HSPI MANAGEMENT CONSULTING

Process mining:
A DATABASE OF APPLICATIONS

2017 Edition

HSPI Management Consulting

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Process Mining: A Database of Applications 2017

Acknowledgements

The idea of creating the present database of applications came up within HSPI in 2016, during an informal meeting about process mining technology and its spread over several business – and not only – situations .

The *need to collect and put into an ordered document* all of the historical information about every application of process mining techniques that we are aware of, has led to the creation of the very first version of " Process Mining: A Database of Applications".

Thanks to all the Firms, the Universities and Institutions, managers, consultants and the researchers involved.

Introduction

The basic idea of process mining is to **extract knowledge from the event logs** recorded by an information system. Until recently, the information stored into these event logs were rarely used to analyse the underlying processes. Process mining aims at improving the control over business processes by providing techniques and tools for discovering performance, organizational and social related information from event logs.

There are three classes of **process mining techniques**. This classification is based on whether there is a prior model and, if so, how the prior model is used during process mining.

- **Discovery**: Previous models do not exist. A new model is constructed or discovered from an event log based on low-level events.
- **Conformance checking**: There is an a priori model. The existing model is compared with the process event logs and potential discrepancies between the log and the model are analysed.
- **Enhancement**: There is an a priori model. The model is extended with a new aspect or perspective, so that the goal is not to check conformance, but rather to improve the existing model.

Our Purpose

The reason why we are carrying out this research is to create the most complete **list of all the adoptions of process mining techniques** and to collect, directly from who has been involved, basic information about the utilization of this methodology.
The purpose of this study is to create a database of practical cases, no matter the specific industries and the final results, with the only aim of *completeness* and *validity*.

The intended audience includes all those **researchers, data scientists, managers and firms that are willing to implement process mining solutions** or simply **explore business potentials of process mining** in improving business processes or in developing new performance management practices based on real data, extracted from their IT systems.

Therefore, the final goal of this knowledge endeavour still remains the same of the first edition, which is to contribute to **build awareness and confidence about process mining methods**.

Please note that HSPI Management Consulting is a **vendor-independent** company

Scope of the Study

The cases collected and listed come from companies which operate **in very different industries and markets**. Specifically, the present industry categories have been identified:

- Service
- Manufacturing
- Healthcare
- Utilities
- Chemical
- Construction

The Service industry is then divided among several *sub-industries* in order to obtain a further level of categorization of the process mining case studies taken into account. More in depth, the present industry is made of the following sub-industries:

- Banking
- Insurance
- Logistics
- Public Sector
- Technology
- Telecommunications
- Transports
- Retail
- Other

The firms analysed operate in many countries, each characterized by **significant differences and unique aspects in terms of competitive scenarios, political, legal and tax environments**. So far, the most frequent countries are:

- Australia
- Austria
- Belgium
- Denmark
- Finland
- France
- Germany
- Italy
- Netherlands
- US

The projects can be executed under the supervision or technical support of some partners which can be **universities, vendor firms, consulting firms**, etc. The most recurrent players involved in the projects considered are:

- Fluxicon Disco
- Celonis
- Eindhoven University of Technology
- Gradient ECM
- QPR
- Queensland University of Technology

Definition and Parameters

The database consists of some mandatory features (Industry, Organization, Process, Description, Year, Partner) which characterize each of the projects collected:

- "Industry" refers to the specific industry in which the organization operates;
- "Organization" indicates the name of the firm where process mining techniques were adopted;
- " Process" is the specific process - or group of activities - in which process mining was implemented;
- "Description" contains a brief overview of the project: the context, the objectives and results (if present);
- "Year" indicates the year (or months, weeks) in which the project was conducted. If not present, the date was assumed to be the same of the working paper or the conference act in which the case was described for the first time;
- "Partner" refers to the Institution (University, Firm, Research Centre, etc.) that has supported the organization during the project.

The evaluation of sources of information is an important step in any research activity. All the elements collected have been validated by HSPI Process Mining Laboratory taking into account all the working papers, conference acts and relevant evidences, and/or via mail and conference calls with the contacts directly involved into the process mining applications listed.

If you are a Company, a University, or a researcher and you want to report a new application of process mining techniques, please contact us at: *process-mining@hspi.it*

Process Mining Applications

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Public Sector	University of Parma (Italy)	*Student's administrative career & General Accounting mgmt.*	University of Parma, in a very important phase of reviewing and centralizing many of its administrative processes, decided to start a Process Mining Assessment to further investigate his processes. The aim of the project is to assess the organization and the activities performed by different faculties, to map processes, capture differencies, examine performance and implement best practice, with the final target to gain efficiency centralizing and standardizing the best-fit process flow.	*2017*	HSPI Management Consulting (Italy)
Service - Transports	NS Dutch Railways (Netherlands)	*Dataset Analysis*	Analysis of all the datasets with Process Mining demostrated that by waiting a few more days before emptying abandoned station lockers would bring to the company a lot of time and effort saved. In addition, Process Mining let NS noticed that some of the OV bikes that where reported as stolen were actually not stolen at all.	*2017*	Fluxicon (Netherlands)
Service - Insurance	Nationale Nederlanden (Netherlands)	*Transactions analysis*	The company got pushback because results were not always aligned with the viewpoints of all stakeholders. For instance, for one process the operational teams experienced a lot of variation - while IT was managing a Straight Through Process. With process mining, it was ultimately possible to get a deeper understanding of how the process was actually working and to take both perspectives into account. Results: ▪ 225.000 process ID obtained, from 600.000 records; ▪ Straight Through Processing (STP) Rate= 87%; ▪ Non STP processes (#44) could ranked based on % of variants an lead time.	*2017*	Fluxicon (Netherlands)
Service - Insurance	CZ (Netherlands)	*IT Audit*	By using process mining techniques, CZ Health Insurance was able to obtain different results from the traditional approach in the preparation, fieldwork, reporting, and follow-up steps in its audits. Results: ▪ Changes 'out of the blue'; ▪ Quality of work measured; ▪ Automated compliancy.	*2017*	Fluxicon (Netherlands)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Utility	**Essent NC (Netherlands)**	*Credit Management*	Discovering why the firm was losing so much money in the payment collection process: the termination of contracts took too long time to be performed. By visualizing the problem, the company was able to understand the actual root causes. Therefore, process mining proved to be so much more meaningful than just a snake plot and a ping-pong factor.	*2017*	Fluxicon (Netherlands)
Service - Insurance	**VGZ (Netherlands)**	*Dental care process analysis*	Solving of many operational problems much quicker by combining Lean tools with process mining. Using process mining, VGZ was able to visualize the flow of the dental care process within weeks. This directly pointed out bottlenecks and it demostrated that there were long waiting times when the work was handed over from medical advisors to experts and vice-versa. By applying the traditional Lean tools, such as 5x Why, CZ was able to pinpoint the actual root causes. Results: ▪ Reduction of the throughput time by 40%.	*2017*	Fluxicon (Netherlands)
Manufacturing	**Veco (Netherlands)**	*Customer journey analysis*	Obtaining a clear visualization of the journey of the customer. Looking into the visualization, a new product development process was discovered. Instead of only producing a sample, in the new product development process pieces needed to be designed, produced and delivered quickly. By shifting priorities, Veco was able to produce customer samples quicker without impacting the regular production lead times. This allows Veco to grow their business, while keeping up the delivery performance for their existing customers.	*2017*	Fluxicon (Netherlands)
Service - Technology	**SIAV S.p.A. (Italy)**	*Order to Cash, Help Desk*	The company aimed to map Order to Cash process (supported by SAP, Microsoft Dynamics and Siav Archiflow document management system) and Help Desk process (supported by Microsoft Dynamics CRM). The OTC process was particularly challenging, because it involves many different information systems; despite this, a consistent mapping between different identifiers has been found during ETL phase, and consistent end-to-end process instances have been extracted. An internal Process Discovery tool has been used to analyze the processes. The result of the study was a detailed report on the real processes, underlining unexpected behaviour and performance issues, valuable information to develop an improvement plan.	*2017*	SIAV S.p.A. (Italy)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Education	The School of Management (VSM) City University of Seattle (US)	*Paths discovery*	The School of Management (VSM) implemented a modern e-learning platform to facilitate more convenient and personalized form of studying. The application for automated processes analysis Minit was used to compare the utilization of the e-learning platform Moodle by different student groups. The School of Management succeeded in putting in action an individual approach to students, and improving their journey to outstanding academic results. This progressive approach to students brings greater renown to VSM and increases students' interest in attending.	*2017*	GRADIENT ECM (Slovakia)
Service - Telecommunications	Telefónica (Spain)	*IT Service Management*	With logs analysis carried out by process mining techniques Telefonica discovered that the incidents were not registered properly in the trouble ticketing tool, as well as that the internal information/reports could be misleading. Results of the project: ▪ A correct incident recording in the trouble ticketing tool used; ▪ Improvement in the relationships with the interested parties; ▪ Updating and improving of operational reports.	*2017*	Fluxicon (Netherlands)
Service - Banking	Bank 1 (NDA)	*Process Analysis*	▪ Analysis of Mortgage Approval process; ▪ Analysis of communication between frontoffice and backoffice; ▪ Preparation of inbank methodology that organizes work in both front and back office.	*2017*	GRADIENT ECM (Slovakia)
Service - Public	Vysoka skola manazmentu / City University of Seattle programs (Slovakia)	*Compare the utilization of the e-learning platform by different student groups.*	▪ Monitor behavior of Moodle users by visualizing the process map; ▪ Display platform usage in a dynamic animation of the process; ▪ Analyze statistics and metrics of the process and its variants; ▪ Analyze the success of individual online activities, evaluate their attractiveness and replace those with low attendance. The project also led to the creation of ideal study roadmaps for each subject. Minit identified an optimal course of study and time requirements for online activities for prospective students.	*2016*	GRADIENT ECM (Slovakia)
Service - Banking	Bank 2 (NDA)	*Process Analysis*	▪ Analysis of Payment Order Processing process. ▪ Analysis of correction/verification team performance. ▪ Identification of infrastructural problems in the involved bank infrastructure.	*2016*	GRADIENT ECM (Slovakia)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Banking	Bank 3 (NDA)	*Process Analysis*	▪ Analysis of Mortgage Approval process; ▪ Analysis of communication between frontoffice and backoffice; ▪ Prepapration of inbank methodology that organizes work in both front and back office.	*2016*	GRADIENT ECM (Slovakia)
Service - Banking	Financial Institution 1 (NDA)	*Mortgage Approval Process*	▪ Analysis of Mortgage Approval process; ▪ Data preprocessing from 10 internal systems.	*2016*	GRADIENT ECM (Slovakia)
Service - Banking	Financial Institution 2 (NDA)	*Claim Processing*	Analysis of the work load of teams of claim processing team and claim preparation team in order to answer the question: why do the teams need to perform working Saturdays once in a while.	*2016*	GRADIENT ECM (Slovakia)
Service - Technology	One of the biggest online games providers (NDA)	*Compare the utilization of the e-learning platform by different student groups.*	Analysis aimed at monetization in online gaming, trying to answer questions: ▪ What is the behaviour of people leaving the game at a certain moment? ▪ Which people and why buy certain extension packs in the game?	*2016*	GRADIENT ECM (Slovakia)
Service - Logistics	GEFCO (NA)	*Order and Invoice Process management*	The aim of the project was to analyze the existing automated processes in play and based on this analysis, identify bottlenecks overburdened human resources, process variants due to their attributes and in latter cases, propose areas in which could benefit from additional optimizations. Gefco utilized Minit to reveal optimization opportunities in its automated business processes, resulting in 60% productivity increase.	*2016*	GRADIENT ECM (Slovakia)
Service - Technology	IT Service Provider company (Italy)	*Help Desk for Universities*	This case study applied process mining techniques to help desk data collected from the company to expose performance issues. The study involved process discovery and comparison of execution traces associated with various cohorts of customers including (i) requiring assistance, (ii) presenting malfunctioning with their system, and (iii) requiring changes. Results: ▪ Real process map was identified; ▪ Origins of bottlenecks and re-loops were detected; ▪ More transparency about the ticket processes was obtained in order to improve customer orientation of its Service Desk.	*2016*	HSPI Management Consultants (Italy); Queensland University of Technology (Australia)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Public Sector	**Copyright mediator company (Italy)**	*Event Licence Approval*	This case study applied process mining techniques to event licence approval process to expose deviations and performance issues. Specifically, the study involved process discovery of the "as is" model and the conformance checking of the "as is" process to the expected process. Aim of the project: finding out the root of the problem that was affecting company's core processes. Results: ▪ Anomalies and bottlenecks were clearly detected; ▪ Was found that core processes didn't perform well because of the lack of quality data and transparent communications.	*2016*	HSPI Management Consultants (Italy); Queensland University of Technology (Australia)
Manufacturing	**Production Company in a B2B environment (Netherlands)**	*Production Process*	Goal: to reduce throughput time from 3 months to 1 months (later further reduction was anticipated). Process mining was used for: ▪ Analysing bottlenecks, which revealed also unexpected ones; ▪ Measuring “as-is” situation (throughput/waiting time per resource); ▪ Improvements to be performed based on event data were identified.	*2016*	Novo Consilium B.V (Netherlands)
Service - Logistics	**Smart Coat Inc. (Belgium)**	*Logistic*	▪ Real business processes discovery; ▪ Removing unnecessary and divergent process activities; ▪ Benchmarking various departments, plants, products or sales channels; ▪ Identification of the bottlenecks, predicting and preventing process errors; ▪ Visualizing the interactions among the employees; ▪ Reporting the exact cost prices of activities.	*2016*	Horsum - Accelerating technology companies (Belgium)
Service - Telecommunications	**Telefónica (Spain)**	*Digital Operations*	Identification of the sources of delays, inefficient communication patterns, and bad practices such as work orders performed out of the scheduled window. As a result, improvements could be made with measurable effects on both the operation costs and the quality of the services.	*2016*	Fluxicon (Netherlands)
Service - Logistics	**Deutsche Post DHL Group (Germany)**	*Audit*	Integration of process mining into DHL's audit process in order to improve both the time spent for the analysis and the depth of the information audited. ▪ They found that process mining helps to reduce the audit time by 25% in comparison to classical data analytics. In addition, they are now able to identify unknown risks in processes, which helps to add more value to the audits.	*2016*	Fluxicon (Netherlands)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Housing	Zig Websoftware (Netherlands)	*Housing allocation process*	Improving the housing allocation process. Every day that a rental property is vacant costs the housing association money. After process mining analysis, these vacancy costs could be reduced by 4,000 days within just the first six months.	*2016*	Fluxicon (Netherlands)
Utility	SPARQ Solutions (Australia)	*Root case analysis*	▪ Improving of the operations; ▪ Discovering the actual problems and involving relevant resources in the root cause analysis; ▪ Analysing the overall dispatching process as well as the maintenance process for a single machine.	*2016*	Fluxicon (Netherlands)
Manufacturing	Zimmer Biomet (Switzerland)	*Value Stream Mapping*	▪ Creating the value stream mapping with a process mining-based analysis of the manufacturing flow in a easier and effective way.	*2016*	Fluxicon (Netherlands)
Service - Banking	ALFAM Consumer Credit (Netherlands)	*Sales Process*	They analysed variation, re-processing, waiting times, and service levels. ▪ By visualizing the processes and the process problems, improvement opportunities were designed in a powerful way.	*2016*	Fluxicon (Netherlands)
Service - Technology	Dimension Data (South Africa)	*Compliance*	Each region was responsible for running their own operations with very little enforced standards from a group perspective. The changing business landscape made it necessary for Dimension Data to standardize all their processes across all continent. Process mining was used in order to support the project.	*2016*	Fluxicon (Netherlands)
Service - Transports	Brisbane Airport Corporation (Australia)	*NDA*	-	*2016*	Queensland University of Technology (Australia)
Service - Telecommunications	Vodafone (UK)	*Process Improvement*	Process Mining facilitated Vodafone's existing SAP infrastructure enabling continual real-time analytics and seamless transition to new process mining functions. Vodafone mentions that process mining also enabled faster GTM: they could resolve things faster and more proactively because they gained more visibility into their processes and operations.	*2016*	Celonis (Germany)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Technology	Xerox (India)	*Process Optimization*	Xerox is currently starting to use process mining in order to develop new technology projects. The focus of these projects will be on analysing complex business processes, designing cost and performance optimized policies for execution, monitoring, and identifying scope for process improvements.	*2016*	Xerox Algorithms & Optimization group (India)
Service - Insurance	Employee Insurance Agency (Netherlands)	*Correlation analysis*	Authors presented such a framework and its implementation in ProM by defining an analysis use-case composed of three elements (one dependent characteristic, multiple independent characteristics and a filter), in order to create a classification or regression problem.	*2016*	Eindhoven University of Technology (Netherlands)
Service - Technology	Basware (Finland)	*Invoice Management*	The analysis was conducted for the invoicing process and for a number of selected customers, all using Basware's invoicing system. They managed to analyse the number of open invoices in order to make comparisons between different invoice types or vendors.	*2015*	QPR (Finland)
Service - Retail	EDEKA (Germany)	*IT Service Management*	The Aim: gaining a scalable on-demand visualization of processes to fully exploit the hidden potential of the ticket data, for optimizing the efficiency and thereby costs of the process. Results: ▪ Quick identification of sources of errors and deviations from the to-be process; ▪ Better workforce planning based on the number of incidents in a given period; ▪ Supporting the standardization of the process.	*2015*	Celonis (Germany)
Healthcare	AMC Hospital (Netherlands)	*Conformance analysis from Billing system*	▪ Mining the complex hospital processes giving insights into the process; ▪ Deriving the understandable models for large groups of patients; ▪ Comparing results with a flowchart for the diagnostic trajectory of the gynaecological oncology healthcare process.	*2015*	Eindhoven University of Technology (Netherlands)
Service - Transports	Dockwise (Netherlands)	*Procure-to-Pay processes*	By using Process Mining, Dockwise was able to: ▪ Discover that 15% of the orders go through a different process; ▪ Determine that are not always adhered to certain rules and arrangements; ▪ Optimize the quality and usefulness of the KPIs; ▪ Create business cases for improvement based on facts; ▪ To prepare the BI environment for the use of Process Mining.	*2015*	Zuiver ICT (Netherlands)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	Atrium Hospital (Germany)	*Conformance analysis*	Process Mining was used in many ways, in order to obtain many relevant results in the healthcare processes: ▪ Visualizing the pathway "Malignant Lymphoma"; ▪ The duration of the different patients was easily fixed and then analysed; ▪ Finding the difference in fixed times for patients in whom a case manager was involved.	*2015*	Zuiver ICT (Netherlands)
Manufacturing	Veco (Netherlands)	*Quality Management (Six Sigma Analysis)*	Veco is a precision metal manufacturer. With more than 15 years of experience in supply chain management, Joris is the operations manager and Six Sigma expert at Veco. He used Minitab to statistically analyse the processes and to drive improvements. According to him, Process mining can leverage the human process knowledge in a powerful way that classical Six Sigma analyses can't.	*2015*	Fluxicon (Netherlands)
Healthcare	Radboudumc (Netherlands)	*Process improvement*	Radboud University Medical Centre is an academic hospital that was quite advanced in the adoption of electronic patient record systems, but process analysis and improvement remained as big a challenge as in all other hospitals as well. Process mining gave advantages to the improvement of healthcare processes based on the example of the Intensive care unit and the Head and Neck Care chain at Radboudumc.	*2015*	Fluxicon (Netherlands)
Service - Banking	DUO (Netherlands)	*Process improvement of finance request*	The new system was introduced with the goal to improve the speed of DUO's student finance request handling processes and to save 25% of the costs. Process mining was used to uncover technical errors in the pilot phase of a new system, as well as to gain transparency in the business KPIs for the new process.	*2015*	Fluxicon (Netherlands)
Service - Public Sector	LatinAmerican University (Colombia)	*Risk evaluation*	▪ Quantifying the level of financial risk associated with each IT service supporting the business process, taking into account different scenarios; ▪ Measuring the expected incomes of business processes, the probability for IT threats, and the changes on the performance of its quality attributes; ▪ Analysing historic events to quantify the impact of IT failures in relation to different time horizons and desired confidence levels.	*2015*	Systems and Computing Engineering Department, School of Engineering, Universidad de los Andes, Bogota (Colombia)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Public Sector	Opéra de Lausanne (Switzerland)	*Users accesses analysis*	Analysis of the users accesses of the Opera's Storage Area Network (SAN) in order to refine the organisation of the SAN.	*2015*	Ville de Lausanne (Switzerland)
Service - Telecommunications	Telecommunication Company (Indonesia)	*Customer fulfilment analysis*	The aim of process mining implementation was to discover the typical customer fulfilment business process. It was also aimed at assessing the current rate of completed customer fulfilment. The company could use the findings as a foundation to improve their business process. First, the completion rate of the customer requests was found to be very low deserved further investigation. Then, findings regarding typical processes could be used to set standard sets of services which will be useful for prediction and planning of capacity.	*2015*	Institut Teknologi Sepuluh Nopember, Sukolilo, Surabaya (Indonesia)
Healthcare	General Hospital of Valencia (Spain)	*Health Process Tracking*	Process mining techniques provided an easy to use way to achieve a view of the deployed process. The algorithm perfectly captured the features of the processes, showing them in an easy and understandable view that was accepted by the medical staff in a real environment. With this information, the health professionals and managers could achieve a real view of the problems that are currently happening. This enabled the improvement of protocols with a better knowledge of the problems, increasing their efficiency and the probability of success.	*2015*	Instituto Universitario de Investigación de Aplicaciones de las Tecnologías de la Información y de las Comunicaciones Avanzadas (ITACA), Universitat Politecnica de Valencia (Spain)
Healthcare	Toulouse Hospital (France)	*Outpatient clinic redesign*	Toulouse Hospital decided to redesign an outpatient clinic in order to mutualize the 11 consulting services of 6 medical specialties. Process Mining clearly appeared as a good solution to support continuous improvement of complex and continuous (24/24) hospital processes. Furthermore, it became a relevant tool in diagnosis phase and also to monitor activities	*2015*	Toulouse Hospital (France)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	Integrating the Healthcare Enterprise (US)	*Audit and node authentication*	Integrating the Healthcare Enterprise (IHE) defines in its Audit Trail and Node Authentication (ATNA) profiles how real-world events must be recorded. Since IHE is used by many healthcare providers throughout the world, an extensive amount of log data is produced. In the research they investigate if audit trails, generated from an IHE test system, will carry enough content to successfully apply process mining techniques. Furthermore they assess the quality of the recorded events.	*2015*	Integrating the Healthcare Enterprise (US)
Healthcare	Hospital in Mainkofen (Germany)	*Care station for elderly people*	The ward is an intensive care station for elderly people suffering from dementia and similar old-age diseases. Each of the patients needs care around-the-clock. ▪ Discovering how real-world processes are executed; ▪ Discovering that the process exhibits a relatively high repetition rate; The process could be documented directly and time-saving in comparison with the past.	*2015*	Institut für Parallele und Verteilte Systeme (IPVS) der Universität Stuttgart (Germany)
Healthcare	Isala Hospital (Netherlands)	*Patients' records management*	▪ Compliance analysis of the whole patients' records management. In average, 30 medical steps were avoided; ▪ Reduction of the emergency management total duration.	*2014*	Eindhoven University of Technology (Netherlands)
Construction	Caverion (Finland)	*Performance Management*	▪ Measuring process performance based on ready defined indicators to ensure proactive actions to any discrepancies; ▪ Quicker invoicing and improved cash flow from discovering and removing process bottlenecks; ▪ Ability to continuously compare and value process performances and variations per country.	*2014*	QPR (Finland)
Manufacturing	Electronic Manufacturer (Netherlands)	*Service Refund Process*	▪ A critical bottleneck at a subcontracting forwarding company could be detected; ▪ Discovering that additional documents were requested due to incomplete information at the beginning of the process if it was started through a particular channel. Understanding the problem could reduce this wasteful activity by more than 85% and significantly speed up the process for the customer and reducing customer complaints as well.	*2014*	Fluxicon (Netherlands)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Insurance	Bridge Loans (South Africa)	*Loan Processes*	▪ Making right corrective actions and making the loan application process 40% faster; ▪ Gaining a better understanding of why actual processes may differ, and measuring the performance of the system processes; ▪ Monthly reports for comparing and analysing process performances; ▪ Proactive process management via quick discovery of problem areas.	*2014*	QPR (Finland)
Service - Telecommunications	Norddeutscher Rundfunk (Germany)	*IT Service Management*	▪ Analysing of Service Desk processes and building the foundation for an optimized Services Management.	*2014*	Celonis (Germany)
Service - Telecommunications	Fiducia (Germany)	*IT Service Management*	Fiducia wished to implement automatic reporting. Results: ▪ Reconstruction of the entire dataset based on HP Service. It is now possible to perform long-time evaluations and process reconstructions based on the data saved in archives of the last 2-10 years; ▪ Using live process reconstruction, the identification and elimination of bottlenecks, long-running tickets and process inefficiencies became possible. To keep track of current trends, live monitoring dashboards were established.	*2014*	Celonis (Germany)
Service - Telecommunications	Hessischer Rundfunk (Germany)	*IT Service Management*	▪ Analysing Service Desk processes and building the foundation for an optimized Services Management.	*2014*	Celonis (Germany)
Manufacturing	Siemens AG (Germany)	*Service Process Management*	With the continuously monitoring and analysis of new data from a multitude of SAP systems around the world, they obtained the following results: ▪ Evidence of weak points; ▪ Enabling constant improvement, harmonization and standardization of processes.	*2014*	Celonis (Germany)
Healthcare	Berufsgenossenschaftliche Unfallkrankenhaus Hamburg stands (Germany)	*Service Process Management*	▪ Clearly assigned tasks, optimized flows of information as well as communication /collaboration across departments and occupation groups that resulted in smooth work flows, short decision making processes and individual solutions. This enabled the best possible treatment and rehabilitation of patients across all medical fields.	*2014*	Celonis (Germany)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Chemical	**Bayer (Germany)**	*Process compliance*	The goal of the project was to bring global transparency to the core processes (procurement, sales and logistics) in order to identity inefficiency potentials and ensure process compliance. Solution: process mining was used to reconstruct and to monitor global processes in relation to efficiency and risk beyond country, system and company borders. Now, processes as well as performance and risk indicators can be dynamically analysed by users.	*2014*	Celonis (Germany)
Healthcare	**Kliniken Südostbayern (Germany)**	*Performance management for medicinal treatment*	The Kliniken Südostbayern decided to use the Process Mining solution for hospital management as a tool to obtain all the needed information. With Process Mining was possible to extract all necessary data from hospital information system (HIS) and to provide a detailed view of treatments.	*2014*	Celonis (Germany)
Service - Banking	**DZ-Bank (Germany)**	*Process data analysis*	Business processes require the highest possible level of transparency. Especially in the banking sector, the analysis of process data from source systems plays a very important role. Employees of the banking sector work with IT-systems every day, for example in relation to electronic files, creating process data continuously. Process mining enabled the improvement of the analysis required.	*2014*	Celonis (Germany)
Manufacturing	**IG Metal (Germany)**	*IT Service Management*	IG Metall placed high expectations on its customer service and internal IT Service Management. That's why the IG Metall had opted for the use of Process Mining. Process Mining made it possible to significantly improve efficiency and quality in the handling of customer requests by visualizing how inquiries are being processed in reality and thus uncovering process weaknesses.	*2014*	Celonis (Germany)
Service - Telecommunications	**SWR (Germany)**	*IT Service Management*	SWR used the software Assyst as its service desk solution and integrated the Process Mining for IT service management in order to analyse its service processes. This enabled the company to substantially improve its Service Management.	*2014*	Celonis (Germany)
Service - Logistics	**Schukat Electronic (Germany)**	*Order Process management*	As a catalogue distributor of electronic components, the company put high emphasis on the ability to deliver and processing orders. Since complete transparency of business processes is also an important component of constant optimization, Process Mining is now part of the IT landscape of the company. In conjunction with SAP HANA, Process Mining every day creates real-time transparency over the actual processes.	*2014*	Celonis (Germany)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Manufacturing	Essmann Automotive (Germany)	*Production process system*	By using process mining the, Eissmann created efficient production processes. Its integration into lean corporate processes and into the management system, represented a key pillar of long-term success. By involving suppliers at an early stage in the product creation process and promoting team-oriented partnerships, Eissmann achieved excellent and competitive products.	*2014*	Celonis (Germany)
Service - Public Sector	Centraal Bureau voor de Statistiek (Netherlands)	*Statistic analysis*	Statistics Netherlands is responsible for collecting and processing data in order to publish statistics to be used in practice, by policymakers and for scientific research. With process mining they have improved their performances.	*2014*	Fluxicon (Netherlands)
Service - Banking	ING (Netherlands)	*Website and call center improvements*	Making sure a customer has the best possible experience when interacting with the company is one the most important goals many companies strive for. ING DIRECT Australia asked for an in-depth analysis of the behaviour of their customers on their website before they called the call center. Using process mining they were able to get valuable business insights to make better decisions on how to further develop both their website and call center.	*2014*	Fluxicon (Netherlands)
Service - Public Sector	Ville de Lausanne (Switzerland)	*Construction permit process*	Analysis of the construction permit process, in order to find bottlenecks.	*2014*	Ville de Lausanne (Switzerland)
Manufacturing	Volvo (Germany)	*Paths discovery*	A first dataset provided data about factory orders for the construction of trucks. The second dataset contained customer orders of trucks. It was discovered that the attribute 'ORDERNUMBER' of any event in a trace of the first log was also displayed in the attribute 'Omnumber' of the event 'Accepted' in the second.	*2014*	Ghent University, Department of Business Informatics and Operations Management (Belgium)
Healthcare	Scottish Rite Emergency Department of Children's Healthcare of Atlanta (US)	*Paediatric asthma emergency department (ED) processes*	Process mining's visual analytics has played an important role in healthcare process analysis. The interactive visual approach enabled users to gain insight into the complexity of paediatric asthma care pro-cesses. It helped with care quality improvement programs, providing comparison, benchmarking and analysis of conformance to existing care protocols.	*2014*	School of Interactive Computing & Tennenbaum Institute, Georgia Institute of Technology (US)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	EU project's MOSAIC (NA)	*Datasets of Type 2 Diabetes analysis*	Process mining methods were executed in order to derive healthcare pathways. The approach started by processing raw data, derived from heterogeneous data sources, and created event logs, which contained meaningful healthcare activities. Once event logs have been obtained and tasks and transitions defined, it was possible to explore how state-of-art process mining techniques could be used to gain insights into patients care.	*2014*	International Conference on Biomedical and Health Informatics (Spain)
Healthcare	Chicago Outpatient Clinic (US)	*Analysis of Workflows in Clinical Care*	Process Mining was used for workflows analysis for outpatient clinic center, admitting high-risk patients and low-risk patients. Based on the results from process mining, a discrete event simulation model was proposed to quantitatively analyze the clinical center. Sensitivity analyses have also been carried out to investigate the care activities with limited resources such as doctors and nurses. The results suggested that the methodology was a useful tool for healthcare process improvement.	*2014*	Department of Mechanical and Industrial Engineering, University of Illinois at Chicago (US)
Manufacturing	A steel manufacturer (UK)	*Process improvement*	Objectives: ▪ To investigate the flows of material through the route; ▪ To get insights and knowledge on the approach by using internal data only. Results: ▪ Identification of some issues with the flows; ▪ Discovering that the large number of processes actually undertaken; ▪ Identification of the issues in relation to the interpretation of the process.	*2014*	A steel manufacturer (UK)
Service - Insurance	Suncorp (Australia)	*Home Insurance Claim*	This project aimed to apply process mining to Home Insurance Claims, processing records provided by Suncorp with the aim of finding insights into the reasons behind long processing times. Results: ▪ Evidence of two major loops, which represented bottlenecks for the entire process. ▪ Processing time reduction from 30-60 days to 5 days (within the SLA conditions).	*2013*	Queensland University of Technology (Australia)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Transports	**Copenhagen Airports A/S (Denmark)**	*Bag-tag Analysis*	▪ Identification of the reasons for KPI discrepancies; ▪ Finding areas with potential process challenges more in depth; ▪ The easy and fast way of looking at the process from different perspectives revealed many new insights; ▪ The perspective could shift from KPIs and bottlenecks, to process performance related to locations.	*2013*	Fluxicon (Netherlands)
Construction	**Ruukki (Finland)**	*Process Management*	Process mining was used to respond to the needs of both system management and business. For System Owners: ▪ Gaining transparency to system usage and enabling more focused guideline enforcement and modifications. For Business: ▪ Supporting prioritization of process improvement activities; ▪ Highlighting the importance of transparent process management over functional siloes.	*2013*	QPR (Finland)
Manufacturing	**Samsung Electro-Mechanics (South Korea)**	*Conformance analysis and machine performance analysis*	▪ The derived process model showed real process flows in the factory and it was used to understand the manufacturing process; ▪ The conformance checking showed how traces fit with the derived model; ▪ The machine performance analysis showed the utilization of their resources; ▪ The analysis results were presented to the managers of SEM, who were impressed by the obtained results.	*2013*	Ulsan National Institute of Science and Technology (South Korea)
Healthcare	**Seoul National University Bundang Hospital (South Korea)**	*Performance Analysis per patient type*	A performance analysis was conducted in order to make a simulation model and to analyse the process patterns according to patient types. The results: ▪ According to the result of comparing the event log and their standard process model, the matching rate was as 89.01%; ▪ Using the performance analysis result, they generated the simulation model. The simulation showed that the 10% increase of patients made the largest change in consultation waiting time; ▪ Extraction of the process models and analysis of process patterns according to patient types. The most frequent pattern of each patient type was discovered.	*2013*	Ulsan National Institute of Science and Technology (South Korea)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Transports	Ana Aeroports de Portugal (Portugal)	*Service Process Management*	▪ Finding a more effective method to balance the workforce; ▪ Changing the process to be much more lean for particular technical categories; ▪ Eliminating non-value-add tasks. ; ▪ Identifying unambiguous performance metrics for the process; ▪ Making changes in the way "Change Orders" are created and recorded in order for technical people to focus on what is really important and improve how they identify execution priorities; ▪ Applying the same practices to other ITIL processes; ▪ Making sure that no "Change Order" was implemented without being previously authorized.	*2013*	Process Sphere - End to end BPM
Manufacturing	IBM i (US)	*Database management*	For IBM i users, the event data were perhaps most prolific and most commonly available in database journals. This provided an event log of potentially thousands to millions of database events related to the files journaled. ... ▪ Setting Journaling Parameters and extracting Journal Data and creating the animation.	*2013*	IBM (US)
Service - Public Sector	Auditdienst Rijk (Netherlands)	*Assurance on the financial statements*	The Dutch National Auditing Service monitors the annual reports of all Dutch ministries and provides assurance on the financial statements that are included. They used process mining in order to perform their audits in a efficient way.	*2013*	Fluxicon (Netherlands)
Healthcare	St Andrew's War Memorial Hospital (Australia)	*Emergency Department Patient Treatment*	This project aimed to apply process mining to provide insights into St Andrew's War Memorial Hospital's (SAWMH) process for treating patients presenting at the Emergency Department (ED) with chest pain. The study involved process discovery and comparison of patient flows associated with patients whose stay in ED was less than 4 hours with those whose stay was longer than 4 hours. The study also aimed to investigate potential delays introduced to the patient flows as a result of conducting routine clinical activities and the determination of factors that influence patients' length of stay in ED.	*2013*	Queensland University of Technology (Australia)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	Seoul National University Bundang Hospital (South Korea)	*Modeling of Outpatient Care Mega-Process*	From a total of 698,158 event logs, the most frequent pattern was found. The matching rate between the expert-driven process model and the machine-driven model was found to be approximately 89.01%. It Was found that process mining techniques could be applied in the healthcare area, and through detailed and customized analysis in the future it can be expected to be used to improve actual outpatient care processes.	*2013*	Industrial Strategic Technology Development Program funded by the Ministry of Knowledge Economy, Korea (South Korea).
Manufacturing	Boxes manufacturing (India)	*Process modelling and improving*	The generated process model reflected the actual process as observed through real process executions. The heuristic mining algorithm gave clear information on how the process was executed, and analysis of the process could be evaluated to improve the performance of manufacturing.	*2013*	Department of Computer Science and Applications, Dayananda Sagar College of Arts (India); Science and Commerce (India)
Healthcare	Dentistry (Netherlands)	*Patient treatment*	For a complex dental process, it turns out that the introduction of new digital technologies is largely beneficial for patients and dental lab owners, whereas for dentists there is hardly any benefit. ▪ The effects of digital dentistry on the implant value chain was investigated using process mining and discrete event simulation. The implant value chain was concerned with all steps that could be associated with dental implants, covering the stages from patient diagnosis until implant placement.	*2013*	Eindhoven University of Technology (Netherlands); Perceptive Software (Netherlands)
Healthcare	Children's National Medical Center (Columbia)	*Adherence to ATLS protocol analysis*	Through process mining they determined compliance with the ATLS protocol sequence, reviewed the most commonly occurring sequence and individual deviations, detected differences in clinical behaviour after the introduction of the checklist. Although the frequency of activations without notification was not reduced, the addition of the checklist to the trauma resuscitation routine helped standardize the care provided specifically for these events.	*2013*	American College of Surgeon's 99th Clinical Congress, Surgical Forum (US)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	IBM T. J. Watson Research Center NY (US)	*Paths discovery*	Identifying care pathways correlated with outcomes from patient event data were of vital importance for gaining the insights of which specific care pathway will lead to a good/bad outcome.Once identified, such care pathways were used by medical boards for refining care plan descriptions for treating particular diseases such as congestive heart failure etc.	*2013*	IBM (US)
Healthcare	Gynaecologic Oncology Department (Belgium)	*Patient treatment deviation analysis*	Using process mining techniques research has demonstrated that the patients' diagnosis-treatment cycles often significantly deviate from the standardized clinical pathways. ▪ Analysing these deviations might result in the further enhancement of the quality of care, the promotion of patient safety, an increase in patient satisfaction; ▪ Understanding pathway behaviour and deviations became possible.	*2013*	Department of Decision Sciences and Information Management, Faculty of Economics and Business (Belgium)
Healthcare	37 hospitals located in the Lombardia Region (Italy)	*Patient treatment*	The work showed that process mining and case retrieval techniques can be applied successfully to clinical data to gain a better understanding of different medical processes for different groups of patients). In this way, not only different practices used to treat similar patients may be discovered, but also unexpected behaviour may be highlighted.	*2013*	Computer Science Institute, Università del Piemonte Orientale, Alessandria (Italy); Università di Pavia (Italy)
Healthcare	Maastricht University Medical Centre (Netherlands)	*Patient routes in a medical Treatment process*	The study used both the heuristic and the fuzzy miner for the process analysis. It was concluded that the heuristics miner is not able to show all low frequent behaviour which makes it difficult to use for extension/improvement research in the medical domain. The fuzzy miner is able to show this behaviour but must be accompanied by the Conformance Checker to make sure that all discrepancies are found between the original process and the acquired event log.	*2013*	Eindhoven University of Technology, University of Technology (Netherlands); Maastricht University Medical Centre (Netherlands)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	Many European academic hospital (NA)	*Diagnosis treatment cycle*	Research demonstrated that the patients' diagnosis-treatment cycles often deviate from the approved and standardized clinical pathways. By Studying these differences may result in the further improvement of the quality of services, the promotion of patient safety, an increase in patient satisfaction and an optimization of the use of resources. Understanding pathways behaviour and deviations becomes possible because of an increased availability of reliable data logs, originated from every hospitals information systems.	*2013*	Department of Decision Sciences and Information Management, Faculty of Economics and Business, Leuven (Belgium)
Healthcare	Dutch Clinic (Netherlands)	*Ambulant surgery process*	It was used the log of a Dutch clinic for the ambulant surgery process. This is a sequential process that deals with both ambulant patients and ordered stationary patients.	*2013*	Eindhoven University of Technology, University of Technology (Eindhoven, Netherlands)
Healthcare	Chania Hospital (Greece)	*Clustering healthcare processes*	The aim was to support decision making by providing comprehensible process models in the case of such flexible environments. Following a process mining approach, they proposed a methodology to cluster customers' flows and produce effective summarizations. Then they proposed a novel method to create a similarity metric that was efficient in downgrading the effect of noise and outliers. It was used a spectral technique that emphasized the robustness of the estimated groups, therefore it provided process analysts with clearer process maps.	*2013*	Eastern Macedonia and Thrace Institute of Technology (Greece); Technical University of Crete, University Campus (Greece)
Service - Logistics	Package Delivery Company (Belgium)	*Machine Configuration*	▪ Evaluation of the correctness of the configuration of the state machine; ▪ Investigation of a huge number of abnormal flows that have been identified by business users; ▪ Linking the different states and events back to the business process.	*2012*	AE architects for business & ICT (Belgium)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Utility	**Alliander (Netherlands)**	*Purchasing*	The Challenges: ▪ Managers thought they knew how processes worked, but it wasn't true; ▪ To find a solution that can be applied to multiple processes and departments; ▪ To discover areas of inefficiency; ▪ To find why staff members had different ways of completing the same process. The Results: ▪ Quick insight into how processes really worked; ▪ Extensive list with potential areas for improvement; ▪ Improved process insight delivers efficiency improvements; ▪ A complete picture of eight business processes that allowed for standardisation and staff re-training.	*2012*	Perceptive Process Mining, Lexmark (US)
Manufacturing	**AkzoNobel (Netherlands)**	*Procure-to-Pay processes*	▪ Management obtained insights into exceptions where the "First time right" principle was not realized; ▪ Peer comparisons between countries helped to identify best practices that could be adopted on the corporate level; ▪ The direct insights in process improvements enabled the desired "value extraction" from the P2P processes; ▪ Compliance control was realized to execute on corporate guidelines that must be followed.	*2012*	Capgemini (Netherlands)
Manufacturing	**Vaisala (Finland)**	*Process Management*	▪ Making effective operations and improved customer satisfaction through clear visual understanding of the real process and the deviations; ▪ Reducing operational costs and time to corrective actions by having the means for effective change management, through fast verification and follow-up of process changes; ▪ Sales process optimization through understanding of the process flows, and the ability to benchmark performances.	*2012*	QPR (Finland)
Service - Telecommunications	**WDR (Germany)**	*IT Service Management*	NA	*2012*	Celonis (Germany)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Banking	Bank of Queensland, (Australia)	*NDA*	-	*2012*	Queensland University of Technology (Australia)
Healthcare	Princess Alexandra Hospital (UK)	*Emergency Department Patient Treatment*	This project aimed to apply process mining to provide insights into Princess Alexandra Hospital's (PAH) "as is" processes for treating patients presenting at the Emergency Department with multiple traumatic injuries. The study involved process discovery and comparison of patient flows associated with various cohorts of patients including (I) patients presenting with minor and major trauma, and (II) patients presenting at different times of the day.	*2012*	Queensland University of Technology (Australia)
Healthcare	Metro North Hospital (Australia)	*Outpatient Referral Process*	Process mining was used to discover models from patient referral, appointment, to provision of a service with a specialist. Key insights obtained from this analysis include lack of implementation of the standards across hospitals, variation and impact of delays on the health and well-being of patients.	*2012*	Queensland University of Technology (Australia)
Service - Public Sector	Queensland University of Technology (Australia)	*Student Services*	The project aimed to apply process-oriented data mining (process mining) to analyse student behaviour (through the use of Blackboard data) in order to increase student retention.	*2012*	Queensland University of Technology (Australia)
Service - Retail	Woolworths (Australia)	*Logistic Process*	The project aimed to apply process-oriented data mining (process mining) to provide insights into Woolworths' Delivery Process. Specifically, the study involved process discovery of the delivery process, and the identification of optimal delivery routes.	*2012*	Queensland University of Technology (Australia)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	Hospital of Sao Sebastiano, (Portugal)	*Emergency Services*	The process mining methodology was applied in the emergency service of a hospital that had its own electronic patient record system, developed in-house. Event data collected from this system was analysed. Using the radiology workflow as an example, they showed how the proposed methodology could provide insight into the flow of healthcare processes, their performance, and their adherence to institutional guidelines.	*2012*	Hospital de Sao Sebastiao, Santa Maria da Feira, (Portugal); Technical University of Lisbon (Portugal)
Healthcare	Medical University of Vienna (Austria)	*Compliance analysis for treatment processes*	The goal of the project was to analyse skin cancer treatment processes regarding their compliance with relevant guidelines. Focus was put on the transformation and integration of the available data sources as well as billing data of the Main Association of Austrian Social Security Institutions. The challenge was to extract and integrate the data in a process-oriented way in order to apply process mining techniques in the sequel.	*2012*	University of Vienna (Austria); Medical University of Vienna (Austria)
Healthcare	Department of Ophthalmology at the University Hospital of Leipzig (Germany)	*Workflow Management*	The objective was the design and the implementation of a surgical workflow management system (SWFMS) that could provide a robust guidance for surgical activities. Results: They demonstrated that a SWFMS with a workflow schema that was generated from a subset of 10 patient individual surgical process models (iSPMs) was sufficient to guide approximately 65% of all surgical processes in the total set, and that a subset of 50 iSPMs was sufficient to guide approx. 80% of all processes.	*2012*	University of Leipzig, Innovation Center for Computer Assisted Surgery (ICCAS) (Germany); University Hospital of Leipzig Department of Ophthalmology and Neurosurgery (Germany)
Healthcare	Dutch Academic Hospital (Netherlands)	*Analysis of Patient Treatment Procedures*	Given the heterogeneous nature of the cases, the research first demonstrated that it was possible to create more homogeneous subsets of cases (e.g., patients having a particular type of cancer that need to be treated urgently). Such pre-processing was crucial given the variation and variability found in the event log. The discovered homogeneous subsets were analysed using state-of-the-art process mining approaches. More specifically, they reported on the findings discovered using enhanced fuzzy mining and trace alignment. A dedicated pre-processing ProM plug-in was developed for the challenge.	*2012*	Eindhoven University of Technology; Philips Healthcare (Netherlands)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	Royal Prince Alfred Hospital Sydney (Australia)	*Patient Treatment*	Gaining Insight from HIV/AIDS Patient Journey Data by using a Process-Oriented Analysis Approach with process mining.	*2012*	School of Information Technologies, The University of Sydney, Australia (Australia)
Healthcare	Mercy Health System St. Louis (US)	*Clinical workflow management*	▪ Automating the method of documenting clinical workflows; ▪ Identifying variations of clinical workflows and optimizing them; ▪ Optimizing clinical workflows.	*2011*	The Healthcare Business Process Management Blog
Service - Insurance	Queensland Nominal Defendant (Australia)	*NA*	NA	*2011*	Queensland University of Technology (Australia)
Service	Multinational enterprise (NA)	*Conformance analysis*	From the analysis performed it was possible to highlight that the most striking of the variations was the difference between the processes executed in each of the order management teams around the world. ▪ The process improvement teams took this information to one of the regular meetings of representatives from the regional teams so they could present findings in order to obtain the standardization level needed.	*2011*	Khalifa University, P.O., Abu Dhabi (UAE)
Service - Insurance	United India Insurance Company LTD. (India)	*Paths discovery*	Process mining techniques were used to obtain meaningful knowledge about flows, in order to discover typical paths followed by particular groups of Insurance holders. ▪ Obtaining understandable mined process models for large groups of services to identify the same and different insurance holder process; ▪ The results were not derived by human thinking: the automated mined process model helped the insurance agent in their daily activities.	*2011*	Bharathiar University, Technical University, Avadi, Tamil Nadu (India); Department of Computer Science, Rashtriya Sanskrit Vidyapeetha, Tirupati, Andhra Pradesh (India)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Insurance	Motor Accident Insurance Commission (Australia)	*Compulsory Third Party (CTP) Claim*	The project aimed to apply process-oriented data mining (process mining) to historical CTP claims processing records provided by multiple CTP insurance providers with a view to exposing impediments to efficient (time & cost) claims handling and to determine the impact of various "context" factors on the process execution.	*2011*	Queensland University of Technology (Australia)
Service - Insurance	Association of Certified Fraud Examiners (ACFE) (US)	*Transactional logs analysis*	Authors presented a case study in which they applied process mining in the context of transaction fraud. Given the procurement process of an organization using SAP as ERP system, they applied the process diagnostics approach to discover the real process and to analyze flaws. ▪ This enabled the explicit possibility of checking internal controls and business rules in more general. This way, process mining enabled auditing by not only providing theory and algorithms to check compliance, but also by providing tooling that help the auditor to detect fraud or other flaws in a much earlier stage.	*2011*	Faculty of Business Economics, Hasselt University, Agoralaan (Belgium); Eindhoven University of Technology (Netherlands)
Healthcare	Hospital for Children, Toronto & Women and Infants Hospital, Providence (Canada, US)	*Patient treatment modeling*	The paper presents a framework for process mining in critical care. The framework uses the CRISP-DM model, extended to incorporate temporal and multidimensional aspects (CRISP-TDMn), combined with the Patient Journey Modeling Architecture (PaJMa), to provide a structured approach to knowledge discovery of new condition onset pathophysiologies in physiological data streams. The approach is based on temporal abstraction and mining of physiological data streams to develop process flow mappings.	*2011*	University of Ontario Institute of Technology, Oshawa (Canada); The Hospital for Sick Children, Toronto (Canada) Department of Paediatrics, University of Toronto, Toronto (Canada)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	**Belgium Hospital (Belgium)**	*Process improvement for breast cancer patients*	They analysed a dataset consisting of the activities performed to 148 patients during hospitalization for breast cancer treatment in a hospital in Belgium. They exposed multiple quality of care issues that will be resolved in the future, they discovered process variations and best practices and issues with the data registration system. For example, 25 % of patients receiving breast-conserving therapy did not receive the key intervention "revalidation". They found this was caused by lowering the length of stay in the hospital over the years without modifying the care process.	*2011*	NA
Service - Telecommunications	**Bayerischer Rundfunk (Germany)**	*IT Service Management*	Aim: To establish an improved Service Desk control station. Results: ▪ Ticket data analysis and telephone routing systems at an hourly rate; ▪ Pre-defined key indicators which provided a quick overview and showed existing trends; ▪ Ready-made analyses of business processes. Due to real time data assessment implemented, the effectiveness of correction measures could be reviewed immediately.	*2010*	Celonis (Germany)
Healthcare	**EncounterPRO Healthcare Resources (US)**	*Systematic Optimization of EHR Efficiency*	The goal was to improve medical practice throughput and throughput time, using process mining as a negative feedback control model in order to visualize, compare, and improve ambulatory EHR patient encounter task workflows. ▪ Generating process models of existing practices; ▪ Comparing measures of productivity (throughput and throughput time); ▪ Explaining differences in productivity in terms of differences in processes; ▪ Suggesting process improvements for low productivity practices. They chose nine paediatric practices relying on the same EHR workflow management system and they compared throughput and throughput times across the practices for October (traditionally a busy month for paediatricians).	*2010*	EncounterPRO Healthcare Resources (US)
Healthcare	**Dutch Hospitals (Netherlands)**	*Process improvement for diabetes foot patients*	The project was divided in three phases: process visualization, process analysis, and evaluation. During these phases, two approaches, process mining and visual analytics were used to visualize and analyze a business case. Based on the outcomes of this, the method was developed. The main finding was the fact that process mining and visual analytics did not provide sufficient process insights. Rather, a combination of both approaches was required.	*2010*	Eindhoven University of Technology, University of Technology (Netherlands)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	Verbeeten Institute (Netherlands)	*Achieve standardizat. in healthcare processes*	Goal: to help healthcare organizations achieving a standardized and high quality care process by using historic information gathered by registering the day-to-day operations with a healthcare information system. The research project successfully evaluated the applicability of process and data mining techniques in the context of the problem definition. However, it must be stated that the unavailability of exact activity and waiting time metrics significantly restricted simulation capabilities.	*2010*	Eindhoven University of Technology, University of Technology (Netherlands)
Healthcare	Maastricht University Medical Centre (Netherlands)	*Conformance analysis on clinical pathways*	The researchers developed and tested dynamic programming formulations for adherence measurement in clinical pathways – based on partially ordered data in medical records and pathway definitions. With these new methods at hand, they analysed clinical pathway adherence at the Cardiovascular Centre of Maastricht University Medical Centre.	*2010*	Institute of Health Policy & Management, Erasmus Medical Centre (Netherlands); Maastricht University Medical Centre (Netherlands)
Service - Public Sector	Dutch governmental organization (Netherlands)	*Process Diagnostics*	Authors proposed a process diagnostics methodology, that gave a broad overview of the process supported by the information system. In the process diagnostics methodology, several perspectives of the process were highlighted. The outcome covered the control flow perspective, i.e. “how the process model actually looks like”, the performance perspective, i.e. “how well does the system perform” and the organizational perspective, i.e. “who is involved in the process and how”.	*2009*	Eindhoven University of Technology (Netherlands)
Manufacturing	ASML (Netherlands)	*Test Processes*	Authors demonstrated that current process mining techniques can already answer many questions, even yield concrete suggestions for process improvement. However, due to the rapid technological advancements, the analysis results presented are likely to be outdated already for the next series of wafer scanners than the ones that they analyzed. To enable a continuous improvement of the test process in ASML, process analysis should be best carried out in an iterative manner.	*2009*	IEEE transactions on systems, man, and cybernetics

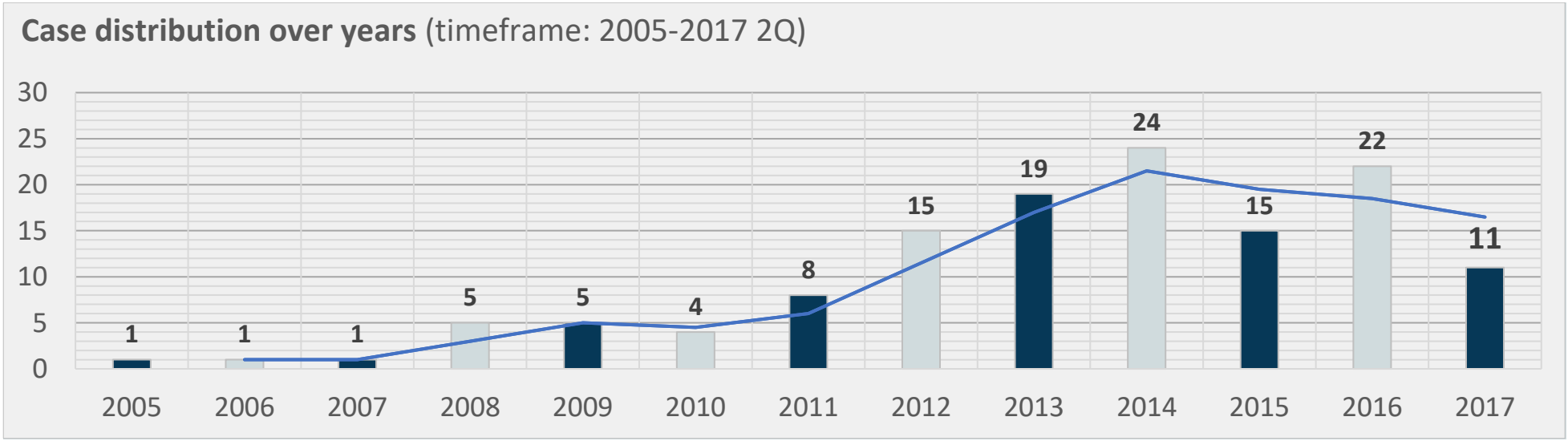
INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	Maxima Medical Centre (Netherlands)	*Patient treatment analysis*	Research objectives: to find the applicability of process mining on acquiring objective process information in the healthcare domain. Several process mining objectives were set: ▪ Researching all the possibilities by discovering the care flow of the rheumatoid arthritis patients; ▪ Checking if the process model discovered in the first objective corresponded to the predefined care paths and to reality.	*2009*	Eindhoven University of Technology, University of Technology (Netherlands)
Healthcare	University Hospital Leipzig (Germany)	*Analysis of surgical intervention populations*	According to differences in patient characteristics, surgical performance, or used surgical technological resources, surgical interventions have high variability. Statistical differences between the gSPMs of ambulatory and inpatient procedures of performance times for surgical activities and activity sequences were identified.	*2009*	Universität Leipzig, Leipzig (Germany); Faculty of Medicine, INSERM, Rennes (France); VisAGeS, INRIA (France)
Service - Insurance	ING (Netherlands)	*Internal Auditing*	Process Mining empowered ING to make a difference in auditing quality by providing better focus on possible risk, control and efficiency issues. Results: ▪ Identification of the most complicated cases and finding out the exceptions; ▪ Detecting policy violations and unusual transactions; ▪ Checking that processes as designed are also being executed the same way; ▪ Verifying if internal controls, such as authorizations, are performed correctly.	*2008*	Bitz Clarity LTD (UK)
Healthcare	Erlangen University Clinic (Germany)	*Business Process Analysis*	In order to support the analysis of the radiology workflows at the clinic, the authors developed a data warehouse for process mining. Despite the limitations, the authors concluded that process mining has a great potential to facilitate the understanding of medical processes and their variants.	*2008*	International Congress of the European Federation for Medical Informatics

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Healthcare	4 Italian Hospitals (Italy)	*Patient treatment*	Process mining was used to discover how stroke patients are treated in different hospitals. There was a need for intensive pre-processing of clinical events to build the event logs. It was concluded that process mining could be successfully applied to understand the different clinical pathways adopted by different hospitals and different groups of patients.	*2008*	Eindhoven University of Technology (Netherlands); University of Pavia (Italy)
Service - Public Sector	Municipality in the Netherlands (Netherlands)	*Modelling of social network and information flows*	Authors addressed three issues (I) Organizational model mining, (II) Social network analysis, and (III) Information flows between organizational entities. With a case study, they have shown how each of these issues can be supported. Moreover, they showed how organizational mining can benefit from creatively using approaches developed for the process perspective.	*2008*	Eindhoven University of Technology (Netherlands)
Healthcare	Zhejiang Huzhou Central Hospital (China)	*Patient workflow*	The study adopted process mining to analyse clinical pathways. The key contribution of the paper is to develop a new process mining approach to find a set of clinical pathway patterns given a specific clinical workflow log and minimum support threshold. The experimental results indicate the applicability of the proposed approach, based on which it is possible to discover clinical pathway patterns that can cover most frequent medical behaviours that are most regularly encountered in clinical practice.	*2008*	College of Biomedical Engineering and Instrument Science, Zhejiang University (China)
Healthcare	Catharina Hospital (Netherlands)	*Analyze careflows of an Intensive Care Unit*	The clustering approach of the DWS Algorithm was able to discover some patterns; however, the discriminants rules were hard to understand. To handle this problem, the author introduced the Association Rule Miner (ARM) plug-in, which aimed at discovering association rules and frequent item sets in the event log. The technique has proved to be useful to obtain patterns in the event log and to group similar patients.	*2007*	Eindhoven University of Technology (Netherlands)

INDUSTRY	ORGANIZATION	PROCESS	DESCRIPTION (Goal, Results)	YEAR	PARTNER
Service - Public Sector	Dutch National Public Works Department (Belgium)	*Invoice Management*	Dutch National Public Works Department is responsible for the construction and maintenance of the road and water infrastructure. Using a variety of process mining techniques, they analysed the processing of invoices sent by the various subcontractors and suppliers.	*2006*	Department of Technology Management Eindhoven University of Technology (Netherlands)
Healthcare	Dutch hospital (Netherlands)	*Logistic process of treating patients*	Authors proposed a knowledge management perspective to provide a strategy for modelling and redesigning a business process. The specific group of patients required the involvement of different specialties for their medical treatment that lead to more efforts regarding the coordination of care for these patients.	*2005*	University of Groningen (Netherlands)
Service - Telecom-	NDA	-	-	*NDA*	Queensland University of Technology (Australia)
Service - Insurance	NDA	-	-	*NDA*	Queensland University of Technology (Australia)
Healthcare	4 South Australian Hospitals (Australia)	*Emergency Department Patient Treatment*	The case study applied process mining techniques to patient flow data collected from patients presenting with chest pain at four South Australian hospitals. The study was a cross-organisational, comparative analysis that aimed to utilise routinely collected patient and treatment data to describe differences in the care processes associated with management of Acute Coronary Syndrome (ACS) practiced in the four hospitals.	*NA*	Queensland University of Technology (Australia)

Infographics

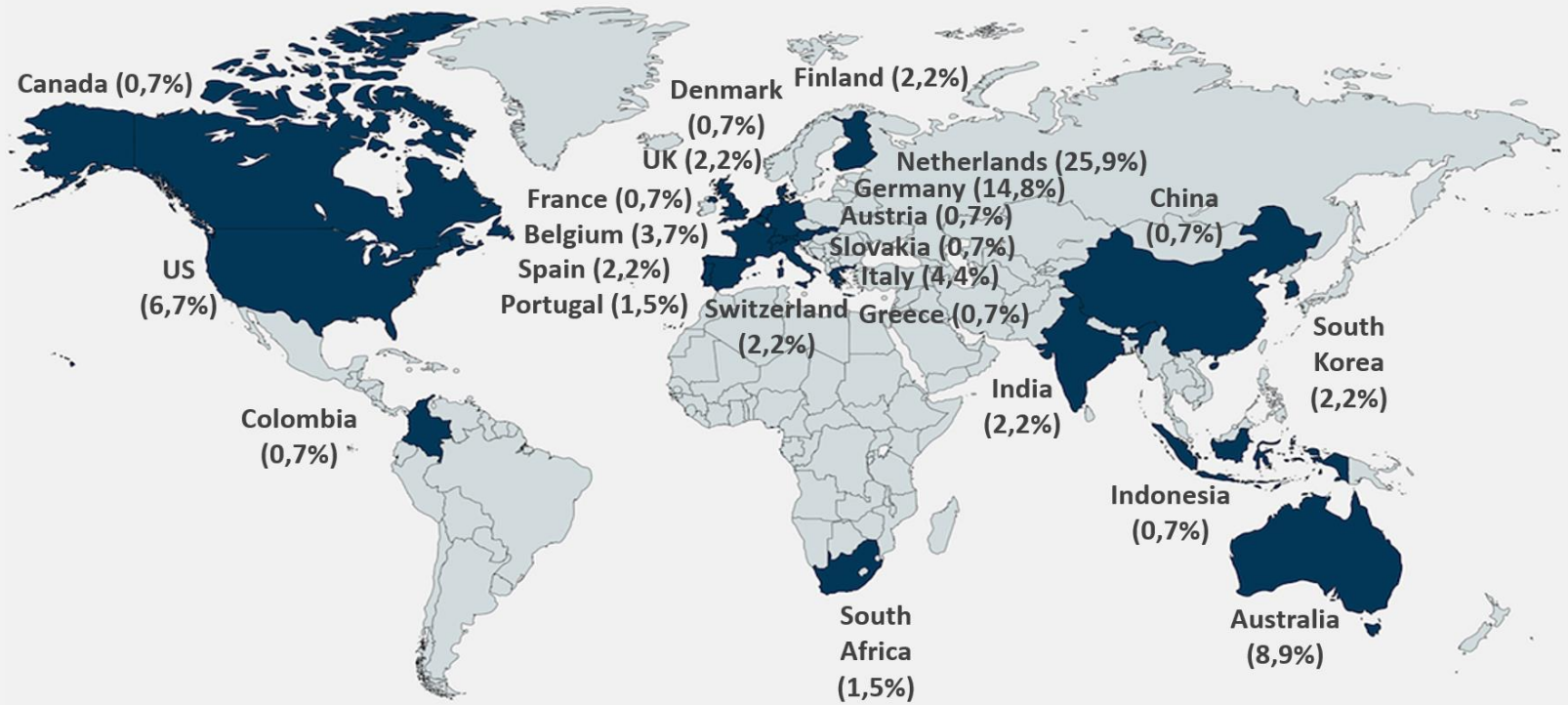
In general, the results of this study confirm that business projects relying on process mining tools and techniques are becoming more popular in recent years. In particular, the histogram shows that the peak achieved in 2014 still remains unreached; anyway after the slightly decrease of applications collected in 2015, the trend has increased again in 2016 moving close to the figures of two years earlier. At present, the cases collected in 2017 (2Q) are 11.



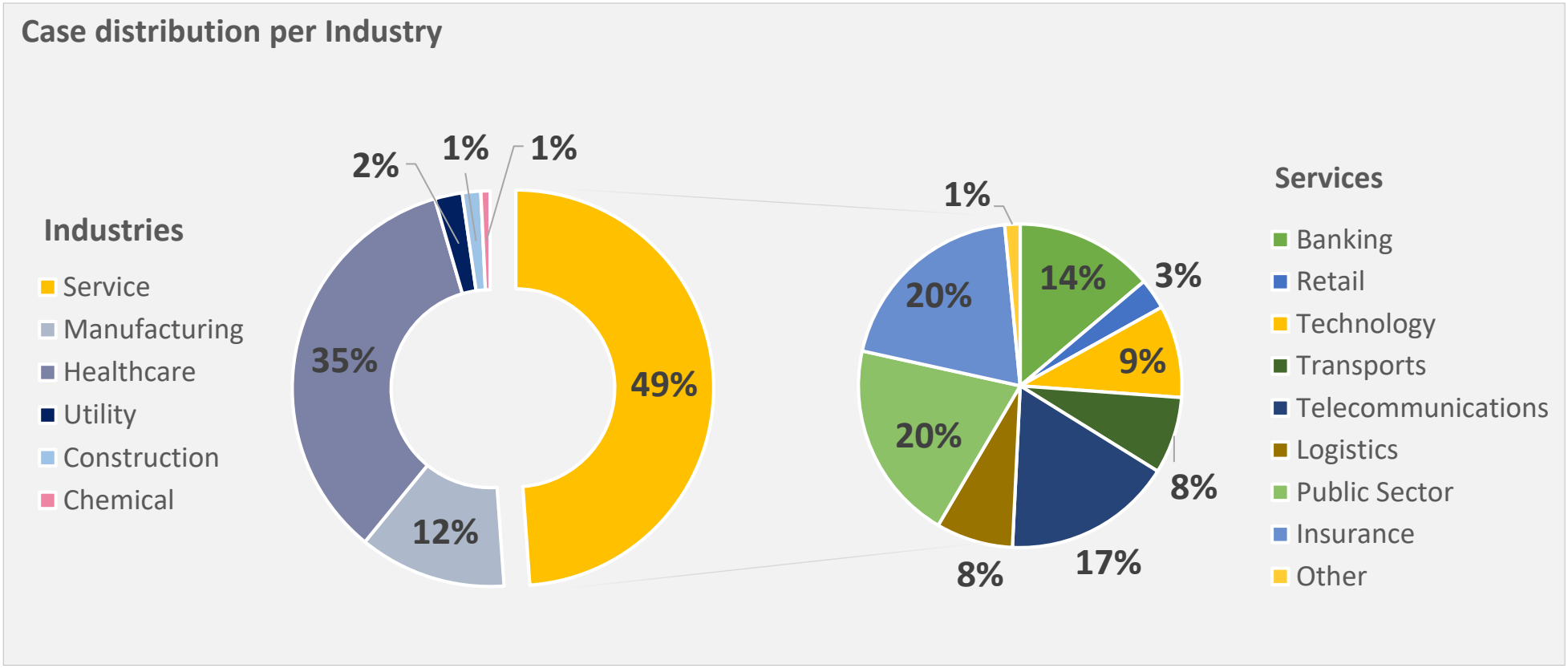
The worldwide cases distribution depicts a situation in which process mining's main users remain concentrated in Europe and in Australia. Indeed, more than 40% of the global process mining applications collected are located in Netherlands and in Germany (25,9% and 14,8%, respectively), partially thank to the spread of the Industry 4.0 master plans and initiatives that are taking place.

in several European Countries in recent years. On the other hand, the Australian Country alone is accountable for another 8,9% of the applications. These global results emphasize the prior role of Universities and excellence innovation Centres in promoting the education and the research of process mining, as well as supporting practical applications in business contexts.

Case distribution per Country



Similarly to past year results, in accordance to the data, the most frequent usage of process mining tools and techniques still remains in organizations operating in **services** (49%), followed by the ones working in **healthcare** (35%) and **manufacturing** (12%). In particular, the cases listed in the service group are analysed more in depth in the following pie chart.



References and Contacts

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