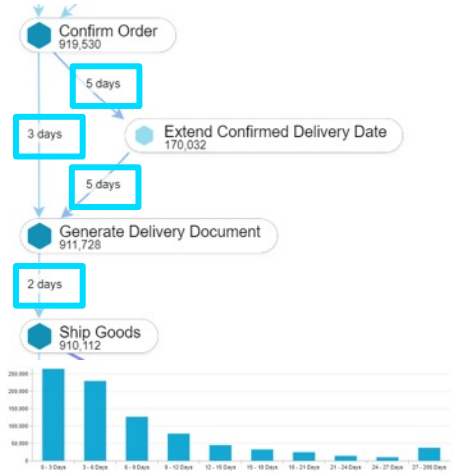
- 500,000 orders >14d between order and shipping ($ 600M)
- 20% reduction (7d average delay)
- 10% return on invested capital

Example above:
$600M * 20% * 10% * 7d delay /365
= $ 230K annual savings

OPTIMIZE WORKING CAPITAL: REDUCE INTERNAL THROUGHPUT TIMES

1 Identify: See where delays occur

Process Analytics



Slow throughput times delay cash collection and impact working capital, for instance:

- Slow order confirmation
- Slow goods issue
- Slow invoicing

Example above:
600,000 orders take more than 3 days between creation and shipping

2 Analyze: Understand root causes for delays

Intelligent App Store

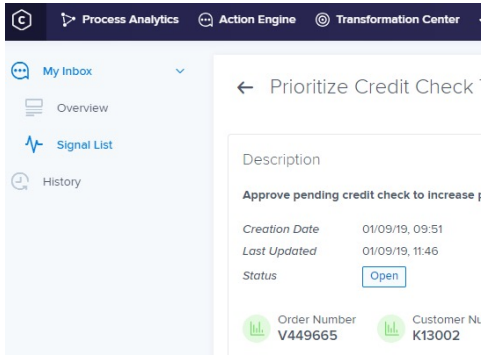
Intelligent Apps help you to determine

- where in the process bottlenecks occur
- reasons for long-runners
- internal best practice

Example above: Delays occur due to bottlenecks in the process and affect high value orders with higher likelihood

3 Operationalize: Proactively reduce throughput times

Action Engine



Action Engine Skills help you to proactively speed up cycle times:

- Remove delivery blocks
- Prioritize orders
- Etc.

Example above: The skill prioritizes orders with high likelihood of delays.

4 Improve: Measure results & sustain

Transformation Center

The Transformation Center helps you to measure & document success stories.

- 600,000 orders >3d between order and shipping ($ 700M)
- 30% reduction (5d average delay)
- 10% return on invested capital

Example above:
$700M * 30% * 10% * 5d delay /365
= $ 288K annual savings

BUSINESS IMPACT OF PROCESS MINING

celonis
Academic Alliance

Efficiency

- Perfect Order
- Automation

Speed and Agility

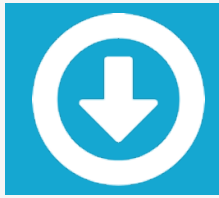
- On-Time Delivery
- Throughput time

Quality and Fulfillment

- Rework
- Rejections

Compliance

- Should-be vs. As-Is
- Process monitoring



Reduce Process Cost

Increase Revenue

Reduce Working Capital

Improved Riskmanagement

CELONIS CUSTOMERS TRANSFORMING

celonis Academic Alliance

ORDER-TO-CASH	SIEMENS	Transformed order-to-cash and eliminated 10M manual activities, saving $15M+ annually
CUSTOMER JOURNEY	innogy	Transformed customer onboarding for 3M customers, "Go-Live Ratio" up 20%, time to delivery down 5 days
IT DELIVERY	Schlumberger	Transformed the IT delivery process introduction of a new ERP affecting more than 20,000 users
PROCURE-TO-PAY	vodafone	Transformed P2P, Perfect PO from 73% to 87%, touchless invoices up 63%, errors down 92%
SUPPLY CHAIN	ABB	Transformed the supply chain, On time delivery up 27%, anticipates to save >$100m

INCREASE REVENUE POTENTIAL

Increase Lead conversion rate:
Identify behavior that serves as leverage in future price negotiations

Prioritize campaigns and speed up sales cycles:
Identify reasons for lost discounts (e.g. maverick buying) and act on them

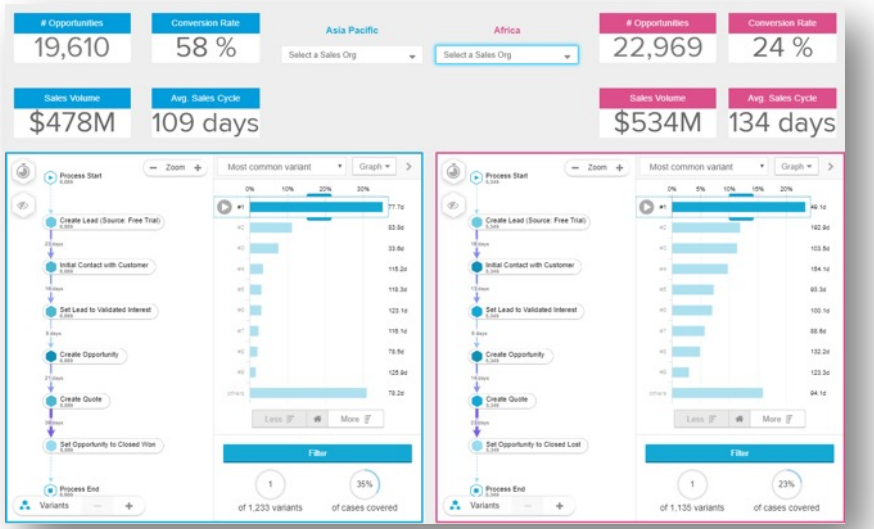
Control Discount Usage:
Analyze in what areas contracts can systematically reduce purchasing spend

Optimize Selling Channels:
Quantify savings potential and prioritize efforts for supplier consolidation

Others:
…

Selected Customers applying Celonis in Sales

ExxonMobil, SIEMENS, BMW, Roche, zalando, KOCH INDUSTRIES INC, CHART, Mexichem, vodafone, uniper, Henkel, B|BRAUN, MARS, swisscom, AIRBUS, GE, ABB, Dow, BOSCH, L'ORÉAL, BD, Bonfiglioli, 3M, Honeywell



Case Study – Speed up Cycle Times

Benchmarking different business units, geographies or product groups with each other, quickly allows to isolate systematic issues as well as identify best practices to speed up cycle times and thereby increase conversion rate. Make sure to never lose momentum in your deals again!

Process Mining values & success stories

Process mining use cases

Identified by Kerremans in Gartner (2019)

Process Improvement & Operational Excellence

- developing advanced discovery and analysis algorithms in order to extract knowledge from the event logs
- controlling executed process instances, detecting process variants, detecting process inefficiencies, resource availability
- supporting decision-making and providing suggestions on process optimization

Improve Audit & Compliance

- This is about comparing as-is vs should-be processes
- check the quality of the discovered process model; detect process issues and their frequency; search for their root cause; overall detect violations to the process standards
- Conformance checking happens on the past and complete event log while Compliance checking is online monitoring of processes

Improve Process Automation

- PM provides operational data and supports estimating the outcome of process automation initiatives before running them
- PM supports process analysts to detect automation opportunities
- helps to analyze and stabilizing processes before automating them
- PM can monitor bots to check if they are alive and send notifications if necessary

Support System Migration & IT Operations

- improvement of development, testing, and system error diagnostic
- IT service management (ITSM) related processes can be categorized in this use case
- PM highlights differences and gaps among systems and how processes are executed in different systems

Support Digital Transformation

- There is a big overlap between this use case, operational excellence, and automation. However, there is a big attention to this use case for discovering digitalization possibilities
- PM techniques can enable the creation of the so-called digital twin of an organization by providing full data connection and representing the virtual version of the processes.

مشتاق شنیدن سوالات
شما عزیزان هستم!

PROCESS MINING APPLICATIONS AND USE CASES

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۲۷ خرداد ۱۴۰۰

با سپاس از شما عزیزان و مدیریت محترم بهفالب که همواره در راستای ترویج فرایندکاوی در ایران تلاش کرده است.