Process Intelligence by ABBYY Timeline

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- Efficiency analysis, RPA

- Simulation
- What-if analysis

Gartner MQ





Discovery & Analytics







Optimization, Automation

- Understand the process
- Find bottlenecks
- Find inefficiencies
- Understand where time (and money) is spent
- Find opportunities for automation



Streamline Mortgage Processing

Results:

Identified 550K+ hours of rework in the mortgage process to settlement, reduced cycle time by >6 days by automating or eliminating repetitive decisioning tasks

\$1.3M Savings in processing time

Improved customer experience, reduced cycle time and eliminated rework by identifying and following a more standard "happy" path



55%

Reduction in fulfillment time



Reduced from the cycle time and 44k hours of effort saved

Multinational Telecom Company:

Process Intelligence Case Study



GOALS:

Identify and justify processes for automation consumer support and truck rolls

International communications vendor drives all operational improvement and automation through data driven insight. Using ABBYY's Process Intelligence leads to an estimated saving of \$8M per year.

RESULTS:

- Identified 9 solutions areas including multiple opportunities for Automation, Virtual Agents, and AI / Machine Learning
- Identified \$8M in savings in first 6 weeks
- An estimated 70% reduction in time and cost, compared to historic manual efforts



Contact Center – Minimum Data Set (MDS) Compliance Use Case



The Contact Center implemented a Protocol of collecting and verifying patient information to reduce insurance claims denials using process insights from ABBYY Timeline

GOALS:

- Reduce front-end denials and re-processing expense for insurance claims
- Improve quality of patient information collection during scheduling of patient services/procedures
- Identify opportunities to improve workforce optimization and compliance with processes

RESULTS:

- Compliance rate with accurate data collection increased from 40% to 87%
- Audit team is now able to monitor compliance for 100% of all scheduler interactions with patients; up from ~5% before Timeline

French Multinational Insurance Company

Challenge:

Our client's primary goal was to streamline the auto claim handling process and improve the overall customer experience by reducing cycle times, reducing rework, and increasing the rate of process automation.

Solution:

ABBYY Timeline was deployed onpremise following specific customer guidelines.

Over 4,600 motor claims and 500,000 events were loaded by extracting and transforming transactional logs produced by the claim management system.



Results:

200+ hours per claim spent in manual tasks were identified using ABBYY Timeline.

More than 50 FTEs were identified as potential savings by automating document processing manual tasks.

Opportunity to reduce settlement times from 8 to 5 months.



	Eve	ent r	'eco	rd
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id, timestamp, event name, attributes

Timestamp	ACUITY_LEVEL_C	Comments	MEANS_OF_ARRV_C	TimelineID	DayOfWeek	Name
3/1/2012 0:07	13	ORDER FOR PATIENT SERVICES	Ambulance	113605460	Thu	ADT ORDER PLACED

Timeline	
Case trace	

Timestamp	ACUITY_LEVEL_C	Comments	MEANS_OF_ARRV_C	TimelineID	DayOfWeek	Name
3/1/2012 0:07	13	ORDER FOR PATIENT SERVICES	Ambulance	113605460	Thu	ADT ORDER PLACED
3/1/2012 0:07	13	ED Disposition set to Admitted	Ambulance	113605460	Thu	Ready for Admit
3/1/2012 0:08	13	LACTIC ACID	Ambulance	113605460	Thu	Lab Ordered
3/1/2012 0:21	13	CALCIUM, IONIZED, PHOSPHORU	Ambulance	113605460	Thu	Lab Ordered
3/1/2012 1:42	13	(Final result) LACTIC ACID, W BLO	Ambulance	113605460	Thu	Lab Resulted
3/1/2012 1:56	13	(Final result) PT/INR	Ambulance	113605460	Thu	Lab Resulted
3/1/2012 1:58	13	(Preliminary result) CBC/DIFF	Ambulance	113605460	Thu	Lab Resulted
3/1/2012 2:02	13	(Final result) TROPONIN T	Ambulance	113605460	Thu	Lab Resulted
3/1/2012 2:02	13	(Preliminary result) CK WITH MB	Ambulance	113605460	Thu	Lab Resulted
3/1/2012 2:03	13	CTA HEAD W/ CONTRAST	Ambulance	113605460	Thu	CT ORDER PLACED
3/1/2012 2:07	13		Ambulance	113605460	Thu	CT ORDER RELEASED
3/1/2012 2:09	13	(Final result) CK WITH MB	Ambulance	113605460	Thu	Lab Resulted
3/1/2012 2:09	13	(Final result) BASIC METAB PANE	Ambulance	113605460	Thu	Lab Resulted

Timeline



Timeline Set

Timeline Set Filters

Timestamp	ACUITY_LEVEL_C	Comments	MEANS_OF_ARRV_C	TimelineID	ROOM_ID	DayOfWeek	Name
3/1/2012 0:01	15	WOLF, M assigned as Physician Ass	Personal Vehicle	113605580		Thu	Provider Assigned
3/1/2012 0:01	15		Personal Vehicle	113605602		Thu	Patient arrived in ED
3/1/2012 0:01	15	BENKINNEY, J assigned as Attending	Personal Vehicle	113605580		Thu	Provider Assigned
3/1/2012 0:01	14		Personal Vehicle	113605592		Thu	Triage Started
3/1/2012 0:01	15	From room 5 to room D08	Other	113605469	915	Thu	Patient transferred
3/1/2012 0:01	12	ED Disposition set to Discharged	Ambulance	113604652		Thu	Ready for Discharge
3/1/2012 0:01	15	First ED Provider Contact	Personal Vehicle	113605580		Thu	First ED Provider Contact
3/1/2012 0:01	14	ED Disposition set to Discharged	Personal Vehicle	113603880		Thu	Ready for Discharge
3/1/2012 0:02	13	BENKINNEY, J assigned as Attending	Ambulance	113604919		Thu	Provider Assigned
3/1/2012 0:03			Ambulance	113605605		Thu	Patient arrived in ED
3/1/2012 0:03	15		Personal Vehicle	113605297		Thu	Ready for Discharge
3/1/2012 0:03	14		Personal Vehicle	113605592		Thu	ED Class set to Emergency
3/1/2012 0:04	14		Personal Vehicle	113605592		Thu	Triage Completed
3/1/2012 0:04			Ambulance	113605605		Thu	Triage Started
3/1/2012 0:04	14	To room 7	Personal Vehicle	113605592	824	Thu	Patient roomed in ED
3/1/2012 0:05			Ambulance	113605605		Thu	Triage Completed
3/1/2012 0:05	15	From room 2 to room D01	Personal Vehicle	113605297	100322	Thu	Patient transferred
3/1/2012 0:06	15	LOW SENSITIVITY CRP, SEDIMENTA	Personal Vehicle	113605470		Thu	Lab Ordered
3/1/2012 0:06	14	LACTIC ACID, LIPASE, HEP FUNCTIO	Ambulance	113605516		Thu	Lab Ordered
3/1/2012 0:07	15		Personal Vehicle	113605602		Thu	Triage Started
3/1/2012 0:07		To room 19	Ambulance	113605605	9118	Thu	Patient roomed in ED
3/1/2012 0:07	13	ORDER FOR PATIENT SERVICES	Ambulance	113605460		Thu	ADT ORDER PLACED
3/1/2012 0:07	13	ED Disposition set to Admitted	Ambulance	113605460		Thu	Ready for Admit
3/1/2012 0:08	15		Personal Vehicle	113605297		Thu	Patient departed from ED
3/1/2012 0:08	13		Personal Vehicle	113603797		Thu	Ready for Discharge
3/1/2012 0:08	15		Personal Vehicle	113605297	100322	Thu	Patient discharged
3/1/2012 0:08	13	LACTIC ACID	Ambulance	113605460		Thu	Lab Ordered
3/1/2012 0:08	15	CH50, TOTAL	Personal Vehicle	113605470		Thu	Lab Ordered
3/1/2012 0:09	14	(Final result) ANKLE, 3+ VIEWS	Personal Vehicle	113605513		Thu	Rad Resulted
3/1/2012 0:09	14	(Final result) FOOT, 3+ VIEWS	Personal Vehicle	113605513		Thu	Rad Resulted



Timeline Set

Timeline Set Filters

18 🕻 25 22 14 11 🕌 9 25 · · · · 8 · · · · · · 26 · · 6 6 🤇 23 28 1 🔇 27 27 · · · · · ·	
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Paths



Triage Started

03/12/2012 12:54 PM 18 1:04 PM 🕔

Patient arrived in ED Triage Started

03/27/2012 3:54 PM 18 Patient arrived in ED 3:55 PM (Triage Started

Schema







Filters and Sets



01 Metrics

- Histogram of pre-defined metrics
- Time range
- Time between specific events

02 Dimension

• Select one or more attribute values

03 Query

ABBYY

• User defined pattern



Event	All events	Attribute	Selected: 130	Options
				If the event happens several times, the
ADT ORDER PLA	CED			attribute should have the given value at
2 CDU(M)		ACUITY LEVEL C	2 818	O First occurrence
CT ORDER PLAC	ED	BED ID	2 819	C Last occurrence
T CT ORDER RELE	ASED	COMMENTS	2 820	Any
3 Consult called		DAYOFWEEK	2 821	C any
Consult respond		DEPARTMENT ID	2 822	
5 Contact Created		MEANS OF ARRV C	2 823	
Decision to Adm	it	ROOM ID	2 824	
ED Census			2 825	
10 ED Class set to C	DU/Holding		1 826	
ED Class set to E	mergency		2 827	
12 ED Class set to F	ast Track		2 828	
13 Evaluation in Pr	ocess(M)		2 829	
14 First ED Provide	Contact		2 830	
Lab Ordered			831	
🔏 Lab Resulted			832	
17 Patient admittee	ł		2 833	
18 Patient arrived i	n ED		2 834	
19 Patient departed	i from ED		2 835	
20 Patient discharg	ed		2 836	
21 Patient error			2 837	
2 Patient roomed	in ED		2 838	
23 Patient transfer	ed		2 839	
24 Patient transfer	ed into ED		840	
25 Provider Assigne	d		2 841	
26 Rad Ordered			842	

Process schema

Generate a directly-follows graph on selected milestones

01 Milestones

- Events that always happen at the same position relative to each other
- "You are American if other Americans say you are one"

02 Schema generation

- Directly-follows graph on milestones
- Manual edit

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03 Quantitative analysis

- Display stats on the graph
- Visual bottleneck search via animation



Paths analysis

Compare event permutations

01 Events

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• User selects events to include

02 Path statistics

- User selects two stats to be displayed per permutation
- Manual edit

03 Quantitative analysis

- Stats on transitions
- Compare paths in different sets



Interval analysis

Histogram of time spent between two selected events

01 Events

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• User selects start and end events

02 Interval statistics

- Histogram of time spent between the two events
- Min/max, 75, 90 percentiles

03 Breakdown by dimension

- User selects an attribute
- Subcharts for each attribute value



Breakdown analysis

Histogram of attribute values

01 Dimension

• User selects an event/attribute pair

02 Dimension statistics

- Histogram of attribute values
- Basic stats

03 Compare to set

- User selects another set
- Ratio of the current set's value to the compared set's value

Breakdown by dimensions

👹 Lab Resulted / Comments 🛛 🗙 🛛 If multiple per timeline, use: first 💙 👘 👘

ort as PNG Export as CSV

Selected value: none

Number of timelines: 12,199 Number of distinct values: 82 Missing values: 11,273







Monitoring & Alerting







Measure performance and effect of change

- Optimization, automation changes
- Continuous performance monitoring (of human, non-automated workforce)
- Automation



French multinational investment bank and financial services company

Challenge:

Our client's main goal was to identify and eliminate non-conforming transactions in order to reduce treasury immobilisation as part of the SEPA payments.

Solution:

ABBYY Timeline was deployed on-premise following specific customer guidelines.

Several customized dashboards with key KPIs were built to be used in daily reports and meetings.

Alerts are being sent to notify users about potential issues in the process.



Results:

- The number of RECALLED payments has been reduced by 55%
- Different analysis were built around top 20 problematic customers and top 20 nonconforming banks
- Fully transparency and traceability of banks that cannot execute recalls in the allotted time

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Fortune 100 financial services firm

Results:

A Fortune 100 financial services firm with over \$1 trillion under management and 5M+ clients turned to ABBYY to monitor transactions and mitigate regulatory risk for investor onboarding.



100%

Transactions are now monitored for compliance to avoid regulator sanctions

>\$2 mil

Savings per year with process automation

Reduced risk of compliance violation with regulators and exposure from fines or PR scenarios

ETL

Repository to manipulate data prior loading it to a project

01 Extract

- Manual upload
- SFTP
- Import from 3rd party

02 Transform

• Type conversion

- New column
- String manipulation
- Delete

• Join

Random sample

03 Load

- Load all data
- Load with filters

ABBYY

No operation running at the moment	Operations: 2 Open to-do list Save as to-do list Delete all	1. Change type Converts the sele into specified typ	e 2. Load in Loads the t new or exis using the L	to project imelines to a ting project DAD function Add opera	tion	
Repository	ER_Date_DaysCom	ments_min_dateadd 🖋	\$ 988 L Uploaded	by token 👼 03/13/2020	4:48 PM 🏾 🏷 Tags: 0	Display qu
	Timestamp 🕕	ACUITY_LEVEL_C i	BED_ID i	DEPARTMENT_ID	Comments (i)	MEANS_OF_ARRV_C
▲ 11-1	Date	Number	Number	Number	String	Number
- upload	2012-03-01T00:01:00.000Z	15			First ED Provider Contact	1
	2012-03-01T00:01:00.000Z	14			ED Disposition set to Discharged	1
i) Details	2012-03-01T00:02:00.000Z	13			BENKINNEY, J assigned as Attending	2
	2012-03-01T00:03:00.000Z					2
	2012-03-01T00:03:00.000Z	15				1
Tables 🗸	2012-03-01T00:03:00.000Z	14				1
	2012-03-01T00:04:00.000Z	14				1
	2012-03-01T00:04:00.000Z					2
axDemo	2012-03-01700-04-00.0007	14	1394	6042	To room 7	1
	2012-03-01700-05-00 0007			0012	10100111	2
R_Data_DaysCommentsArrival	2012-03-01700-05-00.0007	15	10507	340200	From room 2 to room D01	1
	2012-03-01700-05-00-0002	15	10301	340200		1
	2012-03-01100:06:00.0002	15			LOW SENSITIVITY CRP, SEDIMENTAC.	1
	2012-03-01100:06:00.0002	14			LACTIC ACID, LIPASE, HEP FUNCTI	2
Juplicates	2012-03-01100:07:00.0002	15	5010	100070	7 10	1
	2012-03-01100:07:00.0002		5218	103370	10 room 19	2
R_Date_DaysComments_min_dat	2012-03-01100:07:00.000Z	13			ORDER FOR PATIENT SERVICES	2
	2012-03-01T00:07:00.000Z	13			ED Disposition set to Admitted	2
	2012-03-01T00:08:00.000Z	15				1
	2012-03-01T00:08:00.000Z	13				1
= Io-do list 👻	2012-03-01T00:08:00.000Z	15	10507	340200		1
	2012-03-01T00:08:00.000Z	13			LACTIC ACID	2
	2012-03-01T00:08:00.000Z	15			CH50, TOTAL	1
hange-load-derive	2012-03-01T00:09:00.000Z	14			(Final result) ANKLE, 3+ VIEWS	1
	2012-03-01T00:09:00.000Z	14			(Final result) FOOT, 3+ VIEWS	1
hange-load-and-stuff	2012-03-01T00:09:00.000Z	13			(Preliminary result) CBC/DIFF	2
	2012-03-01T00:09:00.000Z	13			(Final result) CBC/DIFF	2
	2012-03-01T00:09:00.000Z	13			(Final result) BASIC METAB PANEL,	2
	2012-03-01T00:09:00.000Z	13			(Preliminary result) CK WITH MB	2
🚹 Big data 🛛 👻	2012-03-01T00:09:00.000Z	15			ED Disposition set to Discharged	1
	2012-03-01T00:10:00.000Z	14				1
	2012-03-01T00:10:00.000Z	13			(Final result) CBC/DIFF	1
	2012-03-01T00:10:00.000Z	13				2
	2012-03-01T00:11:00.000Z	14				1
	2012-03-01T00:11:00.000Z	15				7
	2012-03-01T00:11:00.000Z	15	1569	6042		7
	2012-03-01T00:12:00.000Z	13				1
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	2012-03-01100:12:00.0007	13	7025	350036	To department MS6E IP GWV	11

Process monitoring

Periodic upload into a project; check alert conditions every time

01 Upload

- Manual via browser
- Timeline API

• Sftp

• RabbitMQ

02 Alert

ABBY

- User defines alert conditions
- Who to send the alert to
- In-app, email, sms, webhook

03 Real-time alert

- Events arrive via RabbitMQ
- Worker adds new data and runs alert processing

🔘 Edit alert					×
te	1				
Alert description					
Active					
Author	tamas.mahr@timelinepi.com				
Alert expires in	7 days				
Alert based on Set	All timelines 💙 and (optionally):				
None					
O Query					
O Deadline					
Include timelines					
Include timeline	es even if previously reported				
Include referen	ces to timelines, if not exceeding 10				
Include attributes					
Add					
Alert recipients					
Hint: you can add mult	iple values separated by ','				
SMS to			Email to		
+1555555555		Z	tamas.mahr@timelinepi.com		
Webhooks +					
Scheduled alert					
				Cancel	Save alert
Help					

Prediction







Improved alerting

- Alert users before it happens
- Prescriptive:
 - Tell users what to do to prevent it happening



Outcome forecast

Predict the outcome of a process

01 Outcomes

• A set of events define an outcome

02 Training

- NN inputs:
 - Event sequences
 - Additional attributes

03 Prediction

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- Based on the defined input classify timelines into outcomes
- Filter based on predicted outcome

31 mins Ready for Admit 9:19 PM 28 9:19 PM 🚺 Lab Ordered Configuration X Each forecast includes one or more outcomes. An outcome is defined by the presence of specific events. Create outcomes, select the events Attributes The forecast could depend on the value of some attributes, in addition to the sequence of the events. If that's the case, select the attributes which strongly affect the outcome Select 🗸 Excluded acti Forecasts Some activities are want to exclude from the analysis. Model hospital Outcomes Outcome hospital 🥖 home (99.94%) home 20 30 31 Close

05 PM 19

05 PM 20

Patient departed from ED

Patient discharged

O Help

11:43 PM

11:43 PM 17

19

Patient departed from ED

Patient admitted

Deadline analysis

Find deadline issues in a process

01 Deadline interval

- User selects a set of start and end events
- Provides a time interval

02 Run analysis

• Find timelines where the deadline is missed

03 Filter

ABBYY

• Filter for timelines that miss the deadline

· · · · · ·	New	Open	Save	Save as
art on events		Expect e	vents	
		Calastan	ionto 1	
elect events If multiple, use: fi	irst one \vee	Select ev	ents	
Triage Started	irst one \vee	Triage	Completed	
Triage Started	irst one \vee	W Triage	Completed	
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eaclect events If multiple, use: 1 Triage Started eadline is defined by Time interval Cutoff time	irst one \vee	Select ev	Completed	

Result

1666 timelines 7.10% missed the deadline

Deadline prediction

Predict deadline issues in a process

01 Deadline interval

- User selects a set of start and end events
- Provides a time interval

02 Training

- NN inputs:
 - Event sequences
 - Timestamps

03 Prediction

• Based on existing events, predict the distribution of the arrival time of the end event





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Task Mining







Analysis, automation

- Fill the gaps in process data (there is a 30 minutes gap, what happened?)
- Robotic Process Automation
- Workforce optimization







Task Mining methodology



Task Definition

• Find task instances

1 Start

- Form
- Control

2 End

- Form
- Control

3 What's included

- Automatic
- Manual

ABBYY

lask editor	Formeditor				Log ID 1	II ← 1/5 → All logs				
6 Q			FedEx	StudioTax	New task	Control properties				
1:08:50 🧿	[ChangeElement] Recipient's Zip	*1	4			▼ Control attributes				
1:08:55 🕅	[FocusWindow] FedEx.docx - Word	R			1	Event name: FedEx Ship Manager™ Lite				
1:08:58 🕅	[Copy] FedEx.docx	-				Event value:				
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• Overview

1 Automation candidates

- Cost
- Complexity

2 Candidates distribution

- Complexity
- Gain

ABBYY

3 Executive summary

• Time and money to be saved

Tackview x								
roject details	Automation candidates							
oject creation Wed May 04 2022	Task	Count	Coverage	Events avg	Complexity	Apps	\$ Saved	Linked processes
ogs	 Registration Form 	2	14.232 %	19	0.489	6	188	- 0
vents total 267	Expense Report	3	14.232 %	13	0.416	4	441	1 👄
oject logs	 Registration Form BP 	1	3.745 %	10	0.570	4	216	- Θ
orms	Booking.com	3	19.850 %	18	0.532	4	249	- 🕀
lect screenshots to move between rms	Contact Sales OCR SDK	1	4.494 %	12	0.567	3	76	- 😁
rm editor	Procurement	1	6.367 %	17	0.500	2	113	- ©
sks 6 stances 11 sk definition	Candidates distribution				Executive summary			
sks with fixed cost 6 sks without cost info					We analyzed 4 logs with	267 events, found 6 t	asks that can save	0.000162 hours a month.
ist definition	0.6 -				Now 0.23 hrs →	With au 0.23	tomation hrs	Time saved 0.00 hrs
	- 0.0 - Complexity				Time spent anal	ysis		
	0.45 -				0 \$ →	With au -1K \$	tomation	Money saved 1K \$
	0.4							

Time-spent analysis

• Time spent

• In apps

ABBYY

• On forms

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Task schema

- App level
- Form level

ABBYY

• Command level



Path analysis

• Iterations between forms





Path analysis

• Schema of different permutations







Robotic Process Automation

- Identify the best automation candidate
- Export
 - PDD (Process Definition Document)
 - BluePrism Capture file
 - BPMN -- Chorus BPMN



Simulation







What-if analysis

- Help understanding the effect of changes
- Cheap experimentation
 - Change the process
 - Change the timings
 - Change the resources



Simulation

- **Behvaior mining** •
 - Schema
 - Forking distribution
 - Processing-time distribution
 - Arrival-time distribution
 - Resources

ABBYY



		Filtering tools	٩	٩	Ø	«
Node: Processor Assigned						×
ゲ Incoming transitions						
Resource demand						
Resource type						
Select one 🔻						
From: Coverage Confirmed	From: Reserves Established					
0 3 months	0 47.5 hrs					
Multiplier 1 AVG 28 hrs	Multiplier 1 AVG 5 hrs					

32K

Ō.

M Outgoing transitions

All timelines

32K

Current

- Fork distribution
- Edit numbers to specify fork distribution
- 17.15 % Reserves Established
- 42,75 % Fraud Check
- 40,1 % Appraiser Assigned



Simulation

Results

ABBYY

- Simulation results
- Mined stats
- Current set stats



								Filtering tool	5 Q Q 🕅
Configuration Results								1. Export as C	SV 📑 Delete
Compare with ☑	with min	ed set Compare v	vith current set					C	Clear compariso
 demo ms Mined set 									
Process Milestones Trans	sitions	Resources							
		Cou	unt		Du	iration			
Туре		Timelines	Events	Min	Max	Avg	Total	Cost	
First Notification of Loss	1	31,500	31,500	0	0	0	0	311,220	
	ms	28,160	29,979	0	38 h	11 m	7 mo	296,192.52	
🎸 Coverage Confirmed	1	31,500	31,500	0	19 h	59 m	3у	0	
	ms	29,924	31,111	0	7 d	2 h	10 y	0	
28 Reserves Established	1	17,695	21,361	0	47.5 h	2 h	5 y	718,584.04	
	ms	18,277	18,277	0	6 d	7 h	16 y	614,838.28	
Processor Assigned	1	24,188	29,174	0	20 d	2 h	8 y	0	
	ms	27,532	27,532	0	3 mo	12 h	40 y	0	
🚱 Fraud Check	1	12,644	12,644	0	34 h	85 m	2у	0	
	ms	14,407	16,415	0	7 d	8 h	15 y	0	
Appraiser Assigned	1	24,134	28,311	0	27 d	3 h	12 y	0	
	ms	23,170	23,170	0	3 mo	16 h	44 y	0	
Adjuster Assigned	1	23,689	27,731	0	3 d	2 h	7 y	178,587.64	
	ms	27,005	27,005	0	10 d	9 h	28 y	173,912.2	
📕 Setup Diary	1	22,063	22,063	0	47.5 h	2 h	5 y	0	
	ms	25,830	25,830	0	6 d	7 h	23 y	0	
16 Initial Review Completed	1	23,845	23,845	0	2 d	5 h	14 y	0	
	ms	18,243	18,382	0	8 d	18 h	38 y	0	
13 Estimate Prepared	1	25,661	25,661	0	3 d	9 h	26 y	0	
	ms	15,126	15,126	0	11 d	25 h	44 y	0	
Record Notes	1	25,661	25,661	0	7 d	18 h	52 y	0	
	ms	16,456	16,456	0	27 d	2 d	106 y	0	
	-			0	15 d	9 h	35 V	0	
a Claim Closed	0	31,500	31,500	0	150	511	00)	0	

Thank you

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tamas.mahr@abbyy.com



November 30, 2023

Software Technology











Array of arrays

column1 column2 column3 column4 column5 column6 column7 column8 column9 column10

string	string	date	string	number	number	string	string	date	number
string	string	date	string	number	number	string	string	date	number
string	string	date	string	number	number	string	string	date	number
string	string	date	string	number	number	string	string	date	number
string	string	date	string	number	number	string	string	date	number



Arrays of events

id	event	time	attr1	attr2	attr3	attr4	attr5	attr6	attr7
string	int16	date	string	number	number	string	string	date	number
string	int16	date	string	number	number	string	string	date	number
string	int16	date	string	number	number	string	string	date	number
string	int16	date	string	number	number	string	string	date	number
string	int16	date	string	number	number	string	string	date	number



Array of events

	event	time	attr1	attr2	attr3	attr4	attr5	attr6	attr7
0	int16	date	string	number	number	string	string	date	number
1	int16	date	string	number	number	string	string	date	number
2	int16	date	string	number	number	string	string	date	number



ByteArray + values

				- i						
	event	time1	time2	attr1	attr2	attr3	attr4	attr5	attr6	attr7
			-			I				
0	int16	int16	int16	int16	int16	int16	int16	int16	int16	int16 -
		_				1				
1	int16	int16	int16	int16	int16	int16	int16	int16	int16	int16 -
				I		I				
				l.		-				
values	Null	value1	value2	value3	value4	value5	value6	value7	value8	value9



Columnar format

Store each column as a separate byte array

01 Timeline index

- Timeline start indexes
- Timeline lengths

02 Attribute column

• Use the number of bytes enough to store all values

03 Null values

ABBYY

• Use a separate byte array as Boolean flags



Categorical values

Use separate value arrays to store categorical and string values

01 Categorical numbers

- Short byte array of long values
- Long byte array of short values

02 String columns

ABBY

- One long string array partitioned by columns
- Byte array with appropriate long elements
- Offset array to show the start of attribute X in the string array

