TechnipFMC

pSeven User Conference 2022

ARENA, the future of engineering for flowline studies

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ARENA
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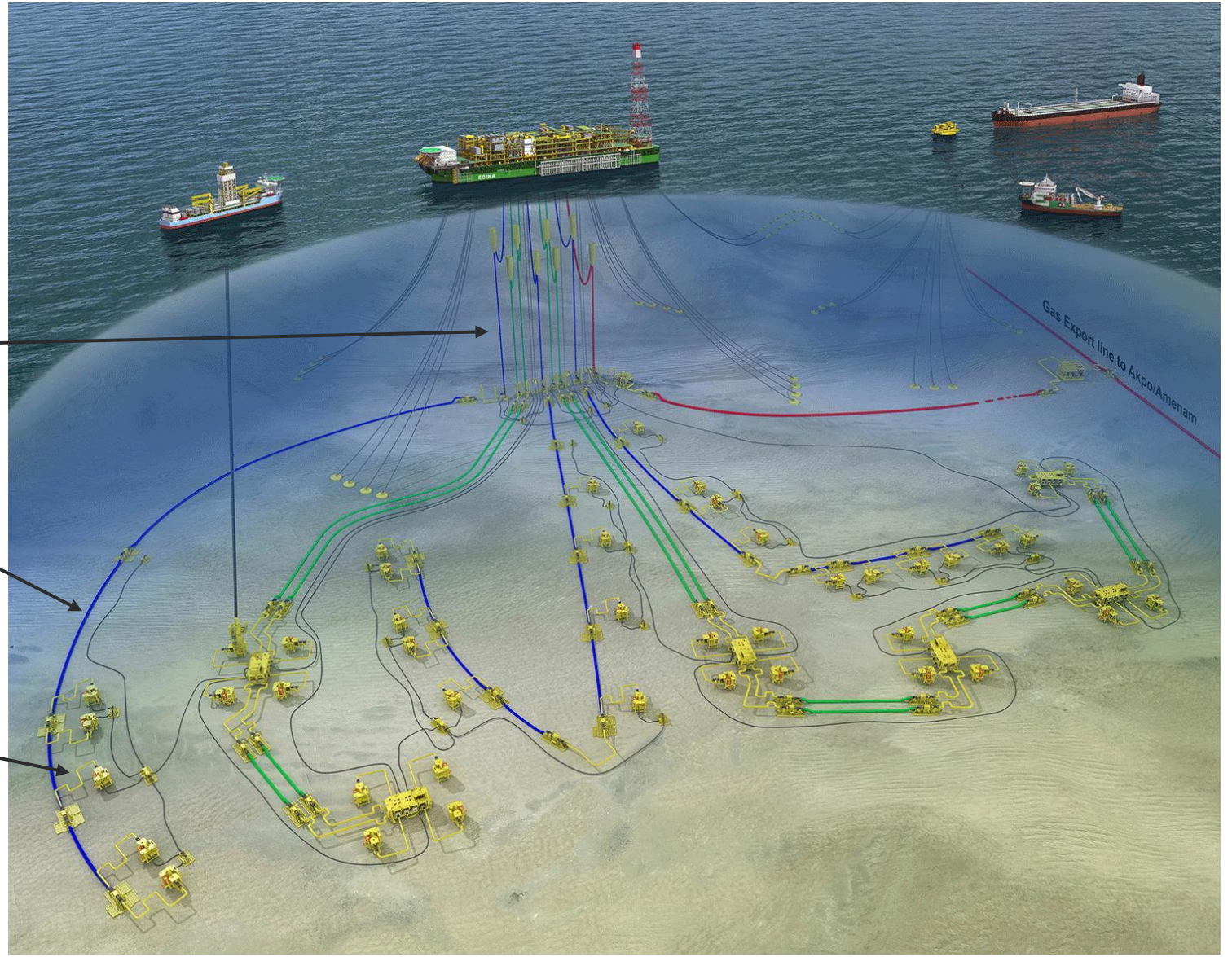
AGENDA

1) What is a flowline?
2) Flowline studies
3) The manual process behind flowline studies
4) The necessity to evolve
5) ARENA overview
6) Achievements and ways forward

1) What is a flowline ?



A flowline is a long pipeline (several kilometers long) resting on seabed and linking wellheads to risers.

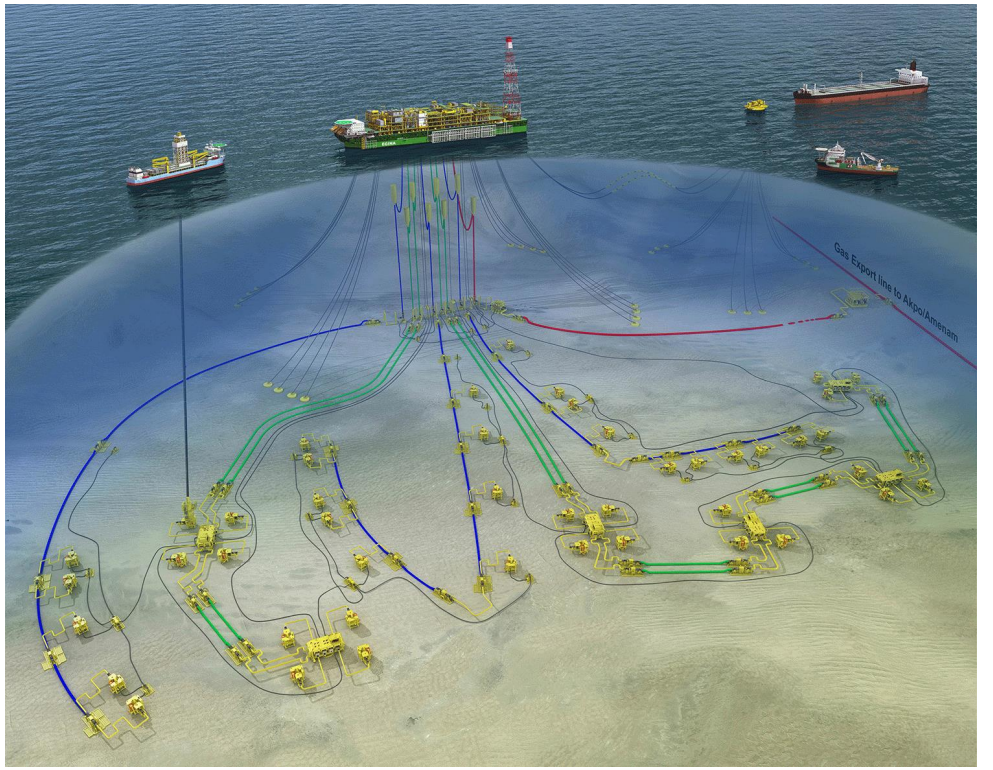
They may contain water, gas oil,…

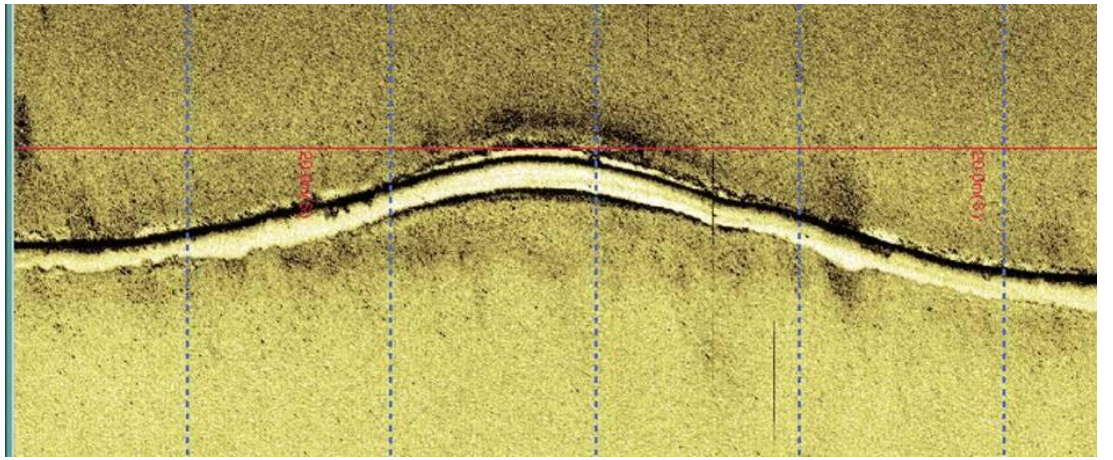
They may be single wall pipe or hose and may be insulated or may include an outer pipe known as pipe in pipe (PIP) system to limit heat losses and protect the inner pipe.

Flowlines are constructed onshore and are lowered to the seafloor.

2) Flowline studies

- As the content may be highly pressurized (up to 900 bars) and hot (more than 100°C), many analyses are necessary to design a flowline :
  - Expansion at both ends
  - Lateral buckling
  - Pipe walking (both ends are permanently moving from their initial position under cycles of heating/cooldown)
  - Structural checks
  - Forces/moments at structure locations
  - Free spans (vibration because of current on not buried sections)
  - Critical buckling force
  - Etc…
- All analyses are performed using Abaqus





3) The manual process behind flowline studies

1. Prepare model files

2. Run the calculation

rescale

ABAQUS

3. Extract the outputs

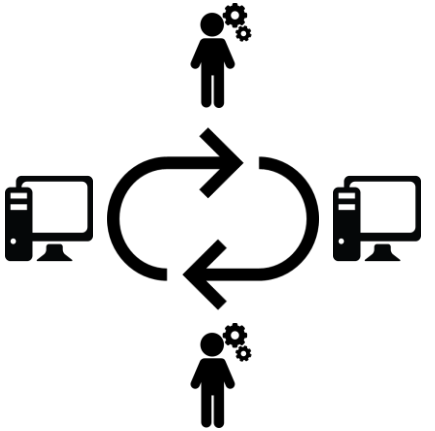
python™

4. Post-process the outputs

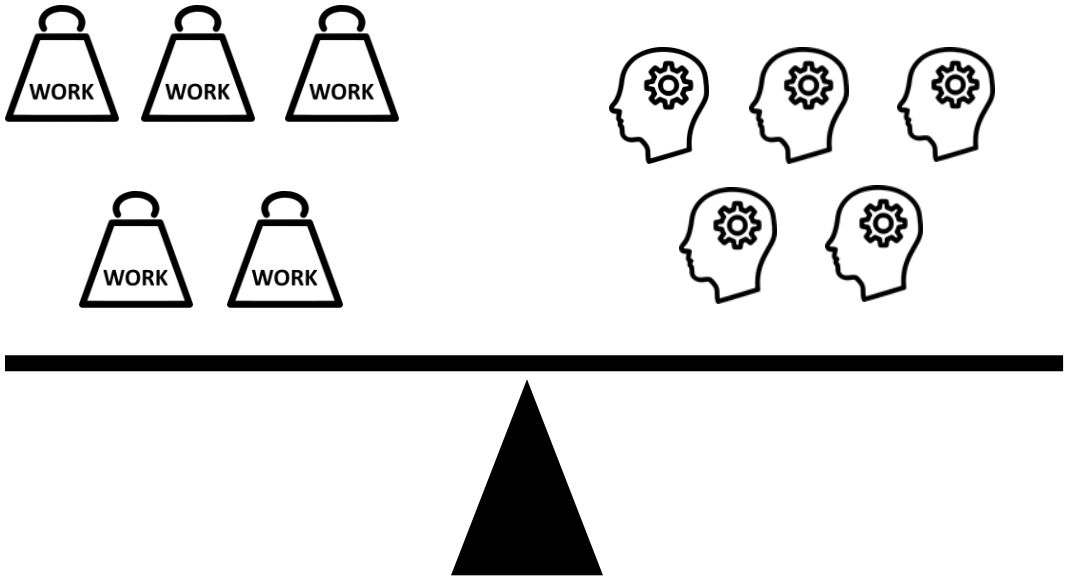
Very repetitive and time consuming

- To be repeated for each analysis, and for each load case (loop on soil coefficients)
  - ⇒ Organization is mandatory as it represents many folders and files
  - ⇒ Many copy/paste and manual modifications
- Calculation may diverge, so user may need to manually tune the stabilization several times.
  - ⇒ No interest from an engineering point of view
  - ⇒ Time consuming (may require months of work to make a calculation converge)
- Abaqus GUI is not adapted to our studies and doesn't help at all for pre-processing and post-processing tasks.

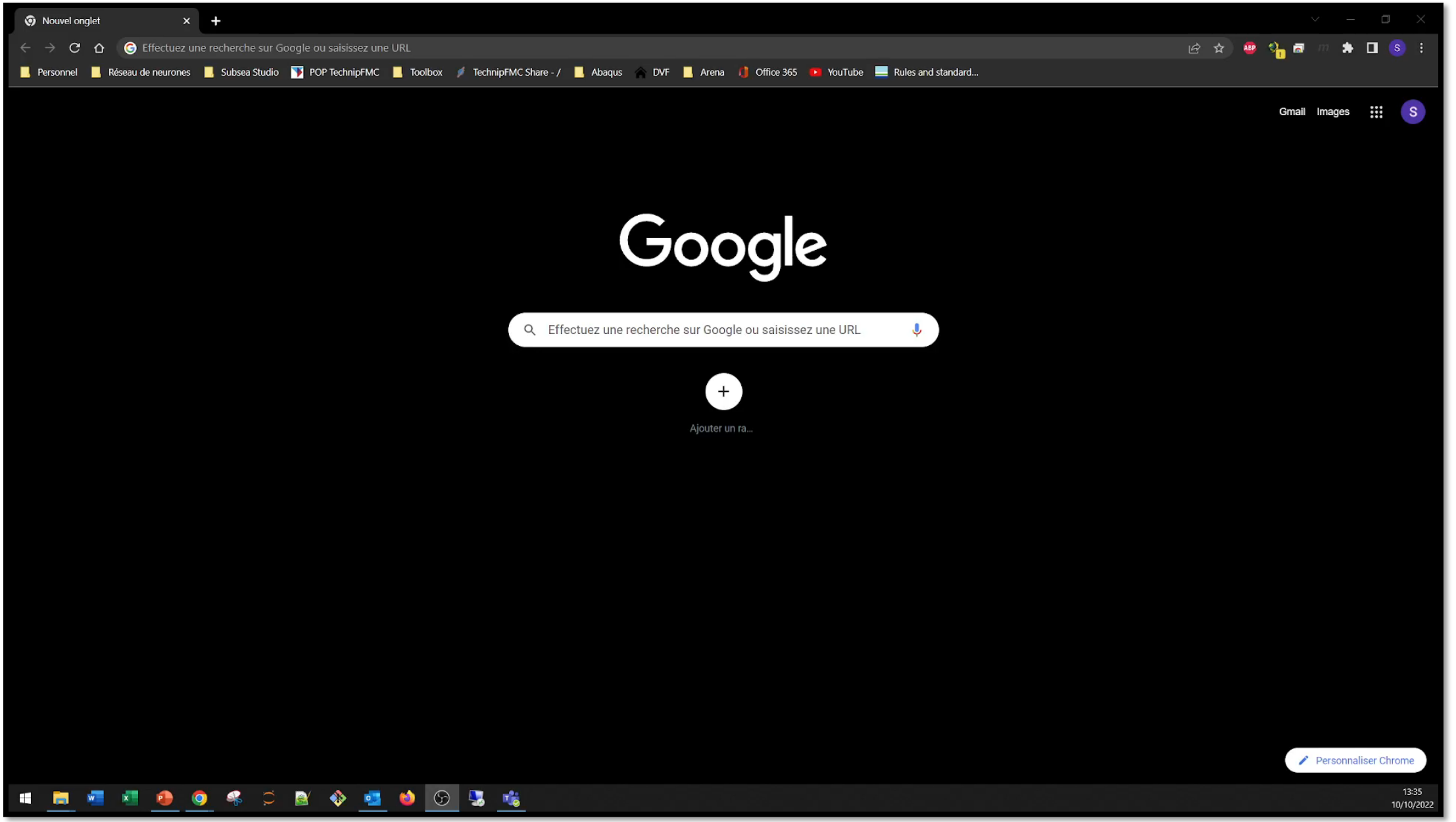
4) The necessity to evolve



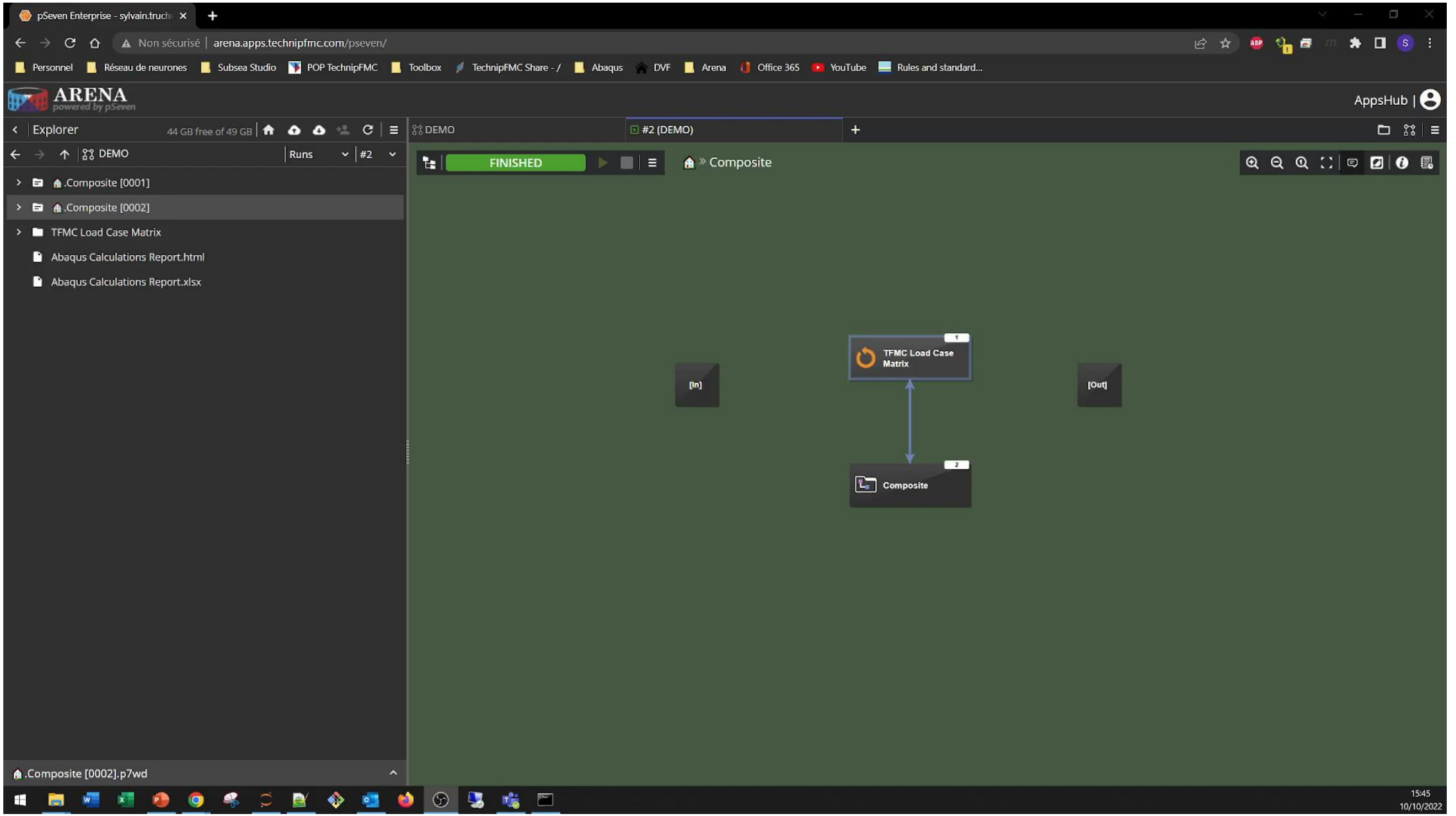
- Challenges we are facing:
  - More and more design constraints (environmental conditions)
    - More iterations required
    - Prices can skyrocket in case of poor design
  - Workload increase post-covid
  - Lower engineer headcount
  - Global cost reductions
  - Competitors' pressure



5) What is Arena? – Edit time



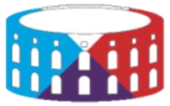
5) What is Arena? – Run time



6) Achievements and ways forward

- Achievements
  - Arena used by 20 active users since October 2021
  - Successful training of engineers (Nîmes, Chennai, Rio)
  - Arena successfully used on 2 major projects
  - Enabled engineers to perform 2-3 times more analyses than manually
  - Very positive user feedbacks end of 2021 (>85% very positive)

- Ways forward
  - Integration of riser and spool tools for specific uses where AI is needed
  - Jumping from 20 to 30 users now, probably more to come…



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THANK YOU