1 Introduction

Hello Brian and Valentin,

I have created a memo for the project to help get us all in sync.

2 Status Update

- Writing to SAP
- Coding on the server side
- Coding on the frontend side
- Academic Papers
- External Stay

3 Writing to SAP

I have had disscussions with people in Paris about writing to SAP. Specificially asked if it would be possible to write to table AFVC column ABLAD which is the column called ”Unloading Point”. This is posible but it will require all my source code to be uploaded to Total Energies servers, which I are a little reluctant to do as I will lose control over the research project.

4 Coding on the server side

Since out last meeting I have done a significant amount of coding on the server side of the application, most of it is related to the tactical model, the algorithm that schedules on the days, to make it dynamic and provide results that are satisfactory.

To reiterate the long term goal here refer to figure 1, 2, and 3. Figure 1 holds all the data needed to make the system function as well as capture all the changes that the end-users make based on the results of the algorithms.

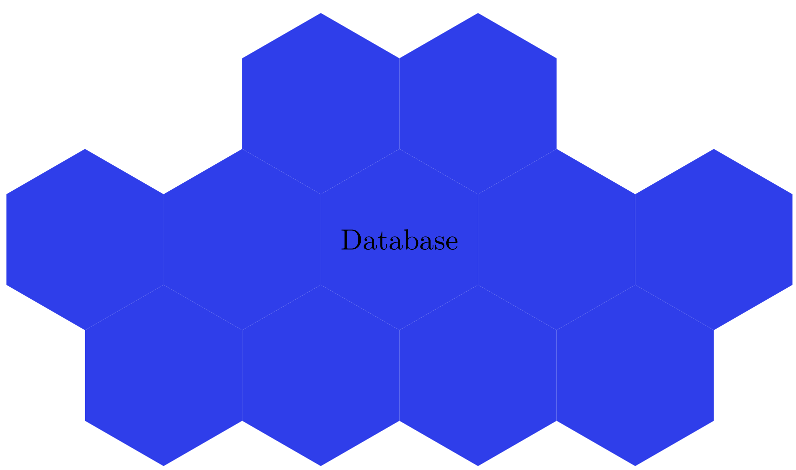

Figure 1: Common database layer for all algorithms in the system. The database layer is initialized from the SAP, and the also receives inputs from the user for **Resources** and **Timehorizons**.

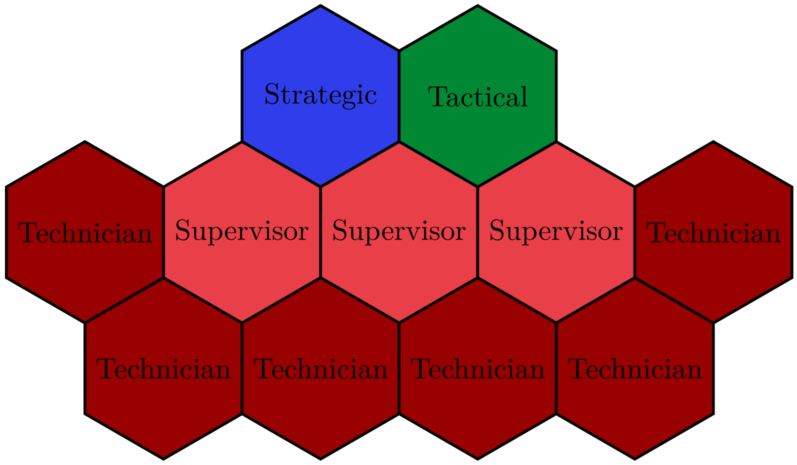

Figure 2: The proposed model setup. The server creates one **Strategic** algorithm as shown in section 8.3, on **Tactical** algorithm as shown in section 8.4, and one for each **Supervisor** as shown in section 8.5, finally there one model for each **Technician** as shown in section 8.6

Figure 2 shows the setup where each hexagon is a mathematical algorithm that is optimizing a certain part of the scheduling process. Here you both have seen a little of the **Strategic** and the **Tactical**. These models will never be able of their own to model the scheduling process therefore user-interfaces are created for each of these stakeholders which is illustrated in figure 3.

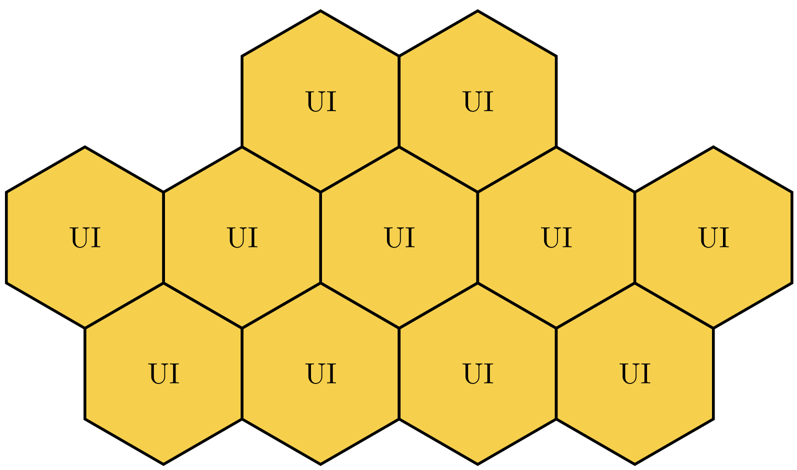

Figure 3: Every algorithm has its own user interface. This means that there will be a view into the system that is unique for each kind of stakeholder.

There are more than these three layers, but I hope that they convey that it conveys what the code is trying to do.

4.1 Separating Responsibilites

Brian mentioned at the previous meeting that for this kind of system it would be crucial that each stakeholder that we want to be part of the system has clearly defined boundaries for what they can and cannot change. In appendix

5 Academic Papers

I unfortunately have to write academic papers even though we do not have solid results yet. The first paper is titled **Actor-based Large Neighborhood Search**, I am trying to complete it as soon as possible that we can get back to testing.

6 External Stay

I am going of external stay in Paris at a company called **Decision Brain** it is a company that creates maintenance scheduling software that resembles the kind of system that we are trying to develop. I am going there with the intention of learning how to best proceed with implementing the system that we are working on here at Total.

7 Problems and Issues

- ”Customer” support
- Funding of the project
- Frontend development

7.1 ”Customer” Support

The success of this project relies heavily on the support from you two. I made the deal with Sebastien Perrier while he was still in Esbjerg that if I made all the backend code where you two would like the code then his team would supply the manpower needed to develop the frontends.

Now the problem is that if I cannot convince the two of you it becomes really difficult to making this work.

7.2 Funding of the Project

The funding for the project is running out so I will not be able to come to Esbjerg as often as I have been previously. I will try to draft a proposal for a project after I come home from Decision Brain, they have a lot of experience with developing systems like the one that we are developing together.

7.3 Frontend Development

A correct implementation of the project will require a lot of frontend development work, which I do not have time to do alone. I am not use how to best solve this issue, especially as I lack the required experience to actually know what to ask for. There is also the issue that the backend code changes quickly.

8 Appendix

8.1 Illustrative Code Parts

```
pub struct UserStatusCodes { pub appr: bool, pub smat: bool, pub init: bool, pub rdbl: bool,
pub qcap: bool, pub rfrz: bool, pub wmat: bool, pub cmat: bool, pub pmat: bool, pub apog:
bool, pub prok: bool, pub wrea: bool, pub exdo: bool, pub swe: bool, pub awdo: bool, pub
rout: bool, pub wta: bool, pub sch: bool, pub sece: bool, pub rel: bool, pub rees: bool,
pub reap: bool, pub wrel: bool, pub awsd: bool, pub sraa: bool, pub qcrj: bool, pub awsc:
bool, pub lprq: bool, pub rrev: bool, pub awca: bool, pub rreq: bool, pub vfal: bool, pub
sreq: bool, pub amcr: bool, pub dfrj: bool, pub vpas: bool, pub dfcr: bool, pub ireq: bool,
pub atvd: bool, pub awmd: bool, pub dfex: bool, pub dfap: bool, pub awpr: bool, } pub struct
StrategicUserStatusCodes { /// Provide the work order number for the work order that you
want to change. pub work_order_numbers: Vec<WorkOrderNumber>, pub sch: Option<bool>, pub
awsc: Option<bool>, pub cmat: Option<bool>, pub wmat: Option<bool>, pub pmat: Option<bool>,
pub snmat: Option<bool>, }
```

8.2 Mathematical Models

8.3 Strategic Model: A Knapsack Variant

Meta variables:

$$s \in S \tag{1}$$

$$\beta(\tau) \tag{2}$$

$$\tau \in [0, \infty] \tag{3}$$

Minimize:

$$\begin{aligned}
&- \sum_{w \in W(\tau)} \sum_{p \in P(\tau)} strategic_value_{wp}(\tau) \cdot \alpha_{wp}(\tau) \\
&+ \sum_{p \in P(\tau)} \sum_{r \in R(\tau)} strategic_penalty \cdot \epsilon_{pr}(\tau) \\
&- \sum_{p \in P(\tau)} \sum_{w1 \in W(\tau)} \sum_{w2 \in W(\tau)} \quad clustering_value_{w1,w2} \cdot \alpha_{w1p}(\tau) \cdot \alpha_{w2p}(\tau)
\end{aligned} \tag{4}$$

Subject to:

$$\begin{aligned}
&\sum_{w \in W(\tau)} work_order_work_{wr} \cdot \alpha_{wp}(\tau) \leq \; resource_{pr}(\tau, \beta(\tau)) + \epsilon_{pr}(\tau) \\
&\quad \forall p \in P(\tau) \quad \forall r \in R(\tau)
\end{aligned} \tag{5}$$

$$\sum_{w \in W(\tau)} \alpha_{wp}(\tau) = 1 \quad \forall p \in P(\tau) \tag{6}$$

$$\alpha_{wp}(\tau) = 0, \quad if \quad exclude_{wp}(\tau) \;\; \forall w \in W(\tau) \quad \forall p \in P(\tau) \tag{7}$$

$$\alpha_{wp}(\tau) = 1, \quad if \quad include_{wp}(\tau) \;\; \forall w \in W(\tau) \quad \forall p \in P(\tau) \tag{8}$$

$$\alpha_{wp}(\tau) \in \{0, 1\} \quad \forall w \in W(\tau) \quad \forall p \in P(\tau) \tag{9}$$

$$\epsilon_{pr}(\tau) \in \mathbb{R}^{+} \quad \forall p \in P(\tau) \quad \forall r \in R(\tau) \tag{10}$$

8.4 Tactical Model: A Resource Constrained Project Scheduling Problem Variant

Meta variables:

$$s \in S \tag{11}$$
$$\alpha(\tau) \tag{12}$$
$$\tau \in [0, \infty] \tag{13}$$

Minimize:

$$\sum_{o \in O(\tau,\alpha(\tau))} \sum_{d \in D(\tau)} tactical\_value_{do}(\tau) \cdot \beta_{do}(\tau) + \sum_{r \in R(\tau)} \sum_{d \in D(\tau)} tactical\_penalty \cdot \mu_{rd}(\tau) \tag{14}$$

Subject to:

$$\sum_{o \in O(\tau,\alpha(\tau))} work_o(\tau) \cdot \beta_{do}(\tau) \leq tactical\_resource_{dr}(\tau) + \mu_{rd}(\tau) \forall d \in D(\tau) \quad \forall r \in R(\tau) \tag{15}$$
$$\sum_{d=earliest\_start_o(\tau)}^{latest\_finish_o(\tau)} \sigma_{do}(\tau) = duration_o(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{16}$$
$$\sum_{d^* \in D_{duration_o(\tau)}(\tau)} \sigma_{d^*o}(\tau) = duration_o(\tau) \cdot \eta_{do}(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \quad \forall d \in D(\tau) \tag{17}$$
$$\sum_{o \in O(\tau,\alpha(\tau))} \eta_{do}(\tau) = 1, \quad \forall d \in D(\tau)$$
$$\sum_{d \in D(\tau)} d \cdot \sigma_{do1}(\tau) + \Delta_o(\tau) = \sum_{d \in D(\tau)} d \cdot \sigma_{do2}(\tau) \quad \forall (o1, o2) \in finish\_start_{o1,o2} \tag{18}$$
$$\sum_{d \in D(\tau)} d \cdot \sigma_{do1}(\tau) = \sum_{d \in D(\tau)} d \cdot \sigma_{do2}(\tau) \quad \forall (o1, o2) \in start\_start_{o1,o2} \tag{19}$$
$$\beta_{do}(\tau) \leq number_o(\tau) \cdot operating\_time_o \quad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{20}$$
$$\beta_{do}(\tau) \in \mathbb{R} \qquad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{21}$$
$$\mu_{rd}(\tau) \in \mathbb{R} \qquad \forall r \in R(\tau) \quad \forall d \in D(\tau) \tag{22}$$
$$\sigma_{do}(\tau) \in \{0, 1\} \qquad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{23}$$
$$\eta_{do}(\tau) \in \{0, 1\} \qquad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{24}$$
$$\Delta_o(\tau) \in \{0, 1\} \quad \forall o \in O(\tau, \alpha(\tau)) \tag{25}$$

8.5 Supervisor Model: An Assignment Problem Variant

Meta variables:

$$z \in Z \tag{26}$$

$$\alpha(\tau) \tag{27}$$

$$\theta(\tau) \tag{28}$$

$$\tau \in [0, \infty] \tag{29}$$

Maximize:

$$\sum_{a \in A(\tau,\alpha(\tau))} \sum_{t \in T(\tau)} supervisor\_value_{at}(\tau, \lambda_t(\tau), \Lambda_t(\tau)) \cdot \gamma_{at}(\tau) \tag{30}$$

Subject to:

$$\sum_{a \in A_o(\tau,\alpha(\tau))} \rho_a(\tau) = work_o(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{31}$$

$$\sum_{t \in T(\tau)} \sum_{a \in A_o(\tau,\alpha(\tau))} \gamma_{at}(\tau) = \phi_o(\tau) \cdot number_o(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{32}$$

$$\sum_{o \in O_w(\tau,\alpha(\tau))} \phi_o(\tau) = |O_w(\tau, \alpha(\tau))| \quad \forall w \in W(\tau, \alpha(\tau)) \tag{33}$$

$$\sum_{a \in A_o(\tau,\alpha(\tau))} \gamma_{at}(\tau) \leq 1 \quad \forall o \in O(\tau, \alpha(\tau)) \quad \forall t \in T(\tau) \tag{34}$$

$$\gamma_{at}(\tau) \leq feasible_{at}(\theta(\tau)) \quad \forall o \in O(\tau, \alpha(\tau)) \quad \forall t \in T(\tau) \tag{35}$$

$$\gamma_{at}(\tau) \in \{0, 1\} \quad \forall o \in O(\tau, \alpha(\tau)) \quad \forall t \in T(\tau) \tag{36}$$

$$\rho_a(\tau) \in [lower\_activity\_work_a(\tau), work_a(\tau)] \quad \forall a \in A(\tau, \alpha(\tau)) \tag{37}$$

8.6 Technician Model: Single Machine Scheduling Problem Variant

Meta variables:

$$t \in T(\tau) \tag{38}$$

$$\alpha(\tau) \tag{39}$$

$$\gamma(\tau) \tag{40}$$

$$\tau \in [0, \infty] \tag{41}$$

Maximize:

$$\sum_{a \in A(\tau, \gamma_t(\tau))} \sum_{k \in K(\gamma(\tau))} \delta_{ak}(\tau) \tag{42}$$

Subject to:

$$\sum_{k \in K(\gamma(\tau))} \delta_{ak}(\tau) \cdot \pi_{ak}(\tau) = activity\_work_a(\tau, \rho(\tau)) \cdot \theta \quad (\tau) \forall a \in A(\tau, \gamma_t(\tau)) \tag{43}$$

$$\lambda_{a21}(\tau) \geq \Lambda_{a1last(a1)}(\tau) + preparation_{a1,a2} \quad \forall a1 \in A(\tau, \gamma_t(\tau)) \quad \forall a2 \in A(\tau, \gamma_t(\tau)) \tag{44}$$

$$\lambda_{ak}(\tau) \geq \Lambda_{ak-1}(\tau) - constraint\_limit \cdot (2 - \pi_{ak}(\tau) + \pi_{ak-1}(\tau)) \\ \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{45}$$

$$\delta_{ak}(\tau) = \Lambda_{ak}(\tau) - \lambda_{ak}(\tau) \quad \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{46}$$

$$\lambda_{ak}(\tau) \geq event_{ie} + duration_{ie} - constraint\_limit \cdot (1 - \omega_{akie}(\tau)) \\ \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \quad \forall i \in I(\tau) \quad \forall e \in E(\tau) \tag{47}$$

$$\Lambda_{ak}(\tau) \leq event_{ie} + constraint\_limit \cdot \omega_{akie}(\tau) \\ \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \quad \forall i \in I(\tau) \quad \forall e \in E(\tau) \tag{48}$$

$$\lambda_{a1}(\tau) \geq time\_window\_start_a(\beta(\tau)) \quad \forall a \in A(\tau, \gamma_t(\tau)) \tag{49}$$

$$\Lambda_{alast(a)}(\tau) \leq time\_window\_finish_a(\beta(\tau)) \quad \forall a \in A(\tau, \gamma_t(\tau)) \tag{50}$$

$$\pi_{ak}(\tau) \in \{0, 1\} \quad \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{51}$$

$$\lambda_{ak}(\tau) \in [availability\_start(\tau), availability\_finish(\tau)] \\ \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{52}$$

$$\Lambda_{ak}(\tau) \in [availability\_start(\tau), availability\_finish(\tau)] \\ \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{53}$$

$$\delta_{ak}(\tau) \in [0, work_{a\_to\_o(a)}(\tau)] \quad \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{54}$$

$$\omega_{akie}(\tau) \in \{0, 1\} \quad \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \quad \forall i \in I(\tau) \quad \forall e \in E(\tau) \tag{55}$$

$$\theta_a(\tau) \in \{0, 1\} \quad \forall a \in A(\tau, \gamma_t(\tau)) \tag{56}$$

References