1 Introduction

Hello Brian and Valentin

!!!

2 Status Update

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

2.1 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 is a little bit at odds with the research part of the project as I will lose control over it.

2.2 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 one that schedules) on the days, to make it dynamic and provide results that are satisfactory. (I think that Brian can quickly test this when it works as I have basically copied the previous project for this algorithm).

To reiterate the long term goal here refer to figure 1, 2, and 3.

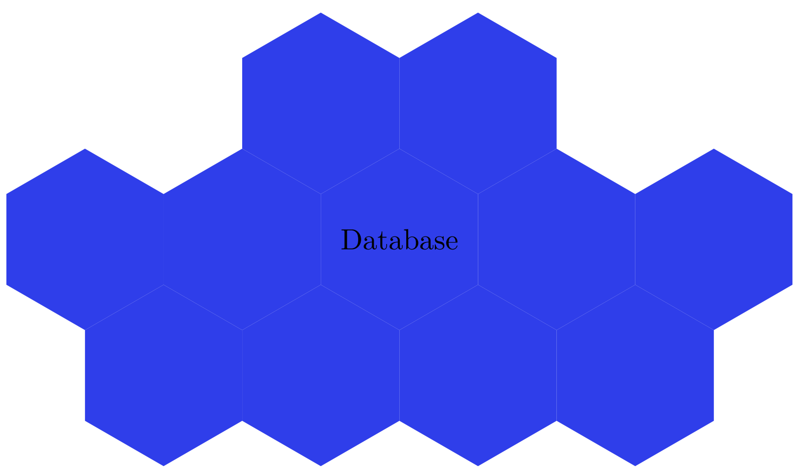

Figure 1: The proposed model setup. The server creates one **Strategic** algorithm as shown in section 7.1, on **Tactical** algorithm as shown in section 7.2, and one for each **Supervisor** as shown in section 7.3, finally there one model for each **Technician** as shown in section 7.4

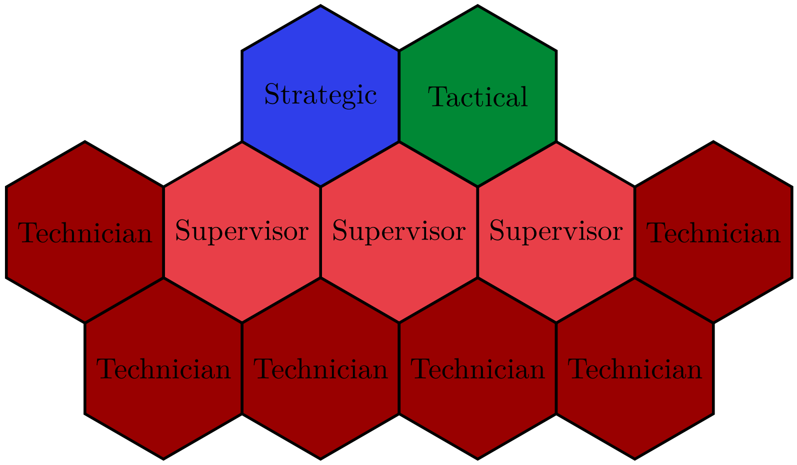

Figure 2: The proposed model setup. The server creates one **Strategic** algorithm as shown in section 7.1, on **Tactical** algorithm as shown in section 7.2, and one for each **Supervisor** as shown in section 7.3, finally there one model for each **Technician** as shown in section 7.4

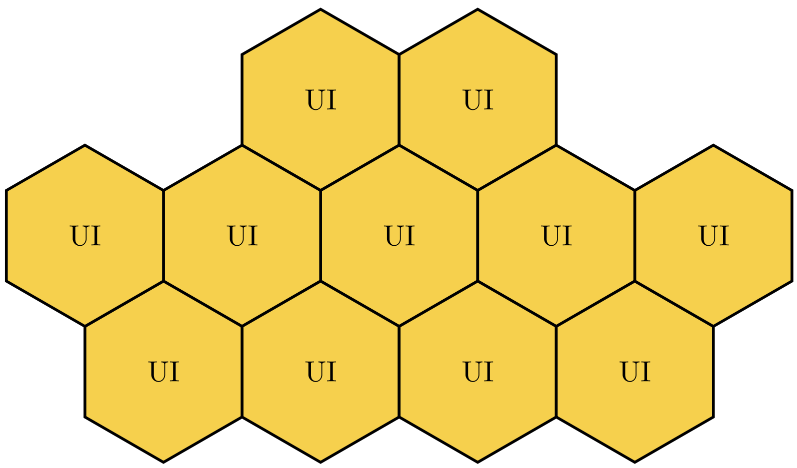

Figure 3: The proposed model setup. The server creates one **Strategic** algorithm as shown in section 7.1, on **Tactical** algorithm as shown in section 7.2, and one for each **Supervisor** as shown in section 7.3, finally there one model for each **Technician** as shown in section 7.4

Figure **??** shows a setup where each hexagon is a mathematical model that is optimizing a certain part of the scheduling process. Where you both have seen a little of the **Strategic**. and the **Tactical**. These models will never be able of their own to model the system as such user-interfaces are created for each of these stakeholders.

2.3 Separating Responsibilites

2.4

3 Academic Papers

I unfortunately have to write academic papers even though we do not have solid results yet. I do not like to do it that way but I need to do it do get my Ph.D. degree. The first paper is called **Actor-based Large Neighborhood Search**, and I am trying to finish it as quickly as possible so that we can get back to testing.

4 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.

5 Problems and Issues

- Lack of communication skills
- Funding of the project
- Frontend development
- ”Customer” support

5.1 Lack of Communication Skills

Throughout the project I am sorry for not being more responsive and giving regular status updates. I think that because I have often waited so long to provide status updates the project tends to shift a little before a make up for it.

5.2

6 Illustrative Code Parts

7 Mathematical Models

7.1 Strategic Model: A Knapsack Variant

Meta variables:

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

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

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

Maximize:

$$\sum_{w \in W(\tau)} \sum_{p \in P(\tau)} strategic\_value_{wp}(\tau) \cdot \alpha_{wp}(\tau) - \sum_{p \in P(\tau)} \sum_{r \in R(\tau)} strategic\_penalty \cdot \epsilon_{pr}(\tau) + \sum_{p \in P(\tau)} \sum_{w1 \in W(\tau)} \sum_{w2 \in W(\tau)} clustering\_value_{w1,w2} \cdot \alpha_{w1p}(\tau) \cdot \alpha_{w2p}(\tau) \tag{4}$$

Subject to:

$$\sum_{w \in W(\tau)} work\_order\_work_{wr} \cdot \alpha_{wp}(\tau) \leq resource_{pr}(\tau, \beta(\tau)) + \epsilon_{pr}(\tau) \quad \forall p \in P(\tau) \quad \forall r \in R(\tau) \tag{5}$$

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

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

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

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

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

7.2 Tactical Model: A Resource Constrained Project Scheduling Problem Variant

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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:

$$\sum_{o \in O(\tau,\alpha(\tau))} work_o(\tau) \cdot \beta_{do}(\tau) \leq tactical\_resource_{dr}(\tau) + \mu_{rd}(\tau) \forall d \in D(\tau) \quad \forall r \in R(\tau) \tag{15}$$

$$\sum_{d=earliest\_start_o(\tau)}^{latest\_finish_o(\tau)} \sigma_{do}(\tau) = duration_o(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{16}$$

$$\sum_{d^* \in D_{duration_o(\tau)}(\tau)} \sigma_{d^*o}(\tau) = duration_o(\tau) \cdot \eta_{do}(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \quad \forall d \in D(\tau) \tag{17}$$

$$\sum_{o \in O(\tau,\alpha(\tau))} \eta_{do}(\tau) = 1, \quad \forall d \in D(\tau)$$

$$\sum_{d \in D(\tau)} d \cdot \sigma_{do1}(\tau) + \Delta_o(\tau) = \sum_{d \in D(\tau)} d \cdot \sigma_{do2}(\tau) \quad \forall (o1, o2) \in finish\_start_{o1,o2} \tag{18}$$

$$\sum_{d \in D(\tau)} d \cdot \sigma_{do1}(\tau) = \sum_{d \in D(\tau)} d \cdot \sigma_{do2}(\tau) \quad \forall (o1, o2) \in start\_start_{o1,o2} \tag{19}$$

$$\beta_{do}(\tau) \leq number_o(\tau) \cdot operating\_time_o \quad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{20}$$

$$\beta_{do}(\tau) \in \mathbb{R} \qquad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{21}$$

$$\mu_{rd}(\tau) \in \mathbb{R} \qquad \forall r \in R(\tau) \quad \forall d \in D(\tau) \tag{22}$$

$$\sigma_{do}(\tau) \in \{0, 1\} \qquad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{23}$$

$$\eta_{do}(\tau) \in \{0, 1\} \qquad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{24}$$

$$\Delta_o(\tau) \in \{0, 1\} \quad \forall o \in O(\tau, \alpha(\tau)) \tag{25}$$

7.3 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:

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

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

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

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

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

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

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

7.4 Technician Model: Single Machine Scheduling Problem Variant

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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