

# Process mining and its impact on BPM

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# Abstract

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Current business environment has no room for inefficiencies, as it can lead the organization to losing out to their competitors, loss of customer trust and cost overruns. Therefore, organizations are now focused on the ongoing monitoring and fine-tuning of their business operations to ensure that they are performing at an optimum level. To enable this, real-time process data capture is essential.

In this context, process mining is an enabler that uncovers the root causes of process inefficiencies by reconstructing and visualizing as-is business process flows and their many variations. Process mining techniques use event data to discover process operations, check the conformance of predefined process models, and enhance such models with information about bottlenecks, decisions and resource usage.

This document explains in detail process mining and its capabilities including process discovery, conformance and process enhancement. It provides a quick overview of some of the process mining tools available in the market and ties the process mining technology to the business process management (BPM) process life cycle. One may also find use cases that describe process mining opportunities in the context of automation and Enterprise Resource Planning (ERP) deployment.



# Beginning of process mining

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The growth of a digital universe that is well-aligned with processes in organizations makes it possible to record and analyze events. Some probable examples of events can be withdrawal of cash from an ATM, a doctor adjusting an X-ray machine, a citizen applying for a driver's license, submission of a tax declaration, and receipt of an e-ticket number by a traveler. The challenge is to exploit event data in a meaningful way – for example, to provide insights, identify bottlenecks, anticipate problems, record policy violations, recommend countermeasures and streamline processes. This is where process mining fits into the conversation, because it aims to do exactly that.

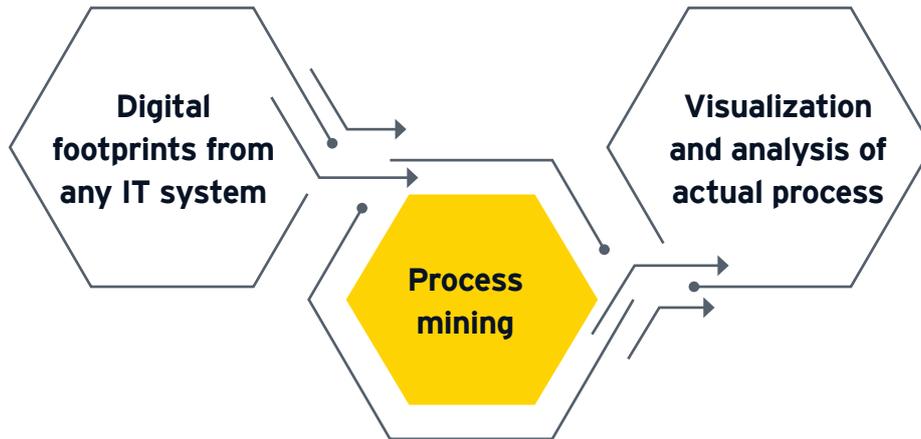
Process mining is an analytical approach that uses data from IT systems to gain objective insights and uncover hidden problems.

Many enterprises are looking to simplify their processes and IT landscapes to reduce costs, and improve customer experience to foster higher retention rates and generate growth. To deliver these goals, removal of departmental and data silos is required. Digital transformation using traditional waterfall approaches and manual process design is lengthy. Process mining offers a much faster approach, which sits well with modern agile development methods, particularly as the impact analysis provides a strong basis for any business case.

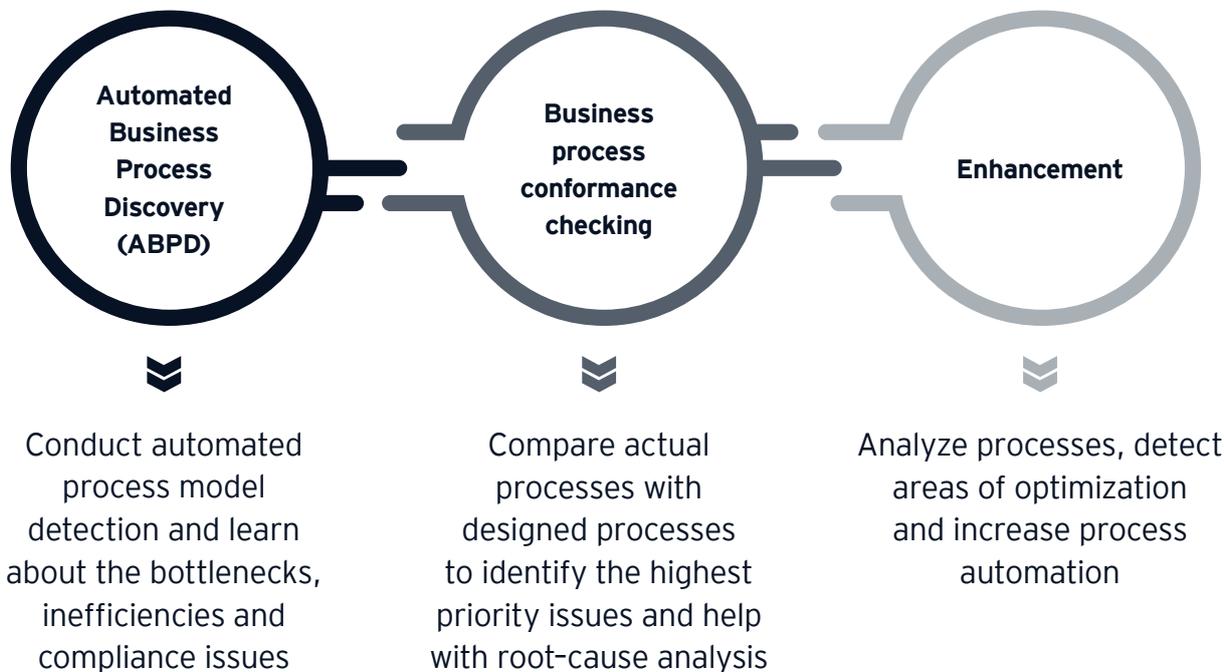


# Fundamental for process mining: event logs

The starting point for process mining is an event log. All process mining techniques assume that it is possible to sequentially record events such that each event refers to an activity (i.e., a well-defined step in some process) and is related to a particular case (i.e., a process instance). Event logs may store additional information about events. In fact, whenever possible, process mining techniques use extra information such as the resource (i.e., person or device) executing or initiating the event, timestamp of the event, or data elements recorded with the event (e.g., size of an order).



## Three key capabilities of process mining



## Automated Business Process Discovery (ABPD)

The first capability of process mining is **discovery**. A discovery technique takes an event log and produces a process model without using any prior information. Analysts use the process discovery capability to gather event data from source software systems and create visualizations of workflow through the systems. They explore the process patterns to uncover situations that cause errors and inefficiencies or aggravate risks.

By starting with exploring the most frequent activities and connections – known as “happy path” – analysts can drill down to explore process variants that are expressed in subsets of the event log data and analyze how these variants differ from each other. The analysis of these process variants reflects significant process rework, steps missed or tasks completed out of order, and so on.

## Business process conformance checking

The second capability of process mining is **conformance**. Here, an existing process model is compared with an event log of the same process. Conformance checking can be used to check if real-time data, as recorded in the log, conforms to the model and vice versa.

Algorithms analyze the level of match between the reference process model and the case paths it reconstructs from log files, and help with root-cause analysis by highlighting any case features that are correlated. Further, some process mining tools also offer features to explore and analyze process performance based on the identities of the individuals and teams carrying out the tasks (for example, to understand where there might be training gaps).

## Enhancement

The third capability of process mining is **enhancement**. Here, the idea is to extend or improve an existing process model using information about the actual process recorded in some event log. While conformance check measures the alignment between model and reality, this third process mining capability aims at changing or extending the existing model. An example is extension of a process model with performance information, such as showing bottlenecks.

Techniques for process discovery take an event log and produce a model. The discovered model is typically a process model (e.g., BPMN,<sup>1</sup> EPC<sup>2</sup> or UML<sup>3</sup>); however, the model may also describe other perspectives (e.g., a social network). Conformance checking techniques need an event log and a model as inputs. The output consists of diagnostic information showing differences and commonalities between the model and the event log. Techniques for model enhancement (repair or extension) also need an event log and a model as inputs. The output is an improved or extended model.

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<sup>1</sup> BPMN: Business Process Model and Notation

<sup>2</sup> EPC: Event-driven Process Chain

<sup>3</sup> UML: Unified Modeling Language

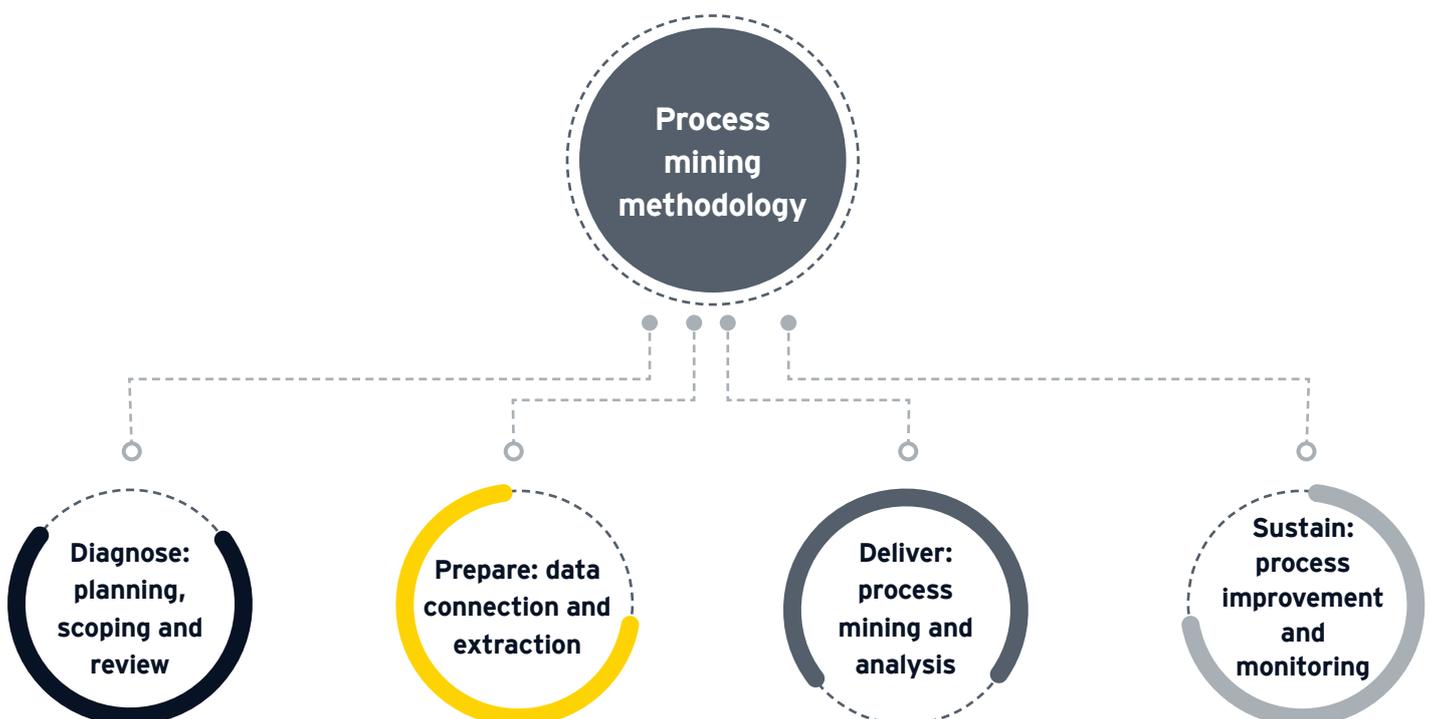
# Perspectives covered by process mining models

Four key perspectives covered by process mining during process discovery include:

1. **The control flow perspective** focuses on the control flow, i.e., the ordering of activities. The goal of this perspective is to find a comprehensive depiction of all possible paths. The result is typically expressed in terms of a process modeling notation (e.g., BPMN, EPC or UML diagrams).
2. **The organizational perspective** focuses on information about resources in the activity, i.e., which actors (e.g., people, systems, roles or departments) are involved and how they are related. The goal is to either structure the organization by organizing people in terms of roles and organizational units or to show the social network.
3. **The case perspective** focuses on properties of cases. Apparently, a case can be defined by its path in the process or by the actors working on it. However, cases can also be characterized by the values of the corresponding data elements. For example, if a case represents a replenishment order, it may be interesting to know the supplier or the number of products ordered.
4. **The time perspective** is concerned with the timing and frequency of events. When events bear timestamps, it is possible to discover bottlenecks, measure service levels, monitor the utilization of resources, and predict the remaining processing time of running cases.

## Implementation of process mining in service delivery

A typical process mining project consists of four phases as shown below:



## Diagnose: planning, scoping and review

During the diagnose phase, the goals and initial analysis questions are defined. The processes in scope, the period of the analysis, the business questions to be answered, the team composition and the analysis timeline are defined at this stage.

## Prepare: data connection and extraction

During the prepare phase, data requirements are defined, the scope of the data extraction is set, and the data is retrieved. The systems and tables that need to be retrieved, the attributes (data fields), granularity of the data, and the logic with which the data should be collected and connected must be defined at this stage.

In many situations, the retrieved data cannot be directly used for process mining and must be prepared and transformed. Depending on different analysis questions, data processing may be executed several times to enable a specific analysis.

## Deliver: process mining and analysis

During the analysis stage of the deliver phase, different process mining techniques are applied to answer the analysis questions. These techniques include process discovery, conformance checking, process enhancement and process analytics. The aim is to relate the analysis findings to improvement ideas that can help achieve the project goals. This includes the correct interpretation of the results. The interpretation needs to be validated and verified by domain experts.

## Sustain: process improvement and monitoring

The insights obtained from the previous stages are used to modify the actual process execution. Herein, process re-engineering techniques and Six Sigma can be leveraged. Finally, process mining can be used to continuously monitor the processes and support continuous improvement.

# Six top tools recognized in the market for process mining

There are several process mining tools in the market, of which some have more commercial appeal while some are used more for academic and research purposes. In any case, to allow process mining objectives to be achieved, these tools are required to have minimum functionalities as given below:

1. Track event logs
2. Monitor process performance

Tools also offer additional value-adding features such as:

1. Being faster, more accurate and able to integrate other technologies (such as machine learning, to provide proactive insights for data-driven decision-making and process improvement)
2. Being collaborative and more secure
3. Offering flexible process reporting
4. Performing key performance indicator (KPI) calculation

Based on EY findings, the six most used process mining tools are: Celonis, ARIS Process Mining, Minit, QPR, Signavio Process Intelligence and ProcessGold. All of them are also recognized by Gartner as market-leading tools. All these tools present the following capabilities:

1. Process discovery
2. Conformance checking
3. Process visualization and performance reporting
4. Insights for improvement (enhancement)

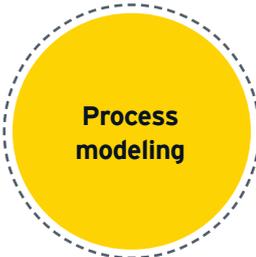


# Process mining optimizing BPM life cycle

An organization concerned about meeting clients' expectations and performing efficiently should have clarity on the operational processes' life cycle. A process is executed for a specific purpose with definite performance expectations; when it is not supportive to the organization's strategy, it undergoes a series of adjustments.

An ongoing operational process is monitored and measured, and its performance is evaluated. Based on the evaluation, different aspects of the process may be changed. This leads to designing of an optimized newer version, which is then implemented, restarting the cycle again: monitoring the process in execution, measuring, evaluating it against the organization's strategy, designing the optimized version and implementing it again. This is the basis of a process life cycle.

Process mining offers numerous advantages during various phases of a traditional process life cycle.

BPM life cycle phase	Key challenges	Process mining capability	Benefits
 <p><b>Process modeling</b></p>	Uncovering the real process as it is and representing it in a model	<b>Process discovery:</b> taking the event log and producing a model	Less time is spent on human judgments, subjectivity and arguments from personal experiences, and the process is more accurately described.
 <p><b>Process redesigning</b></p>	Providing insights into what process changes are needed and where	<b>Powered analysis for process enhancement:</b> enhancing or extending existing process models by using additional data from the recorded logs	Timing, frequency and deviation information are made handy for assertive process improvement recommendations.
 <p><b>Process execution and monitoring</b></p>	Extracting process information, calculating the KPIs and putting the information in the ideal formats for leadership to evaluate	<b>Process monitoring:</b> automatically consolidating data as soon as it is generated during process execution (real time) and updating dashboards	There is no need of spending time collecting and calculating KPIs. Real-time data is automatically feeding KPIs, so that off-track behaviors can be quickly identified and corrected.
 <p><b>Process strategy</b></p>	Achieving full transparency and identifying potential issues as soon as they happen or even before it	<b>Process refinement:</b> refining real-time information for advanced machine learning and artificial intelligence enablement	Important insights are provided by the tool to identify potential improvements and changes needed.

## Process mining during the phase of process modeling (process discovery)

There are several techniques traditionally used for modeling processes. The key challenge for business process analysts lies in uncovering the real process as it is.

With process mining, a process has its inputs traced step by step until the end. The process model is created based on this information. Deviations from the usual path will appear as soon as you repeat the tracking for new executions of the same process. At the end of this exercise, the process model will be clear and complete, and no validations or workshops are needed because this is a fact-based model.

## Process mining during the phase of process redesign (powered analysis and redesign)

The data captured during process discovery and the historical data provide rich information for the redesign phase. The frequency of different paths taken in a process, the throughput time in these different paths, the errors, bottlenecks and other relevant information are made available from the discovery exercise in the previous phase. Then, it is time for the business process analysts to come up with insights – what changes are needed and where. New version of the process can be designed and tested for multiple scenarios, and the most beneficial version is picked up for implementation.

## Process mining during implementation

Implementation of anything new in an organization involves people and, therefore, requires strong leadership and clear communications, along with trainings and a detailed change approach. This phase is not impacted by process mining, but it is key that during implementation, the process performance metrics are understood and agreed, and the mechanism for tracking is designed, to allow process mining in the other phases.

## Process mining during the phase of execution and monitoring (process monitoring)

Monitoring is the core capability for process mining. It is expected that the implemented process works for the extraction of the best results possible. In a traditional BPM life cycle, there is a special activity for business process analysts to extract process information, calculate KPIs and put this information in the ideal formats for leadership to evaluate.

However, with process mining intelligence, the system pulls out the consolidated data as soon as it is generated during process execution. Two key benefits are easily observed:

1. No need of spending time collecting and calculating KPIs
2. Real-time data is feeding KPIs, so off-track behaviors can be quickly identified and corrected

## Process mining for strategy (process refinement)

Changes are inevitable in the dynamic business world. Full transparency is important for an organization to promptly identify the need for change and start acting. With the implementation of process mining intelligence, out-of-the-curve behaviors are identified as soon as they occur and it offers to business analysts an important insight for accelerating strategic decision-making. Inefficiencies, vulnerability, deviations and bottlenecks are exposed by process mining. To empower process refinement, this technology also allows implementation of other technologies such as machine learning and artificial intelligence – they can act on the top of process execution to identify potential issues before they happen and act proactively, resulting in productivity, seamless process execution and assertiveness.

## Process mining provides a link between business intelligence and process modeling and analysis.

BPM tools enable organizations to document the modeled processes and analyze them to identify improvement opportunities. Using these tools, the organizations can also simulate the processes to visualize how a process would run in various scenarios. Eventually, BPM tools also aid in execution, implementation and monitoring of the modeled processes. They leverage existing integration architectures, data sources, applications and legacy systems connected to end-to-end business processes. However, these models are often completely disconnected from the actual event data.

Process mining offers a new approach to improving and optimizing business processes, and the capability expands beyond traditional BPM initiatives. Instead of focusing strictly on process management, process mining offers a transparent, holistic view of all activities taking place within an organization, and allows for deeper analysis of those activities. Process mining techniques offer a dynamic system that can reflect the changes in the process in real time. The purpose here is not to construct a static model.



# Digital transformation driven by process mining

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Process mining can be applied in different areas of an organization. The use cases for process mining are not limited to analyzing or creating a process model. Given the right data, process mining can provide insights into the performance and relations of resources in the process. The way people work together to complete a complex task can be visualized. Process mining can help to provide performance statistics that aren't limited to a single task.

The usage differs with the context of the stakeholder and type of project. Even within a project, process mining can be used in different phases. This section introduces a list of process mining use cases.

## Automation using process mining

Before getting started with an automation initiative, it is crucial to assess whether current processes are efficient and scalable. It is critical to understand the maturity of a process and decide which processes are standardized enough to benefit from robotic process automation (RPA) and which ones need harmonization and standardization prior to starting an RPA initiative.

Process mining helps to reconstruct, visualize and analyze the processes and understand the degree of standardization by looking at the deviations. Its process analytics capabilities enable business users to identify and prioritize RPA initiatives and their economic impact with just a few clicks. In addition, it is possible to combine operational system data to provide full visibility into what actions a user takes at each step in a business process. As a result, the most repeatable patterns in a manual activity can easily be found and prioritized by their impact.

However, implementing bots has a downside too. They are not able to adapt and deviate from their initial configuration, even if that would result in a more favorable overall outcome. Advanced process mining capabilities capture real-time information from all systems in an organization and leverage this information to define the right activity at the right time. This ensures that the robots are working in the most efficient manner to lead a beneficial process outcome.

## ERP consolidation

In IT landscape transformations, process mining is critical. For organizations with multiple ERP systems, consolidation is not as simple as just combining all the data from the existing systems. Over time, these different ERP systems have likely diverged into different variants of the process. Many probably have had patches added over the years, which alter the behavior of the users. There may be varying levels of automation across each deployment. In this case, the major task is to discover how the processes vary from system to system or how the user behavior and interactions differ across business units.

Process mining helps to compare and benchmark each ERP system vs. the others to identify the best practices and, more importantly, differences that must be resolved prior to consolidation. It also helps to identify process owners and users who will need to be trained on process updates.

Post consolidation, use of process mining on an ongoing basis is absolutely critical for process improvement and optimization and to detect potential problems before they create a business impact.

## Operational efficiency

Achieving operational excellence requires new approaches and methods to optimize the current processes.

Automated process discovery helps to visualize the reality of business processes by examining the electronic footprints (event logs) left in various IT systems. From this unstructured data, process mining software will automatically create a process model to enable in-depth analysis.

The benefit here is fast and cost-efficient process discovery that eliminates the need for piecing together of the process from interviews. Automated business process discovery also reduces human errors. Process maps are created from the data logged during normal execution of the process and contain all the nuances of the process, statistical information and variants. Analysis of such process maps will help to uncover exceptions, unusual transactions, bottlenecks, deviations and potential risks in processes.

Process mining can provide enterprise-wide process transparency and identify new opportunities to continuously improve the enterprise's business operations.

## Conclusion

Process mining is an innovative analytical approach using data from IT systems to compile objective insights and uncover hidden problems appearing in business process execution. Process mining bridges the white space between various systems, departments and functions, as it allows to combine information from multiple data sources.

However, process mining is not limited to process discovery and refinement. Event logs are in the center of process mining, and the discovery of process models from event logs fuels the imagination of business process analysts and process owners. Therefore, control flow discovery is often seen as the most exciting part of process mining. With its advanced analytical and intelligent capabilities, process mining plays an essential and fundamental part in digital transformation and achieving operational excellence.

Process mining technology for big data analytics has already started appearing in large companies as a business-critical application in the race for the fastest, most efficient and most transparent processes.

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