1 Agenda

- Current Situation (25 min)
- Envisioned future (25 min)
- Company Structure (10 min)
- Convincing Total (25 min)
- IP concerns (25 min)
- Milestones (15 min)

2 Current Situation

- Manually sending email around
- State duplication
- SAP is not made for/cannot handle optimization workflows. -> you copy the current SAP state to a file (excel) to continue working from there.
- The idea with Ordinator is to be a layer between SAP and the scheduler/supervisor. Ordinator then holds all state which can be manipulated (plannings, optimizations etc.).

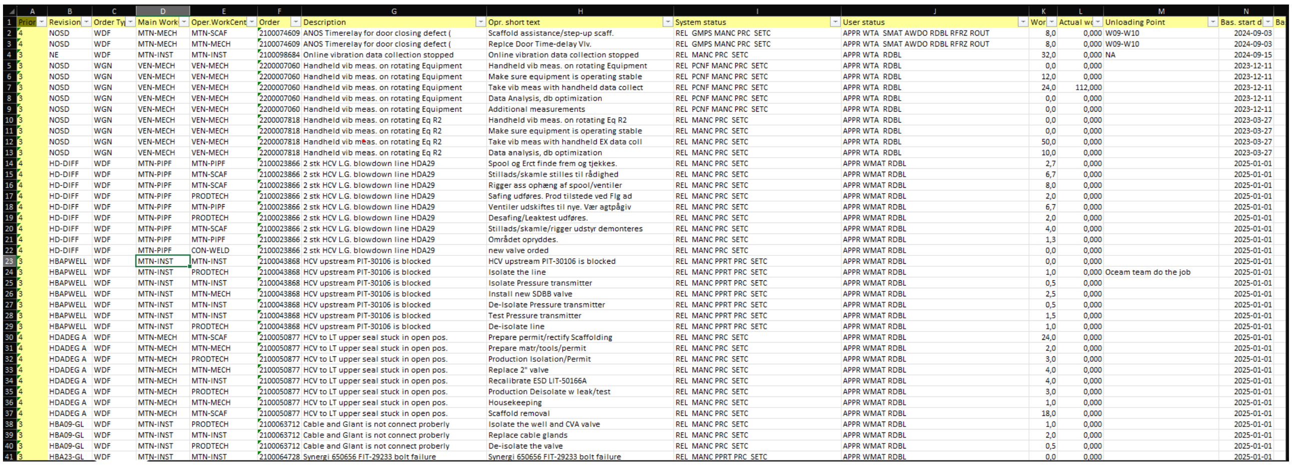

Figure 1: Schedulers view of the scheduling process

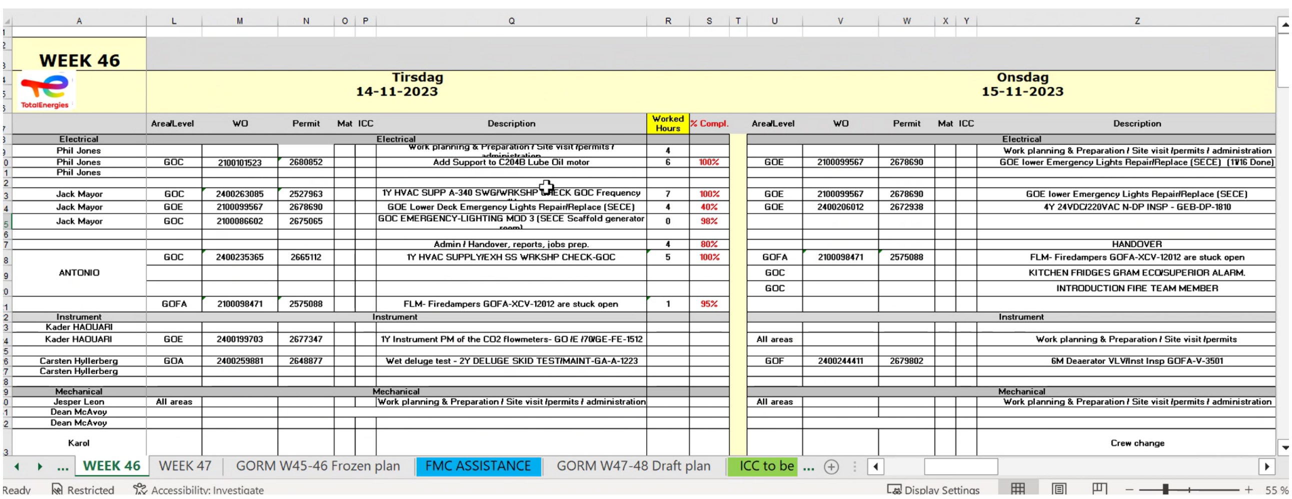

Figure 2: Supervisors and Technicians view of the scheduling process

3 Envisioned Future

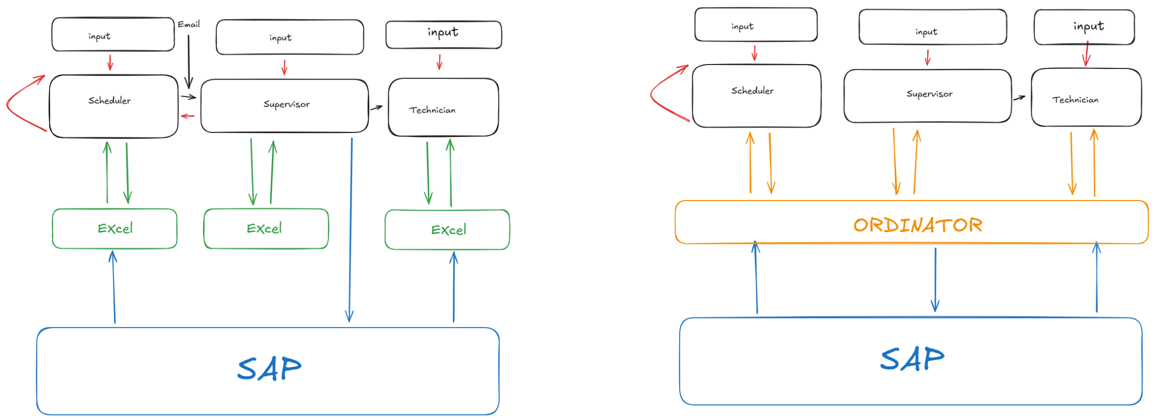

Figure 3: Schematic difference between the current way of doing things versus how it could be done in the future. Each stakeholder can immediately sees an optimized schedule based on the state in the optimization algorithms. This means that the moment that a **Scheduler**, **Supervisor**, or **Technician** sees that there is something wrong his part of the schedule it can be handled immediately. After an excel file has been sent in the as-is example the remaining stakeholders are working blind

3.1 What do we not know:

- Supervisor is a big unknown. How do they work with the information? Do all supervisors do the same?
- Do they know what would be the best for them? DO we?
- What should be the main focus to get a minimum viable product?
- How mature the "engine" (ordinator) should be before trying to convince TotalEnergies?

4 Possible Company Structure

Creating a company splitting the shares equally between the founders giving Niels Henrik a 10% share.

4.1 questions

- Should Total own anything?
- Does DTU need to own anything?

4.2 IP Concerns

- What rights do DTU have to software?
- Do we have a case where DTU are not willing to further this project alone and therefore we can do it ourselves without them?
- What does TotalEnergies expect? Do they expect this to be free or are they willing to fund this project even though it would be through a "subcontractor"?

5 Convincing Total

- How to make Total commit themselves to spend hours on the project.
  - What does this mean for who owns what?
- Booking a meeting with the most relevant stakeholders, and getting a consensus on the project goals.
- Drafting a budget, meaning how many hours there is needed to deliver certain milestones.

- Working on an hourly basis, delivering weekly or monthly results.
- What should the role of Christian's Ph.D. project be until we are ready to create the company?
- One route (best-case-scenario):
  - Christian takes leave of PhD in Autumn
  - Total Energies hopefully is willing to pay for hours in development
  - Christian and Sebastian works full time on paid project to develop
  - Christian returns to finish PhD or project is so mature we cannot stop now.

5.1 Budget

Scipo	Role	Total Hours	Cost per Hour	Skills	Period
Christian Jespersen	Core Developer	320	250 DKK	Optimization Algorithms	2025-09 to 2025-12
Sebastian Dall	Core Developer	320	250 DKK	API, Frontend, Project	2025-09 to 2025-12
Total	Role	Total Hours	Cost per Hour	Skills	Period
TOTAL_DEVELOPER Baptiste Dubillaud	Integration	50-70	500 DKK	Azure, IT infrastructure	2025-09 to 2025-12
TOTAL_MAINTENANCE_METHOD Brian Friis Niels	Domain Expert	40	500 DKK	Understanding of Business Flows	2025-09 to 2025-12
GMC_SCHEDULER Valentin Ispas	Domain Expert	30	500 DKK	Key Stakeholder	2025-09 to 2025-12
GMC_SUPERVISOR <UNKNOWN>	Domain Expert	20	500 DKK	Key Stakeholder	2025-09 to 2025-12
GMC_TECHNICIAN <UNKNOWN>	Domain Expert	20	500 DKK	Key Stakeholder	2025-09 to 2025-12
Material	Role	Total Hours	Cost per Hour	Skills	Period
Server	-	2000	1-5 DKK	-	2025-09 to 2025-12

$$
\begin{aligned}
\text{Total Cost} &= (320 \times 250) + (320 \times 250) \\
&\quad + (70 \times 500) + (40 \times 500) + (30 \times 500) \\
&\quad + (20 \times 500) + (20 \times 500) + (2,000 \times 5) \\
&= 80,000 + 80,000 + 35,000 + 20,000 + 15,000 + 10,000 + 10,000 + 10,000 \\
&= 160,000 \quad \text{(Direct cost for Scipo)} \\
&\quad + 100,000 \quad \text{(Indirect cost for Total)} \\
&= 260,000 \quad \text{Total cost DKK}
\end{aligned}
$$

Total cost per 2 month period **260,000 DKK**

6 Appendix

7 Graphic Overview of the Model Setup

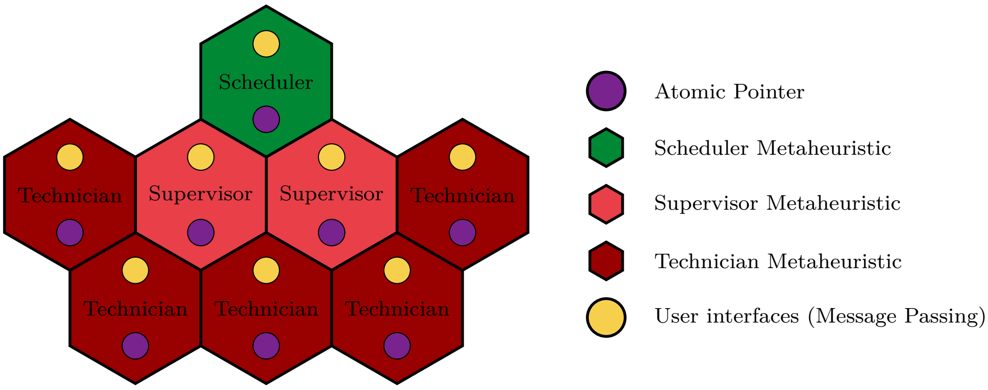

Figure 4: Each model represents a distinct stakeholder with its own UI (yellow) and their solution spaces are tied together with lock-free atomic pointer swaps (purple)

8 Scheduler: Strategic

Meta variables:

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

$$\tau \in [0, \infty] \tag{2}$$

Minimize:

$$+ \sum_{w \in W(\tau)} \sum_{p \in P(\tau)} strategic\_urgency_{wp}(\tau) \cdot \alpha_{wp}(\tau)$$

$$+ \sum_{p \in P(\tau)} \sum_{r \in R(\tau)} strategic\_resource\_penalty \cdot \epsilon_{pr}(\tau)$$

$$- \sum_{p \in P(\tau)} \sum_{w1 \in W(\tau)} \sum_{w2 \in W(\tau)} clustering\_value_{w1,w2} \cdot \alpha_{w1p}(\tau) \cdot \alpha_{w2p}(\tau) \tag{3}$$

Subject to:

$$\sum_{w \in W(\tau)} work\_order\_workload_{wr} \cdot \alpha_{wp}(\tau) \leq \sum_{t \in T(\tau)} \psi_{prt}(\tau) + \epsilon_{pr}(\tau)$$

$$\forall p \in P(\tau) \quad \forall r \in R(\tau) \tag{4}$$

$$\sum_{r \in R(\tau)} \psi_{prt}(\tau) \leq technician\_work_{pt}(\tau, \beta(\tau)) \quad \forall p \in P(\tau) \quad \forall t \in T(\tau) \tag{5}$$

$$\sum_{p \in P(\tau)} \psi_{prt}(\tau) \leq technician\_skills_{rt}(\tau) \quad \forall r \in R(\tau) \quad \forall t \in T(\tau) \tag{6}$$

$$\sum_{w \in W(\tau)} \alpha_{wp}(\tau) = 1 \quad \forall p \in P(\tau) \tag{7}$$

$$\alpha_{wp}(\tau) = 0, \quad if \quad exclude_{wp}(\tau) \;\; \forall w \in W(\tau) \quad \forall p \in P(\tau) \tag{8}$$

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

$$\alpha_{wp}(\tau) \in \{0, 1\} \quad \forall w \in W(\tau) \quad \forall p \in P(\tau) \tag{10}$$

$$\psi_{prt}(\tau) \in \mathbb{R}^+ \quad \forall p \in P(\tau) \quad \forall r \in R(\tau) \quad \forall t \in T(\tau) \tag{11}$$

$$\epsilon_{pr}(\tau) \in \mathbb{R}^+ \quad \forall p \in P(\tau) \quad \forall r \in R(\tau) \tag{12}$$

9 Scheduler: Tactical

Meta variables:

$$s \in S \tag{13}$$

$$\alpha(\tau) \tag{14}$$

$$\tau \in [0, \infty] \tag{15}$$

Minimize:

$$\begin{aligned} &+ \sum_{o \in O(\tau,\alpha(\tau))} \sum_{d \in D(\tau)} tactical\_value_{do}(\tau) \cdot \beta_{do}(\tau) \\ &+ \sum_{r \in R(\tau)} \sum_{d \in D(\tau)} tactical\_penalty \cdot \mu_{rd}(\tau) \end{aligned} \tag{16}$$

Subject to:

$$\sum_{o \in O(\tau,\alpha(\tau))} work_o(\tau) \cdot \beta_{do}(\tau) \leq \Psi_{drt}(\tau) + \mu_{rd}(\tau) \quad \forall d \in D(\tau) \quad \forall r \in R(\tau) \tag{17}$$

$$\sum_{r \in R(\tau)} \Psi_{drt}(\tau) \leq tactical\_resource_{dr}(\tau) \quad \forall d \in D(\tau) \quad \forall t \in T(\tau) \tag{18}$$

$$\sum_{d \in D(\tau)} \Psi_{drt}(\tau) \leq technician\_skills_{rt}(\tau) \quad \forall r \in R(\tau) \quad \forall t \in T(\tau) \tag{19}$$

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

$$\sum_{d=earliest\_start_o(\tau)}^{latest\_finish_o(\tau)} \sigma_{do}(\tau) = duration_o(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{21}$$

$$\sum_{d^* \in D_{duration_o(\tau)}(\tau)} \sigma_{d^*o}(\tau) = duration_o(\tau) \cdot \eta_{do}(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \quad \forall d \in D(\tau) \tag{22}$$

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

$$\sum_{d \in D(\tau)} d \cdot \sigma_{do1}(\tau) + \Delta_o(\tau) = \sum_{d \in D(\tau)} d \cdot \sigma_{do2}(\tau) \quad \forall (o1, o2) \in finish\_start_{o1,o2} \tag{23}$$

$$\sum_{d \in D(\tau)} d \cdot \sigma_{do1}(\tau) = \sum_{d \in D(\tau)} d \cdot \sigma_{do2}(\tau) \quad \forall (o1, o2) \in start\_start_{o1,o2} \tag{24}$$

$$\beta_{do}(\tau) \in \mathbb{R} \qquad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{25}$$

$$\mu_{rd}(\tau) \in \mathbb{R} \qquad \forall r \in R(\tau) \quad \forall d \in D(\tau) \tag{26}$$

$$\sigma_{do}(\tau) \in \{0, 1\} \qquad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{27}$$

$$\eta_{do}(\tau) \in \{0, 1\} \qquad \forall d \in D(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{28}$$

$$\Delta_o(\tau) \in \{0, 1\} \quad \forall o \in O(\tau, \alpha(\tau)) \tag{29}$$

10 Supervisor

Meta variables:

$$z \in Z \tag{30}$$

$$\alpha(\tau) \tag{31}$$

$$\theta(\tau) \tag{32}$$

$$\tau \in [0, \infty] \tag{33}$$

Maximize:

$$\sum_{a \in A(\tau,\alpha(\tau))} \sum_{t \in T(\tau)} supervisor\_value_{at}(\tau, \lambda_t(\tau), \Lambda_t(\tau)) \cdot \gamma_{at}(\tau) \tag{34}$$

Subject to:

$$\sum_{a \in A_o(\tau,\alpha(\tau))} \rho_a(\tau) = work_o(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{35}$$

$$\sum_{t \in T(\tau)} \sum_{a \in A_o(\tau,\alpha(\tau))} \gamma_{at}(\tau) = \phi_o(\tau) \cdot number_o(\tau) \quad \forall o \in O(\tau, \alpha(\tau)) \tag{36}$$

$$\sum_{o \in O_w(\tau,\alpha(\tau))} \phi_o(\tau) = |O_w(\tau, \alpha(\tau))| \cdot \Phi_w(\tau) \quad \forall w \in W(\tau, \alpha(\tau)) \tag{37}$$

$$\sum_{a \in A_o(\tau,\alpha(\tau))} \gamma_{at}(\tau) \leq 1 \quad \forall o \in O(\tau, \alpha(\tau)) \quad \forall t \in T(\tau) \tag{38}$$

$$\gamma_{at}(\tau) \leq feasible_{at}(\theta(\tau)) \quad \forall a \in A_o(\tau, \beta_{)} \quad (\tau) \forall o \in O(\tau, \alpha(\tau)) \quad \forall t \in T(\tau) \tag{39}$$

$$\gamma_{at}(\tau) \in \{0, 1\} \quad \forall o \in O(\tau, \alpha(\tau)) \quad \forall t \in T(\tau) \tag{40}$$

$$\phi_o(\tau) \in \{0, 1\} \quad \forall o \in O(\tau, \alpha(\tau)) \tag{41}$$

$$\Phi_w(\tau) \in \{0, 1\} \quad \forall w \in W(\tau, \alpha(\tau)) \tag{42}$$

$$\rho_a(\tau) \in [lower\_activity\_work_a(\tau), work_a(\tau)] \quad \forall a \in A(\tau, \alpha(\tau)) \tag{43}$$

11 Technician

Meta variables:

$$t \in T(\tau) \tag{44}$$

$$\alpha(\tau) \tag{45}$$

$$\gamma(\tau) \tag{46}$$

$$\tau \in [0, \infty] \tag{47}$$

Maximize:

$$\sum_{a \in A(\tau, \gamma_t(\tau))} \sum_{k \in K(\gamma(\tau))} \delta_{ak}(\tau) \tag{48}$$

Subject to:

$$\sum_{k \in K(\gamma(\tau))} \delta_{ak}(\tau) \cdot \pi_{ak}(\tau) = activity\_work_a(\tau, \rho(\tau)) \cdot \theta_a(\tau) \quad \forall a \in A(\tau, \gamma_t(\tau)) \tag{49}$$

$$\lambda_{a21}(\tau) \geq \Lambda_{a1last(a1)}(\tau) + preparation_{a1,a2} \quad \forall a1 \in A(\tau, \gamma_t(\tau)) \quad \forall a2 \in A(\tau, \gamma_t(\tau)) \tag{50}$$

$$\lambda_{ak}(\tau) \geq \Lambda_{ak-1}(\tau) - constraint\_limit \cdot (2 - \pi_{ak}(\tau) + \pi_{ak-1}(\tau))$$
$$\forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{51}$$

$$\delta_{ak}(\tau) = \Lambda_{ak}(\tau) - \lambda_{ak}(\tau) \quad \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{52}$$

$$\lambda_{ak}(\tau) \geq event_{ie} + duration_{ie} - constraint\_limit \cdot (1 - \omega_{akie}(\tau))$$
$$\forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \quad \forall i \in I(\tau) \quad \forall e \in E(\tau) \tag{53}$$

$$\Lambda_{ak}(\tau) \leq event_{ie} + constraint\_limit \cdot \omega_{akie}(\tau)$$
$$\forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \quad \forall i \in I(\tau) \quad \forall e \in E(\tau) \tag{54}$$

$$\lambda_{a1}(\tau) \geq time\_window\_start_a(\beta(\tau)) \quad \forall a \in A(\tau, \gamma_t(\tau)) \tag{55}$$

$$\Lambda_{alast(a)}(\tau) \leq time\_window\_finish_a(\beta(\tau)) \quad \forall a \in A(\tau, \gamma_t(\tau)) \tag{56}$$

$$\pi_{ak}(\tau) \in \{0, 1\} \quad \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{57}$$

$$\lambda_{ak}(\tau) \in [availability\_start(\tau), availability\_finish(\tau)]$$
$$\forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{58}$$

$$\Lambda_{ak}(\tau) \in [availability\_start(\tau), availability\_finish(\tau)]$$
$$\forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{59}$$

$$\delta_{ak}(\tau) \in [0, work_{a\_to\_o(a)}(\tau)] \quad \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \tag{60}$$

$$\omega_{akie}(\tau) \in \{0, 1\} \quad \forall a \in A(\tau, \gamma_t(\tau)) \quad \forall k \in K(\gamma(\tau)) \quad \forall i \in I(\tau) \quad \forall e \in E(\tau) \tag{61}$$

$$\theta_a(\tau) \in \{0, 1\} \quad \forall a \in A(\tau, \gamma_t(\tau)) \tag{62}$$