



# pSeven User Conference 2022

## ARENA, the future of engineering for flowline studies

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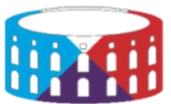
*October 12, 2022*



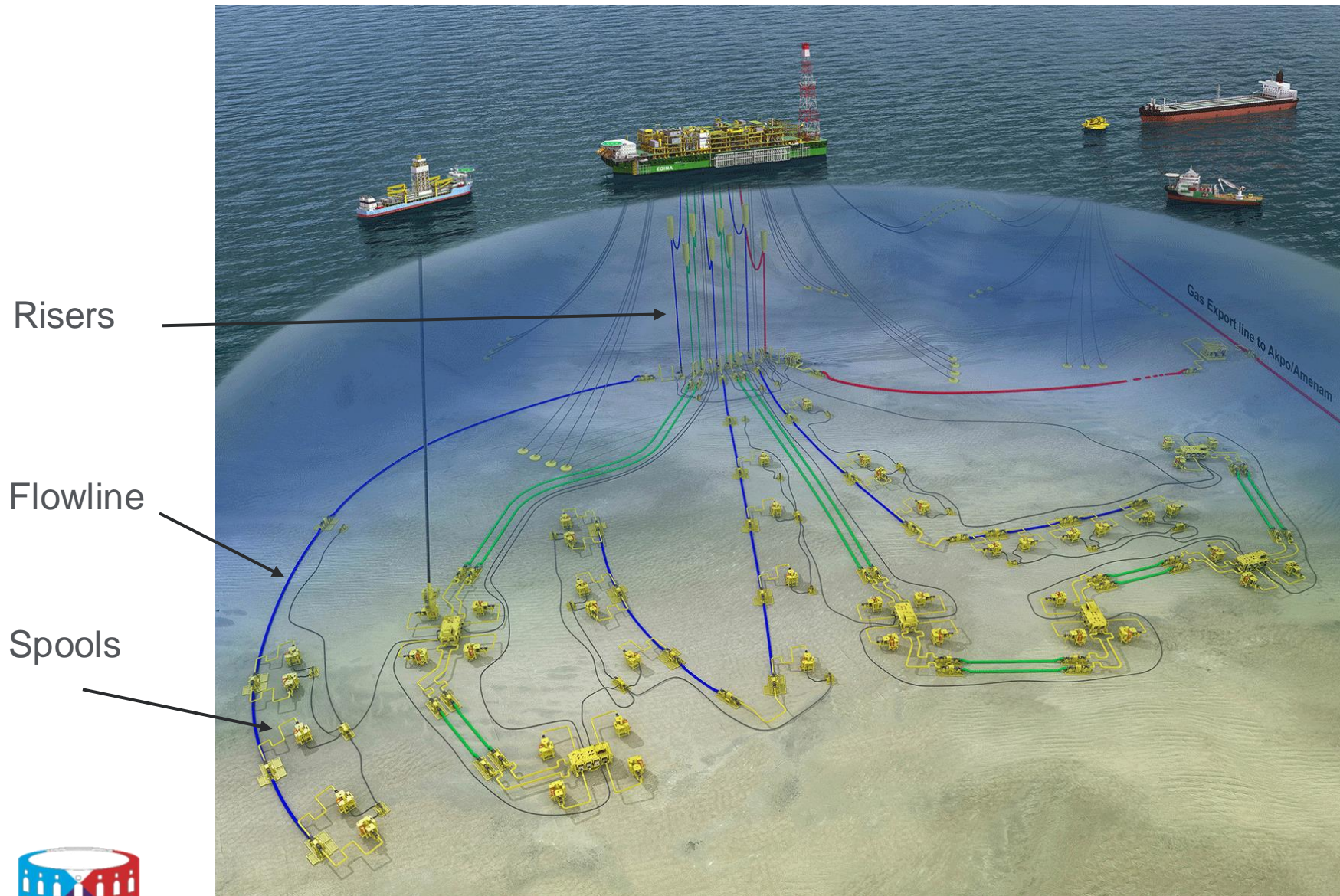
**ARENA**  
*powered by pSeven*

# 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 ?

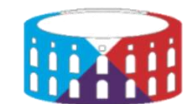


A flowline is a long pipeline (several kilometers long) resting on seabed and linking wellheads to risers.

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.

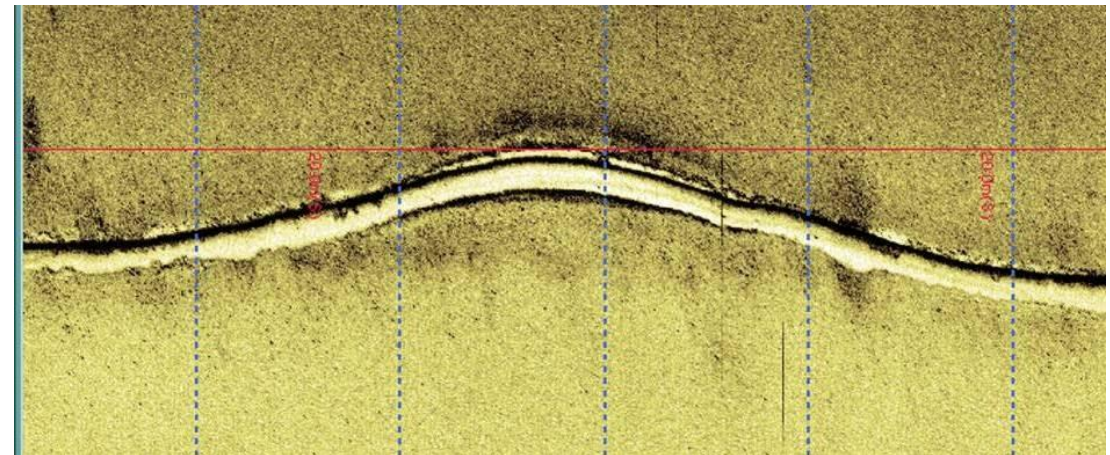
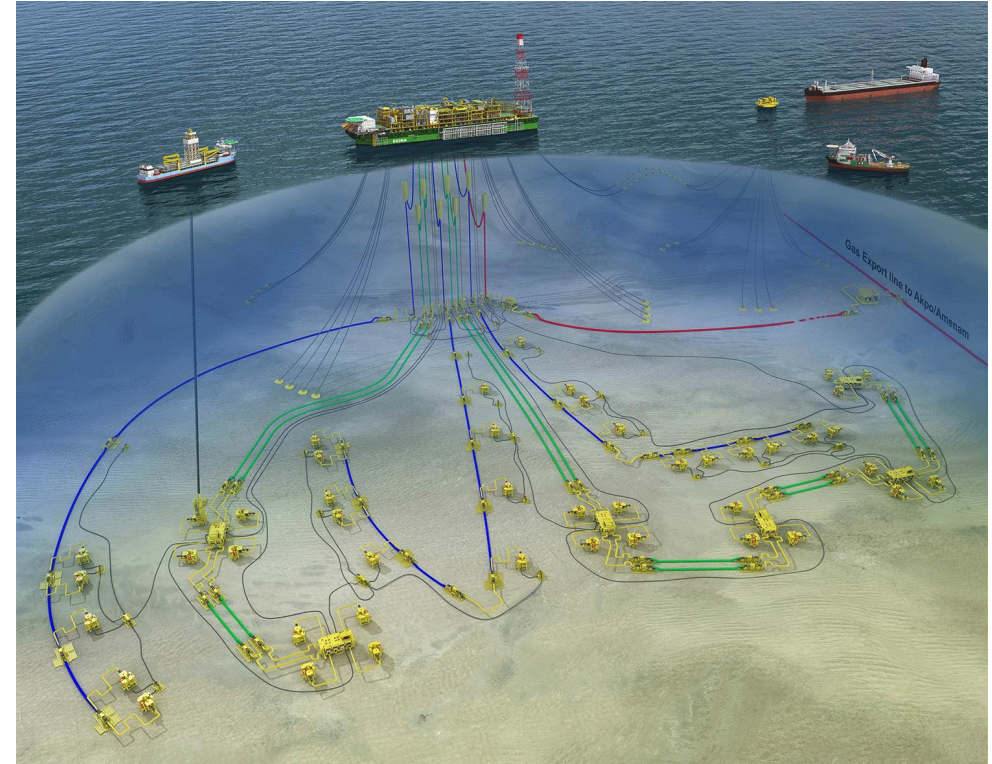
Flowlines are constructed onshore and are lowered to the seafloor.



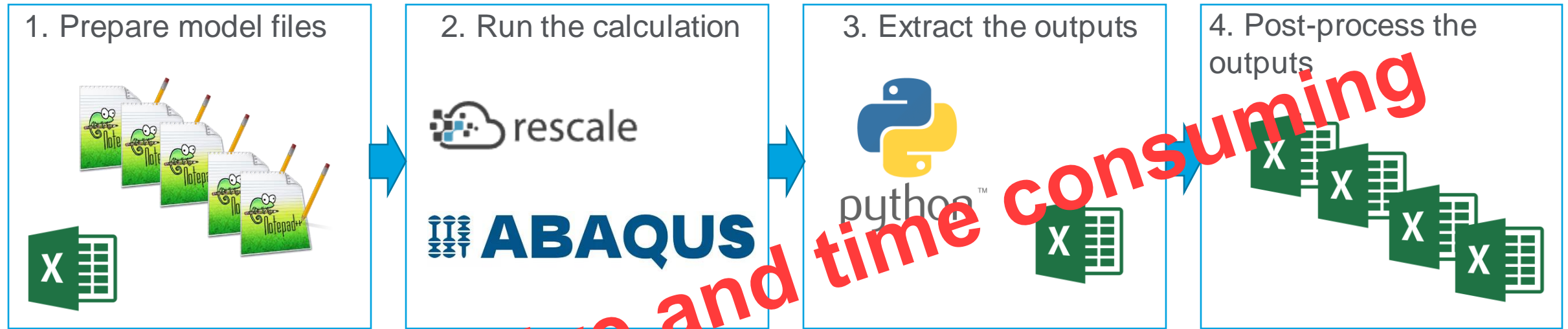


## 2) Flowline studies

- ▶ As the content may be highly pressurized (up to 900 bars) and hot (more than  $100^{\circ}\text{C}$ ), 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



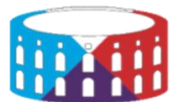
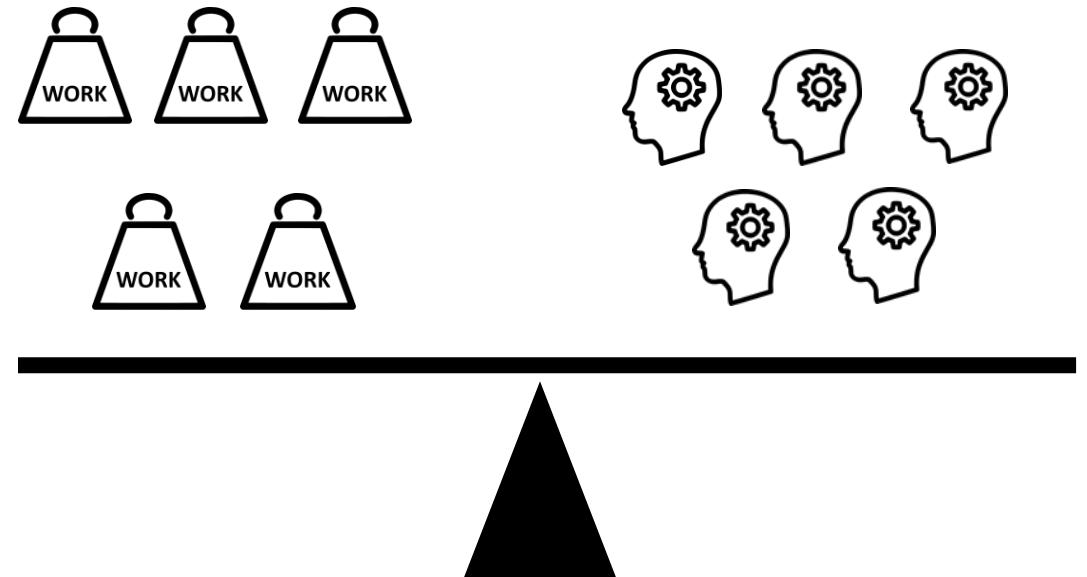
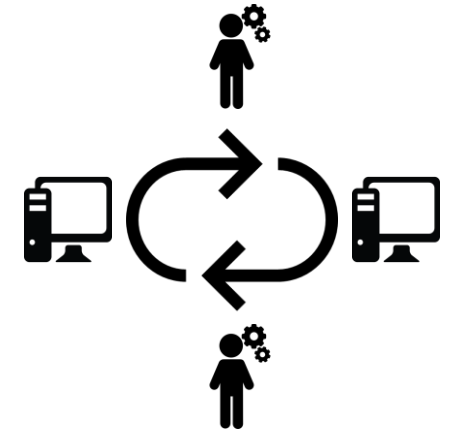
- To be repeated for each analysis, and for each load case (loop on soil coefficients)
  - ⇒ Organization is mandatory as it represents many folders and files
  - ⇒ Many copy/paste and manual modifications
- Calculation may diverge, so user may need to manually tune the stabilization several times.
  - ⇒ 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.



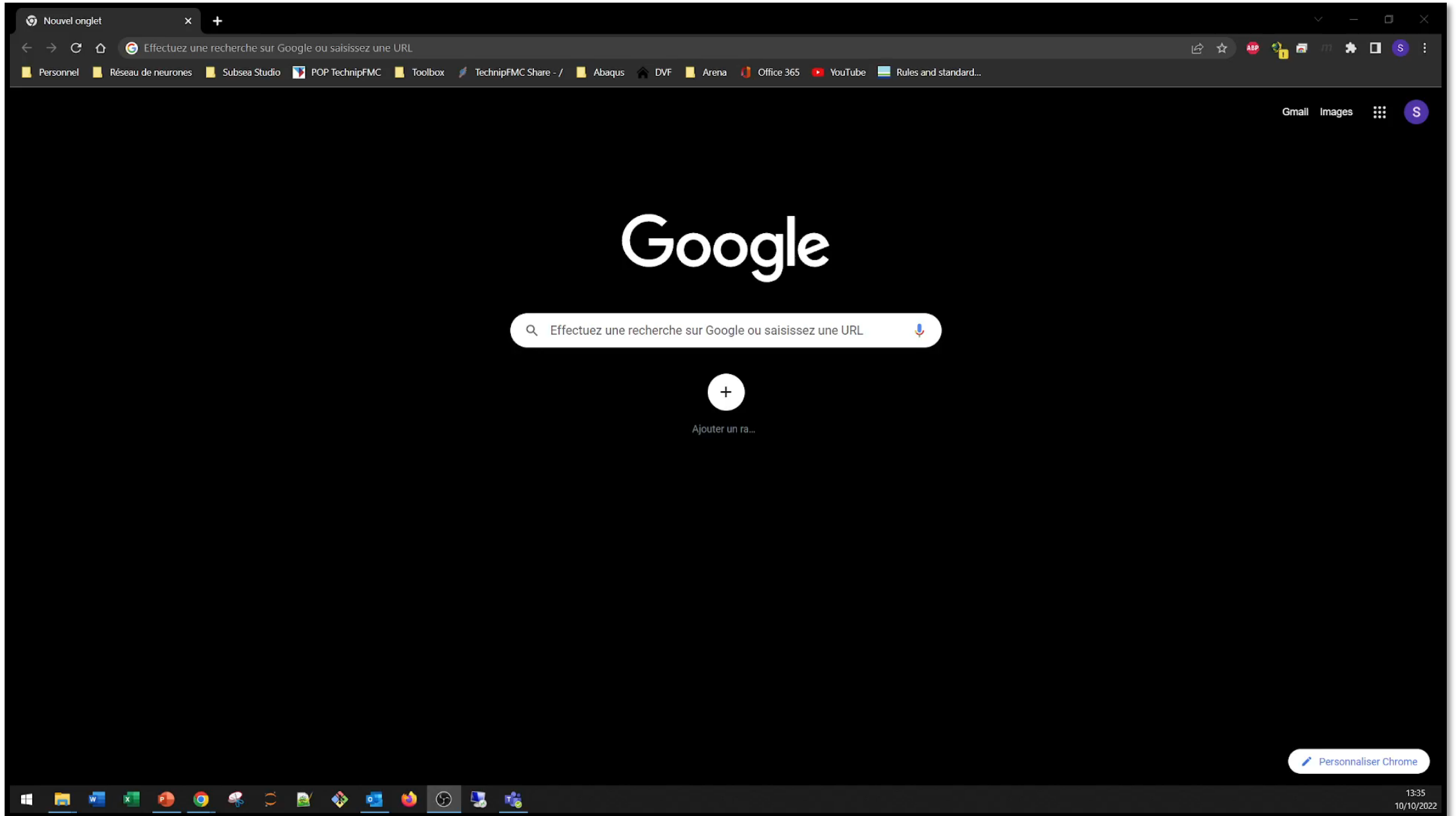
# 4) The necessity to evolve

## ► 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

The screenshot displays the pSeven Arena software interface. The browser address bar shows the URL `arena.apps.technipfmc.com/pseven/`. The interface includes a top navigation bar with the 'ARENA powered by pSeven' logo and 'AppsHub' user profile. Below this is an 'Explorer' sidebar on the left showing a file tree with folders like '.Composite [0001]' and '.Composite [0002]', and files such as 'Abaqus Calculations Report.html' and 'Abaqus Calculations Report.xlsx'. The main workspace features a workflow diagram with a green 'FINISHED' status bar at the top. The diagram consists of three main components: an input block labeled '[In]', a central process block labeled 'TFMC Load Case Matrix' (with a refresh icon and a '1' in the top right corner), and an output block labeled 'Composite' (with a '2' in the top right corner). A double-headed blue arrow connects the 'TFMC Load Case Matrix' and 'Composite' blocks, indicating a bidirectional relationship. The bottom of the screen shows a Windows taskbar with various application icons and a system tray displaying the time '15:45' and date '10/10/2022'.





# 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...





**THANK YOU**