

An Internship Report

on

## **Process Mining Virtual Internship**

Submitted in partial fulfilment of the requirements

for the award of the degree of

## **BACHELOR OF TECHNOLOGY**

in

## **Computer Science and Engineering (Data Science)**

by

**T. HEMA SINDHU**

**(214G1A3224)**



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING  
(DATA SCIENCE)**

**SRINIVASA RAMANUJAN INSTITUTE OF TECHNOLOGY  
(AUTONOMOUS)**

(Affiliated to JNTUA, accredited by NAAC with 'A' Grade, Approved by AICTE,  
New Delhi & Accredited by NBA (EEE, ECE & CSE))  
Rotarypuram village, B K Samudram Mandal, Ananthapuramu-515701.

**2023 - 2024**

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**Department of Computer Science & Engineering (Data Science)**



**Certificate**

This is to certify that the internship report entitled “**Process mining virtual Internship**” is the bonafide work carried out by **T. HEMA SINDHU** bearing Roll Number **214G1A3224** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering (Data Science)** for three months from May 2023 to July 2023.

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**EXTERNAL EXAMINER**



# **PREFACE**

The All India Council for Technical Education (AICTE) is a statutory body, and a national-level council for technical education, under the Department of Higher Education. Established in November 1945 first as an advisory body and later on in 1987 given statutory status by an Act of Parliament, AICTE is responsible for proper planning and coordinated development of the technical education and management education system in India.

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## **Business Activities:**

- Regulation and Accreditation
- Maintain standard norms
- Allocate Funds
- Grant approvals to institutions
- Ensure integrated developed
- Evaluate courses and programs
- Entrepreneurship Promotion

## ACKNOWLEDGEMENT

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**T. HEMA SINDHU**

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## **LIST OF ABBREVIATIONS**

BI	Business Intelligence
EMS	Execution Management System
KPI	Key Performance Indicator
PQL	Process Query Language
ROI	Return on Investment

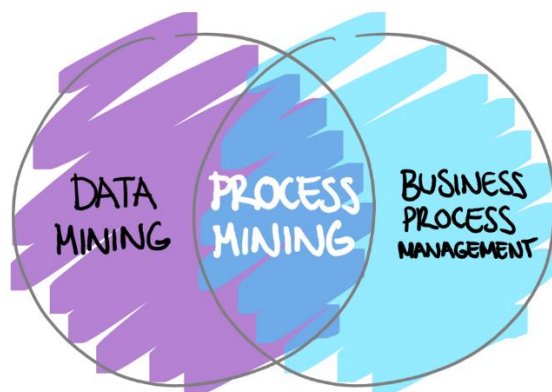


# CHAPTER 1

## INTRODUCTION

### 1.1 What is Process Mining?

Process mining is a data-driven approach to analyze, visualize, and improve business processes based on the event data captured from various information systems. It involves extracting valuable insights from this event data to understand how processes are actually executed in real-world scenarios. By leveraging techniques from data mining, machine learning, and process modeling, process mining aims to provide organizations with a clear and accurate understanding of their operational processes, enabling them to identify inefficiencies, bottlenecks, compliance issues, and improvement opportunities.



**Fig. No. 1.1: Overview of Process Mining**

In traditional business process management, processes are often designed based on assumed models, and any deviations from these models are addressed reactively. Process mining, on the other hand, offers a data-driven approach. It begins with the raw event data that systems capture during the execution of processes. This data might include timestamps, user interactions, status changes, and more.

## 1.2 Components of Process Mining

- **Event Data:** Event data is the raw data collected from IT systems during the execution of business processes. It includes information about actions taken, timestamps, users involved, and relevant context.
- **Conformance Checking:** Once a process model is created, it can be compared to the actual event data to check for deviations between the intended process and its actual execution. This helps identify non-compliance, inefficiencies, and variations.
- **Enhancement and Optimization:** Process mining provides insights into process inefficiencies and bottlenecks. Organizations can then use this information to optimize processes, streamline workflows, and allocate resources more effectively.
- **Process Monitoring:** Process mining allows for real-time or near-real-time monitoring of processes. It helps organizations detect deviations from expected process flows, enabling timely intervention and correction.
- **Performance Analysis:** By analyzing event data, process mining can measure process performance metrics, such as cycle times, waiting times, and throughput. This data-driven analysis helps in understanding the actual efficiency of processes.
- **Predictive Analysis:** Some advanced process mining approaches can predict future process behaviours based on historical data. This can assist in proactive decision-making and problem prevention.
- **Visibility into Actual Processes:** Process mining enables organizations to gain an accurate and unbiased view of how their processes are executed in reality. This visibility is crucial for identifying discrepancies between designed processes and actual execution, highlighting areas of inefficiency, bottlenecks, and deviations.
- **Data-Driven Decision Making:** By analyzing event data, organizations can make informed decisions based on real-world evidence rather than assumptions. This data-driven approach enhances the precision and effectiveness of decision-making processes.
- **Process Optimization:** Process mining helps organizations identify bottlenecks, redundant steps, and areas of inefficiency within their processes.

- **Compliance and Auditing:** Process mining aids in compliance monitoring by comparing the actual process executions to established rules and regulations.
- **Root Cause Analysis:** When issues arise within a process, process mining can help pinpoint the root causes. This enables organizations to address underlying problems rather than just addressing symptoms, leading to more effective solutions.
- **Continuous Improvement:** With continuous monitoring and analysis, process mining supports ongoing improvement initiatives. Organizations can iteratively refine their processes, respond to changing market conditions, and adapt to evolving customer need

### 1.3 Importance of Process Mining

Increasing sales isn't the only way to generate revenue. Six sigma and lean methodologies also demonstrate how the reduction of operational costs can also increase your return-on-investment (ROI). Process mining helps businesses reduce these costs by quantifying the inefficiencies in their operational models, allowing leaders to make objective decisions about resource allocation. The discovery of these bottlenecks can not only reduce costs and expedite process improvement, but it can also drive more innovation, quality, and better customer retention. However, since process mining is still a relatively new discipline, it still has some hurdles to overcome. Some of those challenges include:

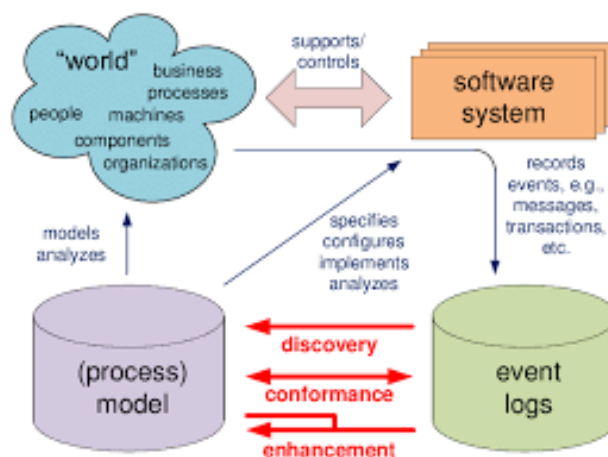
- **Data Quality:** Finding, merging and cleaning data is usually required to enable process mining. Data might be distributed over various data sources. It can also be incomplete or contain different labels or levels of granularity. Accounting for these differences will be important to the information that a process model yield.
- **Concept drift:** Sometimes processes change as they are being analysed, resulting in concept drift

## CHAPTER 2

### TECHNOLOGY

#### 2.1 Process Mining Techniques

Process mining is a technology-driven approach to analysing and visualizing business processes using event data. It involves the extraction of knowledge from event logs recorded by information systems. Several technologies and techniques are employed in the process mining. It is an integral part of data science, fuelled by the availability of event data and the desire to improve processes. techniques use event data to show what people, machines, and organizations are really doing. Process mining provides novel insights that can be used to identify the execution paths taken by operational processes and address their performance and compliance problems.



**Fig. No. 2.1: Techniques of Process Mining**

Process mining typically involves several stages to analyse and improve business processes. Process mining reads this data, converts it into an event log, and then create visualizations of the end-to-end process, along with insightful analytics. These technologies work together to provide insights into process execution, bottlenecks, inefficiencies, and opportunities for improvement. Here are some key technologies used in process mining.

Process mining typically involves several stages to analyse and improve business processes. These stages can be summarized as follows:

- **Data Collection:** Gather event data from various sources, such as databases, logs, or application systems.
- **Event Log Preparation:** Organize the data into event logs that record events, activities, timestamps, and other relevant information. Enrich the event log with additional context or attributes that can aid in the analysis.
- **Process Discovery:** Use process discovery algorithms to generate a process model based on the event data. Common algorithms include the Alpha Miner, Heuristic Miner, Inductive Miner, and more.
- **Conformance Checking:** Compare the discovered process model with the event log to identify discrepancies, deviations, and non-compliance with the expected process flow. Investigate the causes of process deviations and identify areas for improvement.
- **Enhancement and Optimization:** Analyse the discovered process model to identify bottlenecks, inefficiencies, and opportunities for optimization. Use simulation tools to test various process improvement scenarios and assess their potential impact.
- **Monitoring and Continuous Improvement:** Implement real-time process monitoring to detect and address deviations as they occur. Define and track KPIs to measure the ongoing performance of the process.
- **Communication and Reporting:** Create visual representations of the process models, conformance analysis results, and performance metrics to communicate findings effectively. Develop reports and dashboards that provide insights into the process and its performance for various stakeholders.
- **Feedback Loop:** Continuously collect feedback from process users and stakeholders to identify further opportunities for enhancement and refinement.

## 2.2 Different Types of Technology

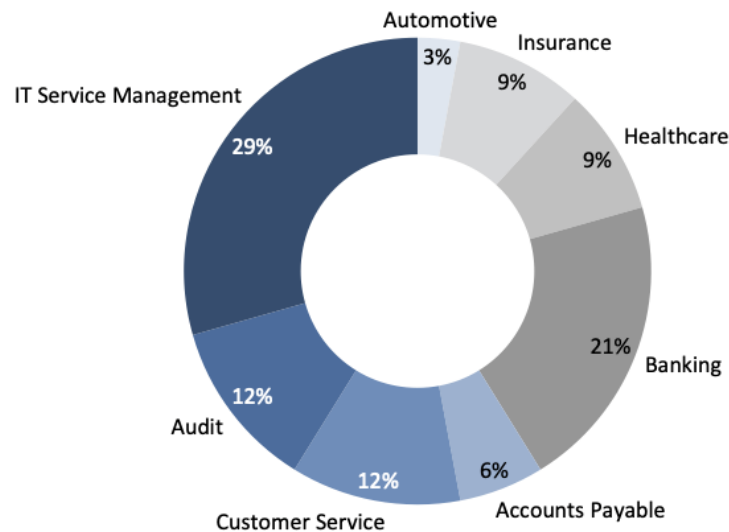
- **Data mining:** Data mining is the process of extracting knowledge from data. In the context of process mining, data mining is used to identify patterns and trends in event data.

- **Machine learning:** Machine learning is a type of artificial intelligence that allows computers to learn without being explicitly programmed. In the context of process mining, machine learning is used to build models that can predict future behaviour of processes.
- **Process modeling:** Process modeling is the process of representing a process in a graphical or textual form. In the context of process mining, process modeling is used to create a graphical representation of the actual process, as opposed to the as-designed process.
- **Business intelligence:** Business intelligence (BI) is a set of technologies and processes for collecting, analysing, and providing insights into data. In the context of process mining, BI is used to visualize and explore the results of process mining analysis.

## CHAPTER 3

### APPLICATIONS

Process mining finds applications in various industries and business areas due to its ability to provide valuable insights into how processes actually work. Some of the key applications of process mining include:



**Fig. No. 3.1: Applications of Process Mining**

- **Financial Services:** Because of the rise in transaction volume and the digitization of more industries, aberrant activity is harder to detect using manual methods. Companies in the financial services sector have the chance to continually and thoroughly identify issues within high-volume processes thanks to process mining, which is a solution to the increased regulatory and audit requirements.
- **Telecommunications:** activations become more and more automated, there is a greater danger of unsuccessful activations. When telecom companies get more orders, process mining gives them the chance to identify pricey issues and client blowback in their Order-to-Activation processes.
- **Healthcare:** The risks associated with preserving population health and achieving individual patient journey objectives rise as data about patient experiences and results keep growing. organizations dealing with the exponential growth of data.
- **Retail:** Due to technology or process problems, retail businesses have seen expensive consumer fallout from complicated e-commerce operations. Process

mining assists merchants in ensuring that consumers can complete transactions efficiently and without issues despite rising transaction volumes.

- **Digital Transformation:** Process mining is frequently used in larger-scale digital transformation initiatives because it can give you the precise insights needed for process improvement, allowing systems to run more quickly, smoothly, and efficiently, as well as objective data-driven insights into the causes of delays and inefficiencies within business processes.

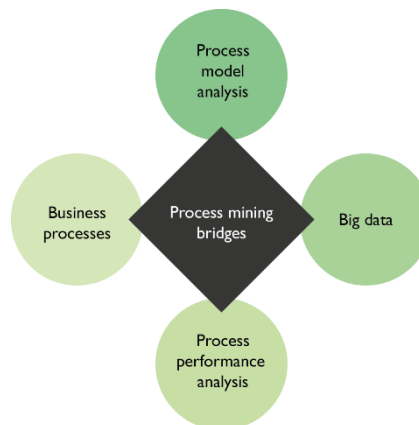


## CHAPTER 4

### MODULES

#### 4.1 Process Mining Fundamentals

Process mining is an analytical discipline for discovering, monitoring, and improving processes as they actually are and not as you think they might be. Process Mining works by extracting knowledge from event logs (also called digital footprints) readily available in today's information systems, in order to visualize business processes—and their every variation—as they run. The Execution Management System (EMS) extends process mining by executing on insights automatically and orchestrating your existing technologies



**Fig. No. 4.1: Process Mining Bridges**

It involves extracting insights from event data to understand how processes function, identifying bottlenecks, inefficiencies, and opportunities for optimization. Key components include data extraction, process discovery, conformance checking, and process enhancement. Fundamentals of process mining refer to the core concepts and principles that underlie the analysis and improvement of business processes using process mining techniques. It involves extracting insights from event data to understand how processes function, identifying bottlenecks, inefficiencies.

## 4.2 PQL Queries

PQL (Process Query Language) Queries are an essential component of process mining. They allow analysts to extract valuable insights from process data. PQL Queries enable you to explore and analyze process behavior, identify bottlenecks, measure performance, and discover patterns within the data. By using PQL Queries, you can ask specific questions about your process and obtain meaningful answers.



**Fig. No. 4.2: PQL Queries**

The Process Query Language (PQL) is a domain-specific language tailored towards a special process data model and designed for business users. PQL enables the user to translate process-related business questions into queries, which are then executed by a custom-built query engine. PQL covers a broad set of operators, ranging from process-specific functions to aggregations and mathematical operators. Its syntax is inspired by SQL, but specialized for process-related queries

## 4.3 Review and Interpret Analyses

Most businesses face numerous improvement opportunities, also called value opportunities—inefficiencies in their processes that prevent them from realizing their full potential. Of course, they can address these value opportunities by improving how the process runs. It turns out they're usually aware of some, not all of the value opportunities. In addition, they may have incorrect assumptions about the cause of certain inefficiencies. Some organizations spend their resources trying to reconstruct the process only to see pieces of the entire picture, and only at a certain point in time.

Others use the digital footprints from their transactional systems to get an objective, real-time perspective on their process. Congrats, your organization is of the latter type! When interacting with the dynamic visual representation and drilldown tools such as tables and charts, one can take an exploratory approach or a confirmatory approach. An exploratory approach is one where you simply explore the data and see what value opportunities jump out at you. You're diving into the data without specific expectations and with an open mind. Analysis tools such as the Process Explorer, the Variant Explorer, and the Conformance checker are ideal for this.

#### 4.4 Execution Management System (EMS)

An Execution Management System (EMS) in the context of process mining typically refers to a system or software used to manage, monitor, and optimize the execution of business processes within an organization. Process mining, in this context, plays a crucial role in analyzing and improving these processes. Here's how an EMS and process mining can be interconnected:

- **Data Capture and Event Logging:** An EMS captures and logs events, activities, and transactions that occur during the execution of various business processes. These events may include user interactions, system actions, timestamps, and other relevant data. Process mining relies on this event data to analyze how processes are executed in practice.
- **Process Discovery:** Process mining techniques are applied to the event data captured by the EMS to create visual representations of the actual processes, known as process models. These process models provide insights into how processes are performed in reality, as opposed to how they were designed to be executed.
- **Performance Monitoring:** The EMS continuously monitors the execution of processes and records performance metrics, such as process duration, bottlenecks, and resource utilization. Process mining tools can use this data to provide real-time insights into process performance and identify areas that require immediate attention or optimization.
- **Process Analysis and Optimization:** Process mining allows organizations to analyze the discovered process models and performance data to identify inefficiencies, deviations from the intended process flow.

- **Compliance and Audit Trails:** An EMS often keeps detailed audit trails of process executions for compliance and regulatory purposes. Process mining can be used to ensure that processes are executed in compliance with established standards and regulations by analyzing the event data for deviations and non-compliance issues.
- **Continuous Improvement:** By combining the insights from process mining with the capabilities of the EMS, organizations can implement a cycle of continuous process improvement. They can make data-driven decisions to optimize processes, reduce costs, improve efficiency, and enhance the overall quality of their operations.

## 4.5 Process Mining transparency

Process mining is a process management technique. It aims to discover, monitor and improve process flows by extracting readily available knowledge from information systems event logs. Process mining provides companies with complete visibility into how processes really work. With these insights, companies can then identify opportunities for process optimization. Transparency in process mining refers to the ability to provide clear and understandable insights into business processes and their execution. It involves making the process mining results, analysis, and methodologies transparent to stakeholders, including process owners, managers, auditors, and end-users. Transparency is essential in process mining for several reasons:

- **Understanding Process Behavior:** Transparency helps stakeholders gain a clear understanding of how their business processes are actually performed in practice. Process mining provides visual representations (e.g., process models, flowcharts, event logs) that make it easier to comprehend complex process behaviors.
- **Identifying Issues and Bottlenecks:** Transparent process mining results allow stakeholders to identify issues, bottlenecks, deviations, and inefficiencies within processes. By understanding where problems occur, organizations can take targeted actions to address them.
- **Data Quality Assessment:** Transparency in data sources and data preprocessing is crucial in process mining. Stakeholders need to know the quality of the data being analyzed, including any data transformations or cleansing that has taken place. Transparent data handling ensures the credibility of the analysis.

- **Model Interpretability:** Process models generated through process mining should be transparent and interpretable. Stakeholders should be able to understand the meaning of symbols, nodes, and arcs in these models without needing deep technical expertise.
- **Audit and Compliance:** Transparency is essential for audit and compliance purposes. Auditors and regulatory bodies need clear documentation and insights into how processes are executed, deviations from standards, and compliance with regulations.
- **Decision-Making:** Transparent process mining results empower decision-makers to make informed choices based on evidence and data. It helps organizations prioritize process improvement initiatives and allocate resources effectively.
- **Communication:** Process mining results should be communicated transparently to different stakeholders. Clear visualizations and reports help convey findings and recommendations in a comprehensible manner.

## 4.6 Tools

Process mining tools are largely used by organizations that want to optimize their processes, conform existing processes to certain specifications, create harmony between distinct processes, or get future predictions regarding their processes. Process mining tools can help you collect data about your processes and then use that data to find ways to improve them in real time, which will ultimately lead to better outcomes across the board. The following is a list of the most widely used process mining tools

- **ABBYY Timeline:** ABBYY Timeline is a cloud-based, AI-driven process mining platform that enables businesses to develop a visual model of their processes, analyze them in real-time to detect bottlenecks, and predicting possible results to help with technology investment decisions.
- **ARIS Cloud Process Mining:** ARIS Cloud is a process-centric management solution that offers process mining solutions. It is accessible and versatile, allowing for additional resources to be deployed as needed. ARIS Cloud includes features such as process versioning, release cycle management, content merging, social collaboration, document management, and customer journey mapping in addition to process design, modeling conventions, method filters, content.

- **Celonis:** It is a powerful and capable process mining suite that collects and analyzes IT data in order to generate actionable insights. It is used to identify and fix operational flaws, making the overall operation more effective. Visual reporting is used by Celonis to help find problems in existing processes.
- **Datapolis Process Intelligence:** Datapolis is a powerful workflow toolkit that unifies process management with datamining. Graphical designs, quick change management, business information, reporting, and integration to Office 365 and SharePoint are just a few of the features offered by Datapolis. addition to process mining
- **Minit:** Minit creates maps of processes that are both visual and interactive so that companies can see how their processes work in real time and innovate with improvements.
- **Kofax Insight:** Kofax analyzes how your processes affect customer satisfaction and profit. This solution incorporates a user analysis interface, process visibility, analytics. As a unified platform, Kofax Insight is powerful for business analytics.



**Fig. No. 4.3: Process Mining Software Providers**

- **ProM:** ProM is a free, cross-platform desktop application designed specifically for process mining. The platform's adaptability and scalability are enhanced by the availability of plug-ins, and creators are encouraged to contribute new solutions. Both ProM and any solutions developed on top of it are freely available under the GPL license.

- **Fujitsu Process Analytics Software:** Fujitsu provides a comprehensive business process management solution that features process management, process analytics, and a business process discovery service. Automated process discovery services give a real-time, end-to-end view of processes, showing problems like bottlenecks and delays. Activity monitoring lets users control the flow of processes in real time and see, analyze, and improve their own processes.
- **Worksoft Analyze:** Worksoft Analyze is an all-inclusive process discovery solution that can be used to record and verify the quality of newly developed procedures. The convenience of this cloudbased service is its portability. In addition to automating the discovery of processes, we can also generate documentation for them without human intervention and streamline testing procedures.
- **SAP Signavio:** Process Transformation Suite SAP Signavio is a portfolio of products designed to streamline operational procedures and facilitate organizational transformation. This web-based service requires little setup, and it can be tested out for free before committing to a full subscription.

#### 4.7 Process Mining Software Key Functions

If your selected process mining software fulfills these key functions, then you have already made a good choice. However, you should always keep in mind that your company's ability to measure, monitor and optimize business processes has a direct impact on revenue and customer satisfaction. Therefore, it is important to choose the right process mining solution wisely to ensure that all business goals are optimally met. If necessary, an expert can also be consulted. Identify bottlenecks & process optimization opportunities Provide insights into failed process steps Ensure end-to-end view of the entire process Monitor performance indicators in real time Perform data cleansing Compliance analysis & gap analysis Provide continuous business process monitoring in real time Improve process model.

## CHAPTER 5

### REAL TIME EXAMPLES

These are just a few examples of how process mining can be applied across different industries. specific applications and benefits may vary depending on the organization and its unique processes.

- **Retail Checkout Process Optimization:** Process mining was used by a retail chain to analyze the checkout process in their stores. By analyzing event data from point-of-sale systems, they identified bottlenecks and areas of inefficiency in the checkout process. This allowed them to optimize cashier assignments, reduce waiting times, and enhance customer satisfaction.
- **Healthcare Patient Pathway Analysis:** hospital utilized process mining to analyze patient pathways in the emergency department. By analyzing event logs from patient admissions, diagnostics, and treatments, they identified delays and inefficiencies. This insight enabled the hospital to redesign workflows, allocate resources more effectively, and reduce patient waiting times.
- **Manufacturing Production Line Optimization:** A manufacturing company used process mining to analyze its production line. By analyzing sensor data and event logs from machines, they identified periods of downtime, bottlenecks, and variations in production. This allowed them to optimize machine maintenance schedules and production sequences, leading to improved overall efficiency.
- **IT Incident Management Improvement:** An IT service provider employed process mining to analyze their incident management process. They analyzed event logs from IT helpdesk interactions and support ticket data. This helped them identify patterns of recurring incidents, root causes of delays, and opportunities for automation in incident resolution.
- **Supply Chain Process Analysis:** A logistics company applied process mining to analyze their supply chain processes. By examining event data from order processing, warehousing, and transportation, they identified inefficiencies and delays in the supply chain. This enabled them to optimize routes, reduce inventory levels, and improve delivery times



- **Financial Transaction Analysis:** A financial institution used process mining to analyze their mortgage application process. By analyzing event logs from application submissions, document verification, and approval steps, they identified bottlenecks and areas for improvement. This led to streamlined processes, reduced processing times, and enhanced customer experience.
- **Customer Journey Mapping:** A telecommunications company used process mining to map the customer journey from initial inquiry to service activation. By analyzing event data from customer interactions across different channels, they gained insights into customer behavior and preferences. This allowed them to tailor their marketing strategies and improve customer engagement.
- **Energy Consumption Optimization:** An energy utility employed process mining to analyze energy consumption patterns in commercial buildings. By analyzing event logs from smart meters and building management systems, they identified opportunities for energy efficiency improvements. This led to reduced energy consumption and cost savings.
- **Fraud Detection:** A financial services provider utilized process mining to detect fraudulent activities. By analyzing event data related to transactions, they identified unusual patterns and deviations from regular customer behavior. This helped them detect and prevent fraudulent activities in real time.

## **CHAPTER 6**

### **LEARNING OUTCOMES**

- Understand what process mining is and the basics of how it works
- Understanding how process mining helps in Business world.
- you will learn to extract to create visual representations of processes to aid decision making and process improvement efforts.
- Process mining can help ensure compliance with regulations and internal policies by identifying deviations and non-compliances in process execution.
- Analyzing process performance metrics and KPIs.
- Summarize what an event log is and why we need it for processing.
- You will gain skills in using process mining tools and interpreting the results to enhance organizational efficiency and effectiveness.
- Understanding how process mining helps to uncover inefficiencies and methods for insufficient process.
- Understanding how to discover, analyses, and improve business process using data driven techniques

## CONCLUSION

In conclusion, process mining within Celonis represents a transformative approach to understanding, optimizing, and innovating business processes. By harnessing real time event log data, Celonis enables organizations to unveil hidden insights, streamline operations, and drive informed decision-making. Through visualization and analysis, process mining empowers users to identify bottlenecks, inefficiencies, and compliance gaps, paving the way for targeted improvements. Celonis's Process Explorer and Variant Explorer provide intuitive interfaces to navigate and analyze process flows, enabling users to uncover patterns, root causes, and optimization opportunities. With Celonis's advanced capabilities, process mining emerges as a vital tool for organizations aspiring to achieve operational excellence and competitive advantage in today's dynamic business landscape. process mining is a powerful technique that enables organizations to analyze and improve their business processes.

- Process mining fundamentals include data extraction, data transformation, and data visualization. These foundational elements are essential for effectively applying process mining techniques and deriving actionable insights from process data.
- Rising star technical topics in process mining, such as PQL Queries and getting data into EMS, further enhance the capabilities of process mining.
- PQL Queries enable analysts to ask specific questions and extract meaningful insights from process data.

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# Certificate of Virtual Internship

This is to certify that

**HEMA SINDHU**

**Srinivasa Ramanujan Institute of Technology**

has successfully completed 10 weeks

**Process Mining Virtual Internship**

during May - July 2023

Supported By **celonis**



**Jerome Geyer-Klingeberg**  
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