WEBINAR - AI IN AVIATION

Solutions powered by CAST - Simulation-based real time demand prediction for better airport resource planning

5TH OF APRIL 2022

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AGENDA

- Introduction of ARC and CAST
- Introduction CAST Solutions
  - Business requirements
  - Approach with CAST
  - Main Features
  - Use-Cases
- Q&A

ARC | COMPANY

BASED IN AACHEN, GERMANY

SPECIALIZED IN AIRPORT CONSULTANCY AND AVIATION SOFTWARE

+ 20 years experience in aviation industry

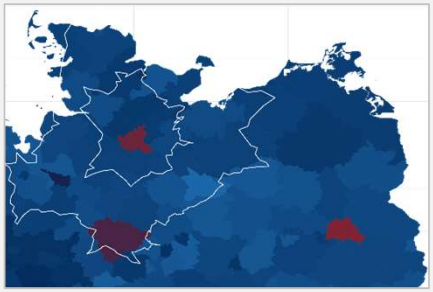
+ 40 experts for airport planning and optimization

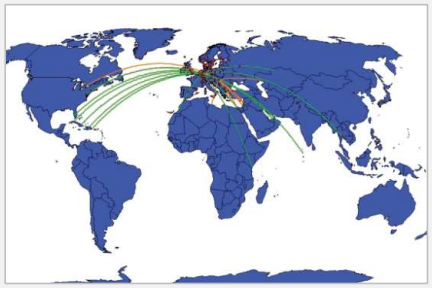
+ 150 worldwide aviation clients

DEVELOPER AND DISTRIBUTOR OF CAST

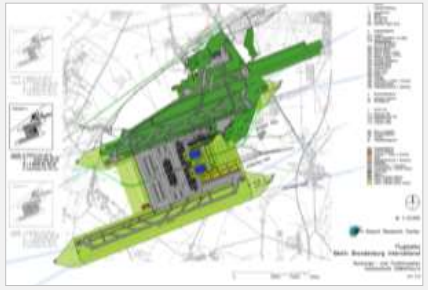
ARC | COMPANY

MARKET ANALYSIS & FORECAST

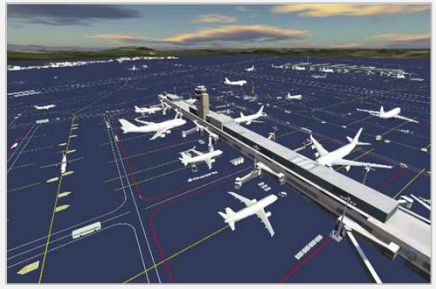




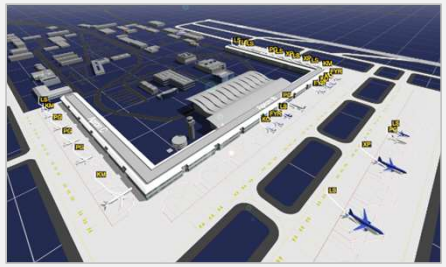
MASTERPLANNING



CAPACITY PLANNING & SIMULATION



CAST DEVELOPMENT



CAST

CAST | SCOPE

CAST TERMINAL SIMULATION

CAST EXPRESS SIMULATION

CAST AIRCRAFT SIMULATION

CAST STAND & GATE ALLOCATION

CAST VEHICLE GROUND HANDLING

CAST VEHICLE LANDSIDE

Terminal

Air|Airside

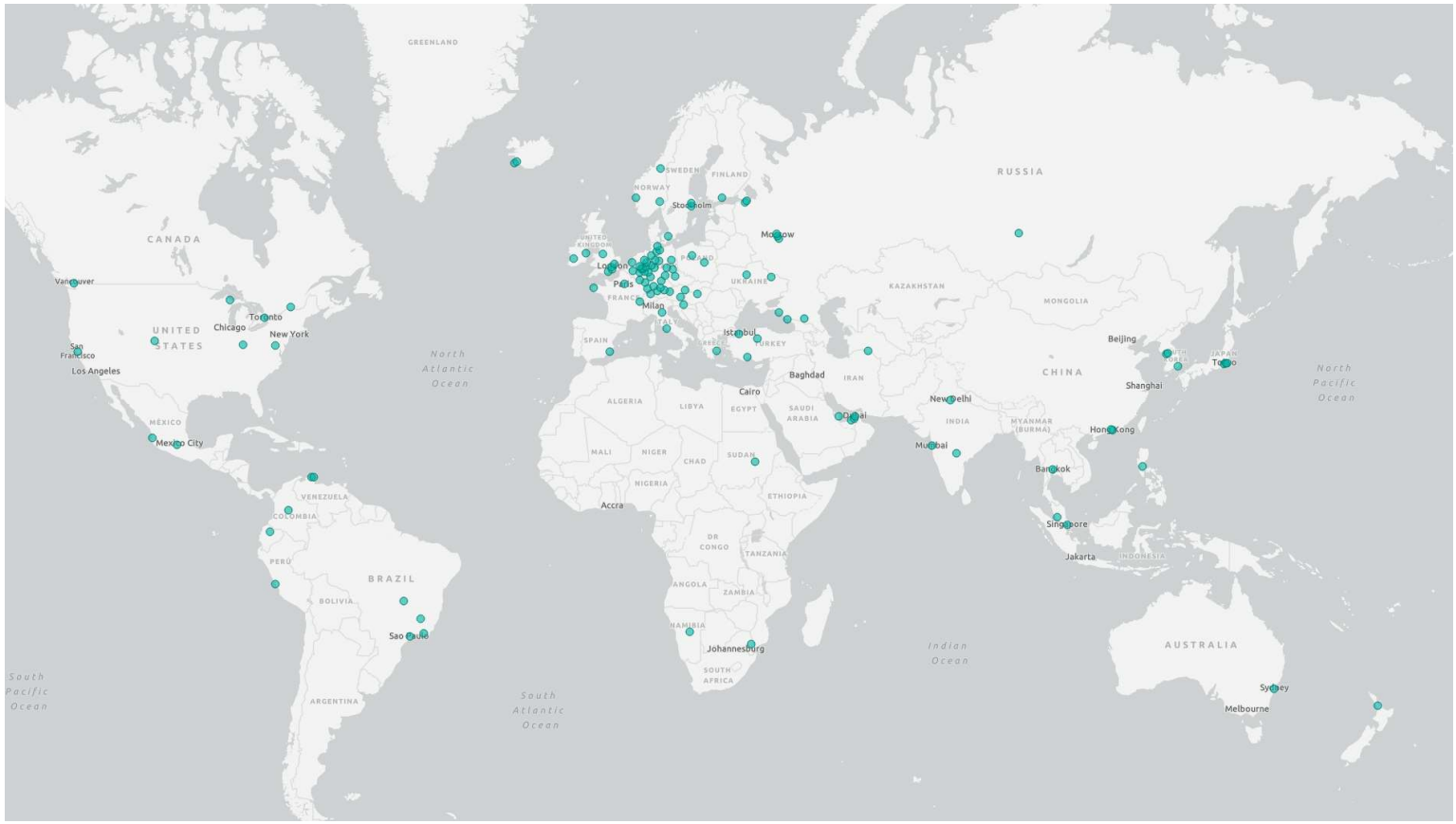
Ground Handling

Landside

Real Time / Operational → Pre-Operational → Tactical → Strategic

SELECTED REFERENCES

- SINCE 1999:
  - > 200 CLIENTS
  - > 100 PROJECT AIRPORTS
  - > 700 PROJECTS
  - > 80 CAST CLIENTS
- AIRPORTS RANGE FROM <500K PAX/YEAR TO 90MILL PAX/YEAR



CAST SOLUTIONS

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CAST SOLUTIONS

BUSINESS PROBLEM

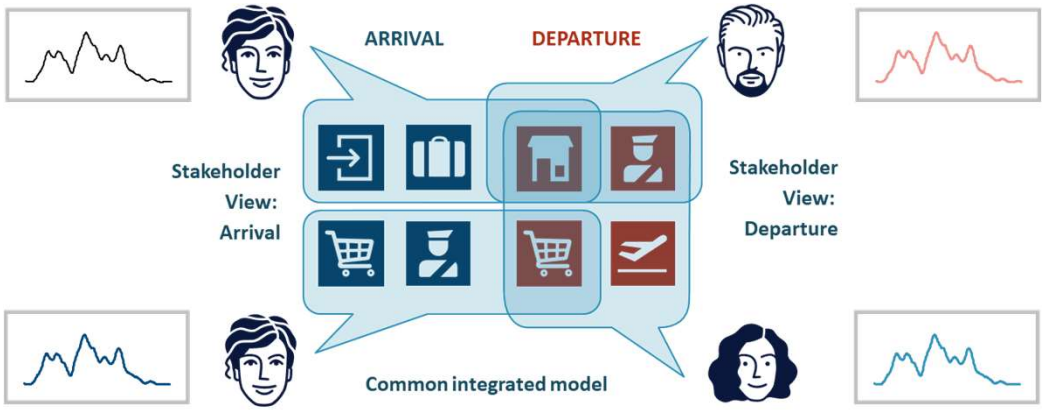
AIRPORT TERMINALS HAVE MULTIPLE PROCESSES, STAKEHOLDERS, DATA SOURCES, DATA QUALITIES, BUSINESS RULES AND MOST OF THEM DO NOT INTERACT WITH EACH OTHER.

THE AIRPORT (TERMINAL) OPERATOR HAS NO KNOWLEDGE OF ALL THE DIFFERENT BUSINESSES TAKING PLACE AND DIFFICULTIES OVERSEEING THE EFFECTS OF CHANGES IN PLANNING AND OPERATIONS

CAST SOLUTIONS

HOW TO SUPPORT?

PROVIDING ALL STAKEHOLDERS WITH THE SAME INFORMATION, SHARING PLANNING RESULTS AND CONSIDERING THE EFFECTS OF PLANNING FOR OTHER PROCESSES / STAKEHOLDERS

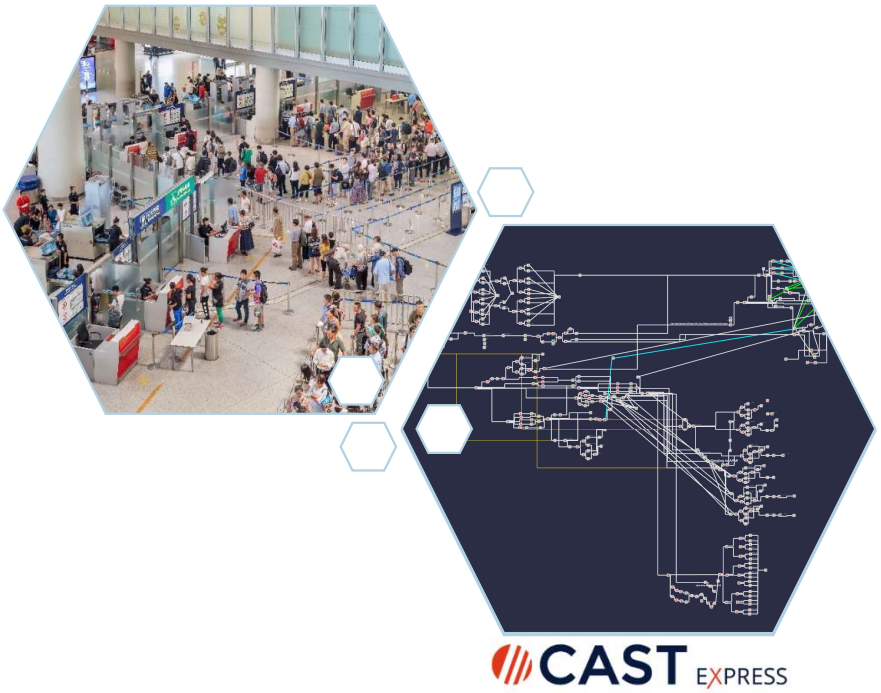


CAST SOLUTIONS

CREATING A DIGITAL TWIN

A DIGITAL TWIN IS A VIRTUAL REPRESENTATION THAT SERVES AS THE REAL-TIME DIGITAL COUNTERPART OF A PHYSICAL OBJECT OR PROCESS.

- TO PROVIDE THE FULL IMAGE OF ALL INTERLINKED PROCESSES → **CAST EXPRESS**
- INTEGRATING THE AVAILABLE DATA-SOURCES TO ENSURE THE MOST ACCURATE VIEW ON THE PROCESSES → **BIG DATA ANALYSIS**



CAST MODULES AND FEATURES SUPPORTING THE DIGITAL TWIN?

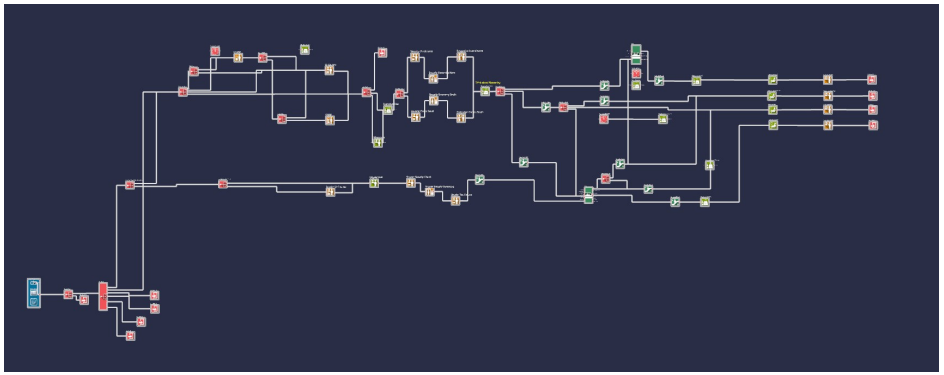
- THE SIMULATION MODEL
- INTERFACES / INTEGRATION TO OTHER SYSTEMS
- DATA PROCESSING
- ANALYSIS AND REPORTING

CAST SOLUTIONS

THE SIMULATION MODEL

USING CAST EXPRESS

- TO SIMULATE ALL TERMINAL PROCESSES
- INCLUDING ALLOCATION LOGICS FOR CHECK-IN, BAGGAGE RECLAIM BELTS, GATES
- WITH FACILITY REQUIREMENT LOGICS SUPPORTING LANE PLANNING
- WITH QUICKER SIMULATION PERFORMANCE

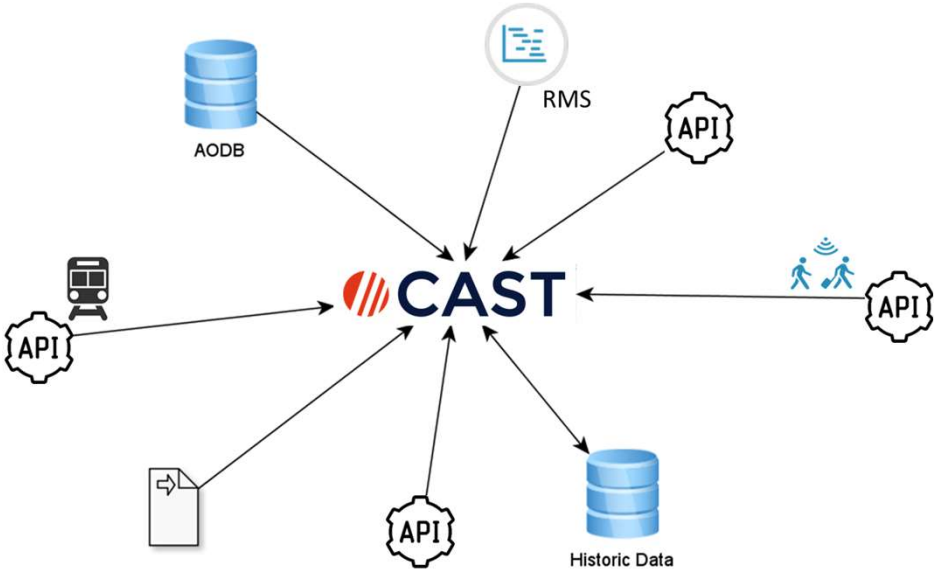


CAST SOLUTIONS

INTEGRATION OF EXTERNAL (REAL-TIME) DATA SOURCES

CAST ALLOWS THE INTEGRATION OF EXTERNAL DATA SOURCES

- AODB OR OTHER FLIGHT SCHEDULE SOURCES
- RESOURCE MANAGEMENT SYSTEMS
- OTHER OPERATIONAL SYSTEMS
- DATABASES WITH HISTORIC DATA
- (REAL-TIME) PASSENGER MONITORING INFORMATION



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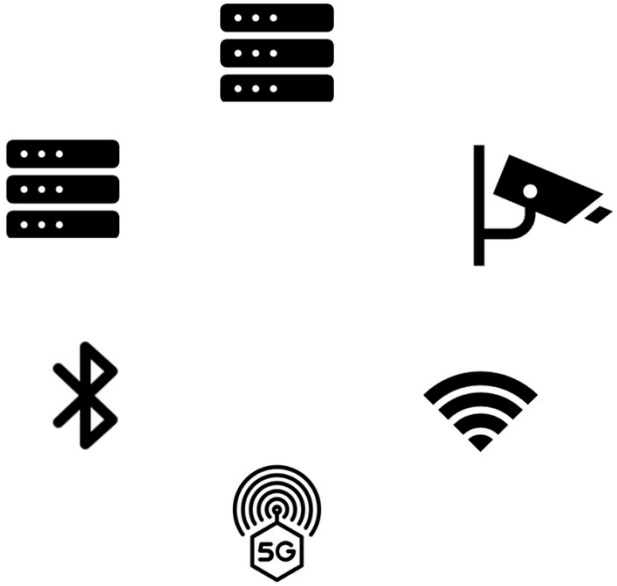
DATA PROCESSING

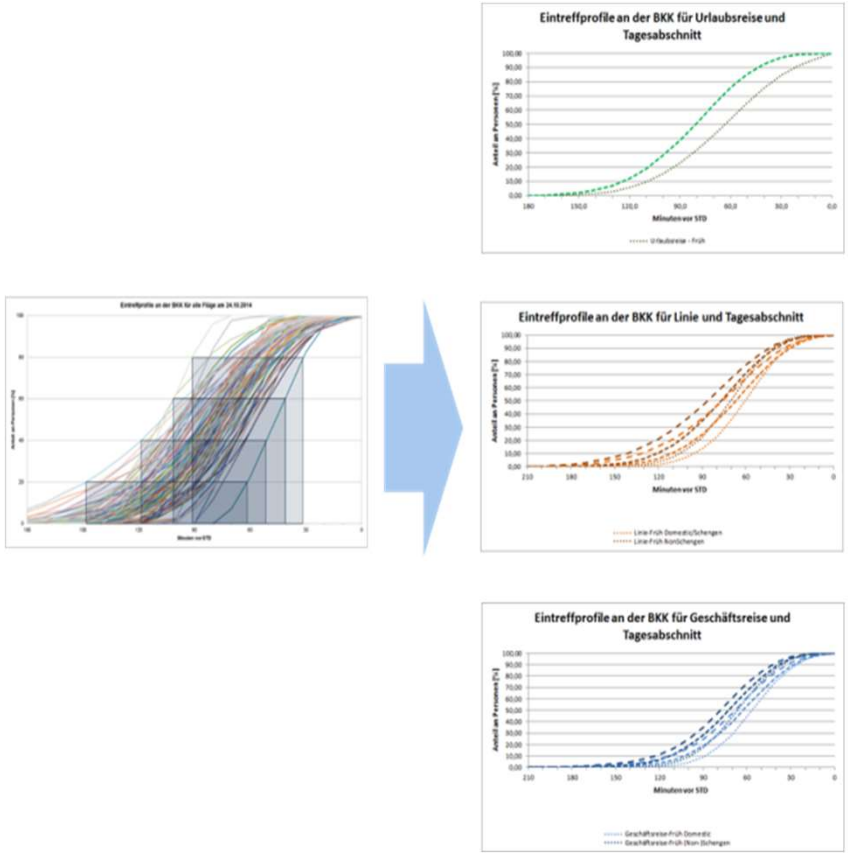
- FLIGHT SCHEDULE INFORMATION (PASSENGER LOADS)
- PASSENGER BEHAVIOR (SHOW-UP TIMES, FACILITY USAGE, ROUTING ETC.)



CAST SOLUTIONS

EXAMPLE FOR DATA PROCESSING

- **ENRICHMENT**: PREDICTING PASSENGER LOADS, TRANSFER SHARES, SHOW-UP PROFILES
- SHOW-UP PROFILES
  - Data collection through Boarding pass scan
  - Clustering data according to flight profiles
  - Development of “passenger behavior profiles”



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DATA PROCESSING

PROVIDING RESULTS TO STAKEHOLDERS

CAST SOLUTIONS

PROVIDING RESULTS TO STAKEHOLDERS

CAST RESULT PRESENTATION BY

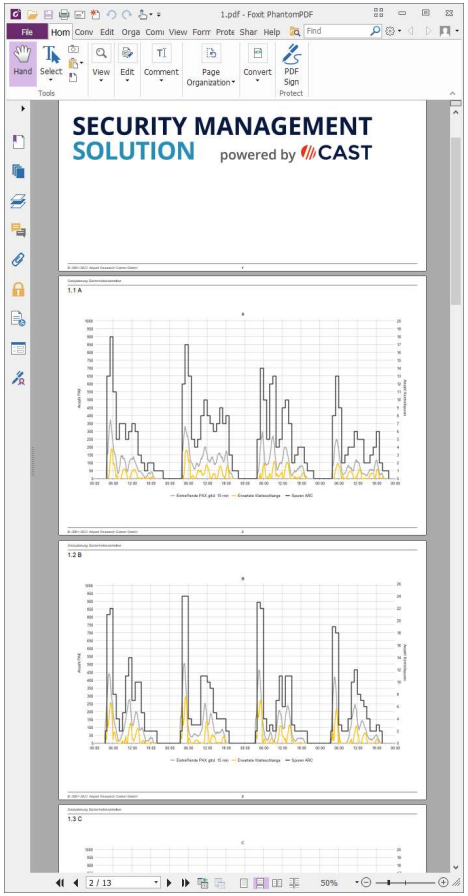
- **DASHBOARDS WITH CHARTS AND TABLES**

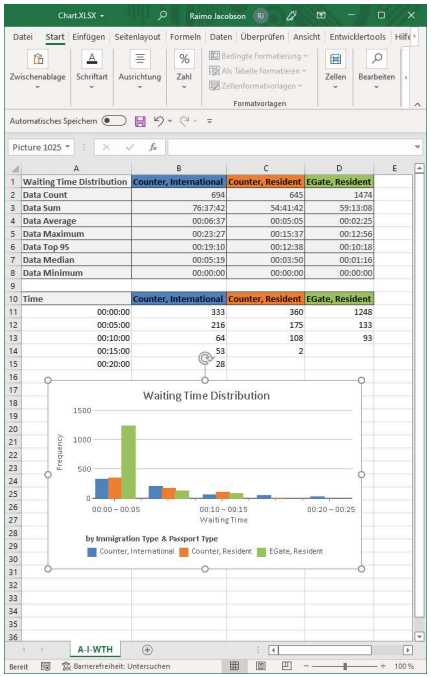
CAST SOLUTIONS

PROVIDING RESULTS TO STAKEHOLDERS

CAST RESULT PRESENTATION BY

- DASHBOARDS WITH CHARTS AND TABLES
- **CUSTOMIZED REPORTS**





Waiting Time Distribution	Counter, International	Counter, Resident	EGate, Resident
Data Count	694	645	1474
Data Sum	76:37:42	54:41:42	59:13:08
Data Average	00:06:37	00:05:05	00:02:25
Data Maximum	00:23:27	00:15:37	00:12:56
Data Top 95	00:19:10	00:12:38	00:10:18
Data Median	00:05:19	00:03:50	00:01:16
Data Minimum	00:00:00	00:00:00	00:00:00

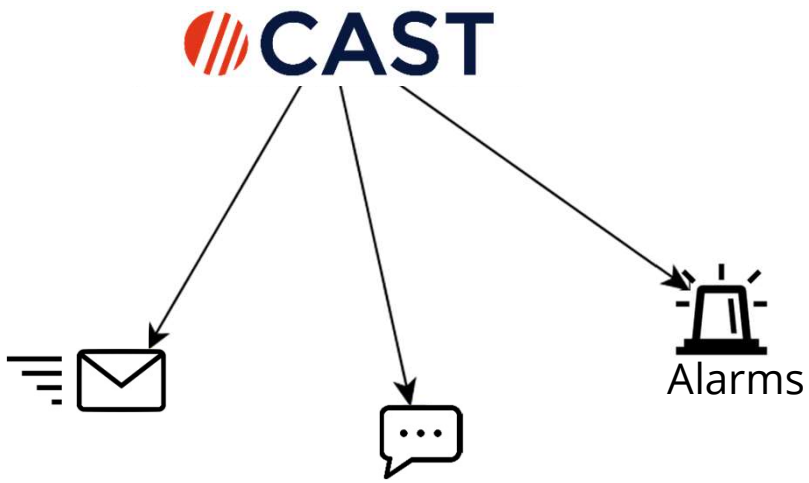
Time	Counter, International	Counter, Resident	EGate, Resident
00:00:00	333	360	1248
00:05:00	216	175	133
00:10:00	64	108	93
00:15:00	53	2	
00:20:00	28		

CAST SOLUTIONS

PROVIDING RESULTS TO STAKEHOLDERS

CAST RESULT PRESENTATION BY

- DASHBOARDS WITH CHARTS AND TABLES
- CUSTOMIZED REPORTS
- **NOTIFICATION OF USERS IN CASE THRESHOLDS ARE EXCEEDED**

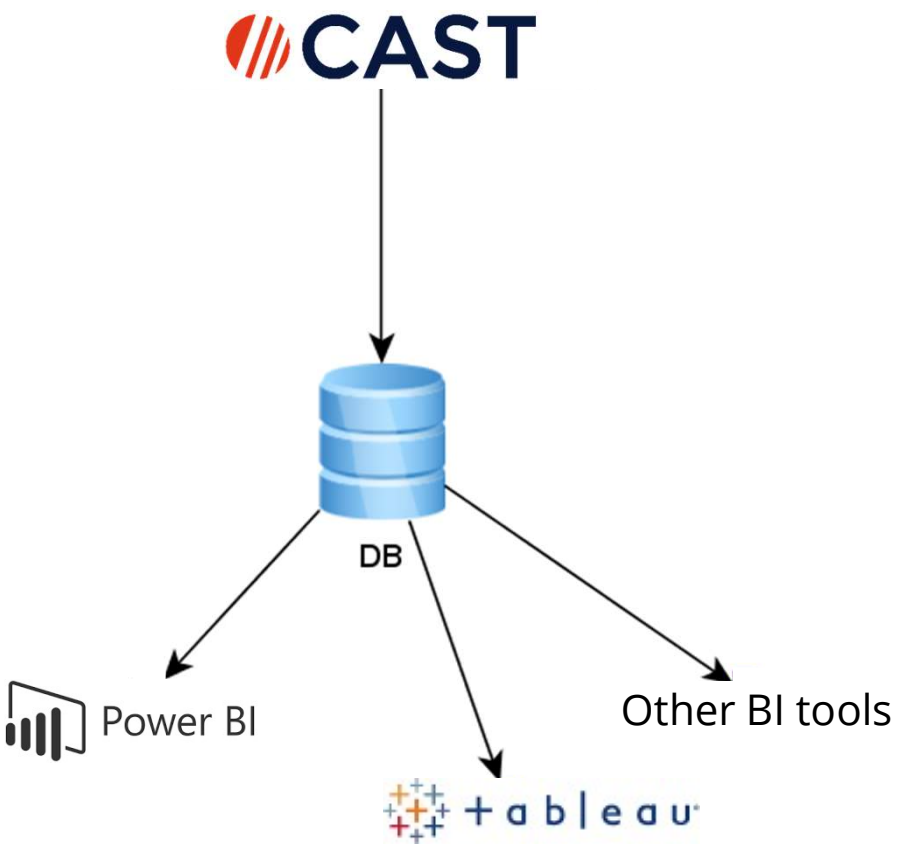


CAST SOLUTIONS

PROVIDING RESULTS TO STAKEHOLDERS

CAST RESULT PRESENTATION BY

- DASHBOARDS WITH CHARTS AND TABLES
- CUSTOMIZED REPORTS
- NOTIFICATION OF USERS IN CASE THRESHOLDS ARE EXCEEDED
- **SHARING RESULTS WITH OTHER SYSTEMS (SAVE TO DATABASES)**

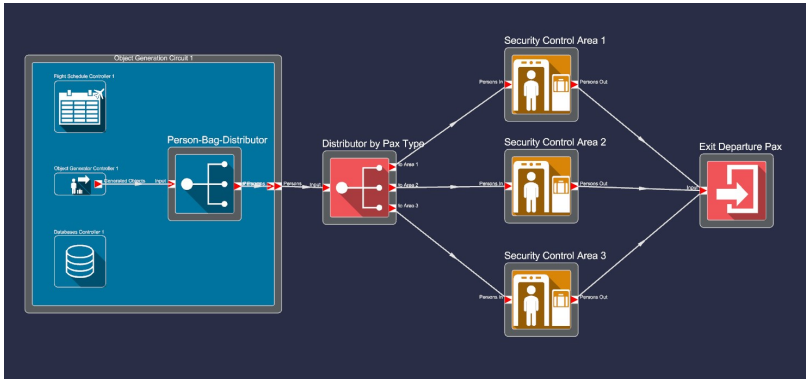


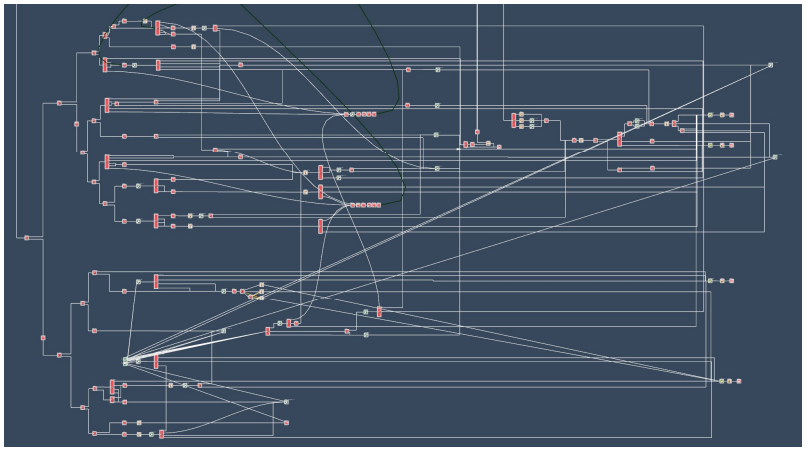
FURTHER FEATURES OF CAST SOLUTIONS

CAST SOLUTIONS

FURTHER FEATURES OF CAST SOLUTIONS

- **SCALABLE**: STEP-BY-STEP DEVELOPING THE SCOPE OF PROCESSES

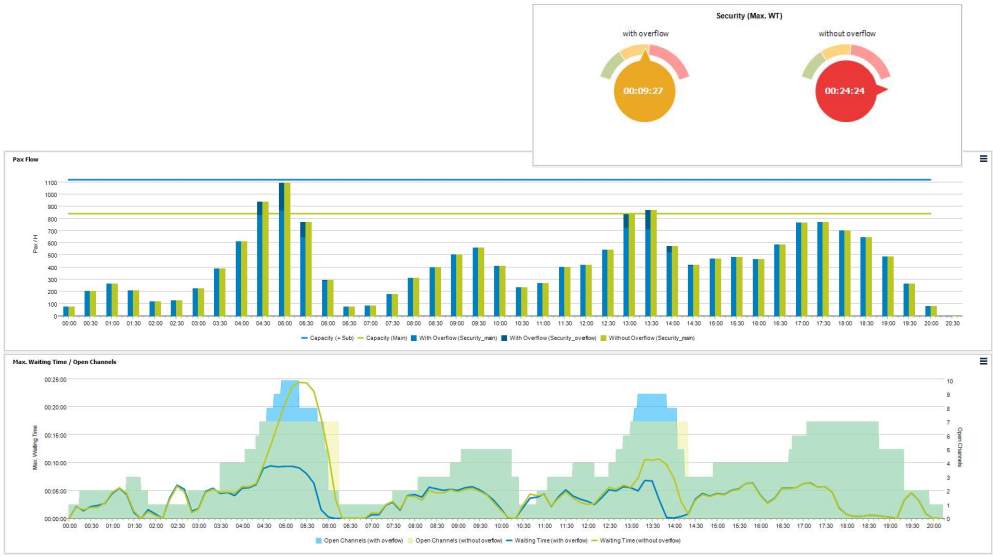




CAST SOLUTIONS

FURTHER FEATURES OF CAST SOLUTIONS

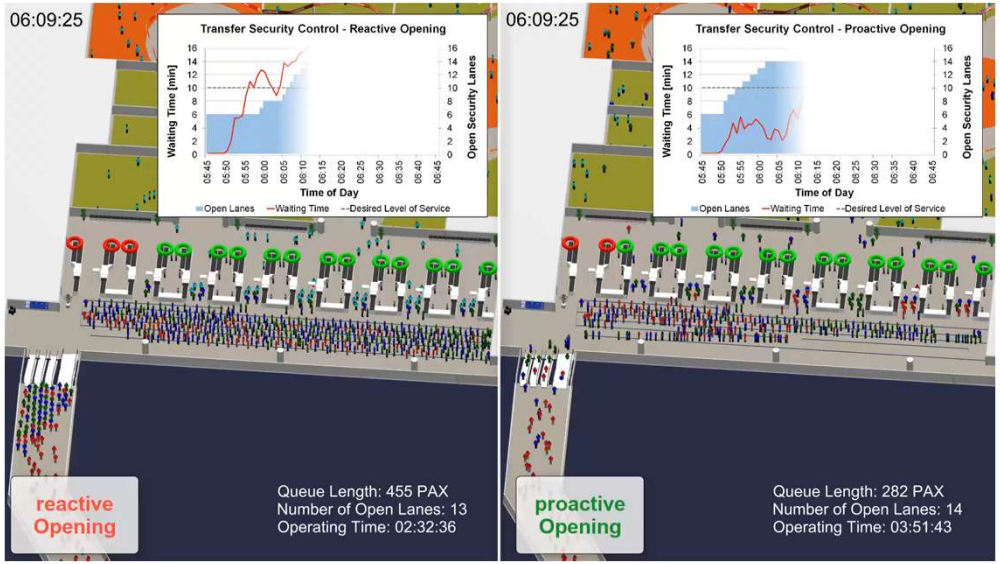
- SCALABLE: STEP-BY-STEP DEVELOPING THE SCOPE OF PROCESSES
- **“WHAT-IF”** TO TEST DIFFERENT OPERATIONAL SCENARIOS



CAST SOLUTIONS

FURTHER FEATURES OF CAST SOLUTIONS

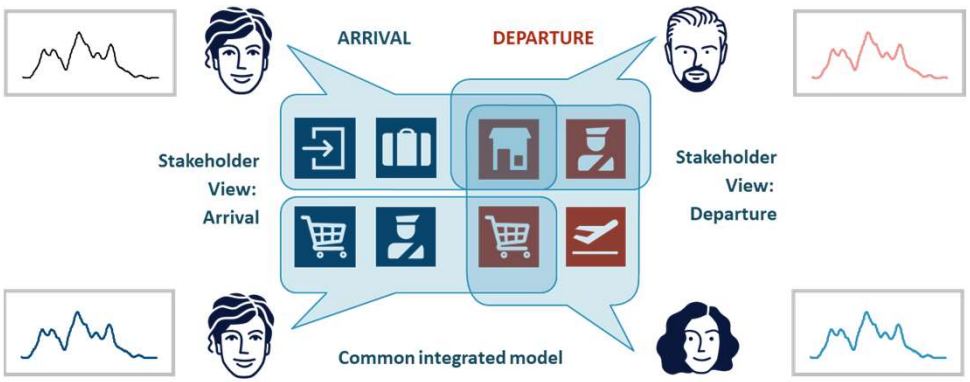
- SCALABLE: STEP-BY-STEP DEVELOPING THE SCOPE OF PROCESSES
- “WHAT-IF” TO TEST DIFFERENT OPERATIONAL SCENARIOS
- **SMART FACILITY REQUIREMENT** LOGIC TO OPTIMIZE LANE PLANNING



CAST SOLUTIONS

FURTHER FEATURES OF CAST SOLUTIONS

- SCALABLE: STEP-BY-STEP DEVELOPING THE SCOPE OF PROCESSES
- “WHAT-IF” TO TEST DIFFERENT OPERATIONAL SCENARIOS
- SMART FACILITY REQUIREMENT LOGIC TO OPTIMIZE LANE PLANNING
- **USER MANAGEMENT**



CAST SOLUTIONS

USE CASES

SECURITY MANAGEMENT SOLUTION powered by CAST

The SECURITY MANAGEMENT SOLUTION matches the resource calculation to the precisely predicted passenger demand and optimizes the level of service for passengers all at once. ARC offers this state-of-the-art software solution especially targeted for security checkpoints.

PAX FLOW SOLUTION powered by CAST

The PAX FLOW SOLUTION provides fast-time predictive analysis of airport terminal processes. Integrated to the airport's operation systems, this solution supports the best possible view on the next hours of operations. Thus, airport operators can use and staff resources more efficiently than before.

USE CASE: SECURITY MANAGEMENT SOLUTION

TASKS

- OPTIMIZING THE PLANNING OF SECURITY LANES
- IMPROVE PASSENGER EXPERIENCE BY AVOIDING LONG WAITING TIMES

- FOCUS ON A SINGLE TERMINAL PROCESS
- INTEGRATION OF EXTERNAL DATA SOURCES
- MAKING USE OF SMART FACILITY REQUIREMENT ALGORITHMS
- PREDICTION OF PASSENGER LOADS AND SHOW-UP PROFILES

CAST SOLUTIONS

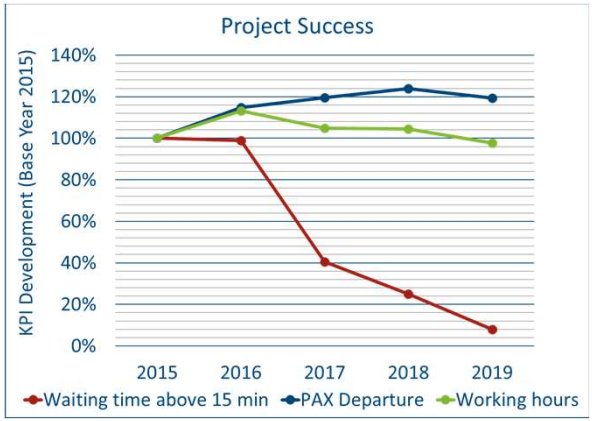
USE CASE: SECURITY MANAGEMENT SOLUTION

SUCCESS STORIES

-60%
waiting times
→ Improved PAX experience

-7%
working hours
→ Higher efficiency

+4%
PAX development
→ Growing PAX demand



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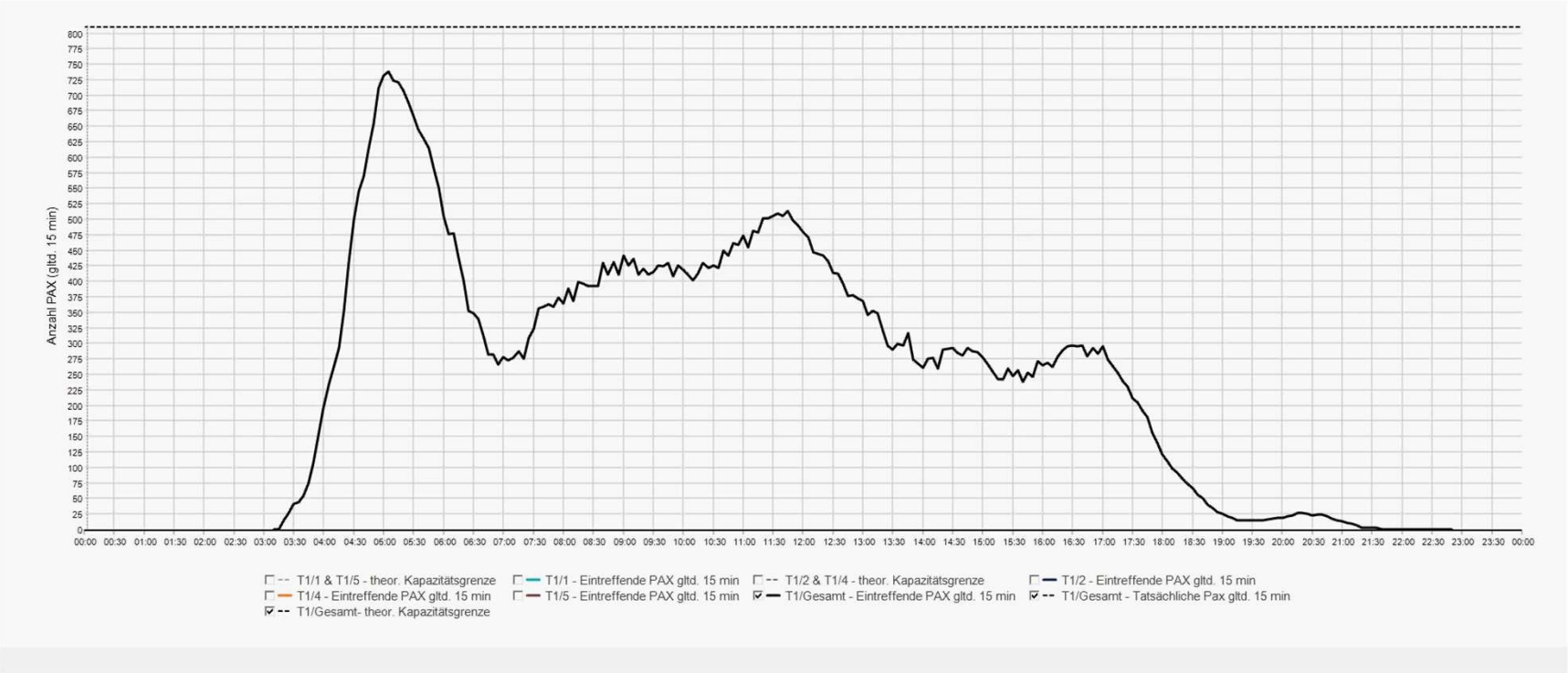
USE CASE: PAX FLOW SOLUTION

- HOLISTIC VIEW ON ALL TERMINAL PROCESSES
- REAL-TIME INTEGRATION OF EXTERNAL DATA SOURCES
- INTEGRATION OF LIVE PASSENGER MONITORING SYSTEMS
- SHARE INFORMATION WITH STAKEHOLDERS
- “WHAT-IF” FUNCTIONALITIES
- PREDICTION OF PASSENGER LOADS, TRANSFER LOADS, SHOW-UP PROFILES

USE CASE: PAX FLOW SOLUTION



ARC | SERVICES

System specification

- Joint system specification together with the airport

System integration

- Full system set-up and integration
- Cloud or on-premises

System configuration

- CAST Express model set-up
- Data analysis and integration
- System calibration
- Set-up of user management
- Analysis and Reporting formats

SUMMARY

Use-Cases

- Optimizing process planning
- Providing situation awareness to all stakeholders
- “What-if” to support the decision-making process
- Supporting all planning time horizons

Impact

- Robust, reliable planning
- Profitability: increase revenue (optimize capacity planning)
- Improve stakeholder involvement (collaborative decision making)

ARC as Partner

- Software and service: licenses, integration and configuration, trainings, support, coaching on demand
- Experienced, industry-approved: hundreds of projects and trainings worldwide

Q&A

Digital Decision Making

AI for Business Operations

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INFORM – Digital Decision Making

AI for better decision-making:
– smart – rapid – interactive

Audi, ABB, Air New Zealand, ALSTOM, AXA, BMW Group, BOSCH, British Airways, Continental, CLAAS, Emirates, Ford, HEIDELBERG, Henkel, HHLA, ING, Leica, Linde Gas, LafargeHolcim, MAN, MTU Aero Engines, MERCK, oerlikon, DIE POST, QANTAS, SAS, Shell, SCHERING, SIEMENS, Deutsche Telekom, thyssenkrupp, UKMail, UNITED, VOITH, VOLKSWAGEN

- **900+ People**
- **1,000+ Clients**
- **40+ Countries**

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Digital Decision Making

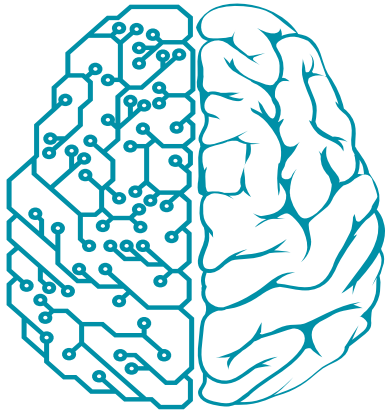
Artificial Intelligence (AI)

optimizing Business Operations

Data Driven AI

Data Analytics
Machine Learning

hidden patterns
self learning



Know-how Driven AI

Mathematical Optimization
Operations Research

expert know-how
agile response

Hybrid A.I.

→ **Productivity**

→ **Resilience**

... streamlining Airport Operations

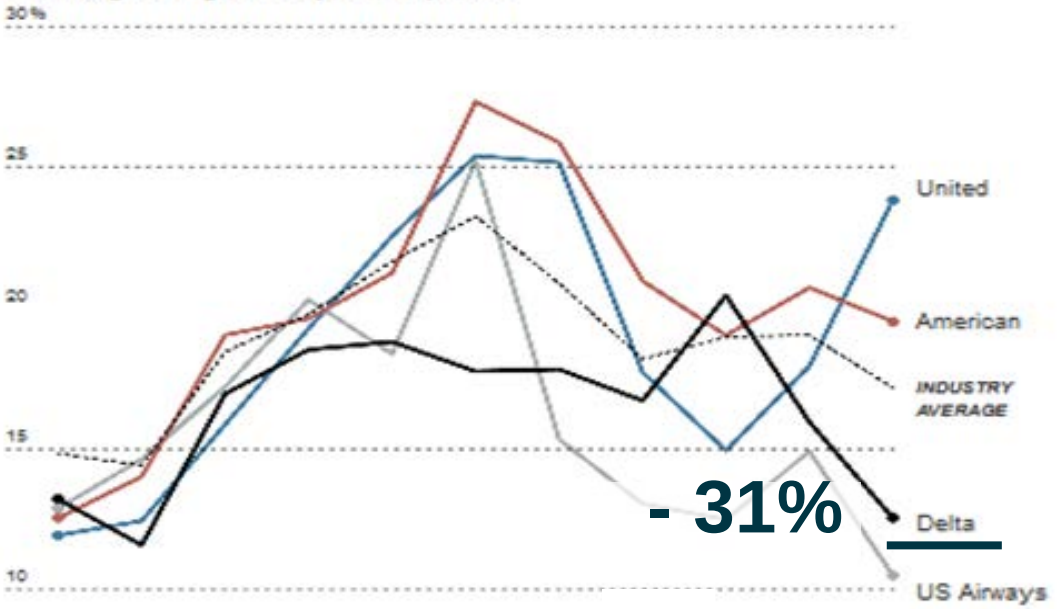
Published: November 20, 2012

Fewer Delayed Flights

The New York Times

By focusing on departing on time — something known in the industry as D zero — airlines have managed to reduce the number of delayed flights in recent years. But these improvements mask some wide discrepancies among carriers. Related Article »

Percentage of flights delayed at departure



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... improving Production Scheduling

Example:

- Manufacturer of machine tool systems
- 280 staff
- Client specific make-to-order production

Results:

- On-time order completion **+ 45%**
- WIP inventories / Working Capital **- 60%**

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... optimizing the Supply Chain

Example:

- Inventory Optimization
- Manufacturer of electrical components
- ca. 70,000 part numbers

Results:

- Inventories 15.0 Mio € → 12.7 Mio €
- ROI = **2.3 Million €** (ca. 15%)

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Digital Decision Making

boosting

Business Resilience

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Example:

Workshop Scheduling

Supplies unexpectedly delayed

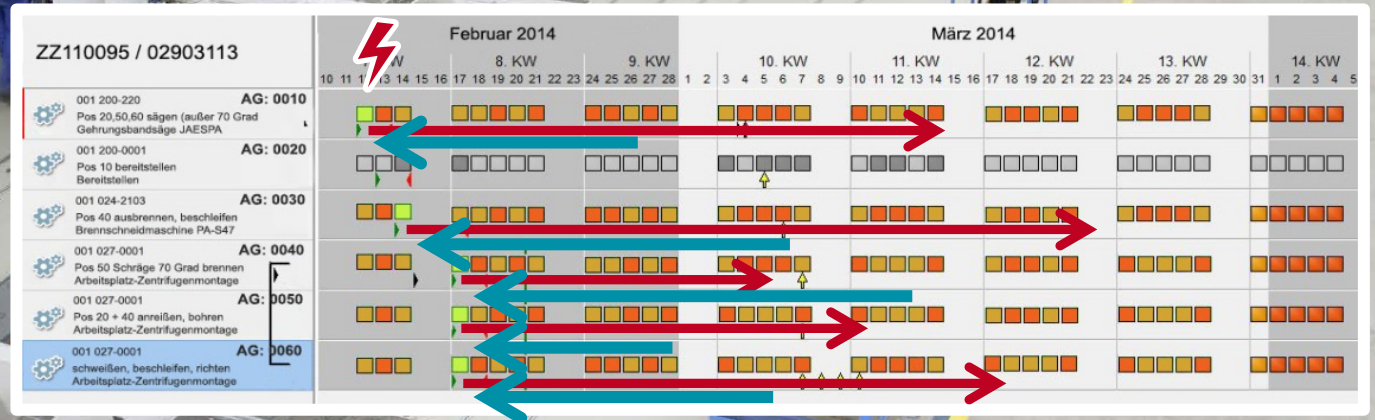
→ Workshop tasks delayed →

→ Free capacity slots

Digital Decision Making

= smart(!) task selection to fill slots

→ mitigating impact of micro disruptions



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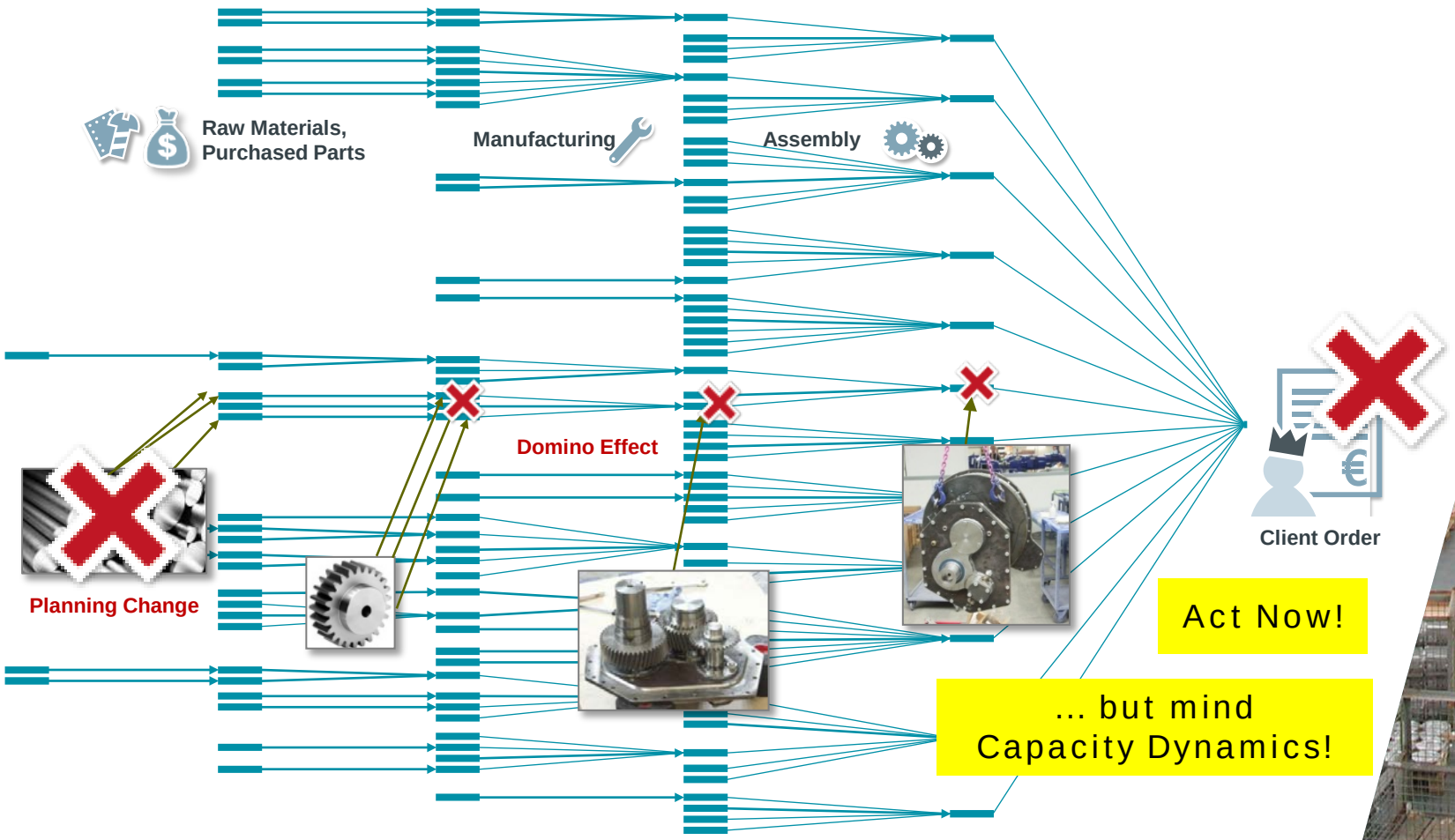
Example: Make-To-Order Production



Act Now!

... but mind
Capacity Dynamics!

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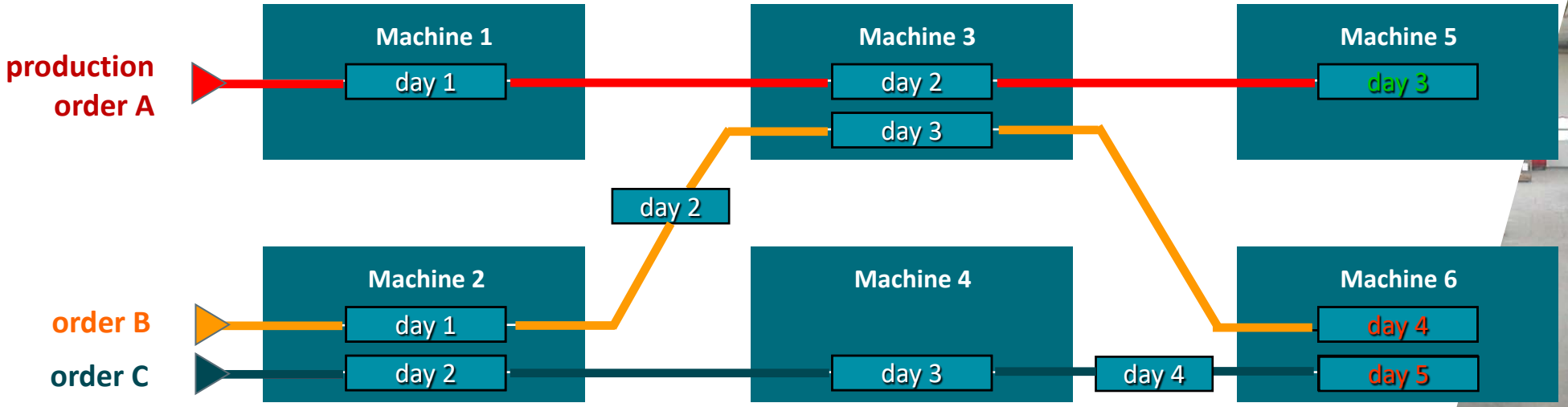
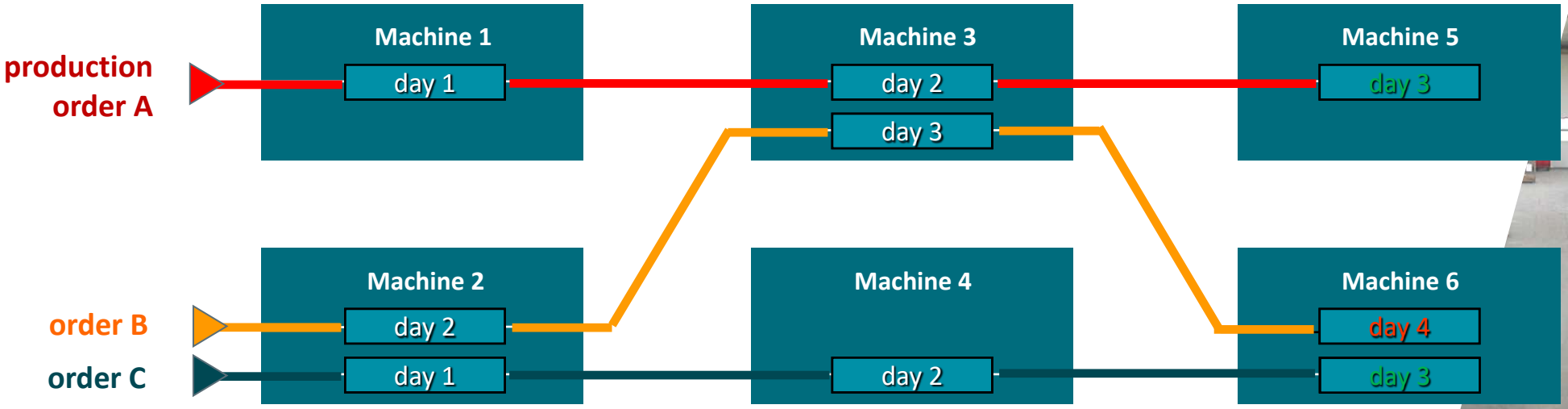
Traditional Planning



High priority first !
(sensible choice)

Total delay: 1 + 2 = **3** days

Digital Decision Making



Low priority first! (counter intuitive)

Delay: **3** days → just **1** day

Compared to traditional planning rules

Digital Decision Making … a really big difference!

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Planning Complexity

3 tasks A B C, A C B
B A C, B C A
C A B, C B A → 1 * 2 * 3 = 6 planning options

N tasks → 1 * 2 * ... * N = N! different plans

(just 10 tasks → 3.628.800 different plans)

Complexity + Dynamics → require → **Digital Decision Making**

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Digital Decision Making
... Production Scheduling

Example:

- Manufacturer of micro electronics
- 300 staff
- 3,500 client orders at any time

Results:

- Standard Delivery Cycle **20 → 10** weeks
- On-time deliveries → 88%

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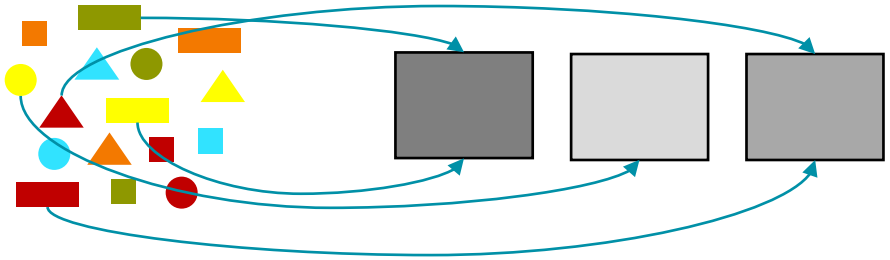
Digital Decision Making
... Batch Optimization

Example:

- Automotive supplier
- Thermal paint finish oven with tray input
- → batch composition matters !



Results:

- Capacity utilization 76% → **98%**
- ROI = **4 Million €** investment avoided

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Digital Decision Making
... Factory Logistics

Example:

– In-plant Transportation
– Fleet of 20 forklifts

Results:

- 100% reliable on-time transportation
- Cost savings **200,000.- € p.a.**

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Digital Decision Making
... Workforce Management

Example:

- Aviation Maintenance (MRO)
- 1,800 staff
- time sensitive 24/7 operations

Results:

- Shift planning efforts **- 97%**
- Legal compliance up to 100%
- Shift roster quality significantly improved

Digital Decision Making
... Aircraft Maintenance

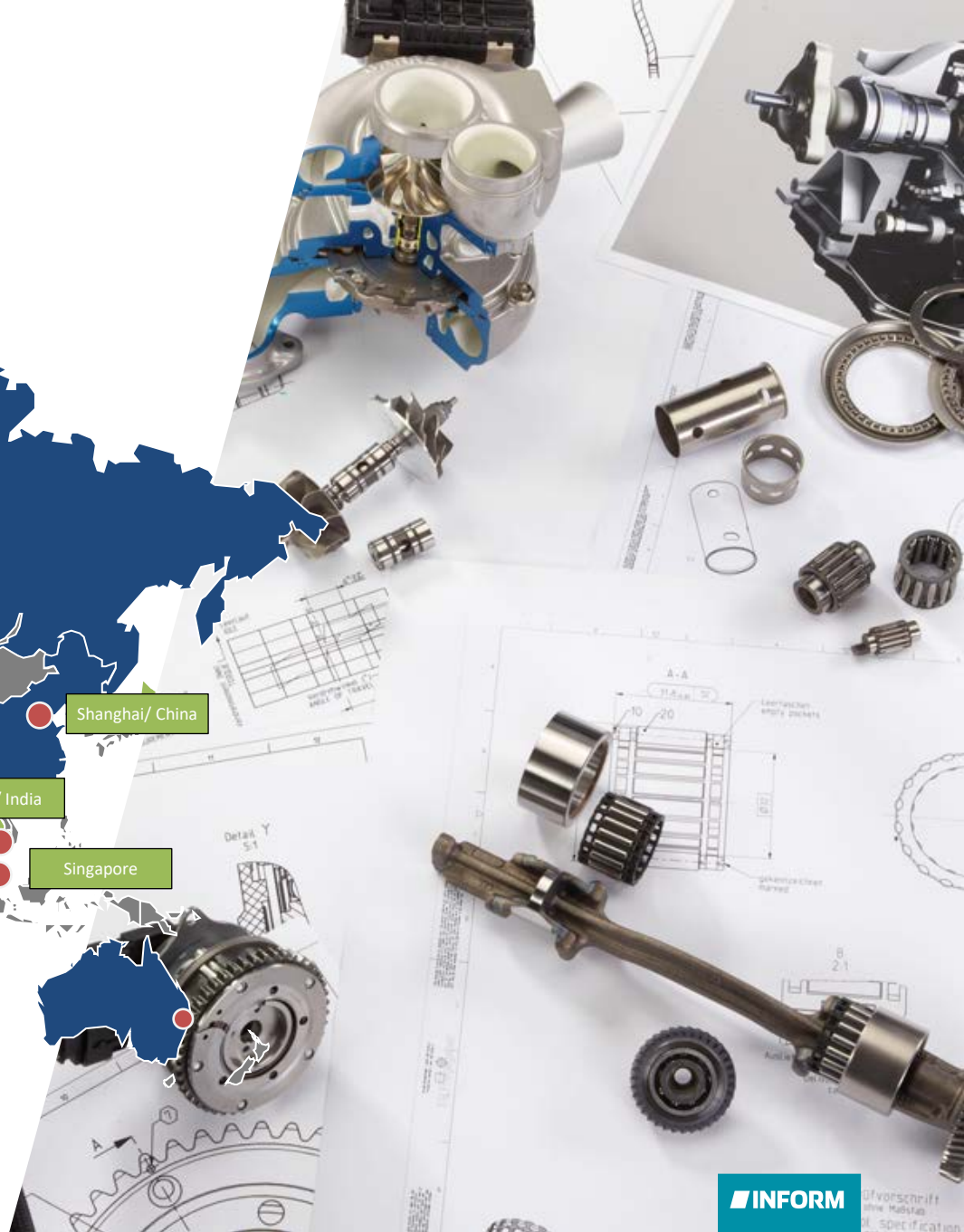
Example:

- Line / hangar maintenance
- with real-time mobile workflows
- scheduling quality matters! (AOG)

Results:

- Reliable on-time performance
- Less open MEL items
- Productivity **+30%**

Digital Decision Making
... Global Parts Logistics



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Digital Decision Making – Summary

Dynamic Business Operations

- ► Production Scheduling
- ► Inventory, Supply Chain Management
- ► Logistics
- ► Maintenance, Spare Parts Distribution
- ► Workforce Management

A.I. Optimization Challenges

— How to smartly **consolidate** certain tasks into batches?

— How to smartly **sequence** multiple tasks?

— How to smartly allocate **capacity** constrained resources?

— How to smartly master time **dynamics** / deadlines?

— How to smartly place / dimension **buffers**?

INFORM

Digital Decision Making – Roadmap

AI Roadmap		IMPACT					FEASIBILITY				
		50%	30%	10%	10%	100%	25%	25%	25%	25%	100%
Use Case (UC)	Impact on	Business Impact	Topicality	Quantifiable Results	Showcase Ability	Total Impact	AI Readyness	Data Availability	Organiz. Readyness	Implement. Time	Total Feasability
Einkauf Rohmaterial	Working Capital	2	4	5	5	3,2	3	5	5	3	4
Simultane Produktionsplanung	Revenue + Costs	5	4	1	2	4	4	3	1	1	2,25
Ersatzteil-Allokation Osteuropa	Costs	5	5	2	3	4,5	4	3	3	3	3,25
Gabelstapleroptimierung	Costs	1	2	5	4	2	5	5	4	5	4,75
Bestandsoptimierung	Working Capital	3	4	4	5	3,6	5	3	4	3	3,75
Engpassbeseitigung Maschinenbelegung	Costs	5	5	4	5	4,9	1	3	1	2	1,75
Behältermanagement	Costs, Working Capital	1	1	2	3	1,3	4	2	4	3	3,25
Produktionsplanung Teilefertigung	On-Time Delivery	5	4	3	3	4,3	5	4	2	1	3

1. Look for AI sweet spots
2. Evaluate impact / costs
3. Identify quick wins
4. Get started! (then learn as you go)