PROCESS MINING PROJECT REPORT

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INTRODUCTION

Process mining is an easy and affordable way to use data science and process analytics methodology to improve, monitor and measure business process performance. You can make more informed decisions, make real-time adjustments and monitor results with little or no human intervention.

Historically, companies would waste thousands of staff hours manually going through documents looking for the information needed to identify problems. Then they would have to guess what the best optimisation solution would be, what the root causes are, how to implement the changes, and finally, monitor everything by hand to evaluate the results. And this worked. However, it still involves guessing during the decision-making process because what you see may not accurately represent a business system. Process mining techniques and algorithms are a digital transformation of these same steps.

Today, with the help of some smart codes, data and process analytics, automated process mining technology creates an accurate visualization of the actual process performance of any event log generating system without being directly involved in mapping and optimizing process flows.

1.1 What can process mining do for me?

Every company, group or organization can benefit from instant and real process automation. These benefits start with greater efficiency within the systems themselves, but also extend to other areas.

You can analyze the effectiveness of employee training and improve it by identifying common mistakes. You'll find opportunities to increase sales and even identify suppliers who can meet the exacting demands of a new project. And the more you automate, the wider these benefits become.

1.2 What are the pillars of process mining?

- **Process discovery**: based on information extracted directly from business systems, models of real processes are automatically created
- **Compliance contro**l: Based on what happens in practice, the insights obtained are transformed into solutions to promote continuous process improvement
- **Continuous improvement**: Actual processes are compared with previously defined models in order to identify and diagnose inefficiencies and problems in the process

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1.3 What are the benefits of applying process mining?

- **More efficient processes**: make the company more accurate in decision making, allowing it to act directly on the root cause of problems, as it has concrete information on how processes occur in practice
- **Continuous process improvement**: analyze processes comprehensively and accurately, identifying the source of each problem and transforming knowledge into solutions
- **Operational cost reduction**: identify and eliminate deviations, bottlenecks and inefficient processes that need to be analyzed or automated
- **Vision for the future**: Invest in your technology infrastructure and correlate data for greater predictability

1.4 How to apply process mining?

Applying Process Mining is easy and practical. The starting point is to transform event data stored in business information systems into an event log to gain insight into business operations.

Automated end-to-end views of the process are then created, generating accurate and detailed information on improvements needed based on what is happening in the process.

2. SALES MODEL

2.1 BPMN Model

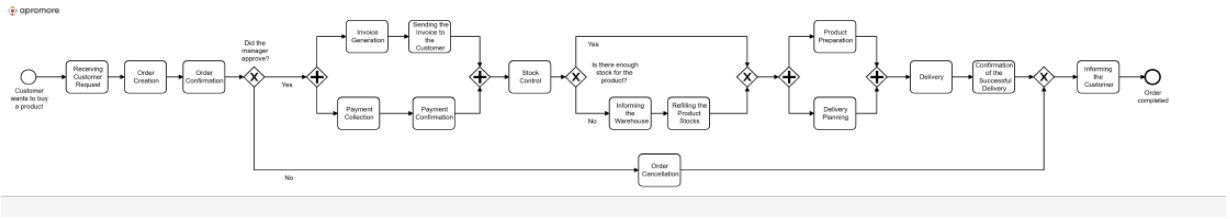
In the BPMN model designed for the process of purchasing a product, it starts with the creation of the order by the customer. This order goes through a confirmation stage, where the manager is responsible for approving or rejecting the request. If the manager approves the order, the process continues with the execution of the collection of the product and the corresponding payment.

Subsequently, an invoice is generated and sent to the customer for their knowledge. The stock on hand is then checked. If there is sufficient stock, the process continues without interruption. However, if there is no stock, the warehouse is notified and the process of stock replenishment is initiated.

Once the stock is replenished, the product is prepared and delivery is planned. Delivery of the product is carried out, followed by a confirmation to ensure that the product has arrived in proper condition. Finally, the customer is informed that their

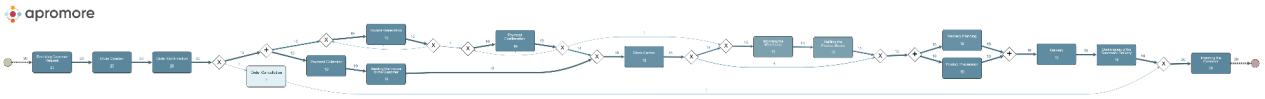
order has been successfully delivered, marking the conclusion of the purchasing process.

This BPMN model gives us a visual and structured representation of the activities involved in the purchasing process, from order creation to product delivery, ensuring
efficient and transparent management of each stage. In addition, the inclusion of decisions, such as manager approval and stock management, allows for adaptation to different situations and ensures that the right decisions are made at each step of the process.



Here you can find the file for the BPMN model: BPMN Image.jpg
And the file for BPMN model: BPMN File.bpmn

The model above was manually prepared by us. The model below, on the other hand, was created using an event log.



Here you can find the file for the BPMN model of event log: BPMN Model of Event Log.png

2.2 Petri Net Model

Petri net model is a graphical and mathematical representation used to model and analyze the dynamics of concurrent and distributed systems underlying business processes. A Petri Net consists of places, transitions, arcs and marks, where each element has a specific meaning.

- **Places:** Represent states or conditions of the system.
- **Transitions:** Represent events or activities that may occur in the system.
- **Arcs:** Connect places and transitions, indicating how marks (activation units) move between them.

- **Marks:** Indicate the availability of resources or the occurrence of events at a location.

In process mining, Petri Nets are used to visually model the workflow, events and dependencies in a business process. These graphical representations provide a clear and understandable view of the system's behavior. In addition, Petri Nets are used to analyze and improve processes, identifying potential problems, bottlenecks, and optimizing the efficiency and performance of business workflows.

The BPMN model is effectively translated into a Petri net, where places and transitions capture events and activities respectively.

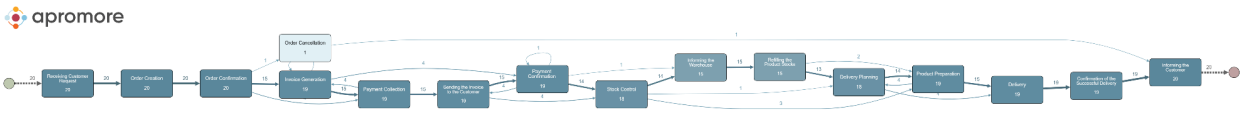
- **Creation of the Order (Start of the Process):** An initial place represents the creation of the order by the customer. This place is connected to a transition that symbolizes the confirmation of the order.
- **Order Confirmation:** The order confirmation transition is triggered by the place representing the order creation. After the confirmation, two divergent transitions are activated: one representing the manager's approval and the other denoting disapproval.
- **Manager's decision:** A gate exclusion (split) reflects the manager's decision. If the order is approved, the collection transition is activated; otherwise, the order cancellation transition is activated.
- **Product collection:** The collection transition is triggered by the manager's approval.
  After collection, a transition is triggered which symbolizes the generation of the invoice.
- **Invoice Generation:** The invoice generation transition is triggered by the collection. After the invoice, a transition leading to the stock control is activated.
- **Stock Control:** The stock control transition is triggered by the invoice generation.
  From here, two divergent transitions represent the stock-based decision: one for the case of sufficient stock and one for the case of insufficient stock.
- **Stock decision:** The gate exclusion represents the stock-based decision. If there is sufficient stock, the process continues; otherwise, a transition is triggered that leads to informing the warehouse.
- **Stock Replenishment:** The stock replenishment transition is triggered by the lack of stock. After replenishment, a transition representing product preparation is triggered.
- **Product Preparation:** The product preparation transition is triggered by stock replenishment. After preparation, a transition is triggered that leads to delivery planning.
- **Delivery Planning:** The delivery planning transition is triggered by product preparation.

After planning, a transition representing the delivery of the product is triggered.

- **Product Delivery:** The product delivery transition is triggered by the delivery planning.
  After the delivery, a transition representing the delivery confirmation is activated.
- **Delivery Confirmation:** The delivery confirmation transition is triggered by the delivery of the product.
  After the confirmation, a transition representing the notification to the customer is activated.
- **Customer Information (End of Process):** The end of process transition is triggered by the delivery confirmation.
  This transition symbolizes the end of the process and the notification to the customer that his order has arrived successfully.

Here you can find the image for the Petri Net model: Petri Net Image.jpg
And the file for Petri Net model: Petri Net File.cpn

2.3 Process Model



In addition to the models above, you can find the process model created using an event log here: Process Model of Event Log.png

EVENT LOG

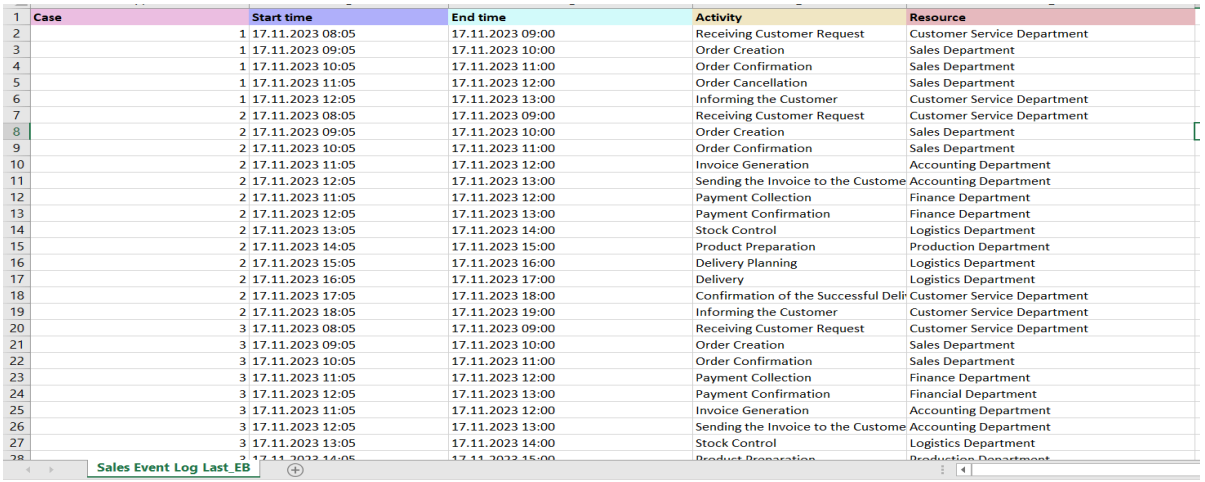
The event log in a BPMN model consists of the systematic collection of events and activities that occur during the execution of a process. Each recorded event provides detailed information on when and how activities occurred, allowing a complete view of the sequence of events over time. This log can include data such as the date and time a task was started and completed, the participants involved, as well as any exceptions or deviations from the predetermined flow.

One of the fundamental benefits of the event log in BPMN is its ability to provide comprehensive visibility into business processes. By analyzing these logs, organizations can identify bottlenecks, inefficiencies and areas for improvement in their operations. In addition, the event log facilitates the detection of potential deviations from the planned workflow, allowing managers to take corrective action in a timely manner.

The usefulness of the event log extends beyond simple monitoring. The data collected can feed into advanced analytical tools, such as process mining, which uncovers hidden patterns, trends and relationships in process execution. This not only helps optimize operational efficiency, but also provides a solid basis for informed decision-making and the implementation of continuous improvements.

3.1 Event log analysis

We will now move on to analyze the event log of our BPMN sales model:



Case	Start time	End time	Activity	Resource
1	17.11.2023 08:05	17.11.2023 09:00	Receiving Customer Request	Customer Service Department
1	17.11.2023 09:05	17.11.2023 10:00	Order Creation	Sales Department
1	17.11.2023 10:05	17.11.2023 11:00	Order Confirmation	Sales Department
1	17.11.2023 11:05	17.11.2023 12:00	Order Cancellation	Sales Department
1	17.11.2023 12:05	17.11.2023 13:00	Informing the Customer	Customer Service Department
2	17.11.2023 08:05	17.11.2023 09:00	Receiving Customer Request	Customer Service Department
2	17.11.2023 09:05	17.11.2023 10:00	Order Creation	Sales Department
2	17.11.2023 10:05	17.11.2023 11:00	Order Confirmation	Sales Department
2	17.11.2023 11:05	17.11.2023 12:00	Invoice Generation	Accounting Department
2	17.11.2023 12:05	17.11.2023 13:00	Sending the Invoice to the Custome	Accounting Department
2	17.11.2023 11:05	17.11.2023 12:00	Payment Collection	Finance Department
2	17.11.2023 12:05	17.11.2023 13:00	Payment Confirmation	Finance Department
2	17.11.2023 13:05	17.11.2023 14:00	Stock Control	Logistics Department
2	17.11.2023 14:05	17.11.2023 15:00	Product Preparation	Production Department
2	17.11.2023 15:05	17.11.2023 16:00	Delivery Planning	Logistics Department
2	17.11.2023 16:05	17.11.2023 17:00	Delivery	Logistics Department
2	17.11.2023 17:05	17.11.2023 18:00	Confirmation of the Successful Deli	Customer Service Department
2	17.11.2023 18:05	17.11.2023 19:00	Informing the Customer	Customer Service Department
3	17.11.2023 08:05	17.11.2023 09:00	Receiving Customer Request	Customer Service Department
3	17.11.2023 09:05	17.11.2023 10:00	Order Creation	Sales Department
3	17.11.2023 10:05	17.11.2023 11:00	Order Confirmation	Sales Department
3	17.11.2023 11:05	17.11.2023 12:00	Payment Collection	Finance Department
3	17.11.2023 12:05	17.11.2023 13:00	Payment Confirmation	Financial Department
3	17.11.2023 11:05	17.11.2023 12:00	Invoice Generation	Accounting Department
3	17.11.2023 12:05	17.11.2023 13:00	Sending the Invoice to the Custome	Accounting Department
3	17.11.2023 13:05	17.11.2023 14:00	Stock Control	Logistics Department

Sales Event Log Last_EB

Here you can find the original document: Sales Event Log Last.csv
Here you can find the modified document: Sales Event Log Last_EB.xes.gz

As can be seen, the average time per activity is 55 minutes for any of the cases.
The activities that have been collected in the event log are as follows:

- Receipt of customer request
- Order creation
- Order confirmation
- Order cancellation
- Informing the customer
- Sending the invoice to the customer
- Collect payment

- Confirmation of payment
- Stock control
- Product preparation
- Delivery planning
- Delivery
- Delivery confirmation
- Invoice generation
- Warehouse information
- Replenishment of product stocks

And the departments that have been involved in the development of the process have been:

- Accounting department
- Financial department
- Logistics department
- Customer service department
- Production department
- Sales department

The sales event log has been created with the fundamental purpose of providing a detailed and structured view of the execution of activities in a company's sales process. Its creation is intended for the collection of key data related to business events and activities to facilitate the monitoring, analysis and continuous improvement of these processes.
The main purpose of the sales event log is to enable the company to understand how interactions with customers unfold and how activities flow over time. This log provides an accurate timestamp for each task, allowing a chronological view of the actions taken by sales teams. By having this detailed information, organizations can achieve the following purposes:

- **Performance Monitoring:** The event log allows managers and supervisors to keep track of the progress of sales activities.
- **Efficiency Analysis**: Detailed information on the duration of each activity in the event log facilitates analysis of operational efficiency. Organizations can identify areas where tasks can be optimized to reduce time and improve productivity.
- **Informed Decision Making:** By understanding how sales develop over time, business leaders can make informed decisions based on hard data. This includes adjustments to sales strategies, resource allocation and customized approaches for specific customers.

The importance of the event log in the analysis of a sales BPMN model lies in its ability to provide a comprehensive, data-driven view of process execution.

This tool not only enables the proactive identification of improvement opportunities, but also supports fact-based decision making, thus contributing to the success and efficiency of business operations.

The fact that all activities in a sales BPMN model have a constant duration of 55 minutes contributes significantly to the consistency of data collection in the event log. This uniformity in execution time offers several key benefits for consistency and interpretation of the recorded information:

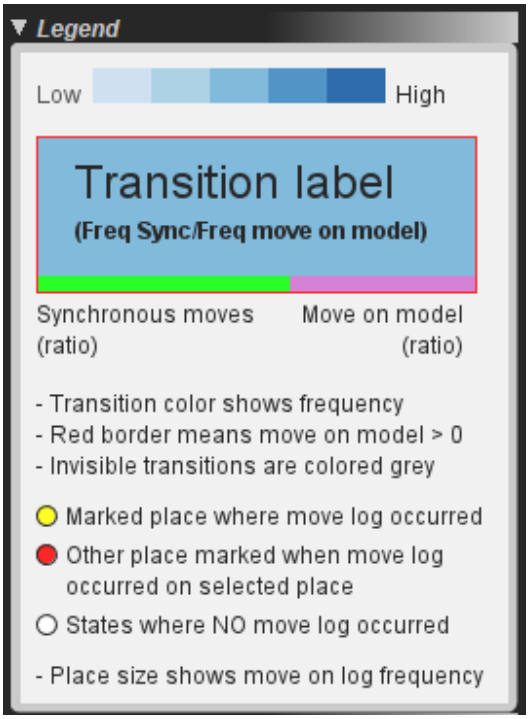
- **Uniformity in time intervals:** consistency in the duration of activities simplifies the event log structure by establishing uniform time intervals between events.
- **Facilitates Temporal Analysis:**consistent 55-minute duration provides a solid basis for temporal analysis.
- **Simplification of statistics calculation**: uniformity in time facilitates the calculation of statistics, such as average execution times of activities and the process as a whole.
- **Reducing variability in the event log:** standardizing the duration of activities helps to reduce event log variability.
- **Improved comparability**: uniformity in the duration of activities improves comparability between different instances of the process or between different sales processes.

4. CONFORMANCE CHECKING

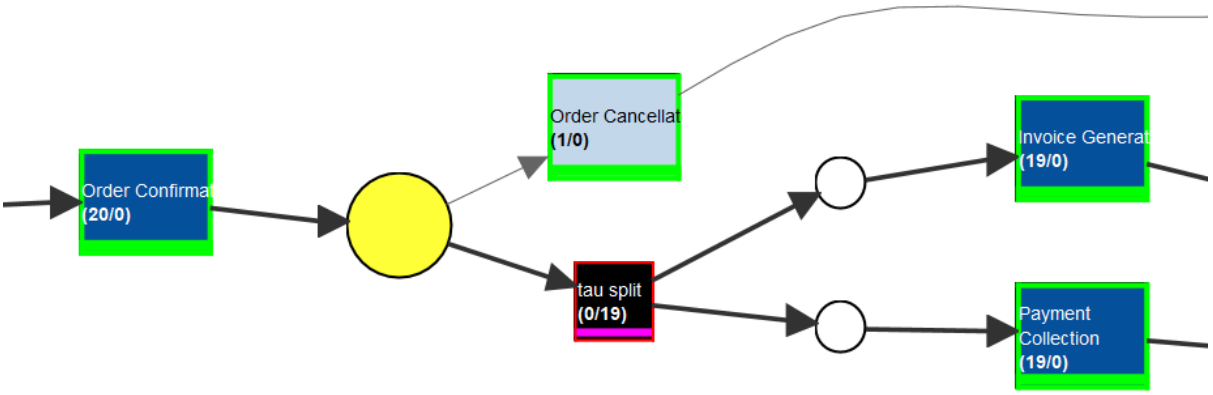
In order to do conformance checking, we need to upload the files into ProM. First, we select both the event log and Petri net model, then, we select the “Replay a log on Petri net for Conformance Analysis” plugin. For setting up the model, we choose events “complete” rather than “start”. After setting up the model with an initial and final marking as well as the mapping between the log and the model, we continue with conformance checking.

Here you can find the image: Conformance Checking.png
The resulting screen is a model with colors indicating the deviations:
The darker blue the fill is, the more frequent an activity in the log. The bottom of each transition shows a green/purple bar indicating the fraction of correct/incorrect

executions. Places that are coloured yellow indicate that there was an event in the log that could not be explained when there was a token in that place. We see that in our model, there are many yellow places.

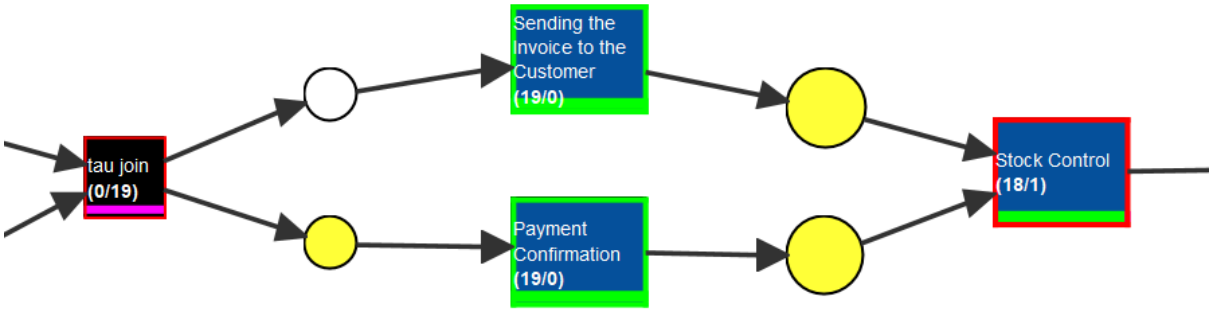


In our first analysis, we see that 20 events are splitting into 1 and 19 events. “Order Cancellation” activity has a gray background. Which means this event is not frequent, and we don’t see purple lines under the activities.

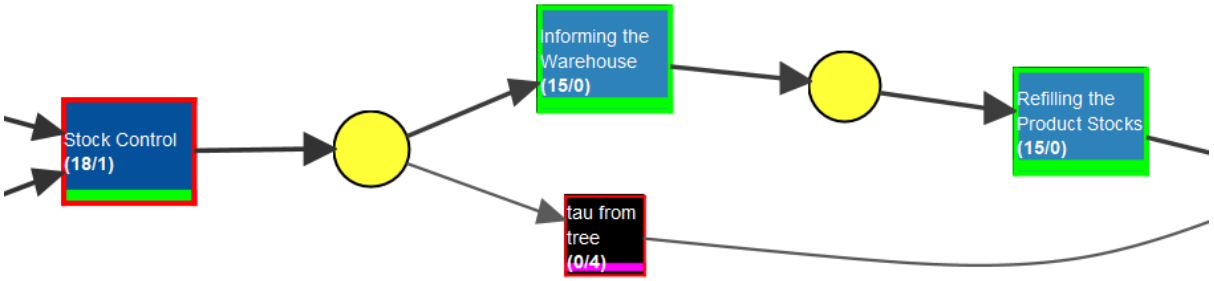


There is a tau split. Tau split represents the time delay between the completion of one activity and the start of another within a process model. Tau split is a parameter in process mining that defines the time it takes for an activity to start or finish after the completion of a preceding activity. This value represents the delay between the

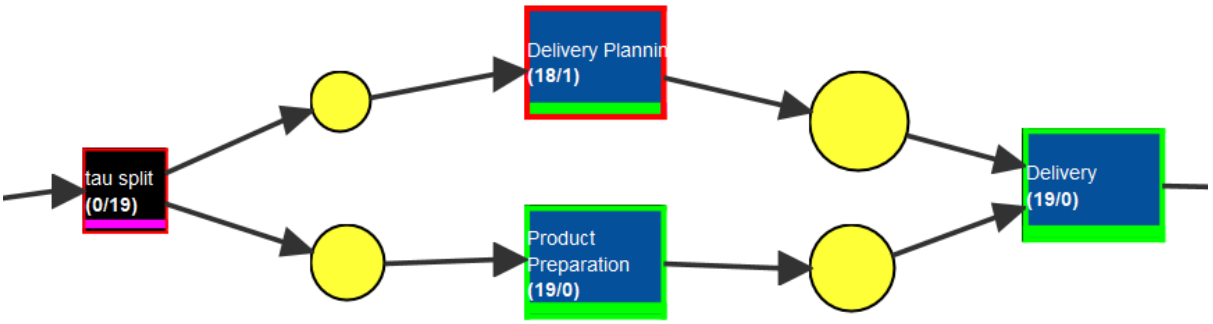
completion of one activity and the start of another within the process model. Tau split is used to assess the conformity of the modeled process with real event data. If the tau split value is inconsistent with actual data, it may indicate unexpected delays or rapid starts in the observed events.



Next, we see that “Stock Control” activity has skipped once. In addition, there is a tau join. Tau join represents the synchronization delay between parallel branches or paths in a process model. It indicates the time that must pass after the completion of parallel activities before the process continues with the next shared activity. Tau join is crucial for modeling and analyzing processes with parallel execution. It ensures that the process model accurately reflects the temporal relationships between parallel activities, maintaining the integrity of the model.



After “Stock Control” activity, we see that events have splitted into 15 events and a tau from tree. Tau from tree is another term in process mining, derived from process trees, which are a representation used for modeling processes. A process tree depicts the sequencing and timing of activities within a process model. Tau from tree represents the durations and ordering of activities in this tree structure. Tau from tree is employed to identify discrepancies between the process model derived from actual event data and assess the performance of the process model.



This scenario indicates that there is an activity in the process model composed of 19 events. Within this activity, the events are clustered in groups of 4, suggesting a pattern or frequency of occurrence for the sub-activities within that larger activity. Additionally, there is another activity in the process model consisting of 15 events, representing a distinct phase or activity in the process.

We also see that “Delivery Planning” activity has skipped once. Up to this point, we have observed in summary that there is one "tau from tree," two "tau split," one "tau join," and two activities with one event skipped each.

4.1 Precision and generalization analysis

Precision measures the accuracy of a process model in predicting or conforming to observed behavior in event logs. It calculates the ratio of true positives to the total number of predicted positives (true positives + false positives). Precision reflects how well the process model avoids making false positive predictions.

Generalization assesses how well a process model generalizes to different instances in the event log. It calculates the ratio of true positives to the total number of actual positives (true positives + false negatives). Generalization reflects the model's ability to capture positive instances in the event log without introducing too many false negatives.

In order to measure precision and generalization, we need to select the event, Petri net model and Replay log, then, we select the “Measure Precision/Generalization” plugin. Here is our model’s measuring results:

Precision : 0,93878
Generalization : 0,94444

Precision value of 0.93878 indicates that this process does not allow much more activity. High precision is not so general. The process model is accurate in predicting or conforming to the observed behavior in the event log. This means that when the model predicts a positive instance, it is correct about 93.88% of the time.

Probability generalization 0.94444 means the model does not cover other behaviors that might exist in the actual process but are not represented in the given event log. This process model won't be able to describe other behaviors beyond what is observed in the event log.

5. PROCESS ANALYSIS

Process analysis in a BPMN model is fundamental to understand, evaluate and improve the efficiency of business processes within an organization.

If all activities are performed consistently in the same amount of time, and there is no significant variability or obvious bottlenecks, the model could be considered stable in terms of execution time.

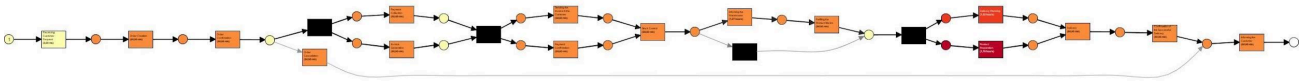
However, it is important to note that in reality, processes may experience variations due to external factors, changes in workload and other unforeseen events. Therefore, it is advisable to continuously monitor and adjust the model as necessary to maintain operational stability.

5.1 Time perspective analysis

Time perspective analysis in process mining involves examining the temporal aspects of business processes to understand how activities unfold over time. This analysis aims to identify patterns, bottlenecks, and inefficiencies in processes. By studying timestamps and durations associated with events, organizations can optimize resource utilization, monitor compliance with timelines, and make informed decisions for continuous improvement. The goal is to enhance overall process efficiency and effectiveness by addressing temporal aspects of business operations.

In order to do time perspective analysis, in ProM, we start by loading your event log into the tool. Once the event log is selected, we apply the "Mine Petri Net with Inductive Miner" algorithm to generate a Petri net representation of the underlying process. After the Petri net is created, we proceed to select both the event log and the generated Petri net.

Following this selection, we initiate the "Replay a Log on Petri Net for Performance Conformance Analysis" operation. After setting up the model with an initial and final marking as well as the mapping between the log and the model, we continue with time perspective analysis.

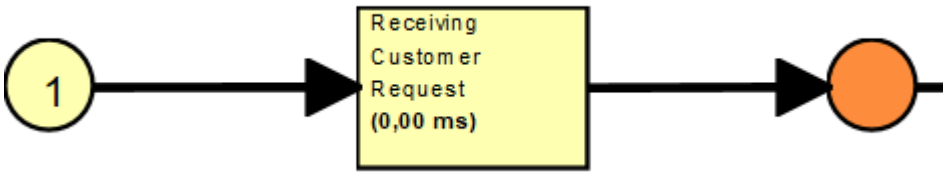


Here you can find the image: [Time Perspective.jpg]

The resulting screen is a model with colors indicating the deviations: The more intense the red fill, the longer an activity takes in the log.

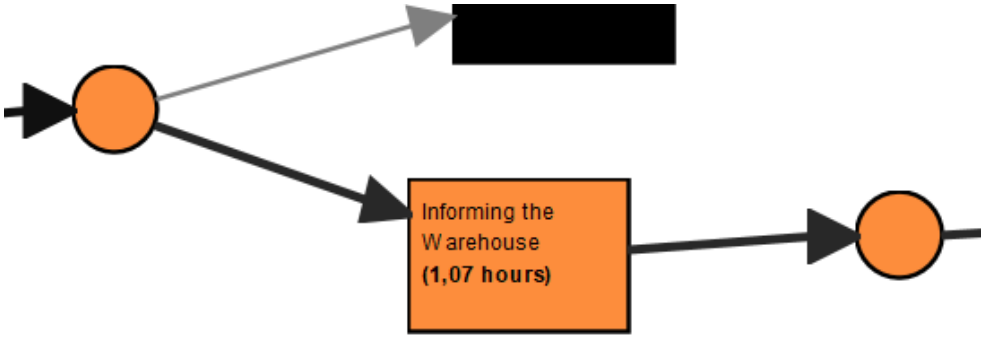
5.1.1 First look to the model

Receiving Customer Request:



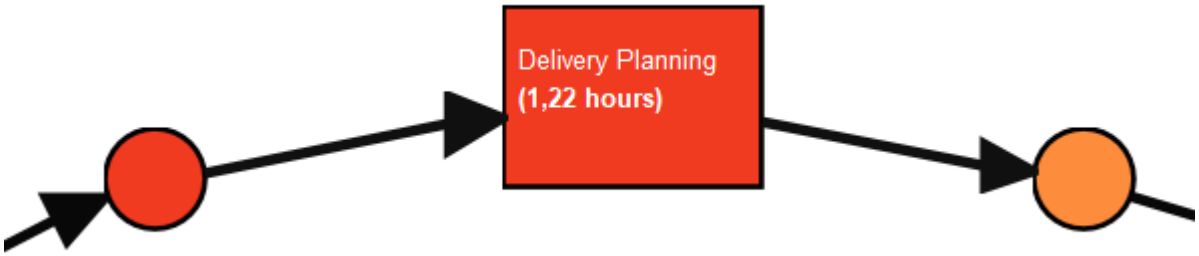
This activity is completed in the shortest time possible (0 ms), serving as a quick and efficient starting point.
To enhance the process, we must ensure the continuity of this swift starting point. Depending on our specific needs and business processes, we should explore the optimization of our processes to achieve even faster acquisition of customer requests.

Informing the Warehouse:



This activity takes an average of 1.07 hours.
To improve, we should review our information transmission processes to reduce the time it takes to inform the warehouse. We may consider incorporating technologies such as automation and real-time notification systems for more efficient operations.

Delivery Planning:

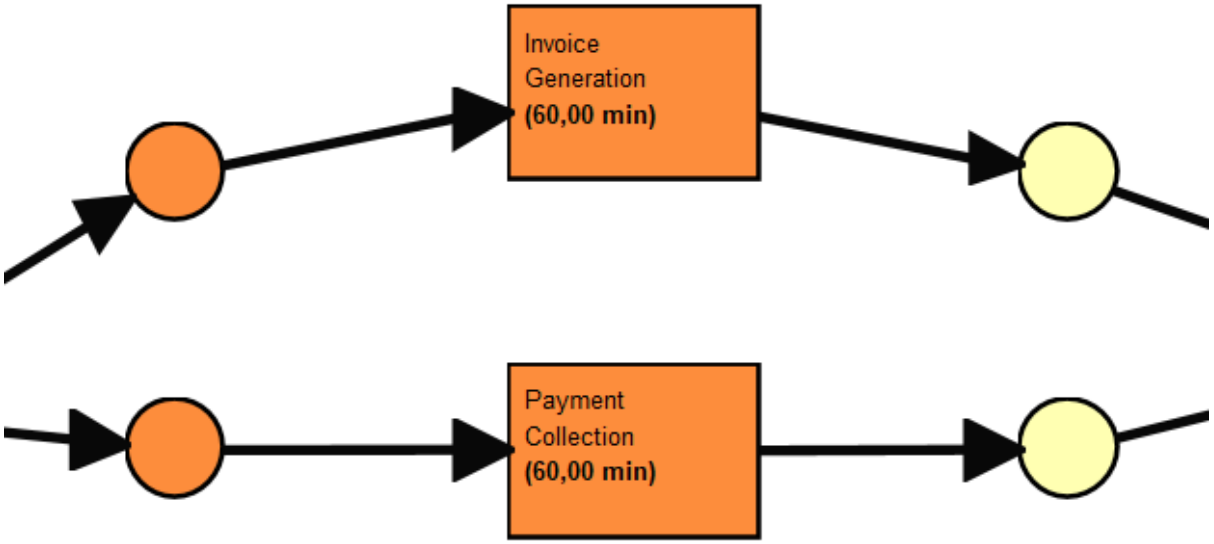


This activity takes an average of 1.22 hours.
To enhance our operations, we can expedite delivery planning by scrutinizing our supply chain and logistics processes. We should leverage data analytics and planning algorithms as part of our considerations.

Product Preparation:

This activity takes the longest, with an average duration of 1.79 hours.
To accelerate our Product Preparation process, we may need to optimize factors like material procurement, labor processes, and equipment usage. Furthermore, we should review our demand forecasting and inventory management practices.

Other Activities:



The duration of all other intermediate activities is 60 minutes.
To reduce the duration of these activities, we should closely examine our processes. We can leverage parallel work, automation, and workflow improvements to optimize these times.

Overall, the varying durations of activities may require a closer focus on specific steps in the process. Specifically, reducing the duration of "Product Preparation" could enhance customer satisfaction and overall delivery processes. Advanced technologies, such as data analytics and process optimization, could be employed for continuous improvement.

5.1.2 Element statistics

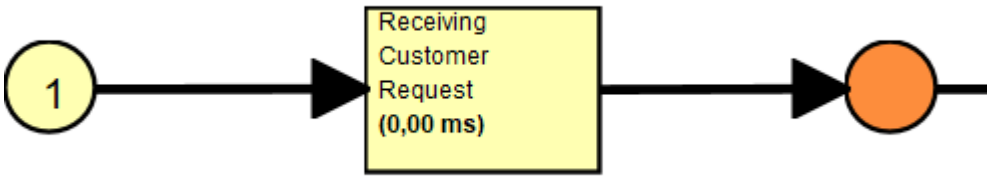
Before we start to analyze element's statistics, let's first talk about what the properties are and what they actually mean.

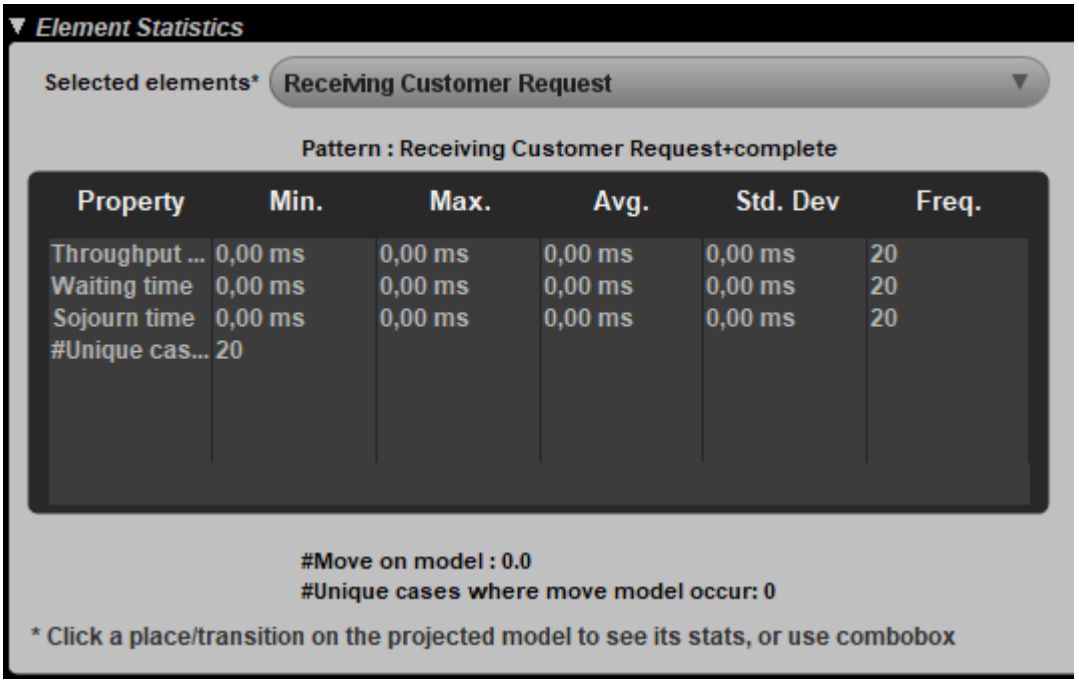
Throughput Time: It is also known as cycle time or lead time, is the total time it takes for a case or process instance to move from the beginning to the end of the process.It is calculated as the difference between the completion time and the start time of a case.

Waiting Time: It refers to the time a case or process instance spends in a waiting state, where no active work is being performed. It is calculated by measuring the duration between the completion time of the previous activity and the start time of the next activity.

Sojourn Time: It is the total time a case or process instance spends within the process, from its initiation to its completion, including both active processing time and waiting time. Sojourn time is the sum of the active time (time spent on activities) and the waiting time.

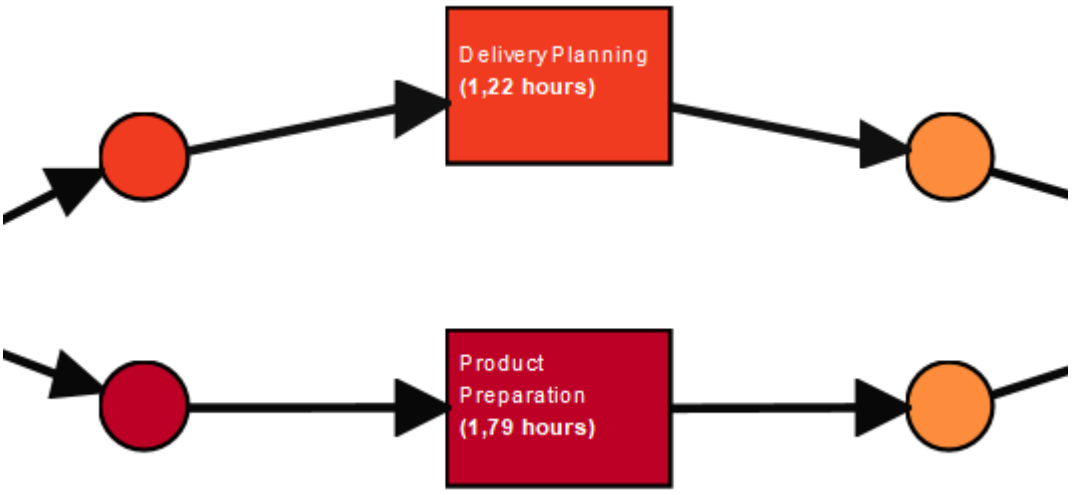
Fastest activity: “Receiving Customer Requests”.

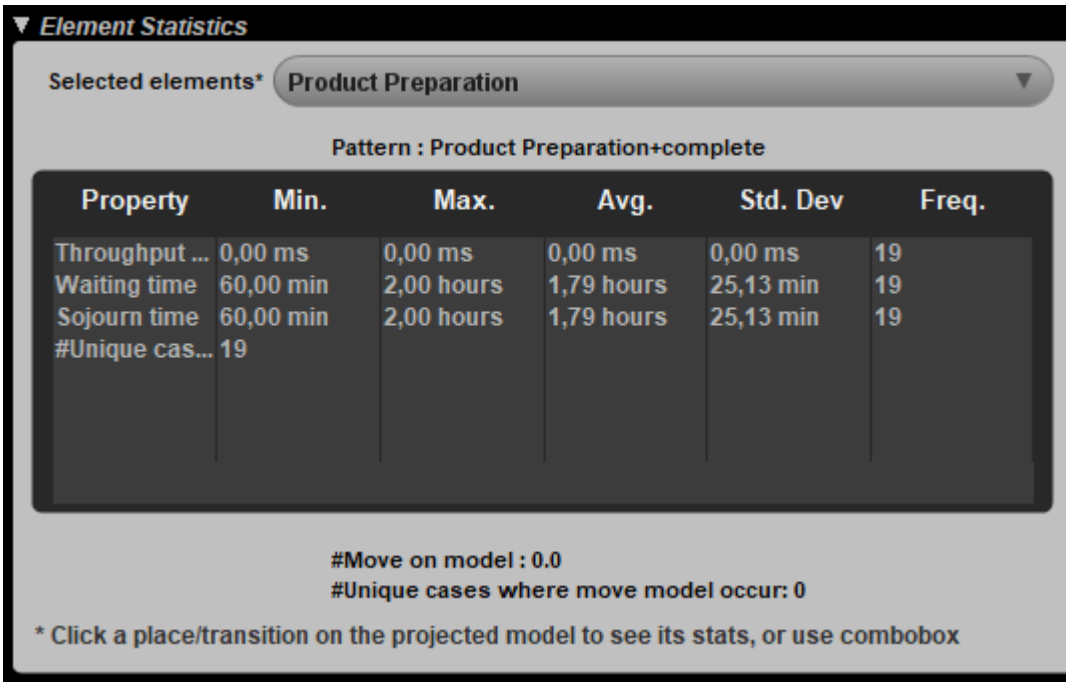




We see that throughput time, waiting time, and sojourn time are all 0.00 milliseconds, which indicates that the case or process instance is moving seamlessly and rapidly through the entire process.The ideal scenario of all time metrics being 0.00 milliseconds suggests an extremely efficient process flow, with no delays or waiting periods associated with this activity. This efficiency contributes to a rapid completion time for the entire process, indicating an optimized and streamlined workflow.

Longest activity: "Product Preparation"





Throughput Time:
The maximum throughput time for Product Preparation is 0 milliseconds, indicating that, even for the longest instances of this activity, the process completes almost instantly. This is a positive aspect as it suggests minimal delays or idle time in the execution of this particular activity.

Waiting Time:
The maximum waiting time for Product Preparation is 2 hours. On average, cases spend approximately 1.79 hours waiting between activities.This suggests that some instances experience relatively short waiting periods, while others encounter longer delays before the "Product Preparation" activity starts.

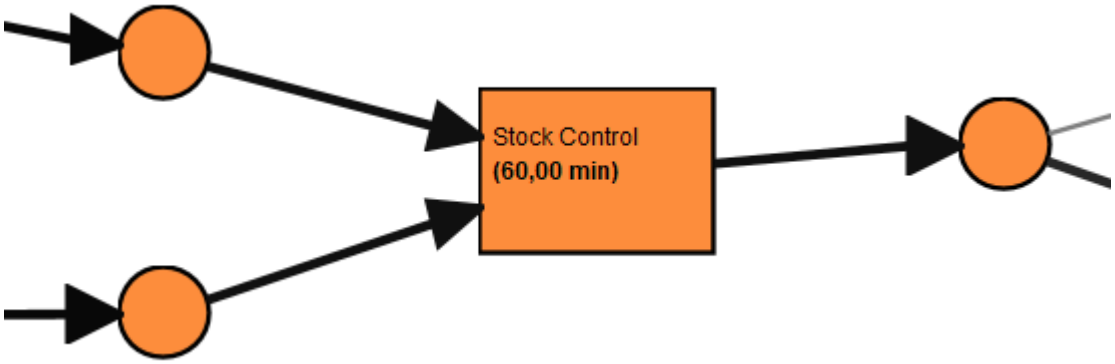
Short waiting times contribute to efficient processing while longer waiting times may lead to potential bottlenecks or delays in initiating product preparation, affecting overall process efficiency.

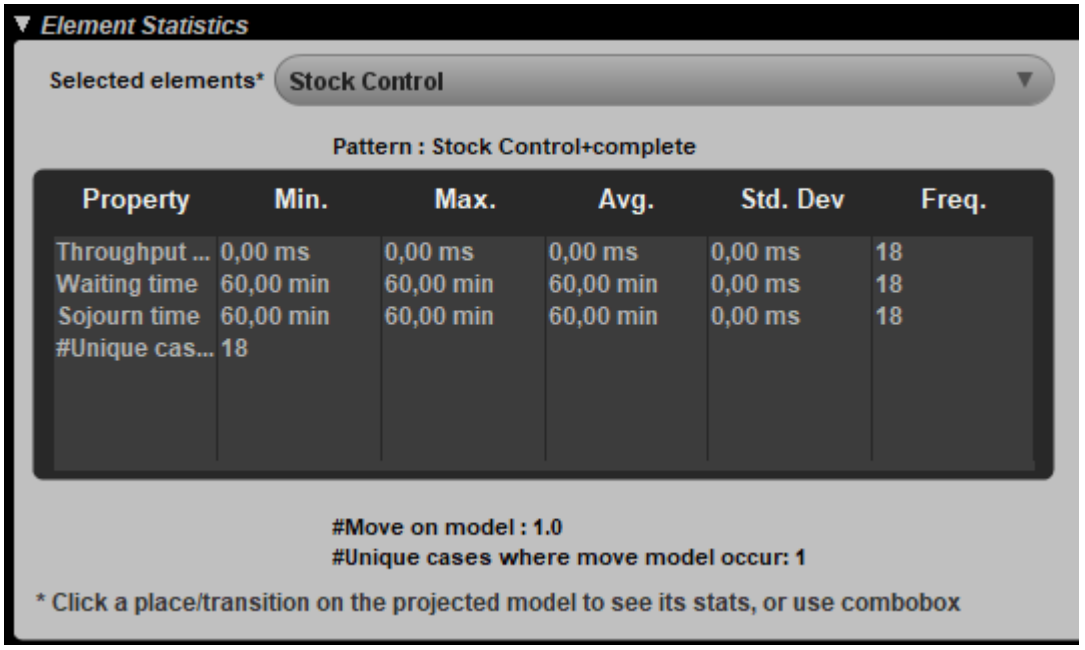
Sojourn Time:
The maximum sojourn time for Product Preparation is 2 hours. Sojourn time includes both active processing time and waiting time. The average sojourn time is approximately 1.79 hours, with a standard deviation of 25.13 minutes, indicating variability in the overall time a case spends in the process, including Product Preparation.

A short sojourn time implies a quick overall process from order creation to product preparation. On the other hand, variability in sojourn time may suggest unpredictable delays for some cases, impacting customer satisfaction.

In summary, The Product Preparation activity shows high efficiency with a throughput time of 0 milliseconds, indicating swift completion. Short waiting times are positive for overall efficiency, but longer waiting times for some cases may require further investigation to identify and address potential bottlenecks. Variability in sojourn time suggests that while most cases experience a quick process, there are instances with less predictable delays.

Usual activities: e.g. "Stock Control"





Throughput Time:
Min./Max./Avg.: All values are 0 ms, indicating that, on average, cases move seamlessly and rapidly through the entire process without any delays. This suggests an ideal or extremely efficient process flow.

Waiting Time:
Min./Max./Avg.: The values are consistent at 60 minutes, meaning that, on average, cases spend 60 minutes in a waiting state between activities. The standard deviation is 0 ms, indicating no variability in waiting times.

The uniform waiting time suggests a consistent delay of 60 minutes between activities for all cases.

Sojourn Time:
Min./Max./Avg.: Similar to waiting time, the values are consistent at 60 minutes, indicating that, on average, cases spend a total of 60 minutes in the entire process. The standard deviation is 0 ms, implying no variability in sojourn times.

The uniform sojourn time suggests that the overall time spent in the process, including both active processing time and waiting time, is constant for all cases.

Overall, the process has an ideal throughput time of 0 ms, indicating rapid and seamless case movement. Waiting time and sojourn time are consistent at 60 minutes, suggesting a fixed waiting period between activities for all cases. The absence of variability in waiting and sojourn times indicates a highly predictable and stable process.

While the process is efficient, it's important to assess whether a fixed waiting time of 60 minutes aligns with business objectives and customer expectations.
We may consider optimizing the waiting time if shorter delays between activities are desired, keeping in mind the impact on overall process efficiency and resource utilization. In summary, the process is highly efficient, but adjustments may be considered based on specific business goals and customer requirements.

5.1.3 Global statistics

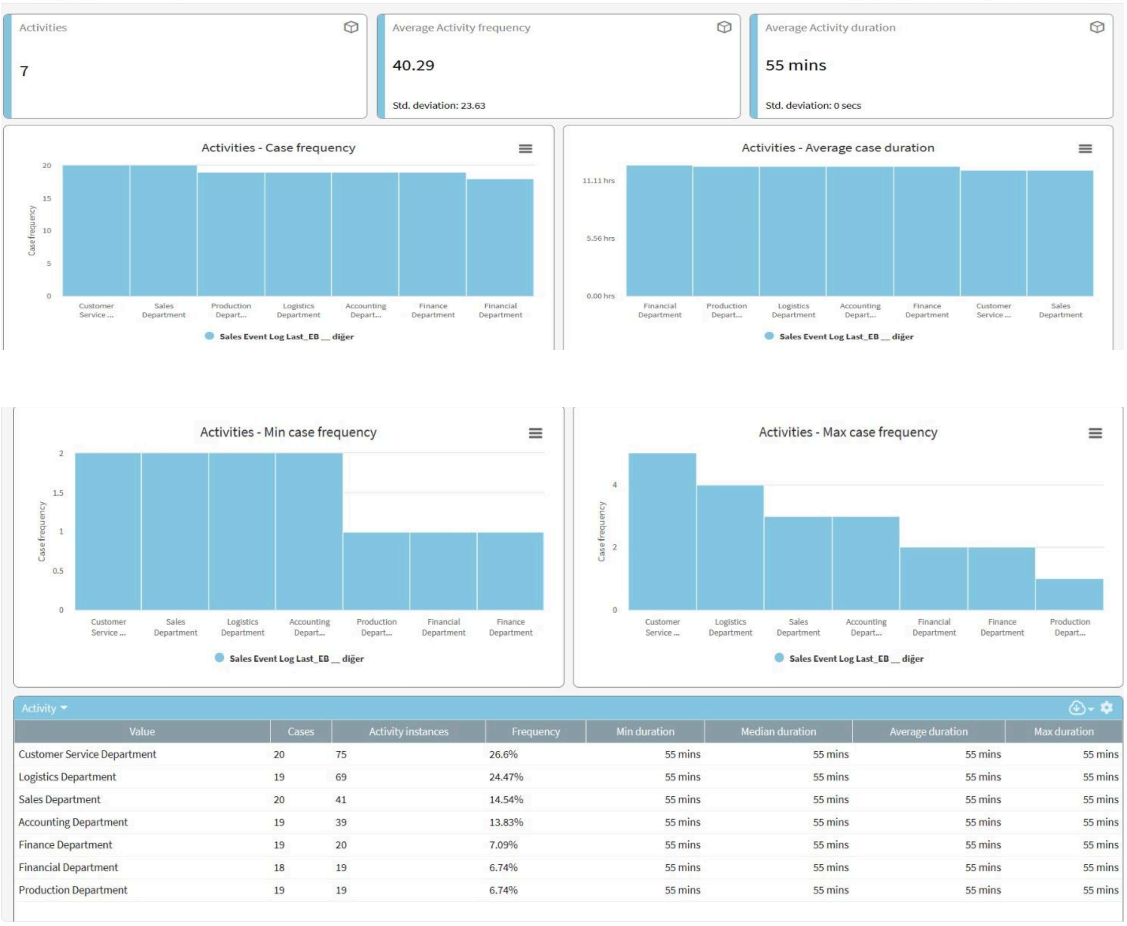
Cases and Fitting:
All 20 cases are categorized as non-fitting, suggesting that none of the cases perfectly adheres to the expected process flow. This could indicate deviations or exceptions in the observed cases.

Properly Started Cases:
None of the cases are categorized as properly started, implying that there might be issues with the initiation phase of the process.

Case Throughput Time:
The average throughput time is 11.20 hours, with a minimum of 4 hours and a maximum of 12 hours. The standard deviation of 1.88 hours indicates some variability in case processing times.
The range from 4 to 12 hours suggests a relatively consistent processing time for most cases.

5.2 Resource perspective analysis

Resource Perspective Analysis in the context of BPMN refers to the assessment and consideration of the resources required to execute a business process. BPMN is a standard notation for business process modelling, and resource analysis in this context involves identifying, allocating and managing the resources that are critical to the efficient execution of processes.



Activity

Value	Cases	Activity instances	Frequency	Min duration	Median duration	Average duration	Max duration
Customer Service Department	20	75	26.6%	55 mins	55 mins	55 mins	55 mins
Logistics Department	19	69	24.47%	55 mins	55 mins	55 mins	55 mins
Sales Department	20	41	14.54%	55 mins	55 mins	55 mins	55 mins
Accounting Department	19	39	13.83%	55 mins	55 mins	55 mins	55 mins
Finance Department	19	20	7.09%	55 mins	55 mins	55 mins	55 mins
Financial Department	18	19	6.74%	55 mins	55 mins	55 mins	55 mins
Production Department	19	19	6.74%	55 mins	55 mins	55 mins	55 mins

In this specific case, the sales model consists of seven different activities, each playing a crucial role in the sales cycle. For a comprehensive analysis, two key metrics have been considered: the average frequency of activities and the average duration of each activity.

The average activity frequency, with a value of 40.29, indicates the number of times each activity occurs in a given period. This data provides a quantitative view of the workload associated with each task in the sales process. Activities with higher frequencies may require a more significant allocation of resources to ensure efficient and timely performance.
Average activity duration, with a value of 55 minutes, refers to the average time required to complete each task. This is crucial for resource planning and time management. Activities with longer durations may influence the overall scheduling of the sales process and require special attention in terms of time and human resources allocation.

Analysing the resource perspective allows identifying potential areas for improvement in the sales model. If some activities have a significant frequency but a relatively short duration, it could indicate underutilised efficiency that could be exploited by reallocating resources. On the other hand, if certain activities have a

long duration, it may be beneficial to examine and optimise processes to improve the overall efficiency of the model.

The combination of these metrics provides a comprehensive understanding of how resources are used in the sales model, allowing process managers to make informed decisions on resource allocation, time planning and performance optimisation. Ultimately, the resource perspective analysis becomes a strategic tool to enhance the effectiveness of the sales team and improve customer satisfaction by ensuring an efficient and well-managed flow of sales activities.

6. SUMMARY

The sales BPMN model demonstrates high accuracy and generalisability, suggesting a robust representation of processes. Potential improvements focus on optimisation, automation and adaptability to ensure continued efficiency and effectiveness in a changing business environment.
Possible improvements that could be made are as follows:

- **Automation and Efficiency:** Explore opportunities for task automation, especially in repetitive processes such as invoice generation and payment confirmation.
  Assess supply chain efficiency and consider automating inventory management.
- **Adaptability to Order Changes:** Strengthen the model's ability to handle order changes, such as modifications, additions or cancellations, more dynamically.
  Ensure that the process of informing the customer about order changes is clear and efficient.
- **Data Analysis and Decision Making:** Integrate data analysis tools to evaluate the performance of the sales process.
  Implement key metrics to evaluate the effectiveness of different stages and make informed decisions.
- **Customer Experience:** Improve communication with the customer throughout the process, from order confirmation to delivery. Consider implementing real-time tracking systems to provide customers with up-to-date information about their orders.
- **Payment Management:** Assess the security and efficiency of the payment confirmation stage.Implement payment management processes that minimise potential errors and improve the customer experience.
- **Inventory and Stock Management:** Review and optimise inventory control processes and product replenishment.Ensure effective stock management to avoid stock-outs or overages.
- **Warehouse Information Integration:** Improve communication and information integration between the warehouse and other stages of the sales process.Ensure proper synchronization of data related to product availability.

- **Training and Continuous Upgrading:** Implement training programmes for staff involved in the sales process.Keep the model up to date with industry best practices and adapt it to changes in sales strategies.

By addressing these areas of improvement, it is possible to further optimize the sales BPMN model, ensuring greater operational efficiency and a more satisfying customer experience.