INFO-H-420
Management of Data Science and Business Workflows

Assignment 2
- REPORT -

Authors:
Cedric Kouamou Djampo
Salma SALMANI

Professor:
Dimitrios SACHARIDIS

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1 Exercise 1 : the cycle time

The cycle time efficiency is calculated as the ratio of the value-added time to the total cycle time (including both value-added and non-value-added time).

From the given text and the BPMN diagram fig 1, we can deduce the following times:

Value-added Time (time where actual work is being done):

- Checking if a new request is known: 10 minutes
- Communicating the resolution to the client (when the request is known): 5 minutes
- Evaluating a new request by Level-2 staff: 20 minutes
- Time required to research and resolve a request: 2 hours
- Writing the resolution to a request: 20 minutes
- Sending the problem resolution to the client by a Level-1 staff member: 20 minutes

Non-value-added Time (waiting time and other non-productive times):

- Requests waiting for Level-1 staff member: 1 hour
- New requests waiting for Level-2 staff: 2 hours
- Time between prioritization and pick up by Level-2 staff: 20 hours
- Time before the resolution is fetched from the ticketing system by Level-1: 20 hours
- Time between sending resolution by Level-1 and receiving client feedback: 20 hours
- Forwarding the request to Level-2 staff (if not solved): 2 minutes

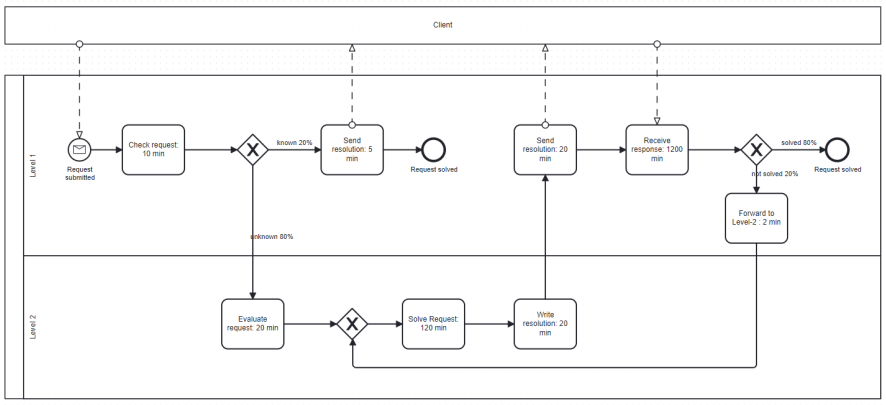


Figure 1: Model 1

Theoretical cycle time:

$$10 + 0.2 \cdot 5 + 0.8 \cdot \left(20 + \frac{120 + 20 + 20}{0.8}\right) = 187 \text{ min}$$

Cycle time = Value-added Time + Non-value-added Time
Cycle time:

$$60 + 10 + 0.2 \cdot 5 + 0.8 \cdot \left(120 + 20 + \frac{1200 + 120 + 20 + 1200 + 20 + 1200 + 2}{0.8}\right) = 3945 \text{ min}$$

$$\text{Cycle time efficiency} = \frac{\text{Theoretical cycle time}}{\text{Cycle time}}$$

$$\text{Cycle time efficiency} = \frac{187}{3945} \approx 0.0474$$

Cycle time efficiency is approximately 0.0474 (or 4.74%), which means that the current process is highly inefficient compared to the theoretical cycle time. In other words, a significant portion of the actual cycle time is spent on activities that don't directly add value.

An efficiency of 4.74% is low, indicating that there's significant room for improvement in the process. It would be beneficial to deeply analyze the process to pinpoint bottlenecks, unnecessary delays, and other sources of non-value-added time, so that corrective measures can be implemented.

Cost-Per-Execution = Processing Cost + Cost of Waste.

$$\text{Cost per execution} = \frac{10}{60} \times 40 + \frac{0.2 \times 5}{60} \times 40 + 0.8 \times \left(20 + \frac{120 + 20 + 20}{0.8}\right) \times \frac{60}{60} = 183,3 \text{ €}$$

2 Exercise 2 : Level-2 staff

The service rate, which is the rate at which a single Level-2 staff member processes requests, can be calculated from the given processing times for Level-2 activities.

The activities for Level-2 are:

1. Evaluate request: 20 min (or 0.333h)
2. Solve Request: 2h
3. Write resolution: 20 min (or 0.333h)

Total processing time for a Level-2 staff member per request = $0.333h + 2h + 0.333h = 2.667h$
Service rate (μ) = $\frac{1 \text{ request}}{2.667h}$ = 0.375 requests/hour
Given the arrival rate (λ) of requests to Level-2 is 1 request/hour.

Using the Little's formula for the M/M/1 queue model, the average number of requests in the system (L) is:

$$L = \frac{\lambda}{\mu - \lambda}$$

To determine the mean waiting time (W) for the M/M/1 queue model:

$$W = \frac{L}{\lambda} = \frac{1}{\mu - \lambda}$$

We need to ensure that $W < 2h$, so:

$$\frac{1}{\mu - \lambda} < 2$$

Given that one Level-2 staff can handle 0.375 requests/hour, and we have an arrival rate of 1 request/hour, the current setup is insufficient (as $\mu < \lambda$).

Now, if we have n Level-2 staff, our new service rate becomes $n \times \mu$.
To ensure the mean waiting time is less than two working hours:

$$\frac{1}{n\mu - \lambda} < 2$$

Substituting in the given values:

$$\begin{aligned}
&\frac{1}{n \times 0.375 - 1} < 2 \\
\Rightarrow\ & n \times 0.375 - 1 > 0.5 \\
\Rightarrow\ & n \times 0.375 > 1.5 \\
\Rightarrow\ & n > \frac{1.5}{0.375} \\
\Rightarrow\ & n > 4
\end{aligned}$$

Given that we cannot have a fraction of a staff member, we need at least 5 Level-2 staff members to ensure the mean waiting time of a request is less than two working hours.

3 Exercise 3: Simulate the business process

In the simulation, we have selected a standard ”8-to-5” work schedule. Therefore, we assumed that a Level 2 employee works from Monday to Friday, from 8 AM until 5 PM. Given that the average request rate is one per hour, we have assumed that the mean inter-arrival time is 1 hours. To model the nature of each request’s arrival, we employed an exponential distribution with an average of 10 hours.

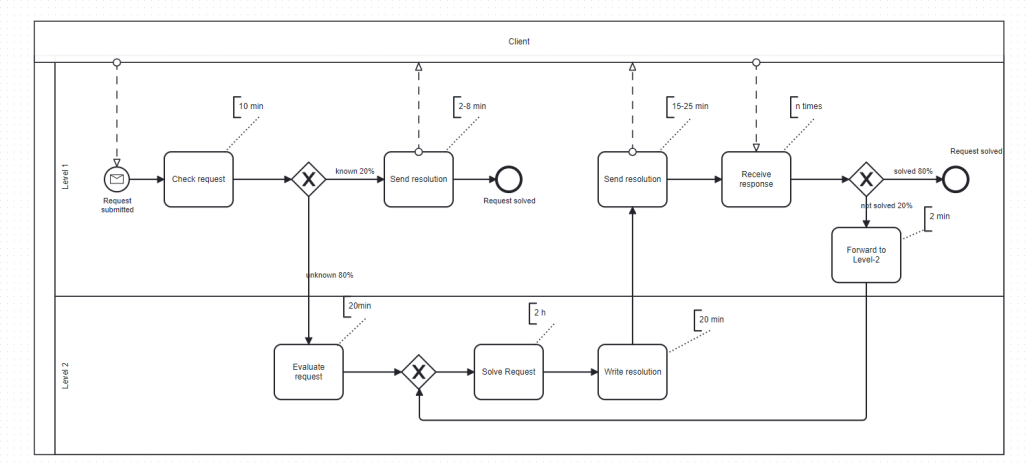
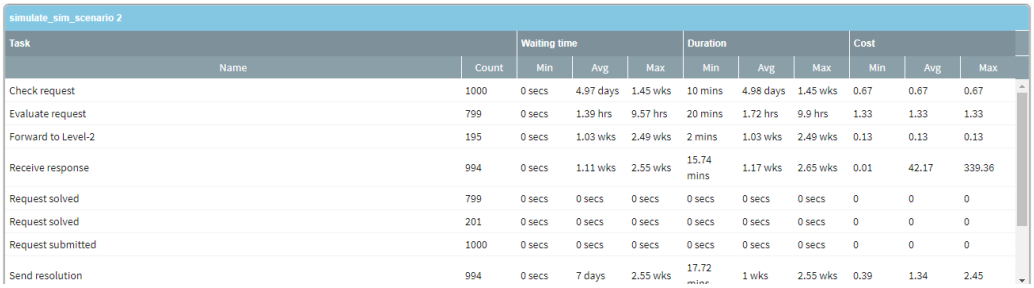


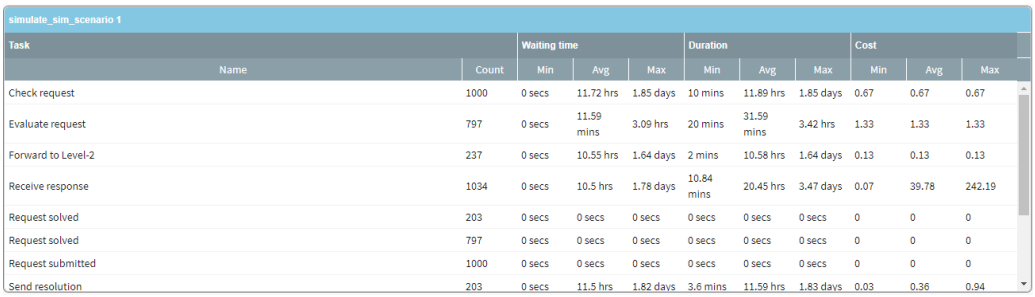
Figure 2: Diagram for simulation



simulate_sim_scenario 2

Task		Waiting time			Duration			Cost		
Name	Count	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Check request	1000	0 secs	4.97 days	1.45 wks	10 mins	4.98 days	1.45 wks	0.67	0.67	0.67
Evaluate request	799	0 secs	1.39 hrs	9.57 hrs	20 mins	1.72 hrs	9.9 hrs	1.33	1.33	1.33
Forward to Level-2	195	0 secs	1.03 wks	2.49 wks	2 mins	1.03 wks	2.49 wks	0.13	0.13	0.13
Receive response	994	0 secs	1.11 wks	2.55 wks	15.74 mins	1.17 wks	2.65 wks	0.01	42.17	339.36
Request solved	799	0 secs	0 secs	0 secs	0 secs	0 secs	0 secs	0	0	0
Request solved	201	0 secs	0 secs	0 secs	0 secs	0 secs	0 secs	0	0	0
Request submitted	1000	0 secs	0 secs	0 secs	0 secs	0 secs	0 secs	0	0	0
Send resolution	994	0 secs	7 days	2.55 wks	17.72	1 wks	2.55 wks	0.39	1.34	2.45

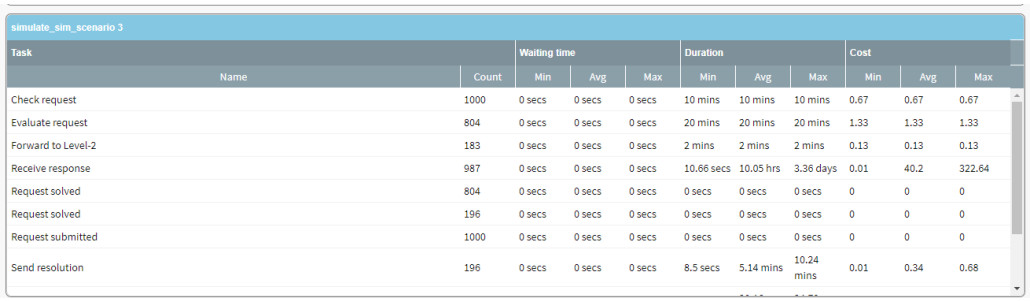
Figure 3: Simulations results with 5 level-1 and 5 level-2 staff members



simulate_sim_scenario 1

Task		Waiting time			Duration			Cost		
Name	Count	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Check request	1000	0 secs	11.72 hrs	1.85 days	10 mins	11.89 hrs	1.85 days	0.67	0.67	0.67
Evaluate request	797	0 secs	11.59 mins	3.09 hrs	20 mins	31.59 mins	3.42 hrs	1.33	1.33	1.33
Forward to Level-2	237	0 secs	10.55 hrs	1.64 days	2 mins	10.58 hrs	1.64 days	0.13	0.13	0.13
Receive response	1034	0 secs	10.5 hrs	1.78 days	10.84 mins	20.45 hrs	3.47 days	0.07	39.78	242.19
Request solved	203	0 secs	0 secs	0 secs	0 secs	0 secs	0 secs	0	0	0
Request solved	797	0 secs	0 secs	0 secs	0 secs	0 secs	0 secs	0	0	0
Request submitted	1000	0 secs	0 secs	0 secs	0 secs	0 secs	0 secs	0	0	0
Send resolution	203	0 secs	11.5 hrs	1.82 days	3.6 mins	11.59 hrs	1.83 days	0.03	0.36	0.94

Figure 4: Simulations results with 10 level-1 and 10 level-2 staff members



simulate_sim_scenario 3

Task		Waiting time			Duration			Cost		
Name	Count	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Check request	1000	0 secs	0 secs	0 secs	10 mins	10 mins	10 mins	0.67	0.67	0.67
Evaluate request	804	0 secs	0 secs	0 secs	20 mins	20 mins	20 mins	1.33	1.33	1.33
Forward to Level-2	183	0 secs	0 secs	0 secs	2 mins	2 mins	2 mins	0.13	0.13	0.13
Receive response	987	0 secs	0 secs	0 secs	10.66 secs	10.05 hrs	3.36 days	0.01	40.2	322.64
Request solved	804	0 secs	0 secs	0 secs	0 secs	0 secs	0 secs	0	0	0
Request solved	196	0 secs	0 secs	0 secs	0 secs	0 secs	0 secs	0	0	0
Request submitted	1000	0 secs	0 secs	0 secs	0 secs	0 secs	0 secs	0	0	0
Send resolution	196	0 secs	0 secs	0 secs	8.5 secs	5.14 mins	10.24 mins	0.01	0.34	0.68

Figure 5: Simulations results with 50 level-1 and 50 level-2 staff members

From the simulation, we can observe that as we increase the number of level 1 and level 2 employees, the waiting time becomes very small.”

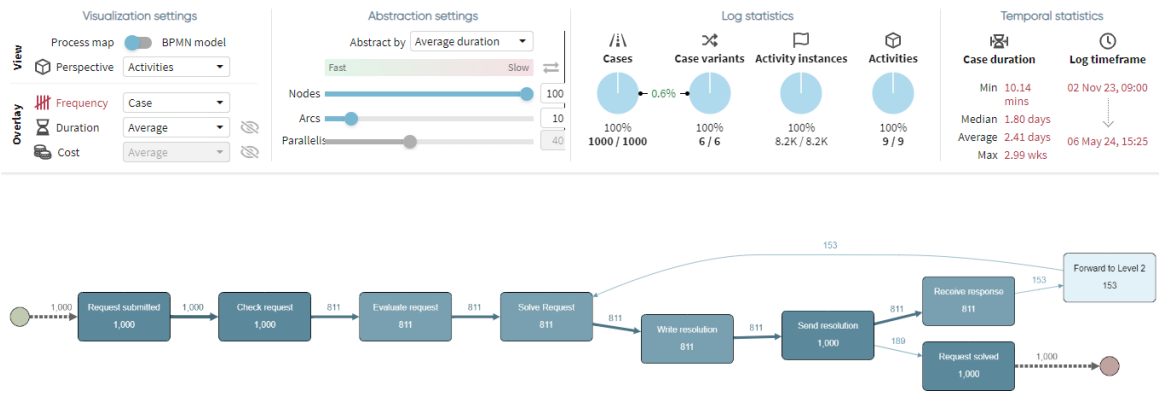


Figure 6: Simulations view

4 Exercise 4: Identify issues and Improve

Name	Explanation	Data / Hypotheses	Qualitative Impact	Quantitative Impact
Extended Wait Times	Delays in request handling at both Level-1 and Level-2.	Requests spend on average 1h waiting for Level-1 and 2h for Level-2.	Lower client satisfaction and potential increase in escalated issues.	Increase in time spent for problem resolution.
Inefficient Knowledge Transfer	Known problems only resolved by Level-1 20% of the time.	20% of cases, the request is known to Level-1.	Time wasted in unnecessary Level-2 escalations for known problems.	Increase in resource costs for Level-2 handling.
Extended Resolution Times	Significant delay between request prioritization and resolution by Level-2.	Time between prioritization and request pickup is 20h.	Delays in problem resolution leading to client dissatisfaction.	Longer overall resolution times and potential backlog.
Request resolving by Level 2 staff	Lengthy waiting time when the request is is forwarded to level 2 stuff	Takes on average 20h for Level-1 to fetch resolution from system.	Hindrance in prompt service delivery and potential misunderstandings.	Additional 20h added to the resolution process.

Table 1: Issue Register for the IT Helpdesk Process

Task Level Improvements

Task Elimination

1. Remove the manual verification to determine if a request is recognized. Instead, maintain an updated database of known requests for automatic classification. This allows requests to be directly assigned to the appropriate junior or senior staff.

2. Upon resolution by a Level-2 staff member, the solution should be communicated directly to the client. This removes the need to pass it through a Level-1 staff member, thus eliminating redundant fetching of the request.

Task Decomposition

1. Combine the activities of request registration and assignment into one streamlined task.

2. Merge the processes of request evaluation and prioritization.

3. Consolidate the research and resolution processes into one activity named 'Resolve the Request'.

Process Level Improvements

Automation

1. For straightforward tasks, like system access requests, eliminate the need for direct interaction with help desk staff. This can be achieved by automating such requests, giving specified employees the permissions to execute certain tasks autonomously.

2. Instead of sending emails for resolution notifications, allow clients to view and update their request status. If the client doesn't update the request within three days, the system should automatically mark it as resolved. If the issue persists, the client can mark it as unresolved, which will notify the Level-2 staff.

Communication Optimization

1. Keep the client informed about the progression of their request. For example, once a request is evaluated, the system should update the status to "evaluated", ensuring transparency throughout the process.

5 Exercise 5: TO BE process.

from the changes that we set above we create a "to-be" process.

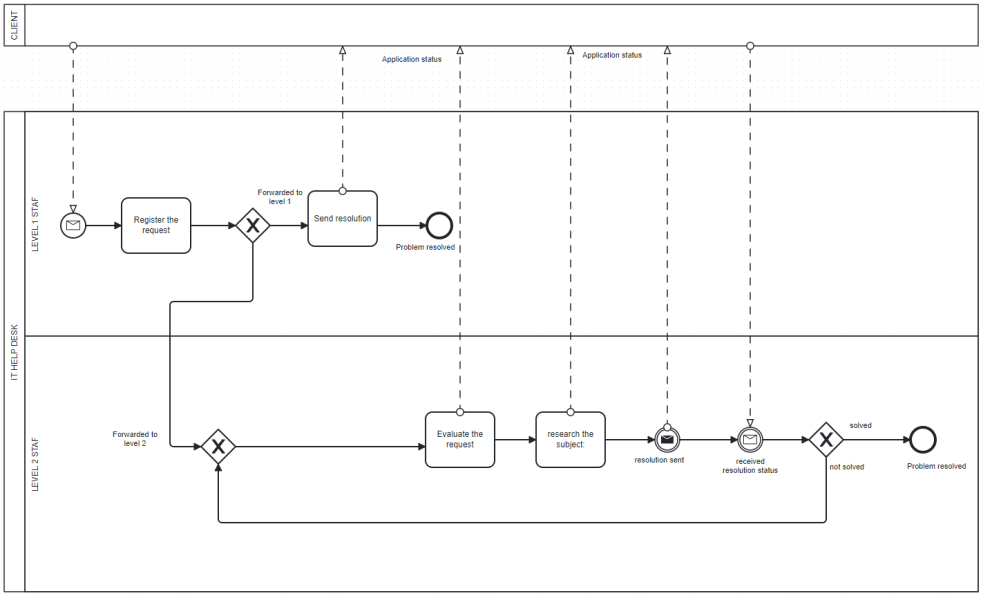


Figure 7: to-be” process