MS-E2177 Seminar on Case Studies in Operations Research
Interim Report for SOK

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1 Changes in the objectives and the scope

The main goal of our project has not changed. The goal is to create a vacation optimization tool for a single Prisma store unit, so that the tool could be implemented in other S Group store units as well. Furthermore, the primary objectives and the scope of the project have not changed.

However, some minor additional objectives for the optimization model to take into account have come up. If there is enough time for us to do this, the model shall consider the vacation wishes of employees for the long vacation. It can result in either $2+2$ or $3+1$ weeks splits for the employees that have enough vacation days. Currently, the model considers all long vacations to be 3 weeks during the most wanted summer period and 1 week during late spring or early autumn.

Another possible enhancement to the model shall be to limit the start of vacations to working days. For example, vacations shall not start during the week of Midsummer.

2 Project status

2.1 Completed tasks

Implementation of the optimization tool with Julia has started, and the first version of the model is working. The first version reads employees' contracted hours, holiday amounts, skills, and last year's holiday dates, as well as the amount of work needed in the store for each week. The data is parsed into matrices in Julia and the optimization model is run. Finally, the optimal holiday dates for next summer are printed out on a new Excel sheet.

However, the model had a critical bug that did not account correctly for the employee skills when distributing the workload. The model defaulted all employees to work on the first available skill in the list, for which they have the required skill. The goal is, however, to fulfill each of the required weekly hours for each skill and then to equalize the balance of required general work hours throughout the summer based on the workload forecast. This bug was solved on 11.3. and the development continues.

2.2 Current tasks

We are currently optimizing vacation periods with real data and also with simplified data. We have chosen a solver that produces a working solution fast enough using multi-threading, but once we get all the constraints working, the efficiency of the solution still needs to be considered. Currently, the major task is to add the remaining constraints and the desired functionalities to the model. For example, the model needs to take into account the wishes of employees but also takes care of absences that do not consume vacation weeks.

2.3   Remaining tasks

After the interim report, the model and its performance should be tested. It should be ensured that the optimization model produces high-quality solutions for the timing of vacations and also analyze possible inconsistencies in the schedules, which we have not yet found. For example, it could be that the optimal solution is the best solution for the store theoretically, but its implementation may violate the bounds of reasonableness.

Once the developed version works and provides solutions that we are satisfied with, the writing of the final report will also begin, and it is important to allocate enough time for this. The target shall also be to develop an acceptable for the client user interface for Excel.

3   Changes to the project schedule

The implementation schedule derived at the start of the project was the following:

- Preliminary tasks, deadline 4.3.

  - Literature review, focus on Kinnunen's master thesis
  - Review of the Finnish laws and union contracts governing vacation hours
  - Formalization of the initial optimization problem
  - Review of software tools needed
  - Meeting with SOK on 6.3. to review the progress and clarify open questions.

- Interim tasks, deadline 14.4.

  - Implement optimization model
  - Test the model's performance, with different solvers
  - Ensure the model produces quality results
  - Implement possible changes to the model

- Final tasks, deadline 12.5.

  - Finalize the model
  - Develop a user interface for the model

The preliminary tasks were done already before the project plan presentations and have no changes to them. They proved important in establishing the foundation for the external and internal understanding of the task. This allowed us to effectively proceed with developing the tool to solve the customer's challenge. The second stage aimed at producing usable results for the client and the third stage incorporated some slack to allow for possible schedule changes.

And indeed, due to the found bug, we will utilize the slack we had added to this project plan and push some of the interim tasks to the third stage, the final tasks. We still aim to complete the optimization model before 14.4.

However, testing and implementation of changes are postponed for the second half of April. Therefore, the remaining schedule is:

- Current task, deadline 14.4.

  - Implement optimization model

- Final tasks, deadline 12.5.

  - Test the model's performance, with different solvers
  - Ensure the model produces quality results
  - Implement possible changes to the model
  - Finalize the model
  - Develop a user interface for the model

4 The updated risk management plan

The greatest issue so far has been slight errors in the optimization model code. Even as the designed model should work well, some issues have risen when multiple people are working on coding. On top of this, there have been some issues with how the optimization model works. Most of these are solvable with extra meetings and better communication. Issues with scheduling team meetings have had a few issues. However, this has occurred only a few times and the impact on the project has been minimal. A way to mitigate this moving forward is to plan the meetings earlier and make sure everyone can make it.

A newly identified risk is if the client requires the optimization model to have many new features. This problem can grow out of hand if the goals are not properly communicated between the client and the team.

Risk	Likelihood	Consequence	Actions
Mistakes in the optimization model	Moderate	Moderate	Check the model in detail
Unrealistic assumptions	Low	High	Agreeing assumptions with the client
Unrealistic goals	Moderate	Moderate	Communicate and agree goals with client
Model is not usable	Moderate	High	Send model tests to the customer
Loss of personnel in the team	Low	Moderate	Regular meetings and internal feedback
Scheduling issues	High	Low	Fixed meeting time

Table 1: Risk assessment