Neste

Interim Report

April 2019

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Project progress

In comparison with the initial research plan, the current project status has resulted in modifying the modeling approach along with the programming branch. The access to the Spiral Software allowed all the team members to investigate better specific features within the planning model. After getting familiar with Spiral, we decided with Neste to give up the idea of the linearization or any other simplification of the model due to its complexity. Apart from that the possibility of applying machine learning techniques that could help to simulate the basic features of the model's behavior will be posed as a future work suggestion. Thus, among all the initially proposed research directions, sensitivity and stability analysis were elicited as the most promising approach.

Meanwhile, the detailed analysis of Spiral software revealed embedded tools for the post-optimality research including methods we are particularly interested in. After consultation with Neste representatives, the decision was to change the planned mathematical programming activity to further investigate the Spiral software used in practice. In order to produce deliverables possible to be used by production processes, Spiral will be used as a basis to perform the post-optimality analysis.
Apart from the Spiral software, the company provided us with their Excel solution for naphtha penetration into the system. This allows to perform comparison of decisions made based on the existing tool and Spiral.

Project status

Previously, the team had difficulties to keep frequent meetings with the company and, as a consequence, there were delays in the projected plan. Their cause was mainly regarding getting access to the software and adjustments of the accounts which hindered our learning of their processes. Finally, we could manage the frequency and productivity of the meetings by organizing them just with people of interest by subject.

The updated project status can be seen in the Appendix 2. As mentioned above there is no delayed activity. The tasks such as "*Searching for useful articles/books*" and "*Learning the feeding processes*" are still under progress as the team changed the focus from the literature of oil blending optimization problems to a more technical literature regarding the optimization tool used by the company.

Summing up, we are currently exploring Spiral software mechanisms for sensitivity analysis and tools to assess solutions' robustness. Furthermore, the team has determined the major features of the decision process what opened the possibility of a deeper comparative analysis of the current methods being used. Discussions about these two project branches are held in the next paragraphs.

Analysis of the current solution

Introducing additional petroleum naphtha for oil distillation affects the blending qualities requirement and, as a consequence, alters other feedstock quantities in the optimal solution. The decision to purchase and introduce additional naphtha for oil distillation is a recurrent one in Neste production unit process due to suppliers offers or market conditions. The quantities of naphtha available for purchasing are discrete with batches being an integer number of halves of a vessel. Naphtha specifications (e.g. heavy and light) have different implications for the decisions regarding the price and embedded qualities. Additionally, naphtha price fluctuation affects the feasibility and optimality of the purchase decision. Ultimately, the availability of other crude oil products, inventories available for them, and market prices for final products affect the possibility and feasibility of introducing naphtha.

Considering current solution of the Neste, the decision process made based on the Excel tool taking into account current market prices for different naphtha qualities and inventories of other crude oil qualities can be improved. The Excel tool is fast,

convenient and practical to use, comparing to the Sales and Operation (SOP) software (Spiral).

Our main task is to develop a model that can be applied for the purchasing decision of naphtha with the time performance comparable to the Excel tool, but with higher accuracy. We are aiming to do this by conducting sensitivity and stability analysis. Results for this analysis could then be used systematically to guide the purchasing decisions of naphtha. If those analysis fulfil Neste requirements, the project could be developed further to include purchasing decisions for other crude oil qualities.

Post-optimality analysis in Spiral

Currently, different post-optimality Spiral tools are being assessed by the group along with Neste personnel in order to choose the ones aligned with the range of problems they have. It is possible to analyse how different scenarios of prices and quantities caps would affect the optimal solution and how the insights coming from it can be used in practice.

In the following weeks we plan to deepen our understanding of Spiral post-optimality features and how they can be tailored to generic scenarios the company can face. As a milestone we can cite a brief to do list:

i) Check differences between price and quantity sensitivity analysis;
ii) Build a consistent uncertainty set for naphtha prices and quantities; and
iii) Form preliminary implications from generic sets to validate results with the company.

Appendix 1

Updated risk table is below:

Risk	Probability	Effect	Impact	Plan to mitigate risk
Team member inactivity or dropout	Low	Other team members need to cover or the person being absent works remotely	Low to medium	Clear schedules, project manager's authority, and informing possible absences well in advance
Too large workload	Medium	Not all objectives will be reached, the results will be inadequate, or work-hours increase drastically	Medium	Frequent communication with Neste and having a clear plan towards the most feasible direction. In case it seems unreachable the willingness to pivot
Challenges in using the Spiral software	Low	Delays on the progress of the project	Medium	Having a low threshold to reach out to Neste in case of problems. Using the Spiral help page and search.
The final model does not satisfy customer needs	Medium	The final model will not provide value, however, the report and literature review might have produced useful results	Medium	Frequent communication with Neste and ensuring that the model developed is relevant and valuable for Neste

Table 1. Risks associated with the project

Appendix 2

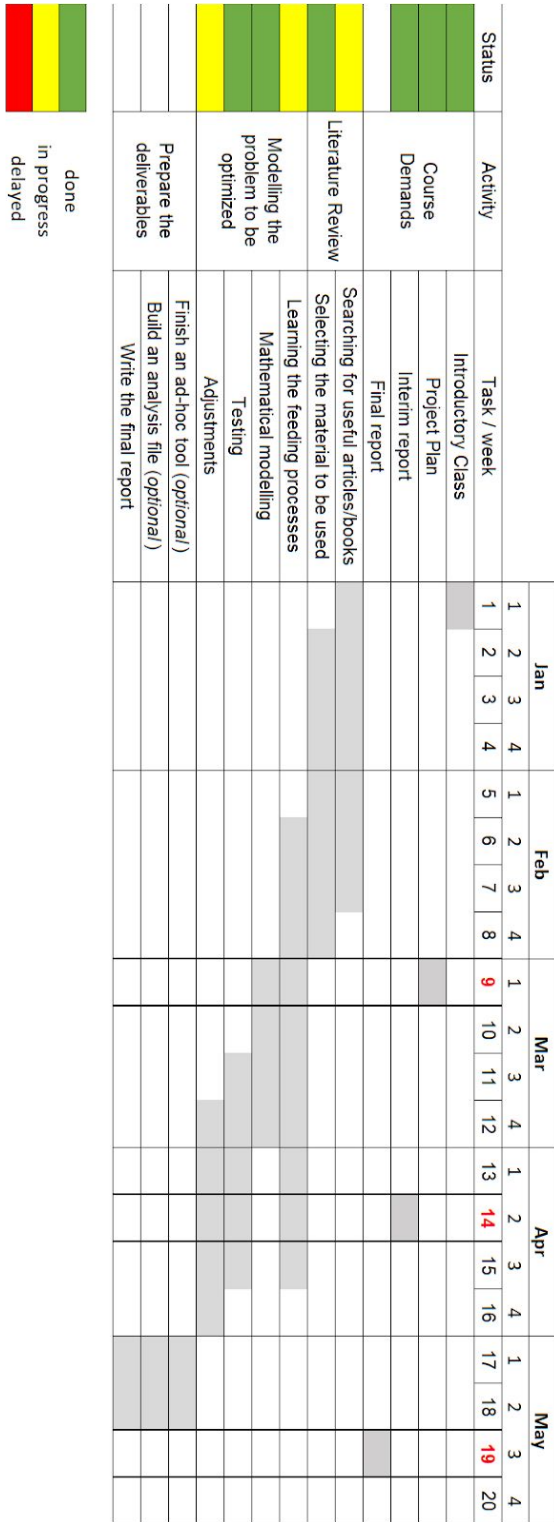| Status	Activity	Task / week	Jan				Feb				Mar				Apr				May			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Course Demands	Introductory Class																				
		Project Plan																				
		Interim report																				
		Final report																				
	Literature Review	Searching for useful articles/books																				
		Selecting the material to be used																				
		Learning the feeding processes																				
	Modelling the problem to be optimized	Mathematical modelling																				
		Testing																				
		Adjustments																				
	Prepare the deliverables	Finish an ad-hoc tool (optional)																				
		Build an analysis file (optional)																				
		Write the final report																				

Legend:
- done
- in progress
- delayed

Figure 1. Updated schedule