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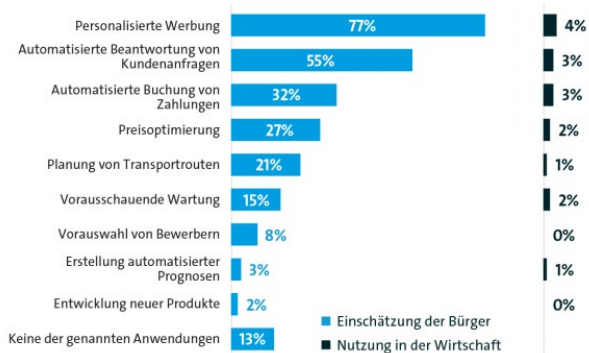
Process Mining: How to pick your process improvement battles?

14. Praxisforum Prozess-, Projekt- und IT-Management,
agilen Methoden und Change, 04. & 05. Mai 2021



Einsatz von KI in der Wirtschaft wird überschätzt

Welche dieser KI-Anwendungen setzen heute eine Vielzahl deutscher Unternehmen ein?



AI ≠ ML ≠ DM ≠ PM



“... we are probably only a month away from having autonomous driving at least for highways and for relatively simple roads. My guess for when we will have full autonomy is approximately three years.”

(Elon Musk, 2015)



The magical black box of deep learning ...



First a failure, now the dominating paradigm

How about managing and improving operational processes?

We need process models that are understandable!

We are interested in improving end-to-end performance and compliance (not a single task)!

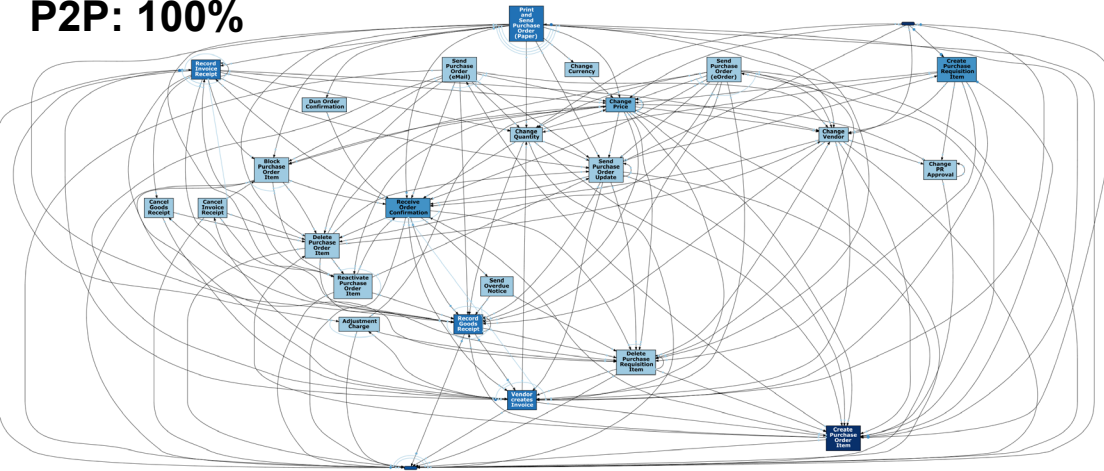
We do not have labeled data, we have SAP, Salesforce, Oracle, Microsoft, Infor, etc. (holding thousands of tables)!



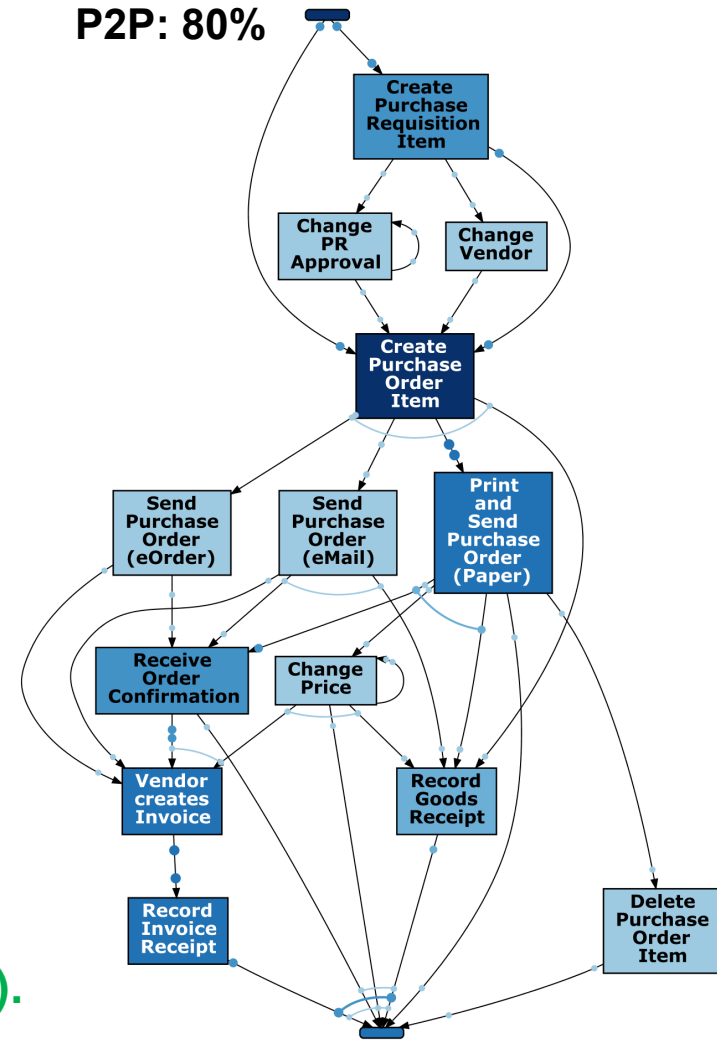
A 3D graphic featuring stylized human figures in red and blue, arranged in a circular pattern. A glowing sphere is positioned at the top center. The text "80 / 20" is prominently displayed in white, bold, sans-serif font across the middle of the image.

80 / 20

P2P: 100%



P2P: 80%



- The remaining 20% of the cases account for 80% of the variants.
- The remaining 20% of the cases account for 80% the friction (rework, complaints, etc.).
 - 80% of the cases are described by 20% of the variants.
 - 80% of the cases cause only 20% of the friction (rework, complaints, etc.).

**We have all been here as
a customer (dozens of
e-mails, phone calls) ...**





20% of cases is causing
80% of the friction!

Deviations

Rework

Loops

Delays

Lost cases

Unresponsiveness

Ping-pong

Fraud

Process mining in 10 minutes

Starting point: Event data

Case ID	Activity	Resource	Timestamp	product	prod-price	quantity	address
...
6350	place order	Aiden	2018/02/13 14:29:45.000	APPLE iPhone 6 16 GB	639,00 €	5	NL-7751DG-21
6283	pay	Lily	2018/02/13 14:39:25.000	SAMSUNG Galaxy S6 32 GB	543,99	3	NL-7828AM-11a
6253	prepare delivery	Sophia	2018/02/13 15:01:33.000	APPLE iPhone 6 16 GB	639,00 €	3	NL-7887AC-13
6257	prepare delivery	Aiden	2018/02/13 15:03:43.000	SAMSUNG Galaxy S6 32 GB	543,99	1	NL-9521KJ-34
6185	confirm payment	Emily	2018/02/13 15:05:36.000	SAMSUNG Galaxy S4	329,00 €	1	NL-9521GC-32
6218	confirm payment	Emily	2018/02/13 15:08:11.000	APPLE iPhone 6s Plus 64 GB	969,00 €	2	NL-7948BX-10
6245	make delivery	Michael	2018/02/13 15:14:04.000	APPLE iPhone 6 16 GB	639,00 €	3	NL-7905AX-38
6272	pay	Emily	2018/02/13 15:20:36.000	APPLE iPhone 6 16 GB	639,00 €	1	NL-7821AC-3
6269	pay	Charlotte	2018/02/13 15:25:21.000	SAMSUNG Galaxy S4	329,00 €	1	NL-7907EJ-42
6212	prepare delivery	Sophia	2018/02/13 15:43:39.000	HUAWEI P8 Lite	234,00 €	1	NL-7905AX-38
6323	send invoice	Alexander	2018/02/13 15:46:08.000	APPLE iPhone 6 16 GB	639,00 €	1	NL-7833HT-15
6246	confirm payment	Jack	2018/02/13 15:56:03.000	SAMSUNG Galaxy S4	329,00 €	3	NL-7833HT-15
6347	send invoice	Jack	2018/02/13 15:57:42.000	SAMSUNG Galaxy S4	329,00 €	3	NL-7905AX-38
6351	place order	Zoe	2018/02/13 16:17:37.000	APPLE iPhone 5s 16 GB	449,00 €	3	NL-9521GC-32
6204	prepare delivery	Sophia	2018/02/13 16:31:28.000	SAMSUNG Core Prime G361	135,00 €	1	NL-7828AM-11a
6204	make delivery	Kaylee	2018/02/13 16:51:54.000	SAMSUNG Core Prime G361	135,00 €	1	NL-7828AM-11a
6265	confirm payment	Lily	2018/02/13 16:55:55.000	SAMSUNG Galaxy S4	329,00 €	4	NL-9521GC-32
6250	confirm payment	Jack	2018/02/13 17:03:26.000	MOTOROLA Moto G	199,00 €	4	NL-7942GT-2
6328	send invoice	Lily	2018/02/13 17:30:16.000	APPLE iPhone 6s 64 GB	858,00 €	4	NL-9514BV-16
6352	place order	Aiden	2018/02/13 17:53:22.000	APPLE iPhone 6 16 GB	639,00 €	2	NL-9514BV-16
6317	send invoice	Jack	2018/02/13 18:45:30.000	APPLE iPhone 6s 64 GB	858,00 €	5	NL-7907EJ-42
6353	place order	Sophia	2018/02/13 20:16:20.000	APPLE iPhone 5s 16 GB	449,00 €	4	NL-7751AR-19
...



71,043 events
12,666 cases
7 activities

Starting point: Event data

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6350	place order	Aiden	2018/02/13 14:29:45.000	APPLE iPhone 6 16 GB	639,00 €	5	NL-7751DG-21
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6185	confirm payment	Emily	2018/02/13 15:05:36.000	SAMSUNG Galaxy S4	329,00 €	1	NL-9521GC-32
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6347	send invoice	Jack	2018/02/13 15:57:42.000	SAMSUNG Galaxy S4	329,00 €	3	NL-7905AX-38
6351	place order	Zoe	2018/02/13 16:17:37.000	APPLE iPhone 5s 16 GB	449,00 €	3	NL-9521GC-32
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6328	send invoice	Lily	2018/02/13 17:30:16.000	APPLE iPhone 6s 64 GB	858,00 €	4	NL-9514BV-16
6352	place order	Aiden	2018/02/13 17:53:22.000	APPLE iPhone 6 16 GB	639,00 €	2	NL-9514BV-16
6317	send invoice	Jack	2018/02/13 18:45:30.000	APPLE iPhone 6s 64 GB	858,00 €	5	NL-7907EJ-42
6353	place order	Sophia	2018/02/13 20:16:20.000	APPLE iPhone 5s 16 GB	449,00 €	4	NL-7751AR-19
...

event =
case +
activity +
timestamp +



Let's look at orders 6350, 6351, and 6352

Case ID	Activity	Timestamp
6350	place order	2018/02/13 14:29:45.000
6351	place order	2018/02/13 16:17:37.000
6352	place order	2018/02/13 17:53:22.000
6352	send invoice	2018/02/19 09:20:28.000
6351	send invoice	2018/02/19 16:08:07.000
6350	send invoice	2018/02/21 09:38:16.000
6350	pay	2018/03/02 12:39:37.000
6352	pay	2018/03/05 15:46:47.000
6351	cancel order	2018/03/06 10:17:01.000
6350	prepare delivery	2018/03/07 13:50:35.000
6350	make delivery	2018/03/07 16:41:01.000
6350	confirm payment	2018/03/07 16:53:00.000
6352	prepare delivery	2018/03/07 17:05:59.000
6352	confirm payment	2018/03/07 17:59:55.000
6352	make delivery	2018/03/08 09:54:36.000

Let's look at orders 6350, 6351, and 6352

Case ID	Activity	Timestamp
6350	place order	2018/02/13 14:29:45.000
6351	place order	2018/02/13 16:17:37.000
6352	place order	2018/02/13 17:53:22.000
6352	send invoice	2018/02/19 09:20:28.000
6351	send invoice	2018/02/19 16:08:07.000
6350	send invoice	2018/02/21 09:38:16.000
6350	pay	2018/03/02 12:39:37.000
6352	pay	2018/03/05 15:46:47.000
6351	cancel order	2018/03/06 10:17:01.000
6350	prepare delivery	2018/03/07 13:50:35.000
6350	make delivery	2018/03/07 16:41:01.000
6350	confirm payment	2018/03/07 16:53:00.000
6352	prepare delivery	2018/03/07 17:05:59.000
6352	confirm payment	2018/03/07 17:59:55.000
6352	make delivery	2018/03/08 09:54:36.000

Order 6350



Let's look at orders 6350, 6351, and 6352

Case ID	Activity	Timestamp
6350	place order	2018/02/13 14:29:45.000
6351	place order	2018/02/13 16:17:37.000
6352	place order	2018/02/13 17:53:22.000
6352	send invoice	2018/02/19 09:20:28.000
6351	send invoice	2018/02/19 16:08:07.000
6350	send invoice	2018/02/21 09:38:16.000
6350	pay	2018/03/02 12:39:37.000
6352	pay	2018/03/05 15:46:47.000
6351	cancel order	2018/03/06 10:17:01.000
6350	prepare delivery	2018/03/07 13:50:35.000
6350	make delivery	2018/03/07 16:41:01.000
6350	confirm payment	2018/03/07 16:53:00.000
6352	prepare delivery	2018/03/07 17:05:59.000
6352	confirm payment	2018/03/07 17:59:55.000
6352	make delivery	2018/03/08 09:54:36.000

Order 6350



Order 6351



Let's look at orders 6350, 6351, and 6352

Case ID	Activity	Timestamp
6350	place order	2018/02/13 14:29:45.000
6351	place order	2018/02/13 16:17:37.000
6352	place order	2018/02/13 17:53:22.000
6352	send invoice	2018/02/19 09:20:28.000
6351	send invoice	2018/02/19 16:08:07.000
6350	send invoice	2018/02/21 09:38:16.000
6350	pay	2018/03/02 12:39:37.000
6352	pay	2018/03/05 15:46:47.000
6351	cancel order	2018/03/06 10:17:01.000
6350	prepare delivery	2018/03/07 13:50:35.000
6350	make delivery	2018/03/07 16:41:01.000
6350	confirm payment	2018/03/07 16:53:00.000
6352	prepare delivery	2018/03/07 17:05:59.000
6352	confirm payment	2018/03/07 17:59:55.000
6352	make delivery	2018/03/08 09:54:36.000

Order 6350



Order 6351



Order 6352



Let's look at orders 6350, 6351, and 6352

Case ID	Activity	Timestamp
6350	place order	2018/02/13 14:29:45.000
6351	place order	2018/02/13 16:17:37.000
6352	place order	2018/02/13 17:53:22.000
6352	send invoice	2018/02/19 09:20:28.000
6351	send invoice	2018/02/19 16:08:07.000
6350	send invoice	2018/02/21 09:38:16.000
6350	pay	2018/03/02 12:39:37.000
6352	pay	2018/03/05 15:46:47.000
6351	cancel order	2018/03/06 10:17:01.000
6350	prepare delivery	2018/03/07 13:50:35.000
6350	make delivery	2018/03/07 16:41:01.000
6350	confirm payment	2018/03/07 16:53:00.000
6352	prepare delivery	2018/03/07 17:05:59.000
6352	confirm payment	2018/03/07 17:59:55.000
6352	make delivery	2018/03/08 09:54:36.000

Order 6350



Order 6351



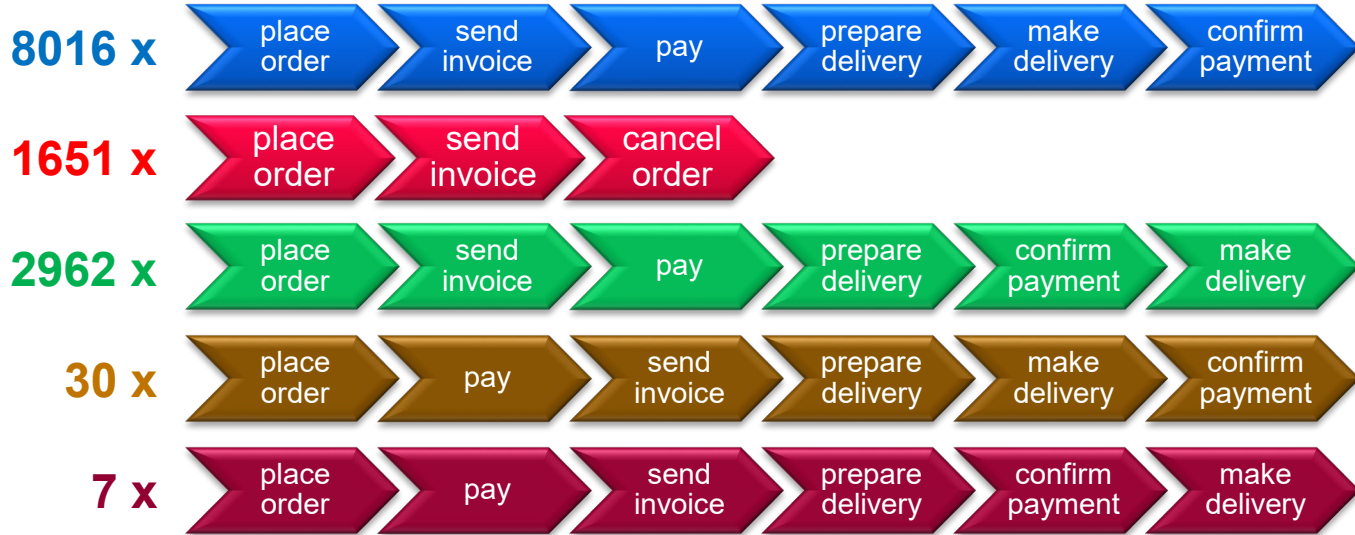
Order 6352



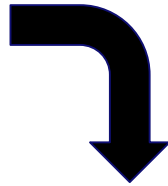
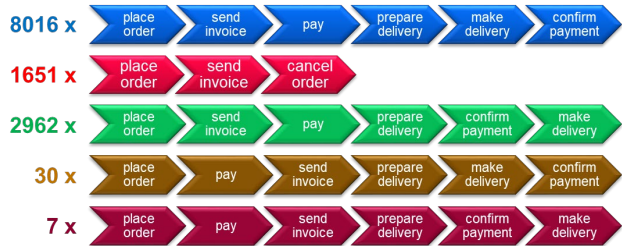
Let's look at the whole event log again

71,043 events
12,666 cases
7 activities

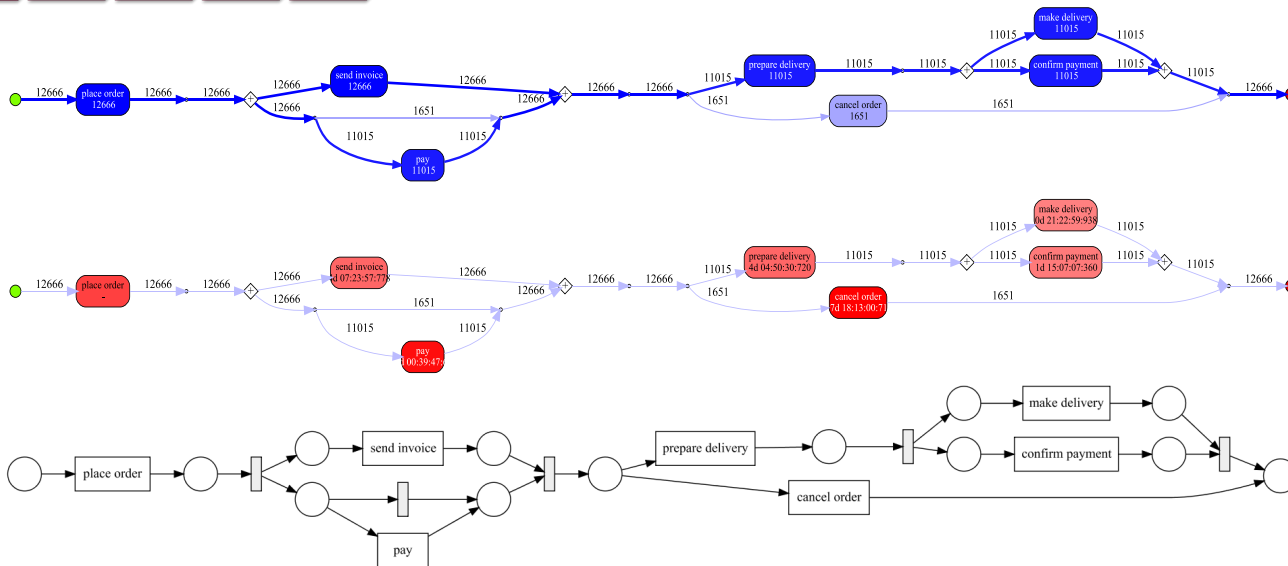
Case ID	Activity	Resource	Timestamp	product	productcode	quantity	address
1001	place order	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1001	send invoice	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1001	pay	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1001	prepare delivery	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1001	make delivery	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1001	confirm payment	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1002	place order	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1002	send invoice	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1002	cancel order	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1003	place order	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1003	send invoice	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1003	pay	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1003	prepare delivery	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1003	confirm payment	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1003	make delivery	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1004	place order	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1004	pay	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1004	send invoice	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1004	prepare delivery	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1004	confirm payment	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1004	make delivery	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1005	place order	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1005	pay	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1005	send invoice	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1005	prepare delivery	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1005	confirm payment	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000
1005	make delivery	shop	2017-01-01 10:00:00	apple	apple	1	10000000000000000000



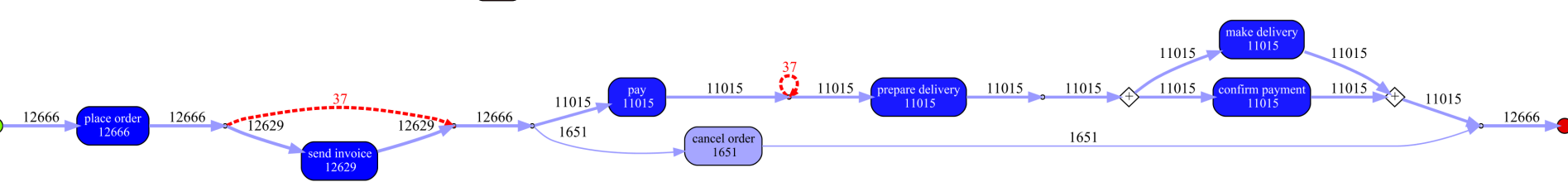
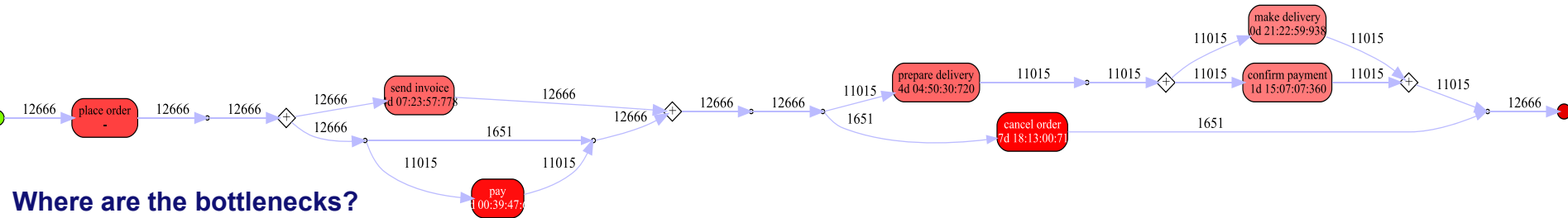
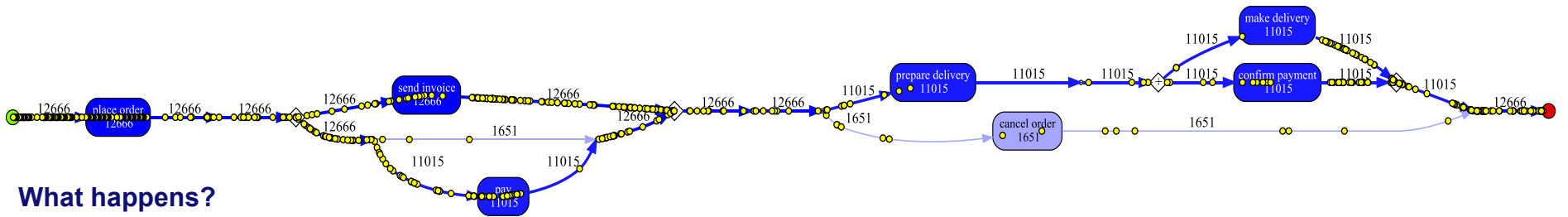
Using the whole event log



No modeling needed!



Performance and Compliance



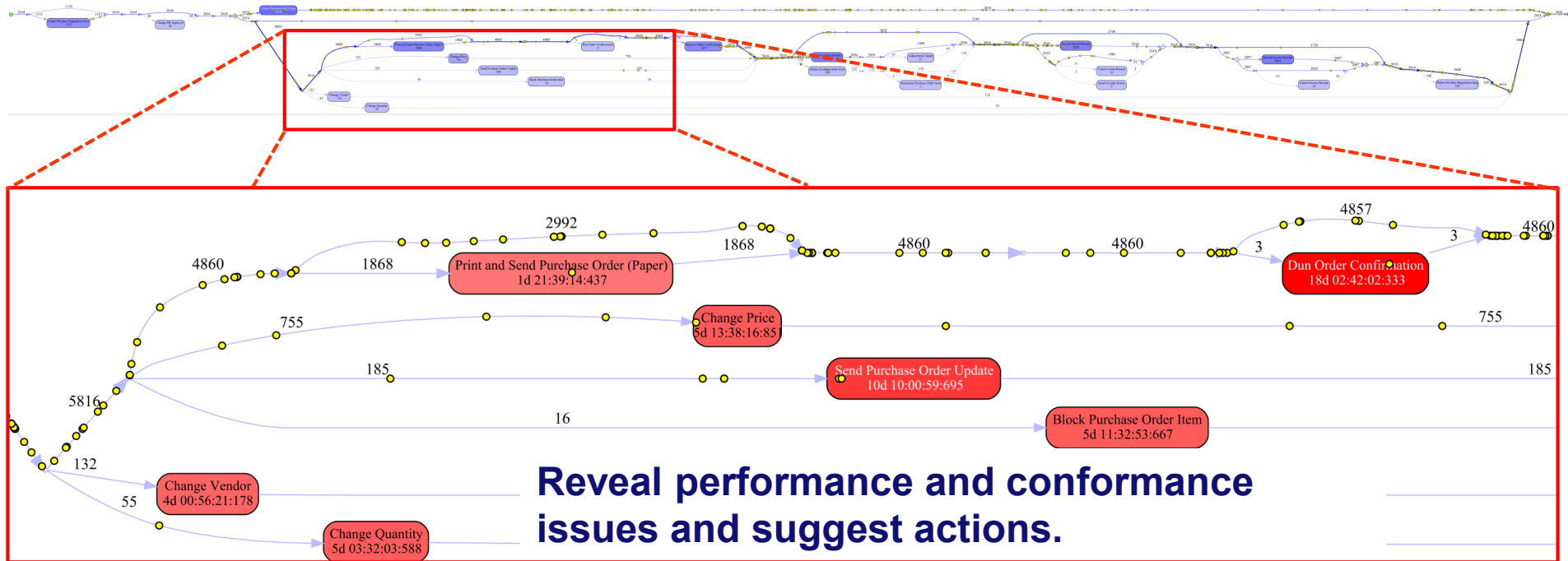
Reality is not so simple



It is common to find thousands of different variants for simple core processes like P2P and O2C!

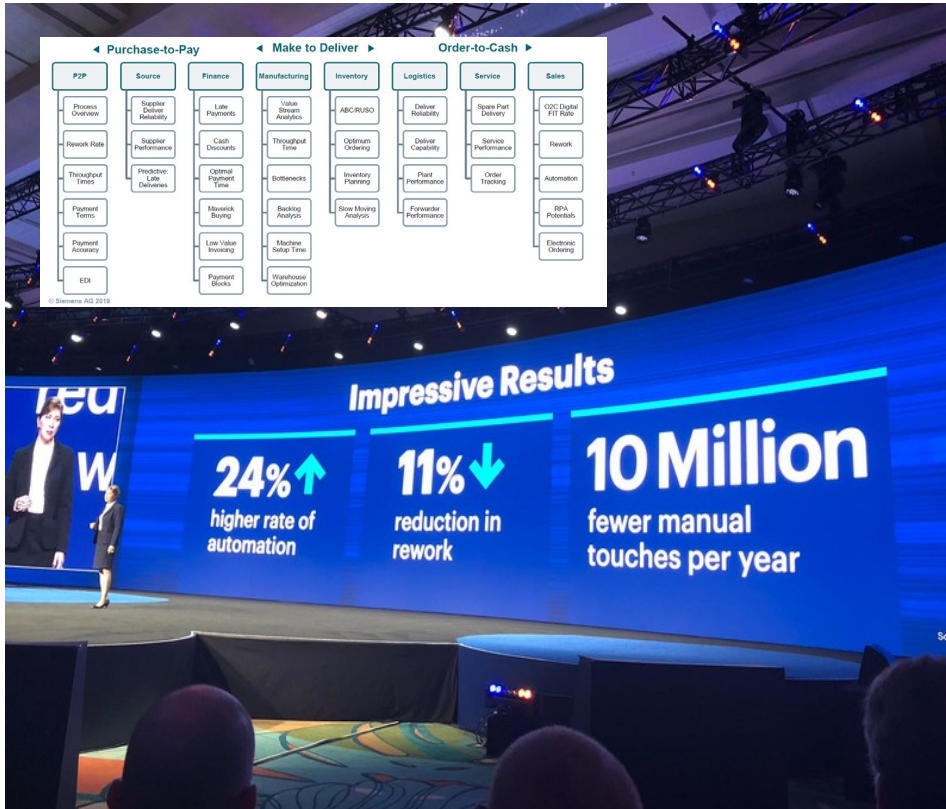
Caused by hand-offs, rework, duplication, ineffective communication, etc.

Process mining helps organizations to address compliance and performance problems

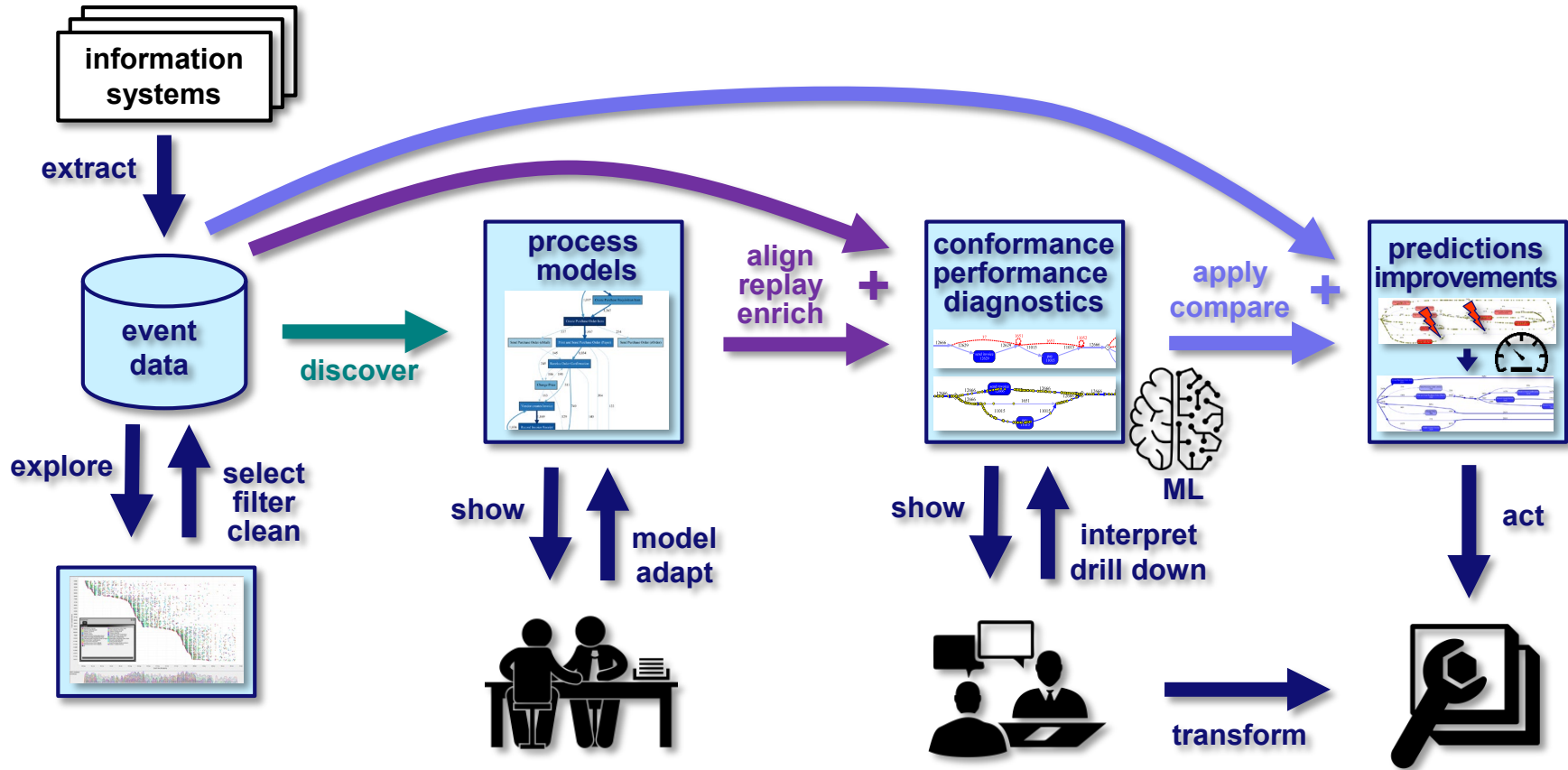


Example: Process Mining @ Siemens

(thanks to Lars Reinkemeyer, former head of process mining Siemens)



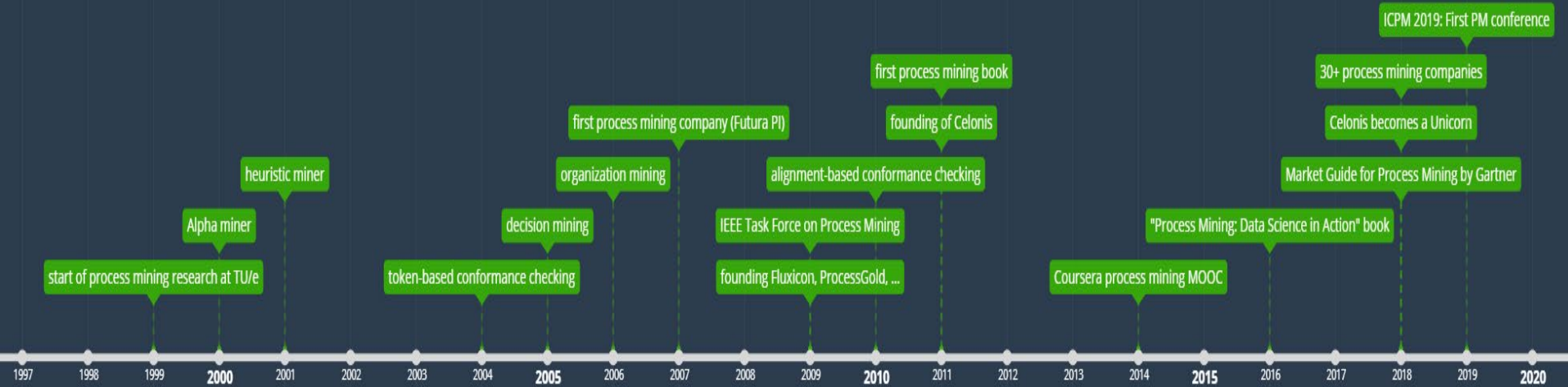
- > 6000 active Celonis users (P2P, O2C, etc.)
- Millions of savings by reducing rework, process unification, etc.
- Improved reliability and responsiveness.
- At an amazing scale, e.g., Order to Cash (O2C) process with >30M cases, >300M events, and >900K variants.



Adoption of PM in Industry

research

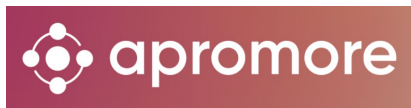
commercial tools



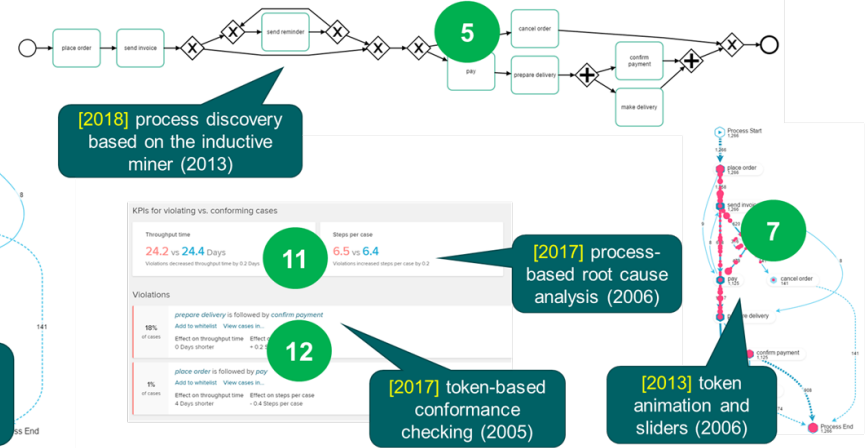
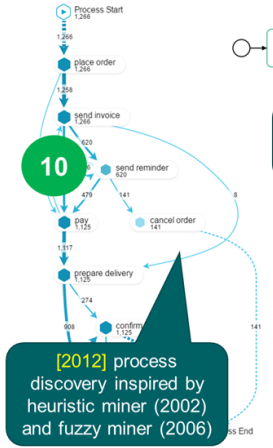
adoption

Over 35 process mining vendors today

(all PM results shown were created using ProM)



Example Process Mining Software: Celonis



- Germany's youngest most promising IT company (valued > 2.5 billion \$).
- Successfully adopted many ideas from research a decade earlier.
- Combining analytics with actions.



Activities

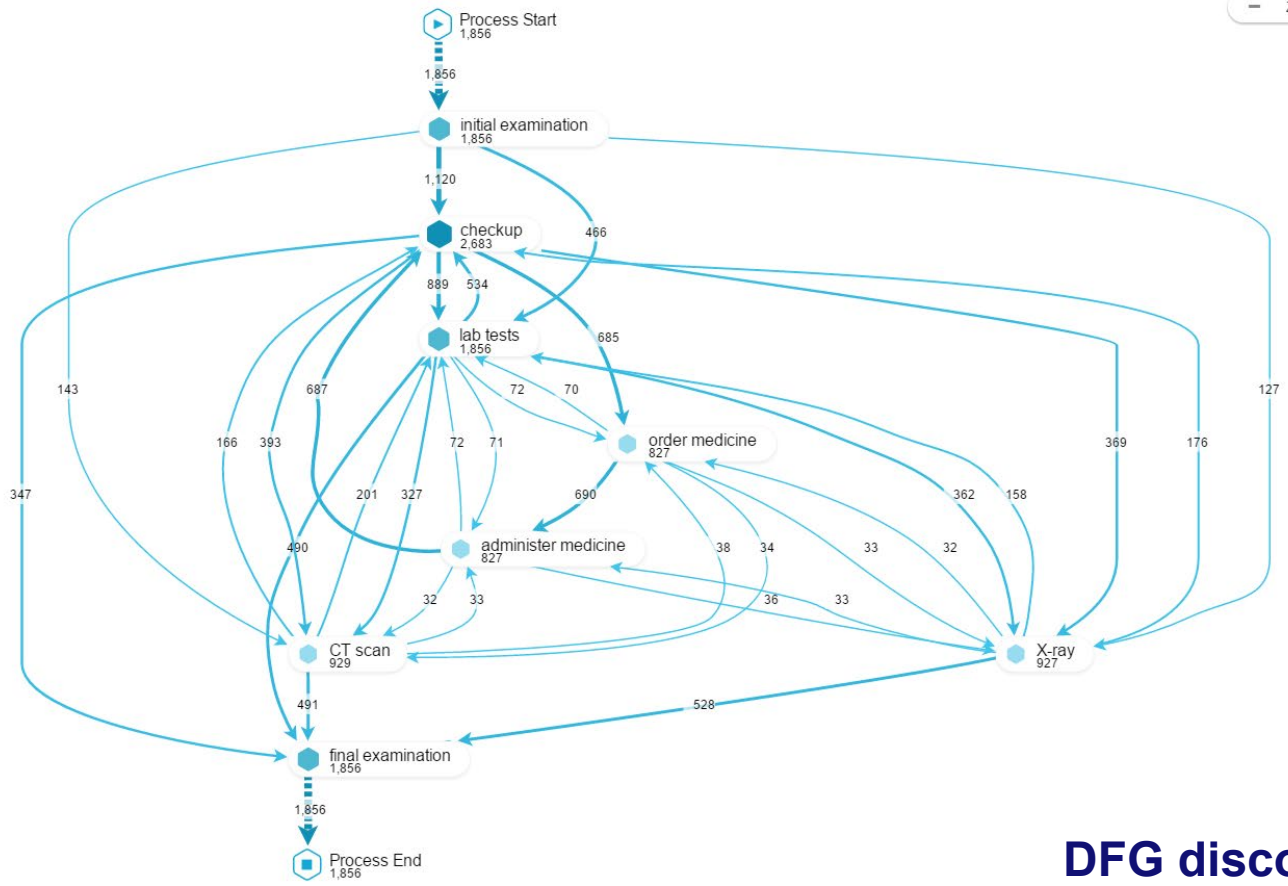
100% of activities

Less More

Connections

100% of connections

Less More



DFG discovery



Activities

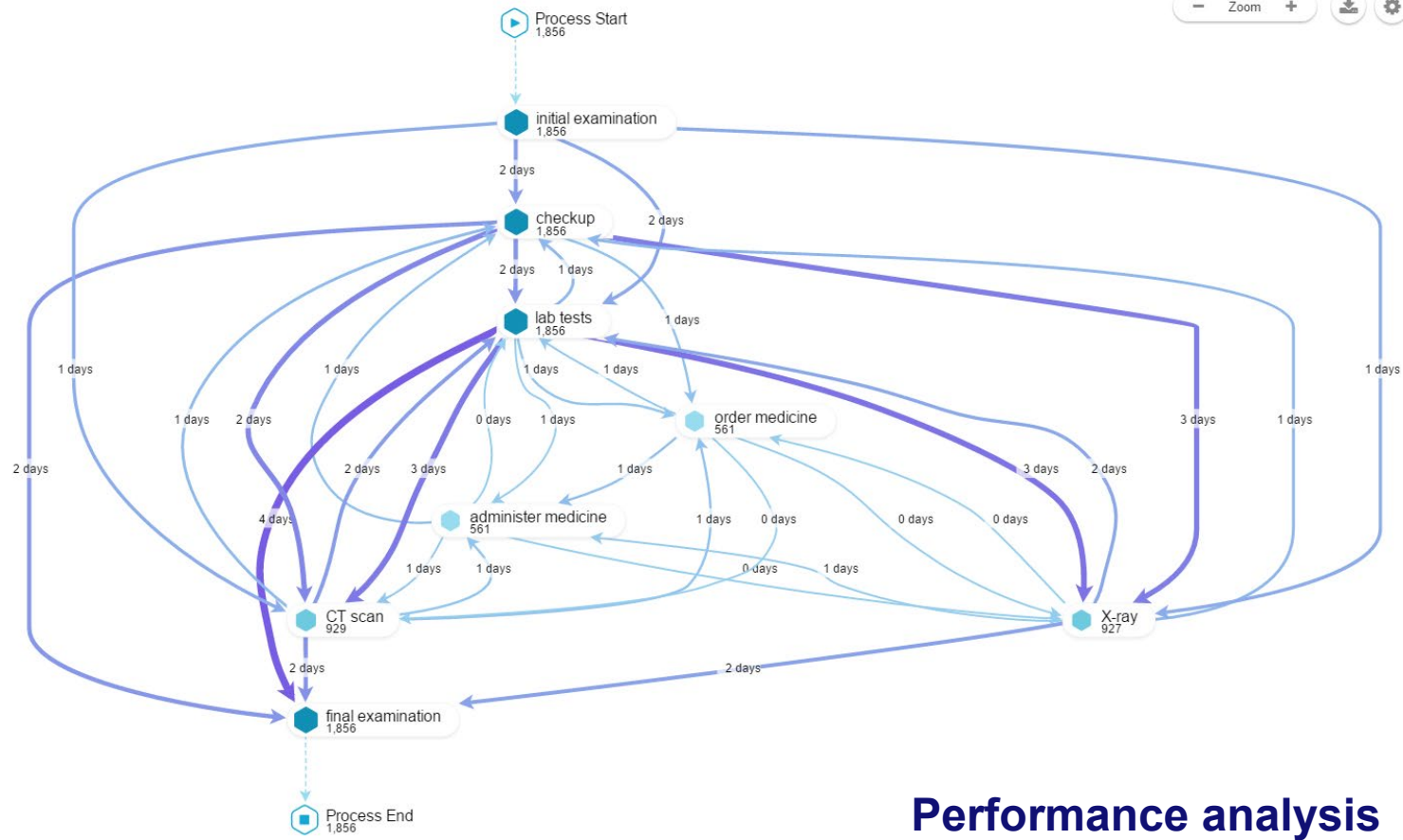
100% of activities

Less - More +

Connections

100% of connections

Less - More +



Performance analysis



Activities

100% of activities

Reset

Less More

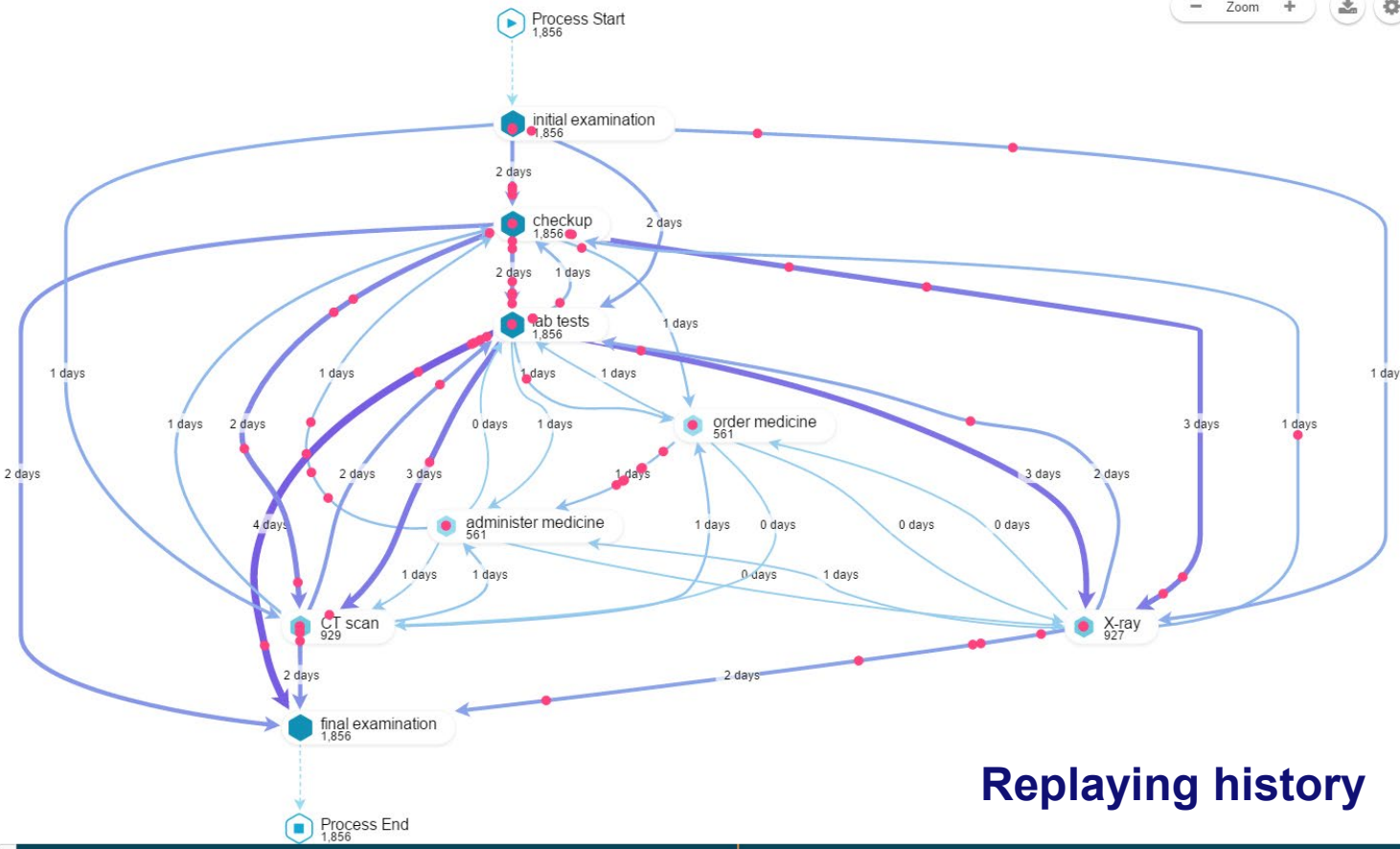
Connections

100% of connections

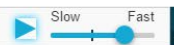
Reset

Less More

Fixed layout



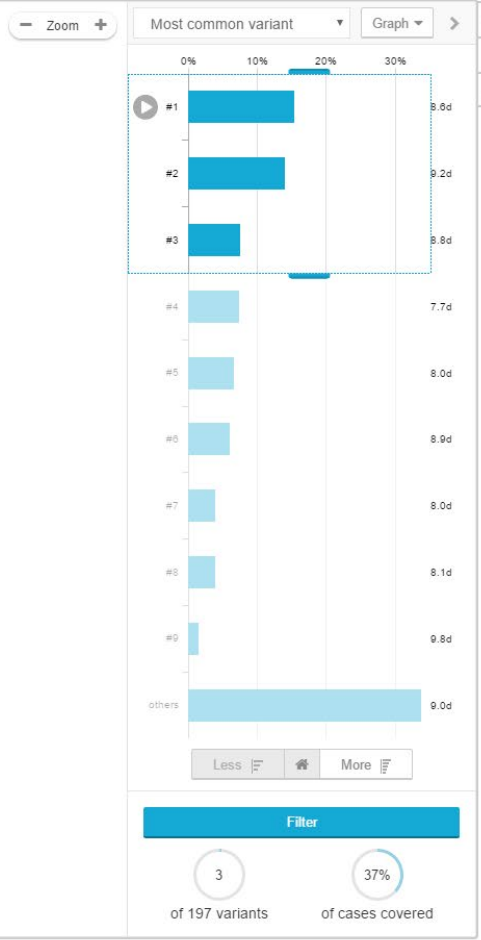
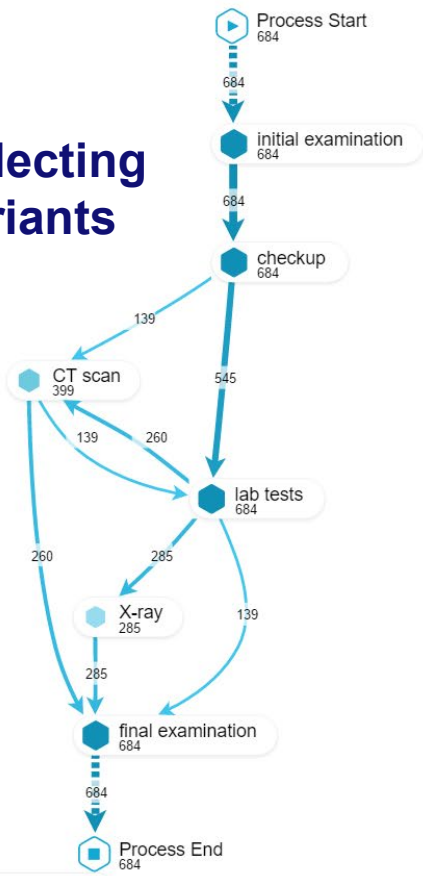
Replaying history



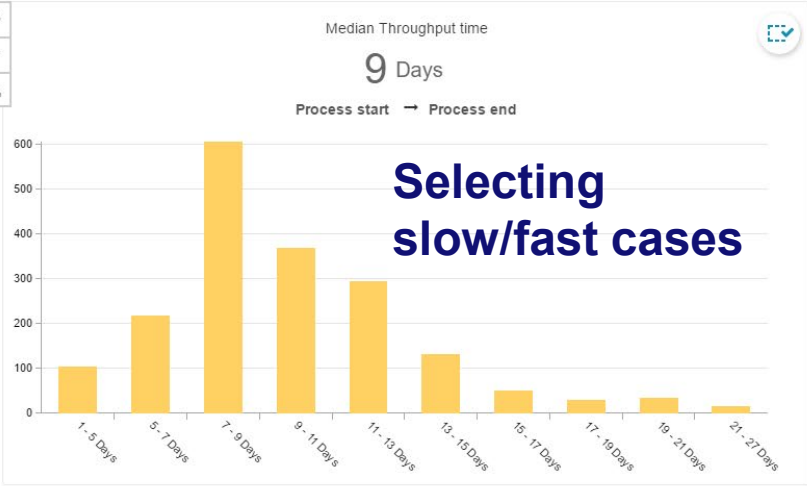
08.07.2015

14.12.2015

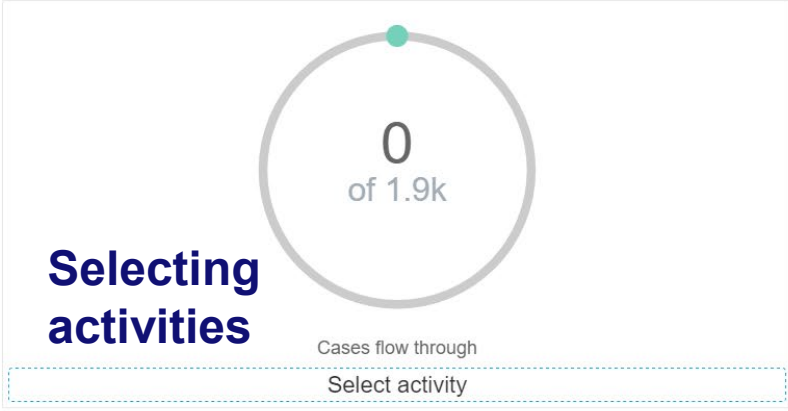
Selecting variants



Selecting slow/fast cases

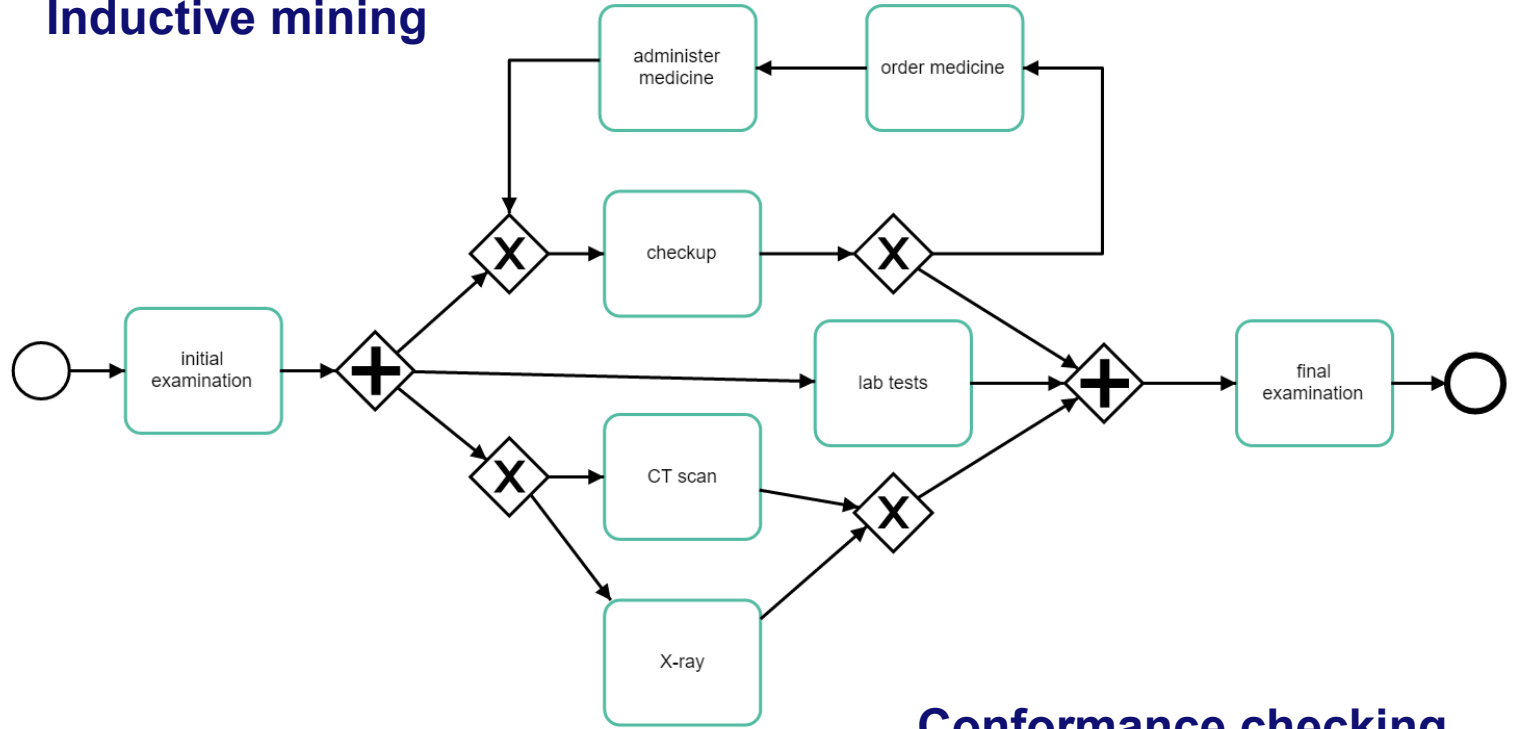


Selecting activities





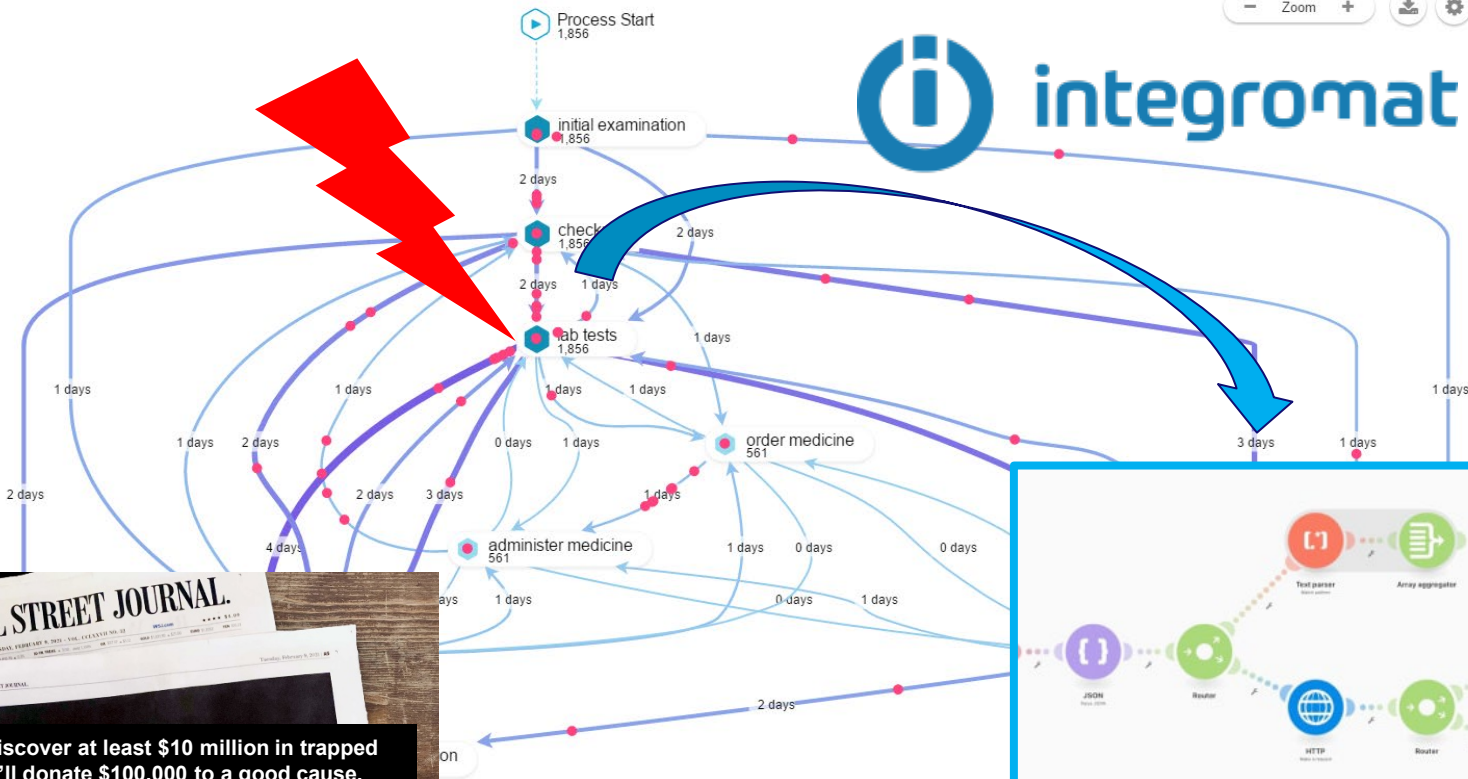
Inductive mining



Conformance checking



Action-Oriented Process Mining (AOPM)



Activities List view

100% of activities

Reset

Less More



THE WALL STREET JOURNAL

What's News

If we don't discover at least \$10 million in trapped capacity, we'll donate \$100,000 to a good cause.

Let's find \$10,000,000 trapped in your business.

Many of the larger organizations in Europe are already using process mining (and we are just at the beginning!)

Deloitte.

SIEMENS



BOSCH

AkzoNobel



PHILIPS

MediaMarkt

L'ORÉAL



CREDEM



Lufthansa

Medtronic



zalando



ABB



Uber

VANDERLANDE



vodafone





Relation to RPA

Robotic Process Automation

- Unlike PM initiated from industry
- Keep original system
- Bottom-up / quick wins
- Complements process mining
 - automate versus analyze
 - task level versus process level



WorkFusion

blueprism®

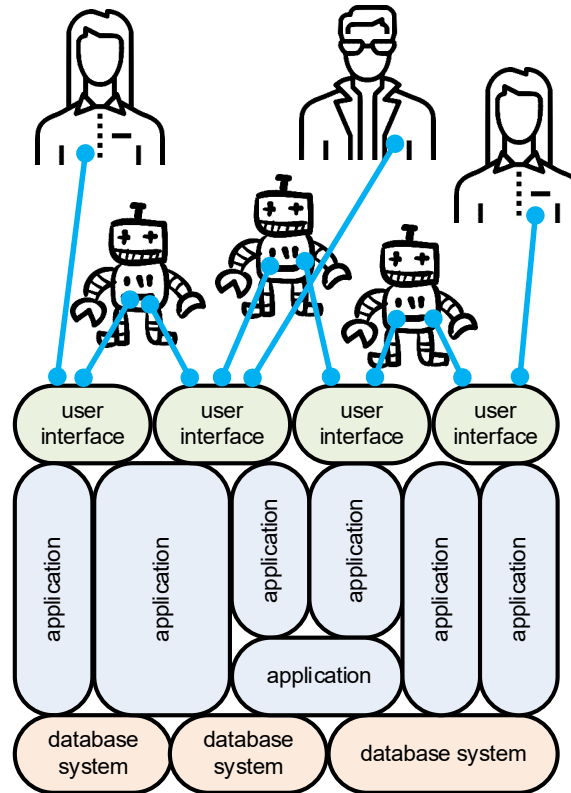
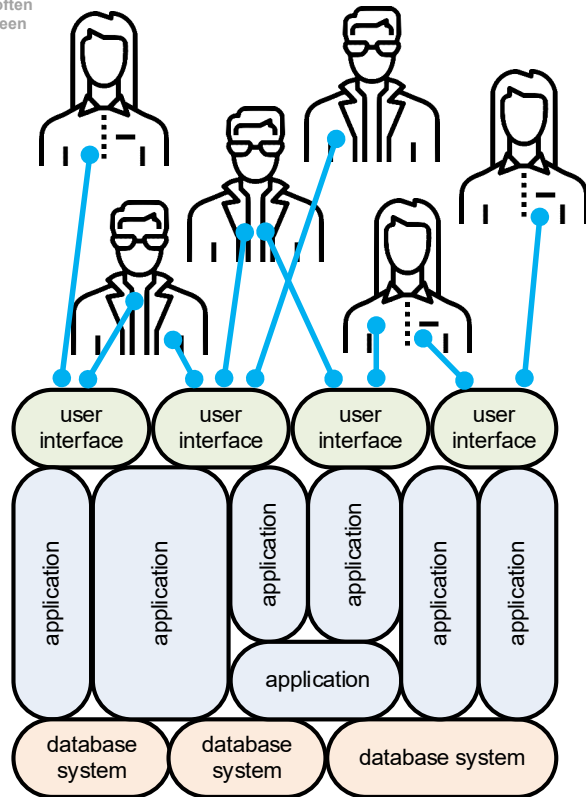
NICE



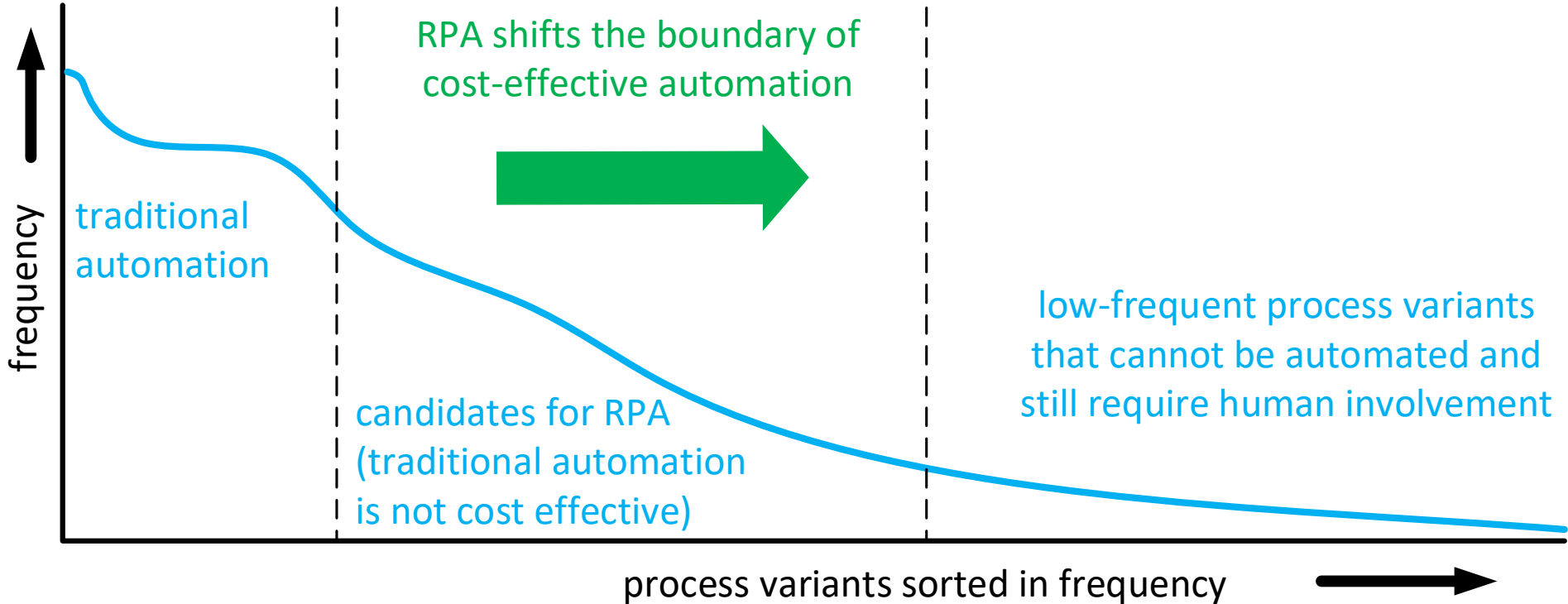
AUTOMATION
ANYWHERE
Go be great.

RPA: The Poor man's WFM system

Humans are often the glue between applications



process mining is able to diagnose the full process spectrum
from high-frequent to low-frequent and from automated to manual



Human Intelligence

people and experiences

flexible
creative
emphatic
instinctive
commonsensical

Hybrid Intelligence

fast
efficient
cheap
scalable
consistent

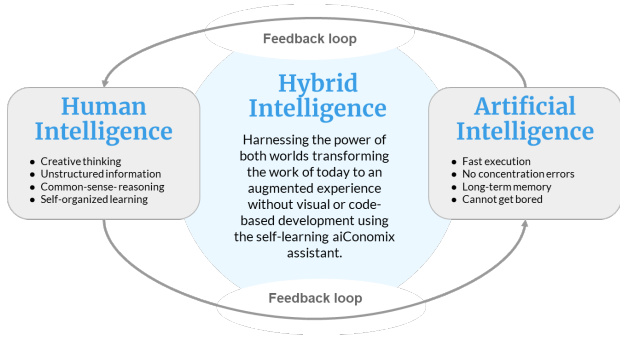
data and algorithms

Machine Intelligence

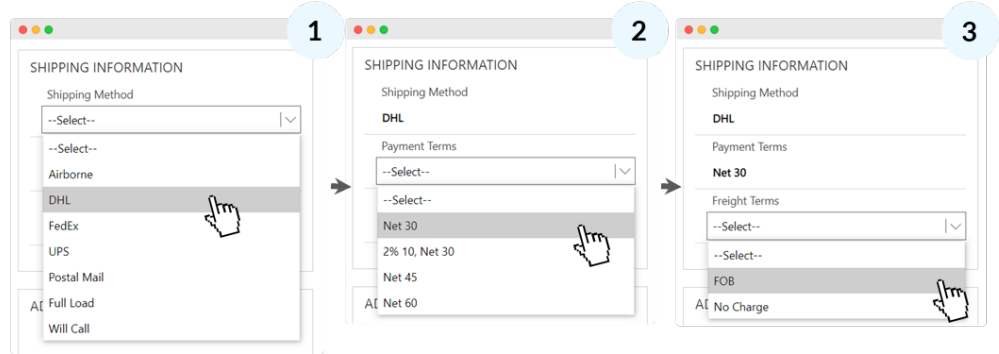
Example Hybrid Intelligence



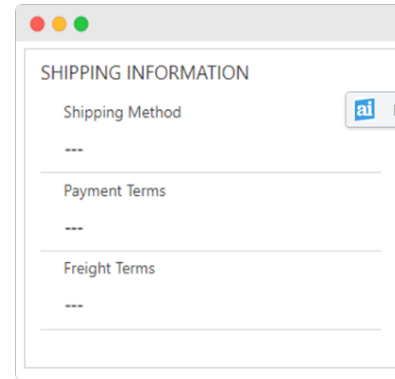
aiconomix.com



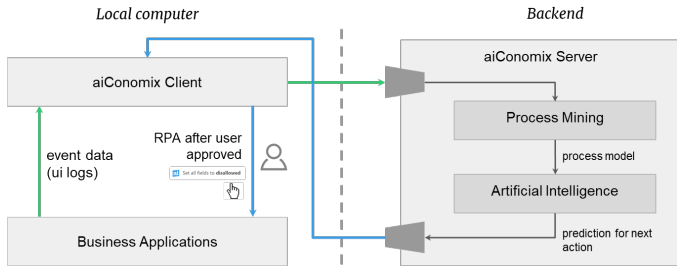
Currently




ai Conomix



Saved Time



Conclusion

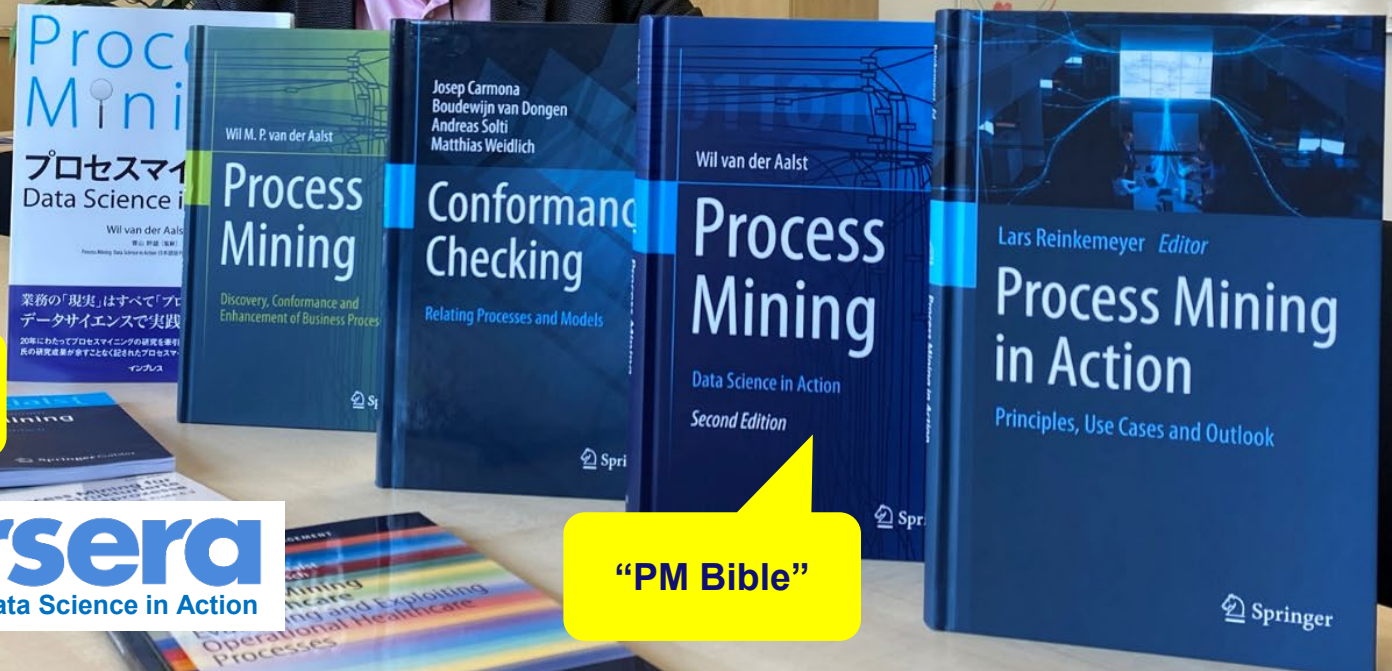


Process mining helps to detect operational friction and can be used to trigger corrective actions, workflows, or redesigns

Process mining helps to detect repetitive tasks and guide RPA initiatives.

Learn more?

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Over 130.000 participants

coursera
Process Mining: Data Science in Action

“PM Bible”