MS-E2177 Seminar on Case Studies in Operations Research
Project Plan for SOK

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1 Background

Our client Suomen Osuuskauppojen Keskuskunta (SOK) is the retail market leader in Finland with almost half of the grocery stores' market share. They are responsible of the strategy of S Group which has more than 1900 stores in Finland. From a strategic point of view, it is important that labor resources are well balanced according to demand and supply. For example, in grocery stores, the need for employees varies seasonally, and the timing of vacations is therefore important to schedule accordingly. Successful timing of vacations contributes to employees' well-being, work quality and reduce personnel costs.

The project is about developing an optimized vacation schedule plan. The goal is to match the workforce demand and supply so that weeks with too few employees are minimized. However, at all times there must be enough workers with right skills to meet the demand. The model should take into account several requirements, such as fulfill laws and collective agreements, enable variety of employees' skills, vacation periods of different lengths and the possibility to take into account employees' vacation time wishes.

The scope of this project is to build an optimization model for vacation and absence planning on a weekly basis for around 100 employees for one year period. The purpose is to first create a working model for an example unit and then expand the model to work in general, regardless of the size of the store. The tool should be such that someone who is not familiar with optimization can build vacation schedules by using our model. Project takes into account only those employees who work according to the work list, i.e., supervisors or external contract workers are not part of the vacation schedule.

2 Objectives

The goal of this project is to create a vacation optimization tool for a single Prisma store unit. The vacation optimization tool should be developed in a way that it could be scaled to all of S Groups commercial establishments.

The purpose of the vacation planning tool is to simplify and speed up the process of creating an optimal schedule; in other words, releasing more resources for real work while minimizing required workforce at any given time. For the model to be able to do this effectively, required constraints need to be identified carefully. The optimization model should consider all the constraints, such as wishes of the employees and their different sets of skills better, than what can be done manually. In addition, interface of the optimization tool should be user-friendly, so that it is easy-to-use for the business units to be able to apply it independently and for the model to be implemented in every S Group business location afterwards.

Our project group consists of students, so for some of us, this is the first possibility to utilize the skills we have learned studying operations research to create something that is valued by any possible future employee, in addition to learning from a real life project.

3 Tasks

The tasks at hand are defined by the requirements directly by the client and by the indirect requirements to complete the objectives.

- Signing non-disclosure agreements with SOK
- Meeting with SOK representatives and receive the data
- Conduct a literature review on optimizing of scheduling of holidays
- Create a preliminary approach for the problem
- Create and prepare for the course presentations and turn ins
- Create the final version of the optimizer

After the data was delivered and the first meeting with SOK was held, this project plan was created. To continue with the approach for an optimization tool for the scheduling of holidays, a literature review has to be done. An important part of the literature review will include Teemu Kinnunen's Master's thesis [3] done on vacation planning for the Finnish train operator VR Group. Furthermore, a broader examination of different methods, tools and approaches will be beneficial.

After studying the possibilities for optimization a first version of an optimization tool will be created and tested. For the first version of the tool the following will be the important aspects to figure out and select:

- The objective function which is to be optimized
- The constraints that bounds the feasible vacation schedules
- The coding language and optimization solver

The objective function has to balance the needs of the company and the preferences of the employees. The objective is determined as a minimization problem, where the goal is minimizing the number of excess employees with the additional costs of not having enough employees and not following employees preferences.

For the constraints, additional investigation about how the law and contracts affect the number and form of a employee's holidays is required. The client has their current data in Microsoft Excel files, and has shown interest to keep

the input and output data within the Excel. After creating the preliminary optimization program and after showing and discussing it with the client, the creation of the actual tool can begin.

4 Schedule

As a team we have decided to meet once a week, and also have additional meetings with the client when needed. A general goal has been to have a weekly goal, that is a reasonable target to complete each week. This ensures the project moves forward.

The project schedule is of course bound to the course plan, which has three target goals that must be reached. These are the preliminary, interim and final reports. We have a few additional targets, to ensure the project does not get delayed.

- Preliminary tasks, deadline 4.3.
  - Literature review, focus on Kinnunen's master thesis [3]
  - Review of the Finnish laws [2] and union contracts [1] 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 models 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 an user interface for the model

5 Resources

The project will require the following resource types: information, data, development tools, people, and time.

The necessary information will be accessed from scientific literature related to

holidays and schedule optimization problems. Among others, the team has familiarized with the approach used by Teemu Kinnunen in his Master's thesis [3] on cost-efficient vacation planning.

S Group provides the group with anonymous data from one of its operational units. The data would include the available workforce and its skills as well as predicted work demand over the 2023 summer holidays. Further information sources will be provided from the Finnish law and work union vacation regulation.

The team expects to design the user interface for the holiday planning tool in Excel. The coding language and optimization language will be decided after theoretical optimization model is outlined. It is probable that the team would use Julia as the coding language and an open-source solver.

The team comprises out of five students of Aalto University's Master's degree in Systems and Operations Research. Comprehensive background in optimization and problem solving is reinforced by coding and data analytics skills with several students having minors in computer science or data analysis.

Finally, the team has two and half months to complete the project as outlined in the schedule section.

6 Risks

We can group risks into three categories: operational, outside, and scheduling.

First, there can be difficulties with creating the suitable optimization model. While scientific literature studied provides efficient optimization methods for holiday planning, our case is complicated by the need to include in the analysis different skills of employees and the requirements for these skills. Thus, it is possible that the resulting model would be too complex for a solver to solve within reasonable time. This risk can be mitigated by implementing a proof-of-concept level optimization model early in the project to evaluate the computational requirements for the basic constraints.

Assumptions made and approximations used during modelling can prove to be a significant risk. As, for example, sick leaves cannot be reliably modelled, the model would use an approximation of how much personnel would be expected missing as well as taking in expected summer workloads. This can be controlled by agreeing with the client the assumptions and approximations used. This would make clear the limitations of the model and highlight early in the project what aspects the client sees as important.

Outside threats are mainly present through collaboration with the client. The

end user reception of the tool can pose a threat. If the users find the tool to be too inflexible, to generate unrealistic vacation plans or the user interface hard to use, this would prove useless the development efforts. Scrum-like approach with regular test releases to the customer could help to obtain negative use feedback before too late.

Received data can prove to be wrong or there can be issues with receiving the data from SOK. Close and regular communication with the client would help.

Our third risk category is personnel and scheduling issues. One possible risk is someone leaving the course, due to for example a family or health emergency. Another possible risk scheduling conflicts, due to work or other courses. The Table 1 summarizes the risks discussed above.

Risk	Likelihood	Consequence	Actions
Theoretical model too heavy for optimization	Moderate	Moderate	Check early and check from literature
Unrealistic assumptions	Low	High	Agreeing assumptions with the client
Model is not usable	Moderate	High	Send model tests to the customer
Wrong testing data	Low	High	Communication with the client
Loss of personnel in the team	Low	Moderate	Regular meetings and internal feedback
Scheduling issues	High	Low	Fixed meeting time

Table 1: Risk assessment

References

[1] Palvelualojen ammattiliitto. *Commercial sector's collective agreement*. 2023. URL: `https://www.pam.fi/en/wiki/commercial-sectors-collective-agreement.html` (visited on 02/24/2023).

[2] Finlex. *Vuosilomalaki*. 2005. URL: `https://www.finlex.fi/fi/laki/ajantasa/2005/20050162` (visited on 02/24/2023).

[3] T. Kinnunen. *Cost-efficient vacation planning with variable workforce demand and manpower*. Espoo, 2016. URL: `https://sal.aalto.fi/publications/pdf-files/tkin16_public.pdf`.