Business Process Analytics

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I. Introduction

Business processes are at the core of organizational operations, enabling the efficient execution of day-to-day tasks and the optimal use of available resources. In the context of hospitals, the processes related to the management of medical supply orders are critical to ensure that both individual patient needs and general hospital departments are adequately supported.

This assignment focuses on modeling and analyzing the order management process for two distinct types of medical supplies: individual-use supplies and general-use supplies. In the case of individual-use supplies, a doctor creates an order for a specific patient, while for general-use supplies, the head nurse orders items for an entire clinical department. These processes involve several key roles: the doctor, the head nurse, the staff responsible for material handling, and the procurement department.

In this work, we will build a detailed process model using Bizagi Studio, a popular business process management tool, to simulate the workflow of these processes. We will define performance criteria to measure the effectiveness of these operations and conduct simulations using different arrival and service distributions to assess the process's efficiency under various conditions.

Additionally, the development of a basic Process-Oriented Information System (POIS) will enable real-time execution of the process. Data collected during the execution phase will be analyzed to further understand and improve the overall performance of the system.

II. Healthcare Material Ordering Process: A BPMN Model and Analysis

This report describes the healthcare material ordering process for both individual-use and general-use supplies within a hospital setting. The process diagram is modeled using BPMN (Business Process Model and Notation), illustrating the interaction between different roles involved in the process, and highlights key decision points and phases. The purpose of this analysis is to describe the key roles, phases, and decisions that shape the flow of the ordering process, along with identifying potential bottlenecks and areas for optimization.

Roles Involved

Several key roles participate in this process:

- **Physician**: Responsible for initiating individual-use orders for patients.
- **Head Nurse**: In charge of making general-use supply orders for a clinical department.
- **Supply Department Employee**: Reviews and processes orders, checks stock availability, and coordinates deliveries.
- **Procurement Department Employee**: Handles orders that cannot be fulfilled internally, forwarding them to external suppliers for replenishment.

Phases of the Process

The process is divided into several key phases that outline the flow from order initiation to final delivery.

Order Placement

The process begins when a **Physician** or a **Head Nurse** fills out an order. The physician's order pertains to **Individual Use** (for a specific patient), while the head nurse's order is for **General Use** (for a clinical department). The requested items and quantities are specified in the order, which is then sent for processing.

This phase captures the demand for supplies, either at the patient level or for the entire clinical department.

Order Review and Item Availability Check

Once the order is received, the **Supply Department Employee** reviews it. The key task at this stage is to determine whether the requested items are available. The flow of the process can take multiple routes depending on availability:

- If **all items** are available, the supplies are delivered immediately to the requester.
- If **no items** are available, the order is forwarded to the **Procurement Department**.
- If **some items** are available, a partial delivery may be made, while the rest of the order is forwarded for procurement, depending on urgency.

Handling Urgent Requests (Individual Use)

In the case of individual-use orders, there is an additional decision point to assess **urgency**. If the missing items are considered critical for patient care, an **immediate partial delivery** of the available items is initiated.

Procurement Process

If the items are unavailable, the order is forwarded to the **Procurement Department**, which logs the missing items and orders them from external suppliers. Once the procurement process is complete, the replenished items are received and processed back into the hospital's stock.

Order Completion and Delivery

The final phase involves the delivery of the requested supplies to the respective department or physician. This can happen either after the initial availability check or after the procurement process is completed. The cycle continues until all items have been successfully delivered.

Flow Decision Points

The process contains several decision points that guide the flow:

- **Item Availability Check**: Determines whether items are fully, partially, or not available.
- **Urgency Evaluation (Individual Use)**: Evaluates if the request requires immediate partial delivery based on urgency.

System Logging and Record Keeping

Throughout the process, various logs are maintained (e.g., received order logs, missing items logs). These logs are critical for tracking the status of orders and identifying areas for improvement in future cycles.

Technology and Tools

This process is modeled for implementation and simulation using **Bizagi Studio**. Through real-time tracking and simulation, Bizagi can help optimize the workflow by analyzing different supply chain configurations, order arrival rates, service times, and stock levels.

Conclusion

This process diagram provides a comprehensive view of the healthcare material ordering process, detailing how hospitals manage their supply chains for both individual and general use. Through the use of Bizagi Studio, hospitals can simulate and refine their processes, ultimately improving their procurement systems and ensuring timely delivery of supplies critical to patient care and departmental operations.

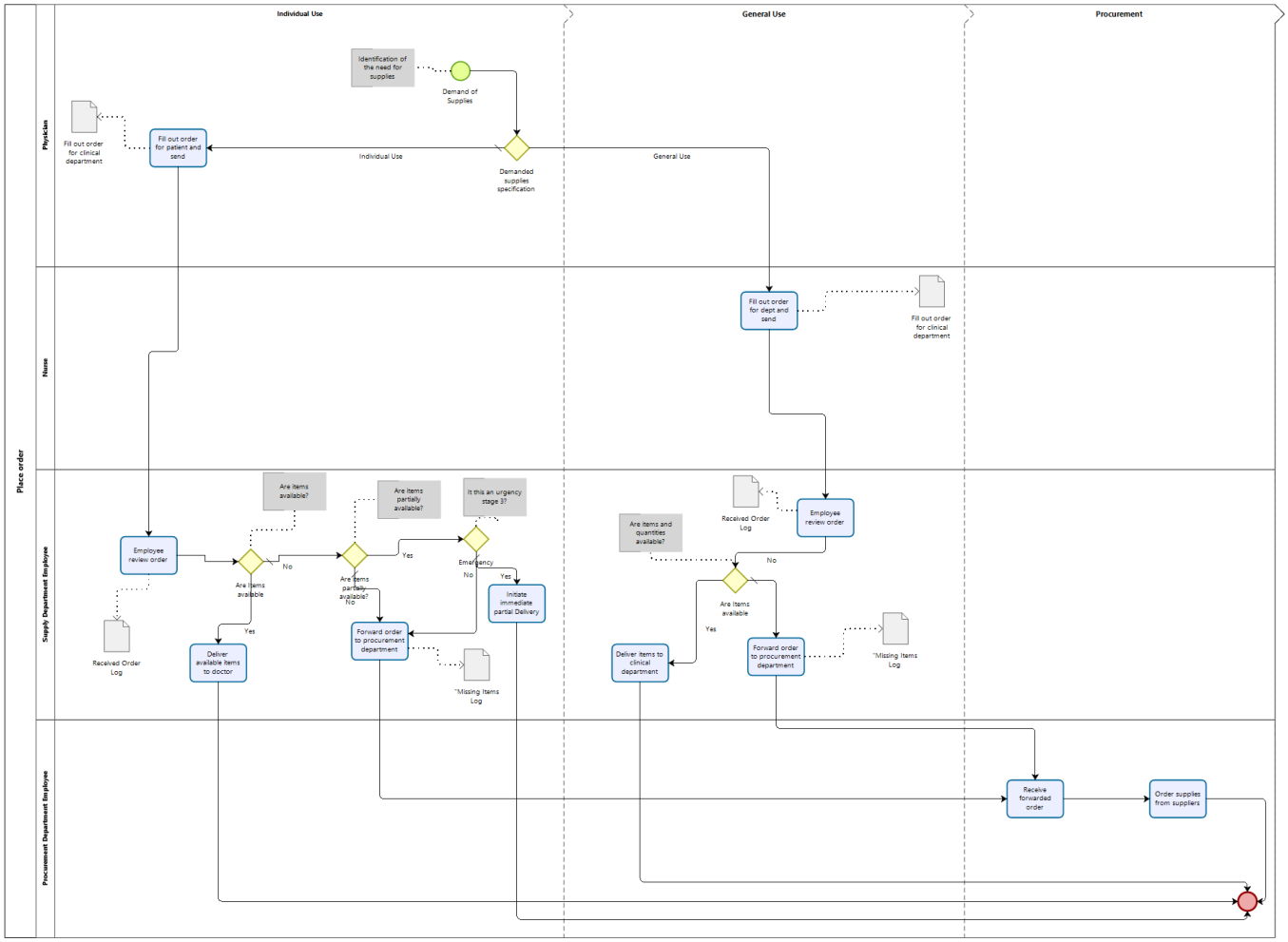


Fig. 1: Healthcare Material Ordering Process Diagram

III. What-If Analysis of POIS

This document explains the results of a what-if analysis conducted on the healthcare material ordering process using data from Bizagi. The analysis focuses on the utilization of resources, specifically the Doctor's role, and the performance of the "Place Order" process across multiple replications.

Resource	Scenario	Utilization	Total fixed cost	Total unit cost	Total cost
Doctor	Daily Order - Replication 1	100.00 %	0	240	240
Nurse	Daily Order - Replication 1	99.98 %	0	191.96	191.96
Employee of Supplies Dep	Daily Order - Replication 1	44.99 %	0	151.17	151.17
Employee of Procurement Dep	Daily Order - Replication 1	61.39 %	0	103.13	103.13

Fig. 2: Healthcare Material Ordering Process Diagram

IV. Resources Analysis

The *Resources* sheet provides details about the Doctor's utilization during the process. The key columns are as follows:

- **Resource**: The resource being analyzed, which in this case is the "Doctor".
- **Scenario**: This column represents different replications of the process.
- **Utilization**: In all scenarios, the utilization of the Doctor is 100%, indicating that the Doctor is always engaged and has no idle time.
- **Total fixed cost**: This column is zero across all replications, indicating that there is no fixed cost associated with the Doctor's role in the process. In this scenario we made part of the Doctors responsibilities to make orders and no extra costs are applied.

Name	Scenario	Type	Instances completed	Instances started	Min. time	Max. time	Avg. time	Total time	Total time waiting resource	Total fixed cost
Place order	Daily Order - Replication 1	Process	118	1,000	12m 47s	21h 50m 11s	11h 14m 40s	209d 8h 28m 19s	207d 17h 28m 46s	20,940
Place order	Daily Order - Replication 2	Process	139	1,000	48m 39s	23h 4m 29s	11h 8m 1s	200d 8h 16m 48s	198d 15h 23s	24,063
Place order	Daily Order - Replication 3	Process	150	1,000	49m 32s	22h 54m 1s	12h 23m 38s	216d 56m 55s	214d 3h 20m 46s	25,779
Place order	Daily Order - Replication 4	Process	132	1,000	14m 54s	22h 54m 41s	10h 33m 21s	189d 6h 44m 51s	187d 14h 13m 6s	22,820
Place order	Daily Order - Replication 5	Process	162	1,000	10m 36s	22h 59m 10s	11h 41m 29s	205d 19h 58m 53s	203d 23h 38m 16s	26,752

Fig. 3: Healthcare Material Ordering Process Diagram

V. Place Order Process Analysis

The *Place Order* sheet provides details about the performance of the ordering process. The key columns are as follows:

- **Name**: Refers to the "Place Order" process, which is analyzed in multiple replications.
- **Scenario**: Different replications of the process (from 1 to 5).
- **Instances completed**: The number of process instances completed during each replication, ranging from 118 to 162.
- **Instances started**: The number of instances started remains constant at 1000 for all replications.
- **Min., Max., Avg. time**: These columns display the minimum, maximum, and average time (in seconds) taken to complete the process. The average time ranges from approximately 2,206,000 to 2,484,000 seconds across different replications.
- **Total time**: The total time spent in the "Place Order" process across all instances within each replication. This is on the order of 1 billion seconds in each case.
- **Total fixed cost**: Represents the fixed cost associated with the process, which varies slightly across the replications (e.g., 12, 30, 9).

The times are estimated by the random destributions specified below:

Role	Distribution	Task Name	Mean Processing Time (secs)
Doctor	Negative Exponential	Fill out order for dept and send	300
Doctor	Negative Exponential	Fill out order for patient and send	**600**
Supply Department Employee	Negative Exponential	Employee review order	**120**
Supply Department Employee	Negative Exponential	Forward order to procurement department	180
Supply Department Employee	Negative Exponential	Initiate immediate partial delivery	**120**
Supply Department Employee	Negative Exponential	Deliver available items to doctor	300

TABLE I: Comparison of processing times for different tasks. Note that **partial delivery of items takes less time** (120 seconds) compared to other methods like full order delivery (300 seconds).

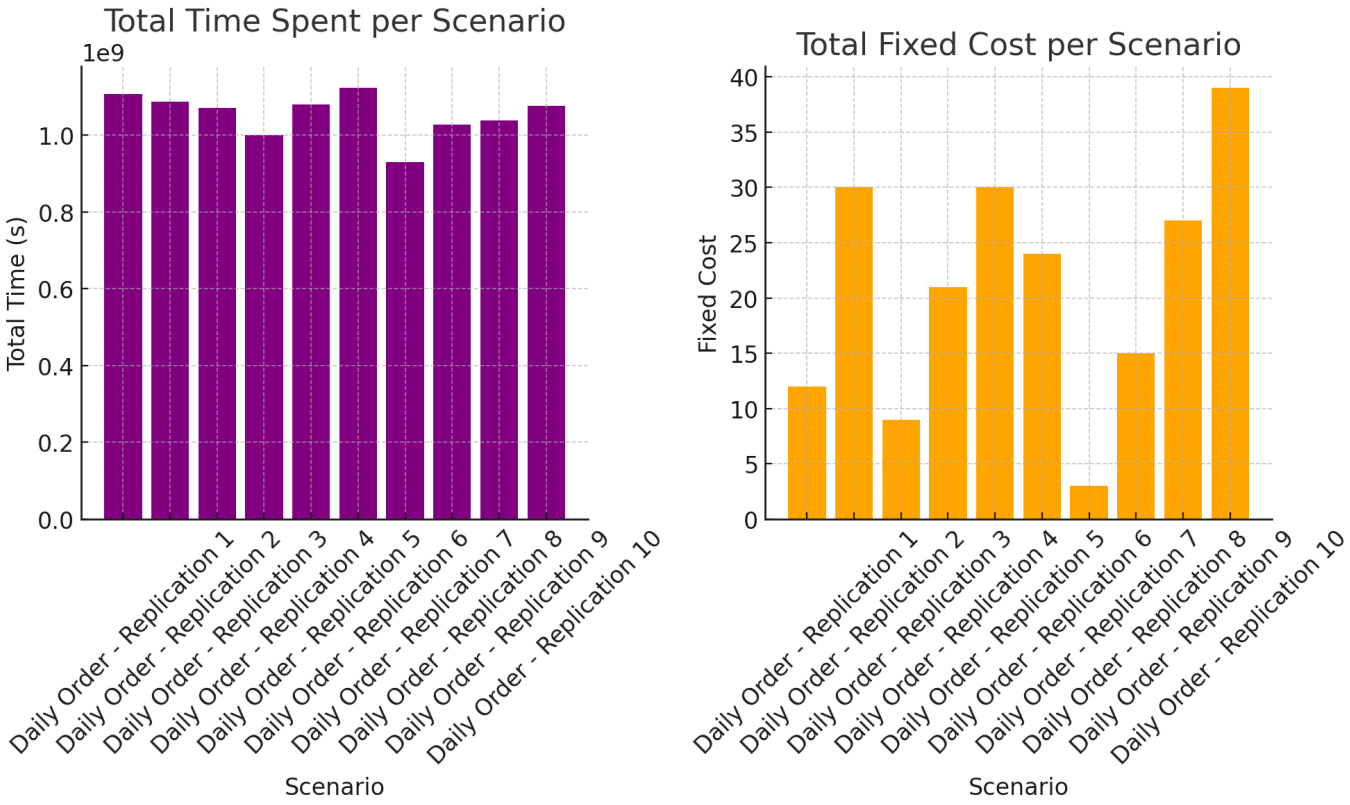


Fig. 4: Here we make a graph from the exported excel just to have a summary of the time spend and the total cost. As explained above the greater portion of the cost is fixed due to the occupation of the Doctors, Nurses and Employees. So, for example, if the doctor is working his 8 hour shift making orders we calculate the costs as such. This helps us to analyze the costs in 10 senarios following Poisson/Exponantial Distributions. In further analysis we can add the extra costs of the partial and immediate deliveries as well as other costs to analyze our budget.

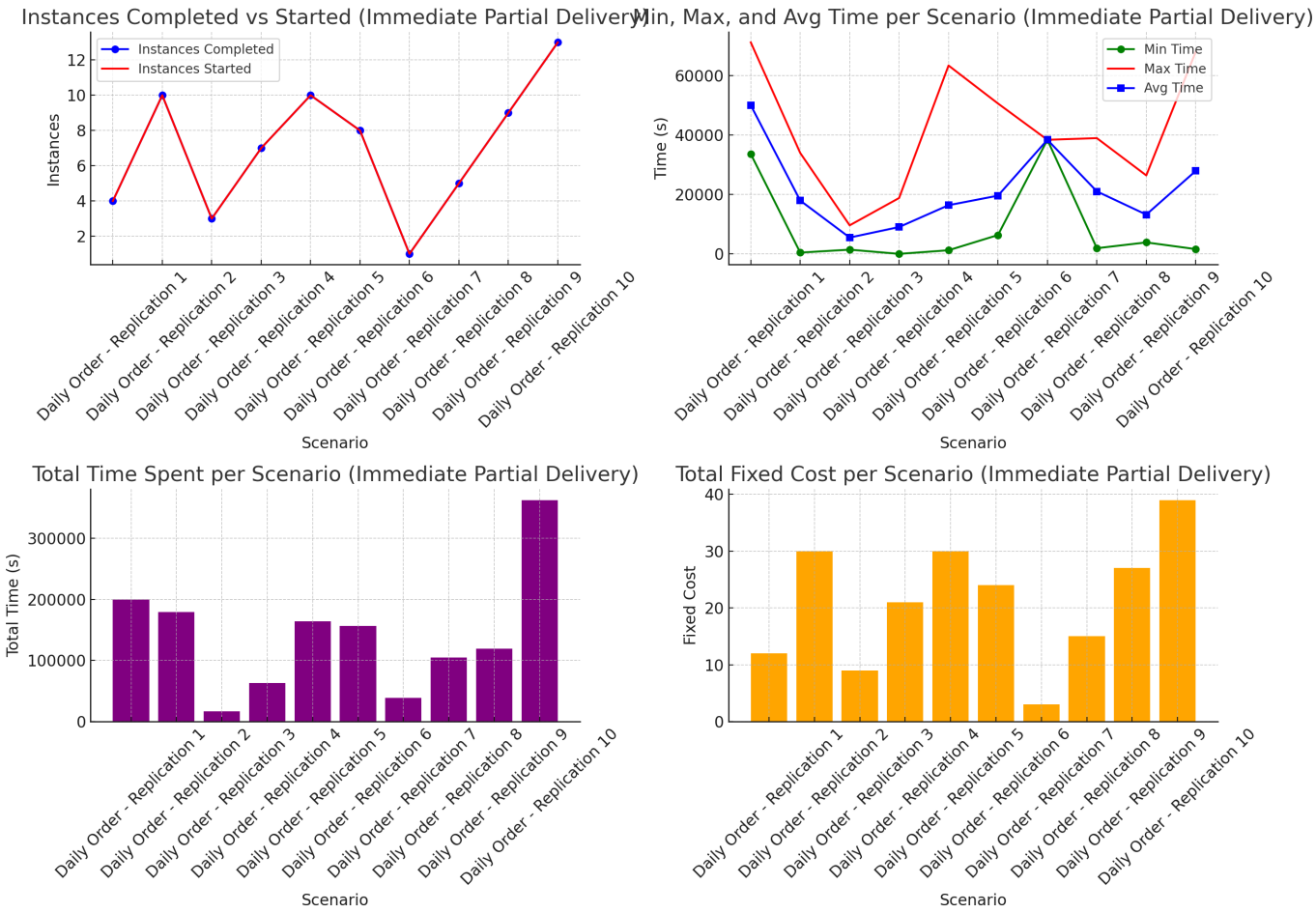


Fig. 5: A special case of the 10 random instances of an Emergency scenario where the Immediat Prtial Delivery is issued. We analyze and summarize the results in completed instances and times it took as well as the costs.

VI. Model Data

Below we give the flow chart that describes the process. We use Order as the key Entity and we ensure the relationships between the other entities and the parameters necessary for our process.

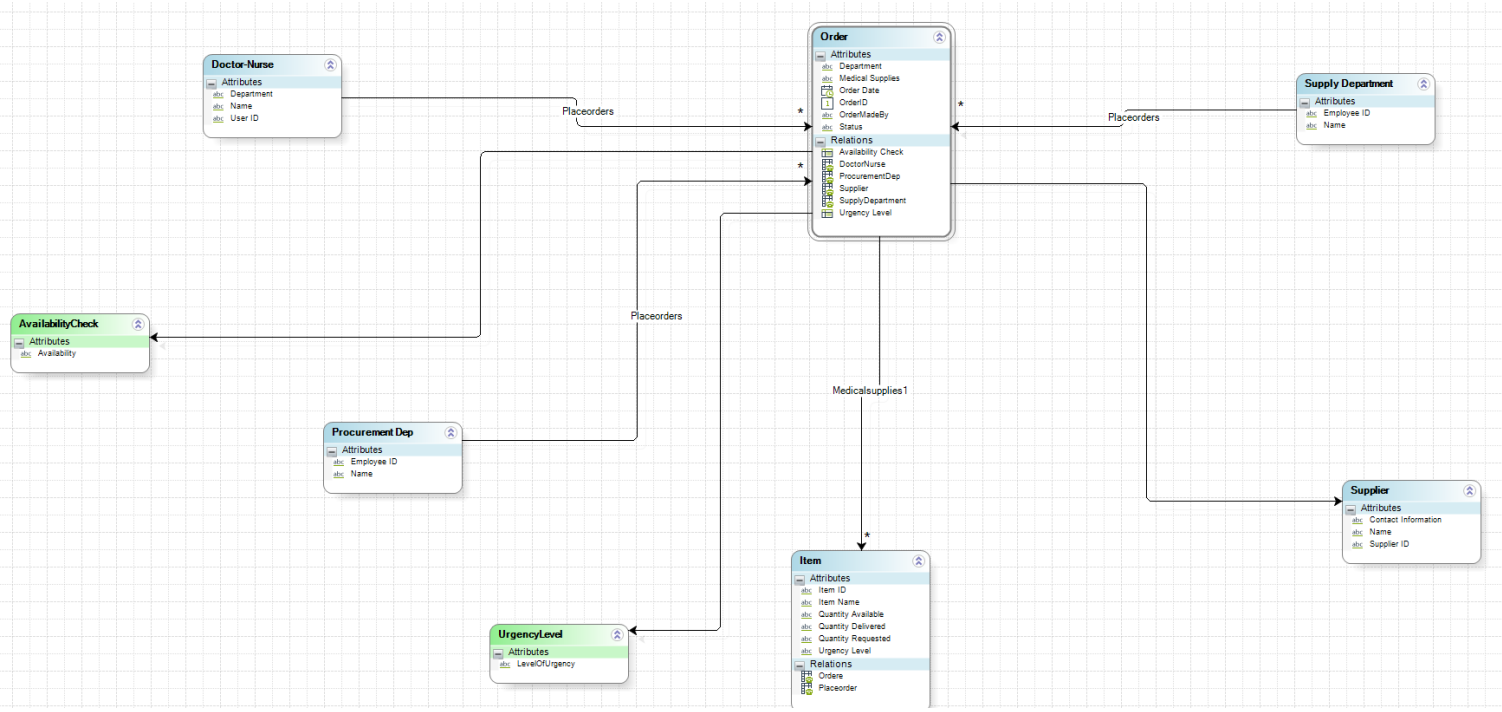


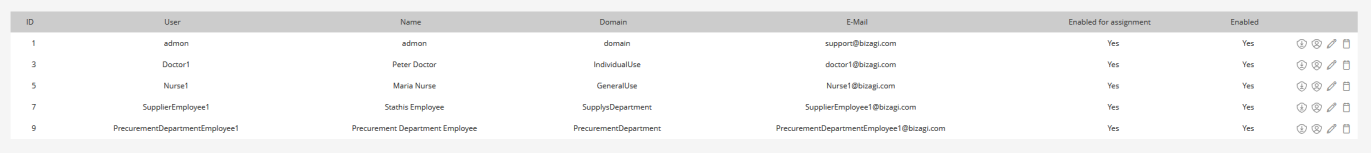
Fig. 6

Entities and Relationships Description

- **Doctor-Nurse**
  - Attributes: Department, Name, User ID
  - Relationship:
    - **One-to-Many**: Can place multiple orders with the entity **Order**.
- **Order**
  - Attributes: Department, Medical Supplies, Order Date, Order ID, Order Made By, Status
  - Relationships:
    - **One-to-One**: Linked to the **Availability Check** entity.
    - **One-to-Many**: Linked to multiple **Doctor-Nurse** entities (orders can be placed by multiple doctors/nurses).
    - **One-to-Many**: Linked to multiple **Procurement Department** entities.
    - **One-to-Many**: Linked to multiple **Supplier** entities.
    - **One-to-Many**: Linked to multiple **Supply Department** entities.
    - **One-to-One**: Linked to an **Urgency Level** entity (each order has one urgency level).
- **Availability Check**
  - Attributes: Availability
  - Relationship:
    - **One-to-One**: Linked to the **Order** entity (each availability check belongs to one order).
- **Procurement Department**
  - Attributes: Employee ID, Name
  - Relationship:
    - **One-to-Many**: Can place multiple orders with the **Order** entity.
- **Supply Department**
  - Attributes: Employee ID, Name
  - Relationship:
    - **One-to-Many**: Linked to multiple **Order** entities.
- **Urgency Level**
  - Attributes: Level of Urgency
  - Relationship:
    - **One-to-One**: Linked to a single **Order** entity (each order has one urgency level).

VII. Bizagi Work Portal

After setting up our environment we run the Bizagi process and we make some orders:



ID	User	Name	Domain	E-Mail	Enabled for assignment	Enabled
1	admon	admon	domain	support@bizagi.com	Yes	Yes
3	Doctor1	Peter Doctor	IndividualUse	doctor1@bizagi.com	Yes	Yes
5	Nurse1	Maria Nurse	GeneralUse	Nurse1@bizagi.com	Yes	Yes
7	SupplierEmployee1	Stathis Employee	SupplysDepartment	SupplierEmployee1@bizagi.com	Yes	Yes
9	PrecurementDepartmentEmployee1	Precurement Department Employee	PrecurementDepartment	PrecurementDepartmentEmployee1@bizagi.com	Yes	Yes

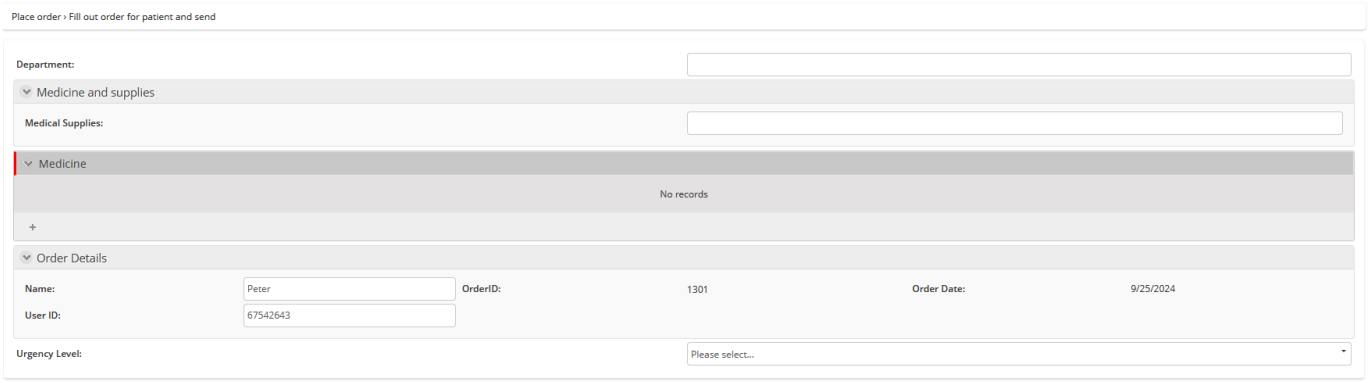
Fig. 7

We've set up the roles for our process and loging in as Doctor Role we will make some orders and begin the process:

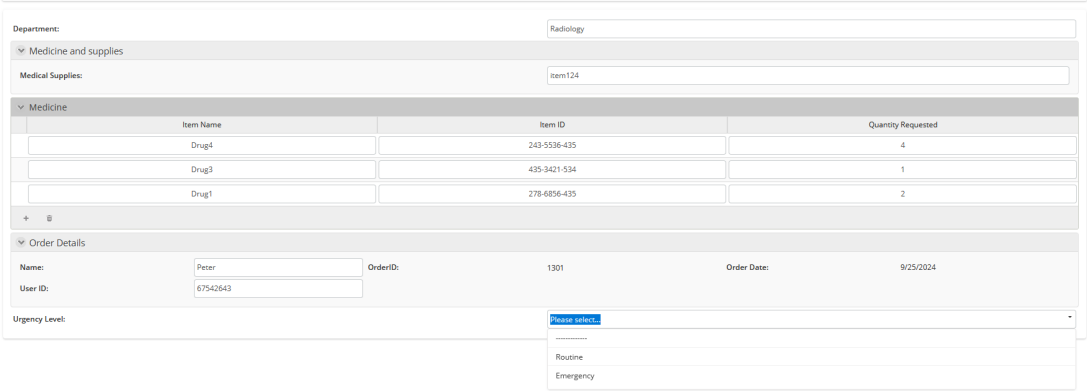
Case Number	Process	Activity
1258	Place order	Fill out order for patient and send
1259	Place order	Fill out order for patient and send

Fig. 8

and as the Doctor role we fill the form:



(a) This is the Initial form seen by the Doctor. Notice that some features are automatically filled. This is a feature of the FUNCTIONS of Bizagi. This tool makes the task of filling the Orders take the nessecery time while avoiding repetitive work



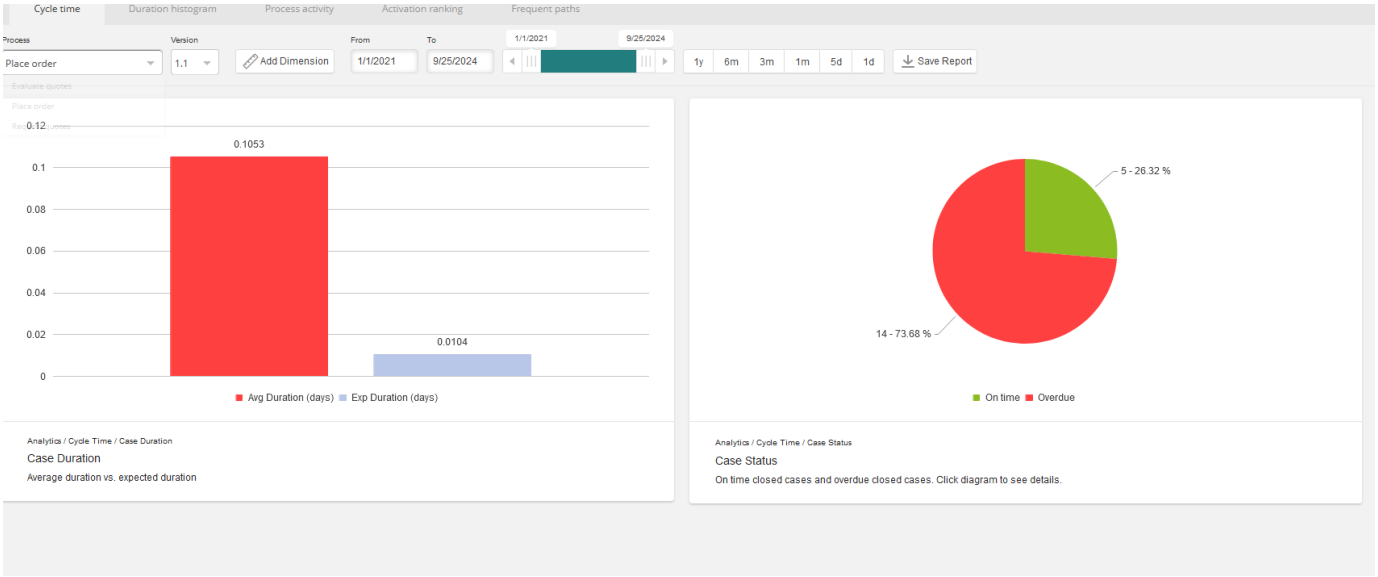
(b) Here we can see the additional choice of Doctor for the Emergency process

The implementation we did for the emergency cases is shown to the Doctor. Nurse Role do not have this clearance as they issue only routine and daily needed medical supplies in our process.

A. Evaluation Metrics and Analytics

We then analyze and make a summary of our process. We made a starting batch of 19 cases to check the results and take advantage of the insight that can be provided with Bizagi.

Below we make a first assessment of the process Cycle Time. The charts record the On time and overdue tasks we have on the first batch of 19 processes. Statistics can be drawn from this tool and we have the advantage of comparing the Avg Duration versus the Exp Duration. This helps us figure out the best way to manage time and distribute the workload.



(a)

Cycle Time Summary	
Closed	19
Avg Duration (days)	0.1053
Exp Duration (days)	0.0104
Std Deviation	0.3153
On Time Cases	5

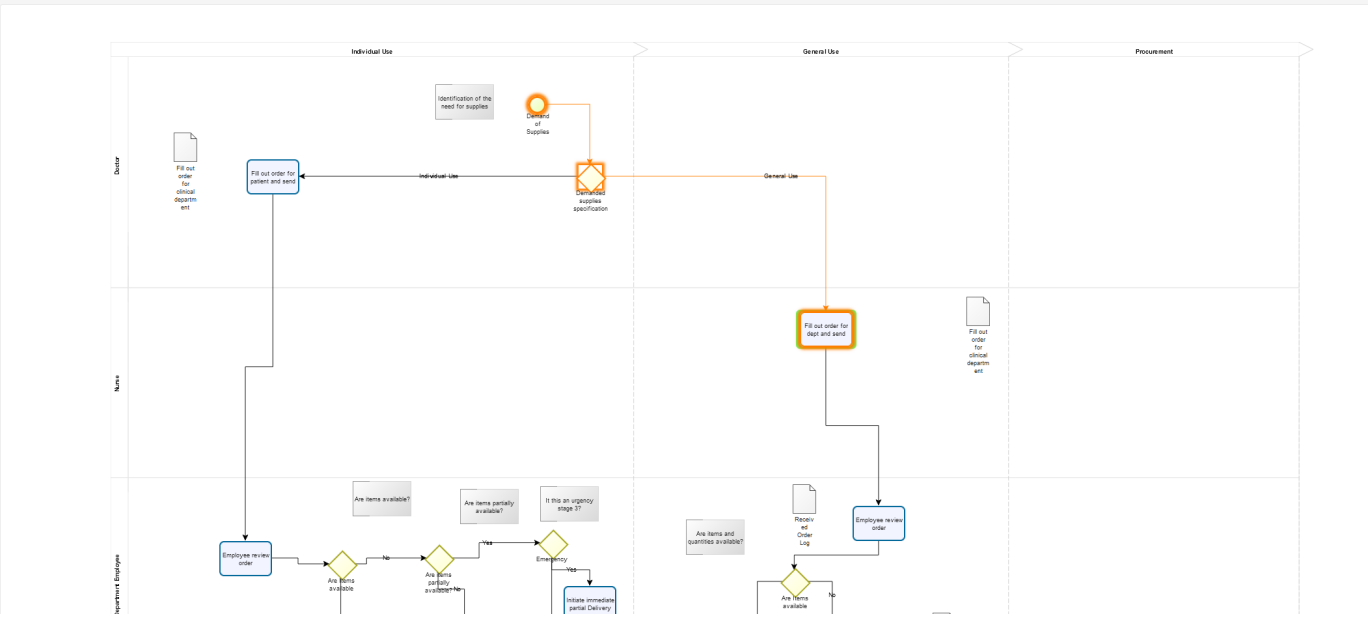
B. Second batch of orders

Moving further with our process we create more orders in order to create a variety in time of completion and that way we can take full advantage of the eval metrics Bizagi provides. This will help us improve and expand our process.

15 more orders can be seen and inspected. This helps us keep track of the due dates.

Case Number	Case creation date	Case due date	View	Admin
1255	9/25/2024 8:04 pm	9/26/2024 8:05 am		
1256	9/25/2024 8:05 pm	9/26/2024 8:05 am		
1258	9/25/2024 8:10 pm	9/26/2024 8:05 am		
1259	9/25/2024 8:10 pm	9/26/2024 8:05 am		
1260	9/25/2024 8:14 pm	9/26/2024 8:05 am		
1261	9/25/2024 8:15 pm	9/26/2024 8:05 am		
1262	9/25/2024 8:16 pm	9/26/2024 8:05 am		
1263	9/25/2024 8:16 pm	9/26/2024 8:05 am		
1264	9/25/2024 8:17 pm	9/26/2024 8:05 am		
1265	9/25/2024 8:17 pm	9/26/2024 8:05 am		
1266	9/25/2024 8:18 pm	9/26/2024 8:05 am		
1267	9/25/2024 8:18 pm	9/26/2024 8:05 am		
1268	9/25/2024 8:19 pm	9/26/2024 8:05 am		
1269	9/25/2024 8:19 pm	9/26/2024 8:05 am		
1270	9/25/2024 8:19 pm	9/26/2024 8:05 am		

Upon further inspection we can see and track the progress of each Order. This is a crucial part of our work. The ability to see the process of the Order is paramaount.
Below we see an example:



Case:	1260	**Process:**	Place order 1.1
Creator User:	Nurse1	**Creation Date:**	9/25/2024 8:14 pm

The following graph shows us the duration in days it took for closed cases to complete. Although we dont have a lot of cases yet this tool helps us see if we have a descending trend in the closing of cases, suggesting that each role completes their task within the scheduled time period. This is particularly helpful when the whole process runs in a span of months where the complexity will be increased.

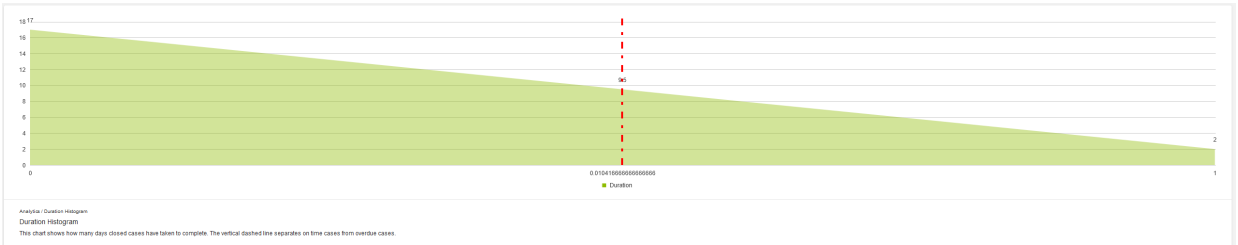
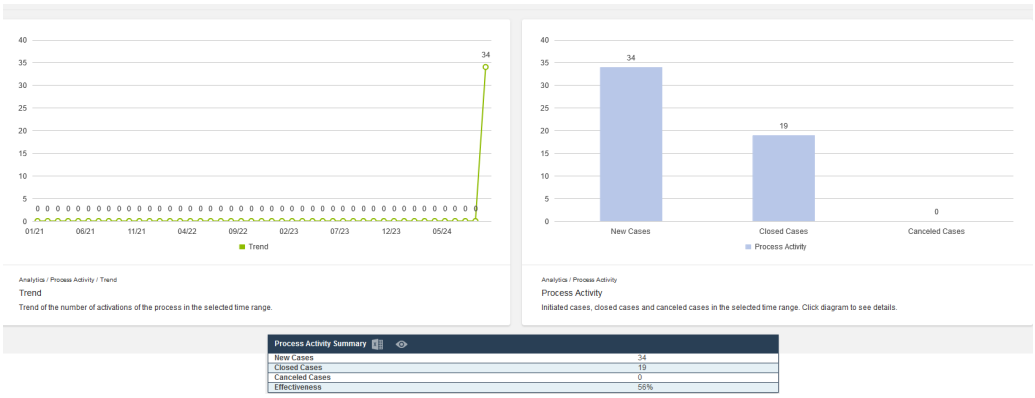


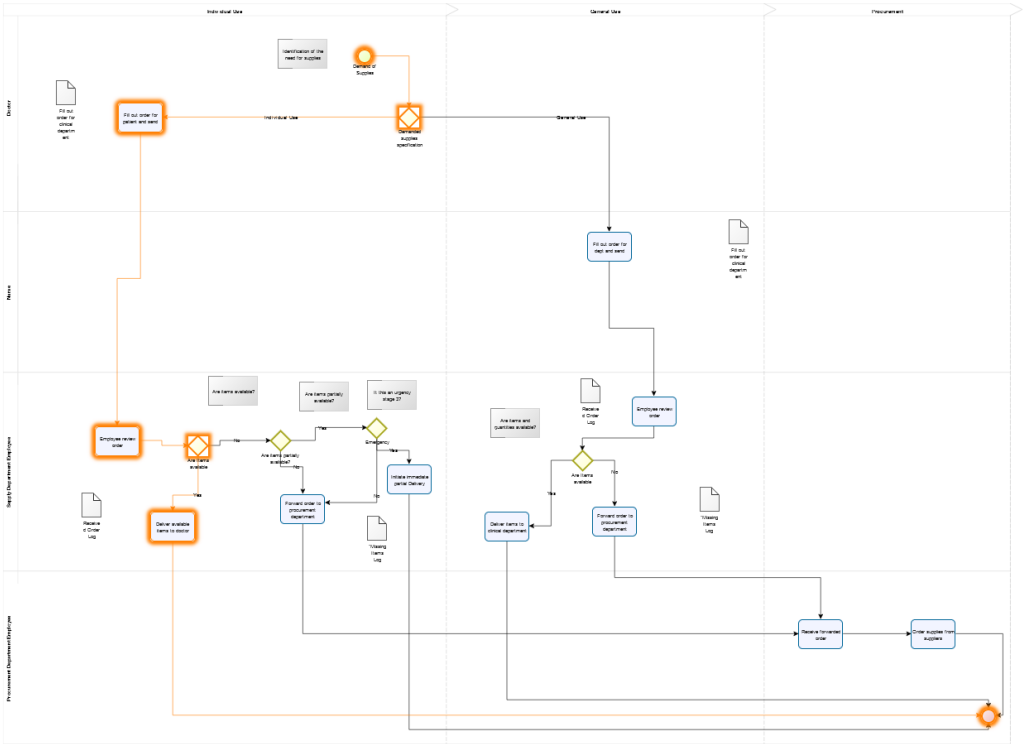
Fig. 11: At the stage of our process this graph is not very insightful because currently we have modulated our proceses to run for 1 day. As we make further batches it will have spaces of ascending and descending completion times (rational numbers that would divide the 1 day). These changes in the type of the monotonous graph will make us identify the the time it takes for the completion of tasks. Red doted line shows the overdue cases.

We track our progress so far taking into account all the batches so far. Here we can see both the new and closes cases as well as the frequency in which they are made daily, along with some metrics.



Tools that give us insight as to which of the pathways is more probable pinpoint exactly where our process shows weaknesses. In cases where the most probable scenario is the Partial delivery we can immediately identify the lack of proper supplement of the departments. This helps us make actionable decisions to improve our structure and benefit the process drastically.

Below we derive that the second batch of orders was successful in efficient supply of the Individual Use cases as the most common path was the one of the Complete delivery.



We also examine exactly the tasks that have contributed to the total count of the On time, at Risk and Overdue running processes. In our second batch where the orders were made today everything is within the time schedule.

Fig. 12: Process stages for order handling and review

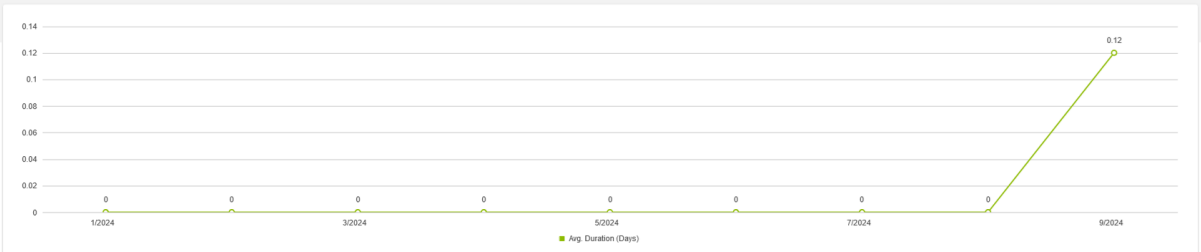
Lastly, we also check some sensors. By implementing stopwatch features we can regulate the pace at which processes and tasks are completed. Below we see a summary of our process:

Cycle Time Summary

Stopwatch	Counts	Sla	Min Duration	Max Duration	Avg Duration	Standard Deviation	On Time	Overdue
Example	19	0D 1H:0.M	0D 0H:0M	1D 0H:0M	0D 0H:51M	0.3153017676423058	89.47%	10.53%
Example33	19	0D 1H:0.M	0D 0H:0M	1D 0H:0M	0D 0H:51M	0.3153017676423058	89.47%	10.53%
Order TIme	16	0D 0H:5.M	0D 0H:0M	1D 0H:0M	0D 1H:0M	0.3415650255319866	87.5%	12.5%

Level of Service

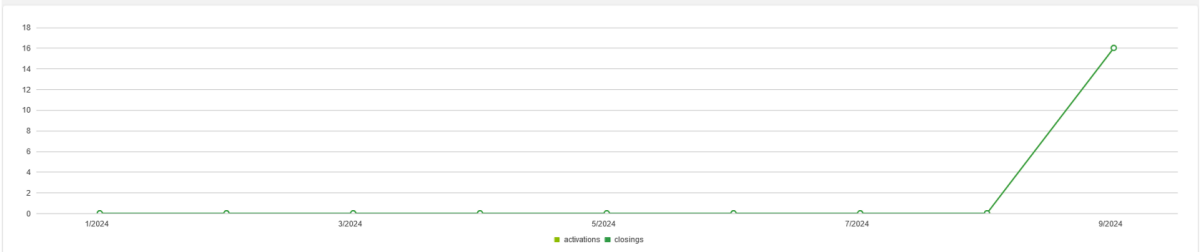
Stopwatch	< 1 day	1 day	2 days	3 days	4 days	5 days	6 days	> 6 days
Example	100%	0%	0%	0%	0%	0%	0%	0%
Example33	100%	0%	0%	0%	0%	0%	0%	0%
Order TIme	100%	0%	0%	0%	0%	0%	0%	0%



Sensors / Stopwatches / Duration trend

Duration trend

The chart shows the stopwatch's average duration trend. Calculations are based on process instances in which the end-activity of the stopwatch was finalized within the selected time period.



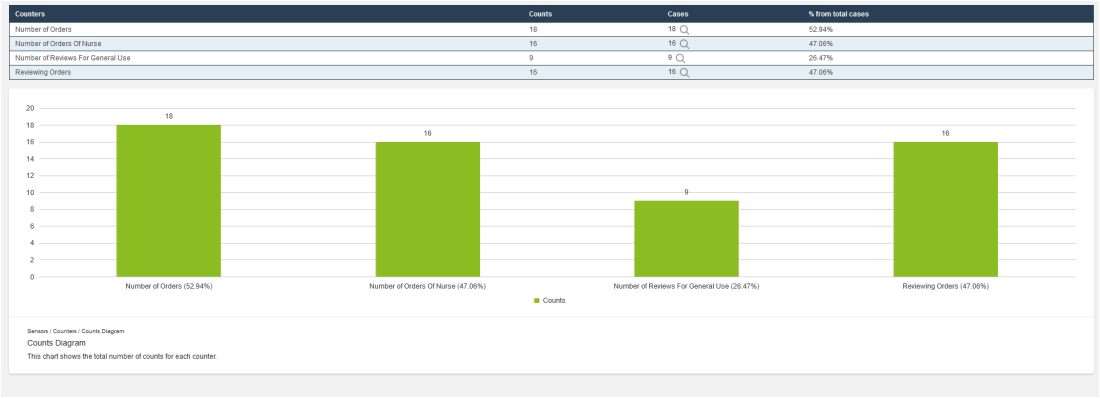
Sensors / Stopwatches / Activations vs Closing trend

Activations vs Closing trend

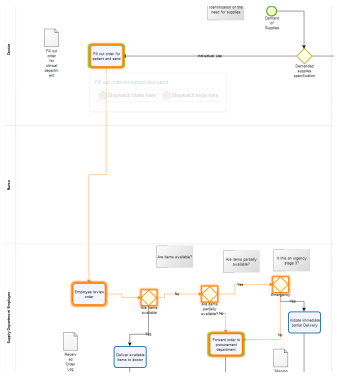
Trend of the number of activations versus the number of closings of the stopwatch.

None of the processes took more than a day to complete. Also we can see the On Time and Overdue %. Other information like Max and Avg Duration are also displayed. This can impact our decision making in a detrimental way.

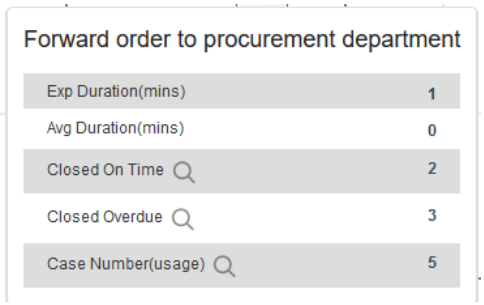
The Count metric helps us keep track of the work balance. We clearly monitor what tasks take place in or process. Another KPI that is a valuable information to have.



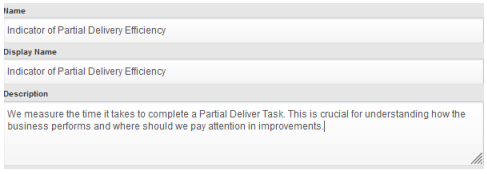
VIII. Example Of Actionable Decisions



(a) Stopwatch of the pathway that leads to Partial Delivery



(b) Forward order to procurement department



(c) Indicator of Partial Delivery Efficiency

Fig. 13: Process stages for partial delivery and efficiency indicators

We check our statistical tool. As a result with the data we have so far we can conclude that the Emergency cases are handled correctly and on time

Stopwatch	Counts	Sla	Min Duration	Max Duration	Avg Duration	Standard Deviation	On Time	Overdue
Example	24	0D 1H:0:M	0D 0H:0M	1D 0H:0M	0D 1H:40M	0.41485111699905347	79.17%	20.83%
Example33	24	0D 1H:0:M	0D 0H:0M	1D 0H:0M	0D 1H:40M	0.41485111699905347	79.17%	20.83%
Indicator of Partial Delivery Efficiency	5	0D 0H:10:M	0D 0H:0M	0D 0H:0M	0D 0H:0M	0	100%	0%
Order TIme	18	0D 0H:5:M	0D 0H:0M	1D 0H:0M	0D 0H:53M	0.3233808333817773	88.89%	11.11%

Level of Service

Stopwatch	< 1 day	1 day	2 days	3 days	4 days	5 days	6 days	> 6 days
Example	100%	0%	0%	0%	0%	0%	0%	0%
Example33	100%	0%	0%	0%	0%	0%	0%	0%
Order TIme	100%	0%	0%	0%	0%	0%	0%	0%
Indicator of Partial Delivery Efficiency	100%	0%	0%	0%	0%	0%	0%	0%

Fig. 14: Stopwatch and Service Level Data for Partial Delivery Efficiency

We don't have a large number of instances (and the cases that failed to be delivered in less than a day and with a time duration greater than 10 minutes. But this tool will allow us to govern such sensitive cases and be prepared to make the right decisions especially in such crucial matters.

Queries

We also gather all our data in one place and compare the individual processes. We can search for names of Doctors and Nurses that issued orders, the quantities that have been requested and delivered.
In the example below we compare the Emergency instances that where addressed with Partial or Complete delivery. This will highlight key indicators as to how our process performs.

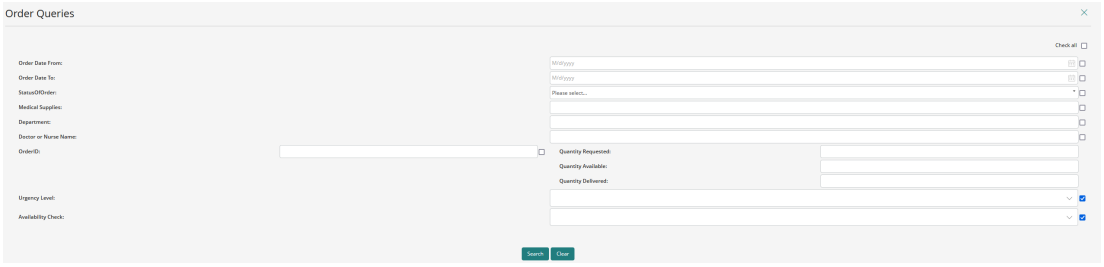


Fig. 15: Order Queries Interface Showing Filters for Dates, Department, Status, and Medical Supplies

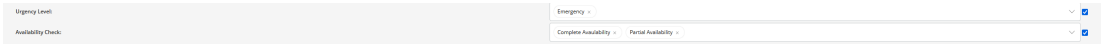


Fig. 16: Urgency Level and Availability Check Filters in the Order Queries Interface

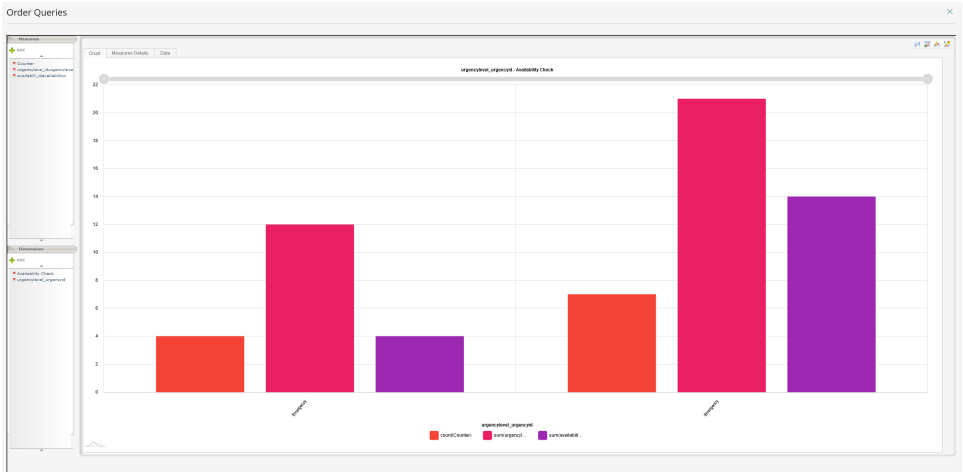


Fig. 17: Graphical Representation of Order Queries by Urgency Level and Availability Check

In the analysis above, we examine two scenarios for addressing emergencies: one with Complete Availability (left) and another with Partial Availability (right). From left to right, the chart presents the count of orders, the sum of Urgency Levels, and the sum of Availability. The data clearly shows that Partial Availability is more frequent than Complete Availability. This insight provides valuable information, indicating that the process is effective in prioritizing and delivering resources under varying conditions. However, it also highlights potential issues within the supplier system, suggesting that its stocking capabilities may require further investigation to ensure it can fully meet demand in critical situations.

IX. Meta Analysis and Key Performance Indicators (KPIs)

In business process management, several Key Performance Indicators (KPIs) are used to evaluate and improve performance. Here we itemize the most critical indicators with examples.

- **Capacity Indicator**: A measure of the ability of a business process to produce goods or services over a specific period. It evaluates how efficiently resources are utilized to meet demand. For example, in our healthcare material ordering process modeled in Bizagi Studio, a capacity indicator could assess the number of medical supply orders the procurement department can process daily. A potential capacity indicator could be: "The procurement department can process 100 orders per day." If demand exceeds this capacity, it may signal the need for more resources or process optimization. We would easily test this by puting counters on tha task "Receive Order" of the Procurement Department field and check if such a cases arises.
- **Productivity Indicator**: A measure of how effectively resources are used to produce goods or services. It focuses on the ratio of output produced to the resources (such as time, labor, or costs) consumed. In our healthcare material ordering process, a productivity indicator could assess how many orders a supply department employee processes in an hour. For example: "One employee processes 20 orders per hour, while another processes 15 orders per hour," indicating varying levels of productivity. With a stopwatch and a more personalized profile of 2 Supplies employees, the right Performers adjustments and a monitor in the sensors of the Bizagi work portal we can immediately access information like this and regulate the work balance for more efficient performance.
- **Profitability Indicator**: A measure of the financial performance of a process or company, reflecting the percentage ratio of profit to total revenue. For instance, in our context of healthcare material procurement, profitability can be calculated as the profit from supplying materials compared to the total sales of these materials. An example could be: "If the total revenue from orders is $200,000 and the profit is $20,000, the profitability is 10%." This helps determine the financial efficiency of the procurement process. This result is outside of our current implementation but using the powerfull tools of Bizaki it can easily be an expansion of the current process. A current example can be the cost of the supply dept order vs the procurement dept order. We set those to have different rates because its a logical assumption that an internal order would be cheaper that an external one.
- **Return on Investment (ROI) Indicator**: A measure that evaluates the efficiency of an investment by comparing the profit generated to the initial investment. In our healthcare material ordering process, ROI could measure the returns from an investment in new procurement technology or systems. For example: "If a hospital invests $500,000 in a new ordering system and generates a profit of $20,000 from efficiency improvements, the ROI would be 4%." This indicator helps assess the financial benefits gained from investments in process improvements.
- **Competitiveness Indicator**: A measure of a company's performance relative to its competitors, often using market data. In the context of the healthcare material ordering process, this could evaluate how efficiently the hospital's supply chain performs compared to other hospitals. For example: "If Hospital A can process and deliver 200 supply orders per day, while Hospital B can only handle 150 orders, Hospital A is more competitive." This indicator helps organizations benchmark their processes and identify areas where they can gain a competitive advantage.
- **Effectiveness Indicator**: A measure of how well the actual results of a process align with the expected outcomes. In the healthcare material ordering process, effectiveness could be evaluated by comparing the timely delivery of medical supplies with the hospital's service level targets. For example: "If the goal is to fulfill 95% of orders within 24 hours, and 90% of orders are actually fulfilled within that time, the effectiveness rate is 90%." This helps determine whether the process is meeting its objectives.
- **Value Indicator**: A measure of the relationship between the perceived value of a product or service and the cost incurred to acquire it. In the healthcare material ordering process, this could assess whether the cost of acquiring medical supplies is justified by their perceived benefit to patient care. For example: "If the hospital spends $10,000 on a batch of medical supplies, but the perceived benefit is only valued at $8,000, the value indicator would be negative, indicating inefficiency." This helps organizations assess whether they are receiving sufficient value for the costs they incur.

X. Conclusion

In this report, we examined the healthcare material ordering process, analyzing its phases, roles, and decision points using Bizagi Studio as a business process management tool. We modeled both individual-use and general-use supply processes, focusing on the roles of physicians, nurses, and supply department employees. By leveraging Bizagi's simulation and analysis features, we were able to evaluate various performance metrics, including process efficiency, resource utilization, and order delivery times. Our findings indicated that partial delivery processes, particularly in emergency cases, are critical for maintaining efficiency and ensuring timely delivery. The statistical analysis tools helped us identify bottlenecks and optimize resource allocation for improved operational performance. These insights are invaluable for making data-driven decisions, refining the workflow, and ultimately enhancing patient care.

References

[1] Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2018). *Fundamentals of Business Process Management*. Springer, Berlin, Heidelberg.

[2] van der Aalst, W. M. P. (2016). *Process Mining: Data Science in Action*. Springer, Berlin, Heidelberg.

[3] Weske, M. (2012). *Business Process Management: Concepts, Languages, Architectures*. Springer, Berlin, Heidelberg.

[4] Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2018). *Fundamentals of Business Process Management*. Springer, Berlin, Heidelberg.

[5] van der Aalst, W. M. P. (2016). *Process Mining: Data Science in Action*. Springer, Berlin, Heidelberg.

[6] Weske, M. (2012). *Business Process Management: Concepts, Languages, Architectures*. Springer, Berlin, Heidelberg.

[7] Reijers, H. A., & Mans, R. S. (2015). *Business Process Management: A Comparative Analysis of Workflow and Data-Driven Approaches*. Springer, Cham.

[8] Khosrow-Pour, M. (Ed.). (2020). *Advanced Methodologies and Technologies in Business Operations and Management*. IGI Global.

[9] Jeston, J., & Nelis, J. (2014). *Business Process Management: Practical Guidelines to Successful Implementations*. Routledge.

[10] Scheer, A. W. (2012). *Business Process Engineering: Reference Models for Industrial Enterprises*. Springer Science & Business Media.

[11] Hammer, M., & Champy, J. (2009). *Reengineering the Corporation: A Manifesto for Business Revolution*. HarperCollins.