



Lars Reinkemeyer

Process Intelligence in Action

Taking Process Mining
to the Next Level

 Springer

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*Dedicated to all the Process Intelligence
Aficionados and Change Makers who are
passionate about changing the Game.*

Foreword



Digital Transformation and Process Intelligence: A Leadership Responsibility

In 2019, Celonis was the winner of the Game Changer Award in the category “Operations of the Future.” As a member of the jury, I was immediately enthusiastic about the enormous potential of Process Mining, the impact on productivity increases, and the power to transform toward excellent processes.

Thanks to state-of-the-art Process Intelligence, processes can be efficiently analyzed and optimized within and across business functions very fast. This not only provides companies with complete transparency of the quality of actual process flows; it allows for a data and fact-based foundation to realize enormous value potential in the shortest possible time for a wide variety of business areas and functions.

For me, modern leadership requires—in addition to necessary technical changes and new methods—a continuous and future-oriented evolution of goals and corporate culture. A successful and holistic transformation is the prerequisite for the ultimately decisive competitive advantage of an organization.

Digitalization and innovation are the key drivers of progress and transformation in today’s business world and thus for entrepreneurial success. In a digital enabled

organization, leadership's success is fueled by its capability to transform based on insights from real-time data.

The unique advantage of Process Intelligence results from the fact that this technology can be used across all industries and departments, leading to significant process improvements and value generation in many units within the company. To this respect, companies and users particularly appreciate the rapid scalability of Process Intelligence.

Dr Lars Reinkemeyer is an international expert in the field of Process Mining and Process Intelligence. This book serves as a compass, offering guidance, inspiration, and practical advice for navigating the opportunities, challenges, and pitfalls of this journey.

Former CEO of BMW Group
Munich, Germany

Harald Krüger

Foreword



I first discovered Process Mining in 2017. At the time, I was the president of SAP Japan, the Japanese subsidiary of SAP SE, where I had been working for about 20 years. For many years, I was involved in applying data and IT to corporate management through the proposal and provision of ERP, CRM, and Business Intelligence to customers. By standardizing operations, we create an enterprise IT infrastructure that generates standard and usable data, and we maximize profits and strengthen the enterprise by making various business decisions in real time as much as possible. It has been a very challenging job and I have been involved in the strategic IT of many of Japan's leading customers, but it has also been 20 years of dealing with "IT that doesn't quite deliver tangible results, especially impacting Profit & Loss."

Then I learned about Process Mining. Bringing the visibility of a new axis of "Why is it happening?" and "In what cases?" to the world of Business Intelligence, where the visibility of "What's happening?" was limited, makes it easier than ever to drive the real causes of challenges and appropriate actions. Moreover, rather than relying on on-site interviews and human hypothesis-building capabilities, the combination of transaction data and timestamps recorded in the IT system alone can provide sufficient visualizations of business processes and performance to approximate the true causes of problems.

When I met Bastian Nominacher, Co-CEO of Celonis, I said, "ERP and other business applications can be leveraged with Process Mining to realize their inherent value and potential." Two years later, in February 2019, I had the honor of taking the

stage at a press conference in Tokyo to announce the establishment of Celonis in Japan.

Having moved to Fujitsu as CIO in 2020, I am now implementing the hypothesis that “combining business applications with process mining maximizes enterprise IT ROI.” Founded 88 years ago, Fujitsu has 124,000 employees worldwide and 3.7 trillion yen in sales. Like other large companies, it faces challenges in its business processes and IT systems, which are complex and subject to efficiency challenges. There are 60 different IT systems running just through the buying process. These separate IT systems, built by region, country, and business unit, are spewing subtly different and distinct data that impedes visibility across the enterprise. With more than 4000 business applications running globally, the Fujitsu Group is hampering the ability to use data in its operations. The company is currently investing hundreds of millions of dollars in a management initiative called “OneFujitsu” to design global standard processes for each major business process and create an IT system that can instantly understand global business conditions. Process Mining is one of the themes at the core of this effort and has been trialed and delivered on several projects over the past 3 years. Once global standardization has been achieved for each major business process, such as finance, purchasing, ordering, service delivery, project management, and human resources, Process Mining can monitor all transactions at all times, providing forward-looking visibility and control of changes, challenges, and possibilities in various businesses. With this capability, I believe that there will be a significant difference in performance between companies that achieve Process Intelligence and those that do not, not only at the management level but also with each employee in the field.

The key is the following three sets:

1. Toolset: Work at the business application layer to implement standard business processes and structures that enable data-driven management and implementation of Process Mining, as exemplified by Celonis.
2. Mindset: The potential of Process Mining and the digital literacy and mindset of CEOs, CFOs, CHROs, CROs, and CMOs who work strategically on business processes and IT systems. CIO/CDO awareness and actions to foster and provide leadership.
3. Skillset: Gain the ability to implement Process Intelligence, both organizational and personal. The traditional separation of business analysts from IT data scientists will not maximize Process Mining’s capabilities.

From 1980 to the 1990s, there was a period in which Japanese companies achieved growth through “Kaizen,” the practice of making various issues better each day at the workplace. These were excellent results, but they were “analog” approaches that were challenging in scale due to the high level of attributes, culture penetration, and time required to develop human resources. Process Mining is a “digital” approach that scales rapidly globally with a standard common language that transcends the language and culture of “data” and a superior user interface.

Through its focus on the “three sets”—Toolset, Mindset, and Skillset—the company is looking forward to the strategic use of IT and data in management, which in turn can directly lead to corporate competitiveness.

We congratulate Dr Lars Reinkemeyer on the publication of *Process Intelligence in Action* and hope that as many companies as possible will implement its essence.

Fujitsu Limited Corporate
Executive Officer EVP, CDXO/CIO
Tokyo, Japan

Yuzuru Fukuda

Preface

The biggest reward for health professionals is to use personal experience and technologies such as x-ray to help people's health and support them in living a better life. The biggest reward for IT and business professionals is to use experience and technologies such as Process Mining and Process Intelligence to help companies increase efficiency, transform, and realize value. To date, companies have realized multiple billions of dollars and euros of value, accountable to the usage of Process Mining and thus rewarding companies as well as engaged professionals. And this reported value is only the tip of the iceberg, as many companies have additionally realized non-tangible values, e.g., in the form of increased customer satisfaction, employee satisfaction, or reduction in CO₂ emission.

Statements from companies such as BMW, that almost every single produced car is touched by Process Mining, give a flavor of the impact of this innovative capability. Companies like ABB, Bosch, and Siemens have been using Process Mining for many years—partially for more than 10 years—to drive continuous marginal improvements with some of them realizing hundreds of millions of value. They regularly find areas for continuous improvements, in established core processes such as Procurement, Supply Chain, and Sales Order processing as well as in industrial core processes, taking marginal steps every day in the endless quest for process perfection, productivity improvement, and value realization.

Value is not only realized by large organizations with huge numbers of processes, complex system landscapes, millions of process variants, and trillions of events. Midsize companies like Allstate, athenahealth, BSH, MANN&HUMMEL, Zeiss, and many more take equal benefits from turning process complexity into an opportunity for efficiency increase realized with Process Intelligence.

But how do these companies realize value? How do they turn insights from Process Mining into Process Intelligence, initiate actions, and impact, which ultimately materializes in the form of tangible value? What are the secrets to apply a technological capability not only for process experts, but for the benefit of all levels of an organization from top management to hundreds or thousands of business users? How can you ignite on your journey and get started, step by step? What is the impact of GenAI? This book will provide you with answers to all these questions and many more.

Process inefficiencies have many aspects and implications. Did you ever wonder why digital native organizations such as Amazon allow you to place an order on the fly, which is swiftly delivered within 24 h, while other companies need to employ legions of people for processing purchase and customer orders? Why there are still so many people wasting time to manually execute repetitive process steps and working on mundane activities, which do not create any value added for the organization? The good news is that this has already improved tremendously in the last couple of years. Many companies have seen impressive progress, and this book is all about sharing such experiences and providing best practices from the people who have done it hands-on.

Twelve transformation and CoE leaders share their experiences as samples from innovative companies around the world, different industries, and different perspectives. These samples and multiple practitioners' quotes provide testimonials not only to the power of this capability but also to the unique, open, and trustful culture which has grown in the global community.

In addition to these practical use cases which are presented in Part II of the book, Part I and III complement the practitioners' insights with my own experiences, building on 10+ years working with Process Mining and Process Intelligence: the first 7 years leading the Process Mining practice at Siemens, complemented by 3 years as a Transformation Advisor and Chief Evangelist at Celonis. During these years I had the opportunity to advise hundreds of companies at different stages in their journey, with many companies achieving their ambitious aspirations.

This book follows a similar structure to my first book *Process Mining in Action*¹ and complements this publication from 2020 in three aspects:

1. While the first book has a strong focus on the fundamentals of Process Mining, this book expands on intelligent process execution and organizational implications.
2. The use cases in this book go beyond standard use cases such as P2P and O2C, but rather focus on more sophisticated topics such as supply chain optimization, organizational impact, and transformation.
3. GenAI as the most disruptive power of our time has a significant impact so that the outlook in Part III provides new perspectives.

This book has been written independent from any vendor, aiming to educate on the category of Process Intelligence and the power of data to support process transparency and digital transformation. All customer samples, which are not explicitly quoted with a person, are taken from public conferences, events, workshops, or other openly available sources.

¹ <https://link.springer.com/book/10.1007/978-3-030-40172-6>

This book is written ...

- By practitioners for practitioners: easy to read, easy to understand, easy to adopt for pragmatic actions. Many parts of the book provide operational, hands-on tips for those who want to accelerate process transformation in their own organization.
- For transformation and CoE leaders, who want to learn from peers and understand how they can improve impact in their own organization.
- For senior executives, who want to get an understanding of Process Intelligence and how they can engage to make this capability a transformation booster.
- For consultants who want to learn about practical best practices.
- For anybody who wants to understand how to turn insights into action and value.
- For anybody interested in GenAI and the impact on Process Intelligence.
- For Change Makers who want to become Game Changers.
- For beginners as well as advanced readers.
- To evangelize on the category of Process Intelligence.

Outline of the Book

Part I presents the evolution from Process Mining to Process Intelligence, setting the stage with an easy-to-understand analogy from the evolution of x-ray. The following chapters guide the reader step by step how to ignite and get started, how to drive adoption, and which are the critical success factors to scale a digital transformation. For value—as the name of the game—a proven methodology from identifying, framing, and realizing is presented, supported by real-life examples. To make it all happen, best practices on operating models and CoEs are discussed as well as how a digital transformation can be supported. As success never comes without failure, unsuccessful examples are exposed in Chap. 8. Part I is supported with numerous quotes from practitioners and summarized with 10 key learnings in Chap. 9.

Part II presents 12 use cases written by practitioners and transformation and CoE leaders who have applied PI in their respective organizations and written the chapters in their spare time. All use cases have been written independent from any particular software vendor, with a focus on evangelizing the category and showcasing how companies leverage Process Intelligence to realize value. Many of the use cases contribute additional practical examples to topics described in Part I, such as Operating Model and CoE (BMW), Digital Transformation (Reckitt), System Transformation (Bosch), Community (Ingka), Supply Chain (Siemens), or Value Methodology (PepsiCo).

Figure 1 provides an overview of the contributing companies and topics which are described in detail in Part II:

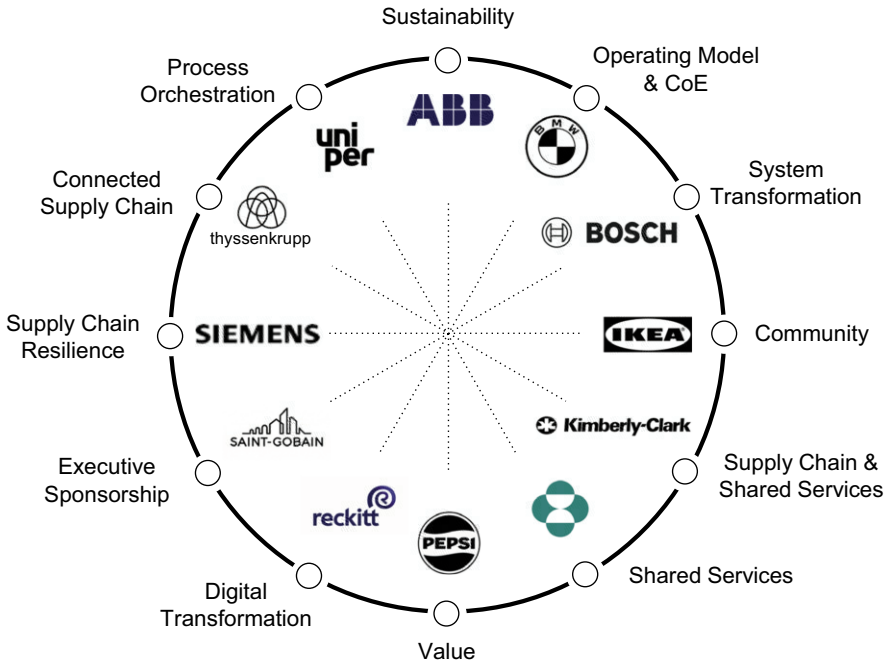


Fig. 1 Use cases

Part III provides an outlook on the future of Process Intelligence, from an academic and an operational perspective. Wil van der Aalst, as the inventor and godfather of Process Mining, shares his academic perspective, discussing the importance of Object-Centric Process Mining (OCPM) for unleashing ML and AI. The last chapter provides scenarios on the future of intelligent business execution and the impact of GenAI on technology, platforms, and organizations. The imagined scenarios shall give a taste of the future while also discussing challenges and limitations of LLMs and AI. This chapter is building on many discussions with thought leaders and visionary experts. While the future is always difficult to predict, this part will hopefully provide the reader with some inspirations for the exciting journey ahead.

Munich, Germany

Lars Reinkemeyer

Acknowledgments

Writing a book is like shaping a sculpture: you start with an idea, a rough sketch, and imagining the overall outline. The first draft table of contents forms the contour and sets an initial structure, which is continuously filled with more detailed ideas. As the single chapters take shape, the overall red thread must be considered for the benefit of the overall oeuvre. All parts subsequently come together and form a concise work, which is hopefully appreciated by the reader's eyes and helps to evangelize the category of Process Intelligence.

The first acknowledgment goes to the contributing authors, who have not only achieved amazing impact within their respective organizations but also openly shared their individual experiences. It is contributors like you who are the backbone of a global, innovative community, which so powerfully collaborates and inspires each other.

Similarly, the numerous quotes from experienced practitioners give testimony to this active community—a global community of Change Makers, passionate about changing the game, who help evangelizing on the topic. Interacting with this community is highly motivating and provides a continuous source of inspirations. The regular CelCoE community workshops are at the heart of this interaction and provide an amazing, open, and trustful exchange.

The two forewords from Harald Krüger and Yuzuru Fukuda not only provide strategic guidance but are a distinction for Process Intelligence. Your patronage exemplifies how modern management can take advantage of the power of data to drive sustainable transformations.

The Celonis team has not only been extremely supportive during the period of writing this book, but also an infinite source of experience and innovation. Acknowledgment goes to Gunther Rameseder for providing the liberty to write the book, André Heinz for support in navigating contractual implications, and the thought leaders Martin Klenk, Jeff Naughton, Cong Yu, and Eugenio Cassiano, without whom the outlook described in Part III would have been pure hallucination.

On the academic side, Wil van der Aalst invented the topic more than two decades ago and never seems to get tired of leading with innovations such as OCPM. Tom Davenport was a role model for translating complex constellations into an easily digestible form and make it adoptable for daily management, similar to Maximilian Röglinger with his insatiable hunger for pushing the organizational evolution.

My best friends Bernd Brockmeier and Jörg Breuer have spared neither time nor effort to join me in my author’s retreat and contributed many great ideas during numerous discussions and with their invaluable proof reading. Similarly, my father has spent many hours in most probably exhaustive reading through the draft version, which was then perfected by Springer Press, represented by my editor Ralf Gerstner.

My family has—again—been highly supportive and endured my time off in the author’s retreat, far away from mind and sight.

Writing this book has been an exceptional adventure and was only possible in an exceptional author’s retreat in Jamaica, provided by Daniel Eugster. Last but not least, Ian Fleming has been a role model for writing a book on that magic island.



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About the Editor



Lars Reinkemeyer is Chief Evangelist at Celonis. In this role he advocates Process Mining and Process Intelligence and builds awareness and strong communities such as the “CeloCoE Champions League” bringing together companies which have realized >\$10 million value and the “CeloCoE Transformation League” for companies with >\$1 million of value realized. Since joining Celonis in 2021, he had the opportunity to advise hundreds of companies how to turn Process Mining Insights into Action and Value. His advisory focus is on digital transformation, operating models, CoEs, and sustainable value realization.

In 2020, he published his first book on *Process Mining in Action* with Springer Press.¹ In 2019/2020, he was visiting scholar at the University of California in Santa Barbara (UCSB) and guest speaker at Stanford Graduate School of Business. He is a regular lecturer at [FAU Erlangen-Nürnberg](#), [Hochschule St Gallen](#), [TUM](#), and has published in the *Harvard Business Review*.²

Until 2020 he was senior executive of Siemens AG and gained hands-on experience with Process Mining technology since 2014, when he established a central CoE which today supports thousands of Siemens colleagues across the whole value chain. He joined Siemens AG in 1994, right after he earned a master’s degree in business administration and a PhD from the University of Cologne.

¹ <https://link.springer.com/book/10.1007/978-3-030-40172-6>

² <https://hbr.org/2023/10/transform-business-operations-with-process-mining>

Abbreviations

AI	Artificial Intelligence
API	Application Programming Interface
A/P	Accounts Payable
A/R	Accounts Receivable
BI	Business Intelligence
BOM	Bill of Material
BPM	Business Process Management
BPMN	Business Process Management and Notation
BPO	Business Process Outsourcing
BTO	Build to Order
CCPI	Cross Company Process Intelligence
CDH	Cloud Data Hub
CDP	Carbon Disclosure Project
CoC	Center of Competence
CoE	Center of Excellence
CPG	Consumer Packaged Goods
CRM	Customer Relationship Management
CSR	Corporate Sustainability Reporting Directive
CTO	Chief Transformation Officer
DFG	Direct Flows Graph
DMGF	Data Management Governance Function
DPO	Days Payables Outstanding
DPT	Digital Process Transformation
DSO	Days Sales Outstanding
DTO	Digital Twin of an Organization
DTS	Digital Technical Services
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
ESG	Environmental, Social, Governance
ETL	Extract, Transport, Load
EWM	Enterprise Warehouse Management
e2e	end to end
GBS	Global Business Services
GDPR	General Data Protection Regulation

GenAI	Generative Artificial Intelligence
GHG	Greenhouse Gas
HCM	Human Capital Management
HR	Human Resources
IoT	Internet of Things
IIoT	Industrial Internet of Things
KPI	Key Performance Indicator
LLM	Large Language Model
LLS	Lean Six Sigma
MASH	Material Shortage
MES	Manufacturing Execution System
ML	Machine Learning
MRP	Manufacturing Resource Planning
MRT	Magnetic Resonance Tomography
NPS	Net Promoter Score
OCED	Object-Centric Event Data
OCPI	Object-Centric Process Intelligence
OCPM	Object-Centric Process Mining
OTIF	On time in full
O2C	Order to Cash
PI	Process Intelligence
PIG	Process Intelligence Graph
PIP	Process Intelligence Platform
PLM	Product Lifecycle Management
PO	Purchase Order
PoC	Proof of Concept
POTI	Process Organization Technology Information
PPI	Process Performance Indicator
PR	Purchase Requisition
P2P	Purchase to Pay
RCA	Root Cause Analysis
RDS	Relational Database Service
RFT	Right First Time
RoI	Return on Investment
RPA	Robotic Process Automation
SCM	Supply Chain Management
SLA	Service Level Agreement
SME	Subject Matter Expert
SPG	Slow Pay Gap
SQL	Structured Query Language
S2P	Source to Pay
UI	User Interface
UX	User Experience
VUCA	Volatility, Uncertainty, Complexity, Ambiguity
WMS	Workplace Management System

From Process Mining to Process Intelligence

“Process Mining is a method in data science and process management that focuses on analyzing business processes based on event logs. Essentially, it involves using specialized algorithms to gather insights from event logs that record business processes in enterprise systems. The primary goals are to discover, monitor, and improve real processes by extracting knowledge from event logs readily available in today’s information systems.” This rather factual and dry definition, formulated by ChatGPT, is sparing on the disruptive potential that Process Mining can generate for organizations to drive process efficiency and transformation. And it spares on the most important success factor for Process Mining, the human factor. In my own experience, a technology like Process Mining cannot be a panacea to resolve organizational and process inefficiencies, but it is always about the people who are essential for success. People, whom we call Change Makers as they consider inefficiencies not a failure, but an opportunity to initiate actions, drive change, and realize Value.

In order to tap into this factor, this book and in particular this Part I will focus less on technological capabilities, but more on the human and organizational factors, what it takes to evolve from Process Mining insights to Process Intelligence (PI) and generate impact for an organization. It starts describing the evolution from the dark ages, where no process insights were possible, to a digitally-enabled organization using the evolution of the medical x-ray as an analogy. It provides a step-by-step guide how to ignite and get started, how to drive user adoption and how to scale. Critical success factors are discussed, with many quotes and practical examples. For value—as name of the game—this part shows the dimensions how value is measured and provides a pragmatic path to value methodology. Centers of Excellence (CoE) and operating models are discussed in detail, complemented with a chapter explaining why PI is the perfect single source of truth to support process and system Transformation in a digital age. This part concludes with challenges, pitfalls, and failures to spare the reader from paying their own apprentice’s premium.

Lars Reinkemeyer

Abstract

Similar to x-Ray, Process Mining has gone through several steps from invention to understanding, adoption and impact. The evolution of Process Mining is described in four phases—building on an analogy with x-Rays—from dark ages to first light, turning insights into action and digital enablement. Process Intelligence is defined as an evolutionary step to Process Mining, going beyond process insights and facilitating intelligent process execution. The Process Intelligence Platform is introduced as the central nervous system of an organization, one common semantic layer bringing together data, process knowledge and people, allowing for continuous business process optimization.

Processes are the lifeblood of an organization. As per Tom Davenport “Processes are the structure by which an organization does what is necessary to produce value for its customers.”¹ ChatGPT defines processes as “a set of structured activities carried out by people or systems in a sequence or as a workflow to achieve a specific organizational goal. Processes are fundamental to a company’s operations, as they ensure that various tasks are performed efficiently and effectively”.

Though processes are typically well designed, they often become inefficient in daily operations, as single activities do not follow the predefined and most efficient path. Instead, they leave the so-called “happy path”, which defines the optimal and most efficient way a process should take. Implications of these deviations are

¹https://en.wikipedia.org/wiki/Business_process

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Evolution

The bigger Picture

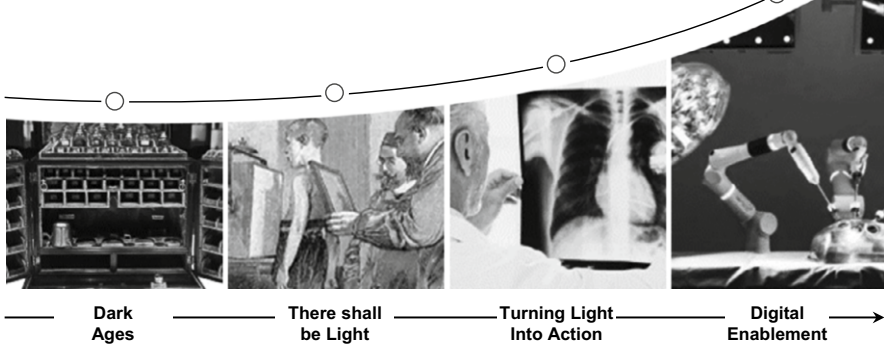


Fig. 1.1 Evolution of Process Mining

manyfold, such as a customer shipment not arriving at the confirmed delivery date, a supplier payment cleared too late, a customer order reworked multiple times—which means manually touched and changed repeatedly. To identify and remediate these types of inefficiencies, Process Mining has evolved during the last 20+ years as a kind of process x-ray for organizations.

Since Process Mining was invented at the end of the last millennium, it has gone through several stages of evolution as visualized in Fig. 1.1. From academic research spreading light into the previously dark ages, to companies turning this light into action, and ultimately towards a digital enablement of processes and organizational efficiency.

This chapter sets the stage by explaining the evolution of Process Mining using an analogy of medical x-rays.

Dark Ages

For 99% of the time of its existence, mankind had no possibility to observe and to understand what was actually happening in a human body. In those dark ages people had to make assumptions and make medical decisions based on what they thought would be right, without insights into the full complexity of a human body. Early medics had to guess the root causes of diseases and pain—such as toothache—and might only have some abstract model of what the human body's interior might look like.

For 99% of the time of its existence, enterprises had no possibility to observe and to understand what was actually happening in a daily process. In those dark ages people had to make assumptions and make business decisions based on what they thought would be right, without insights into the full complexity of a process flow. Early process experts had to guess the root causes for process inefficiencies—such

as late deliveries or late payments—and might only have some abstract model of what the business process flow might look like.

In a first attempt to address these challenges, the concept of “Business Process Modelling” (BPM) was invented in the 1960s.² But processes only became a new productivity paradigm in the 1990s, when companies started to think in processes rather than functions and procedures.³ This came in line with the rapid growth of ERP systems in the 1990s, which were established to allow for an integrated management of business processes. ERPs and other systems such as CRM, HCM, MRP, SCM, PLM or WMS were designed to support transactional activities. They store and execute business information, thus facilitating information exchange based on single event logs. While BPM is used to define and model how processes are supposed to flow, reality often shows significant deviations of process flows within and across those systems.

Despite progress in BPM, it was not possible during these initial dark ages to visualize how a process was actually executed. Process models could only support as an abstract representation of what people thought the process should look like, sometimes enhanced with examples, which might be collected with stopwatching and interviews. However, this approach was far from a fair representation of actual process flows. A perfectly designed purchasing process for a part worth \$5 might have one single approval step in the abstract BPM model but turn out to have more than 10 distinct approval steps in real life—as many companies would discover with the new light provided by Process Mining.

There Shall Be Light: From the Dark Ages to Process Mining

Wilhelm Röntgen started to work on x-rays in 1895, when he produced and detected electromagnetic radiation for the first time in a wavelength known as x-rays. This led to significant advancements in understanding the internal complexity of the human body. He is considered the father of diagnostic radiology, the medical specialty which uses imaging to diagnose disease.⁴ He earned the inaugural Nobel Prize in physics in 1901.

Wil van der Aalst started to work on Process Mining in 1998, when he developed the first Process Mining algorithms (e.g., to discover Petri nets from event data). This led to significant advancements in understanding the complexity of actual business processes. He is considered the Godfather of Process Mining, the event log-based visualization of process flows. To date, he has earned multiple awards, e.g. the Alexander-von-Humboldt Professorship, Germany’s most valuable research award.

²Williams, S. (1967) “Business Process Modeling Improves Administrative Control,” In: *Automation*. December 1967, pp. 44–50.

³Asbjørn Rolstadås (1995). “Business process modeling and re-engineering”. In: *Performance Management: A Business Process Benchmarking Approach*. p. 148–150.

⁴https://en.wikipedia.org/wiki/Wilhelm_Röntgen