Taking Advantage in CAE Democratization for FEA Tasks by combining ANSYS PyOWA and ANSYS Discovery

Headquarter Research & Technology / P-CT-S – Simulation & Quality Tools
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Weimar, 24.10.2024

Rheinmetall corporate structure

RHEINMETALL GROUP

Vehicle Systems Europe	Vehicle Systems International	Weapon and Ammunition	Electronic Solutions	Power Systems*	Central Division
Business Units					
Tactical Vehicles	United Kingdom	Direct Fire	Integrated Electronic Systems	Air Management	Purchasing
Logistic Vehicles	Asia Pacific	Indirect Fire	Air Defence and Radar Systems	Thermal Management	Corporate Social Responsibility (CSR)
Turrets	North America	Propulsion Systems	Product and Airborne Solutions	Electrification / Digitalization	Project Management/ Business Excellence
CBRN* Solutions		Protection Systems	International Projects and Services	Castings	Divestment Projects
		Projects & Services	Aeronautical Systems	Bearings	
				Trade	
				Hydrogen (Business Area)	
				Invent (Business Area)	

* Chemical, Biological, Radiological and Nuclear

* New division since 01/2024: Previously divisions Sensors and Actuators + Materials and Trade

Key figures at a glance

7,2 BnEUR
SALES, 2023
(2022: 6.4 BnEUR)

138
CUSTOMER LOCATIONS

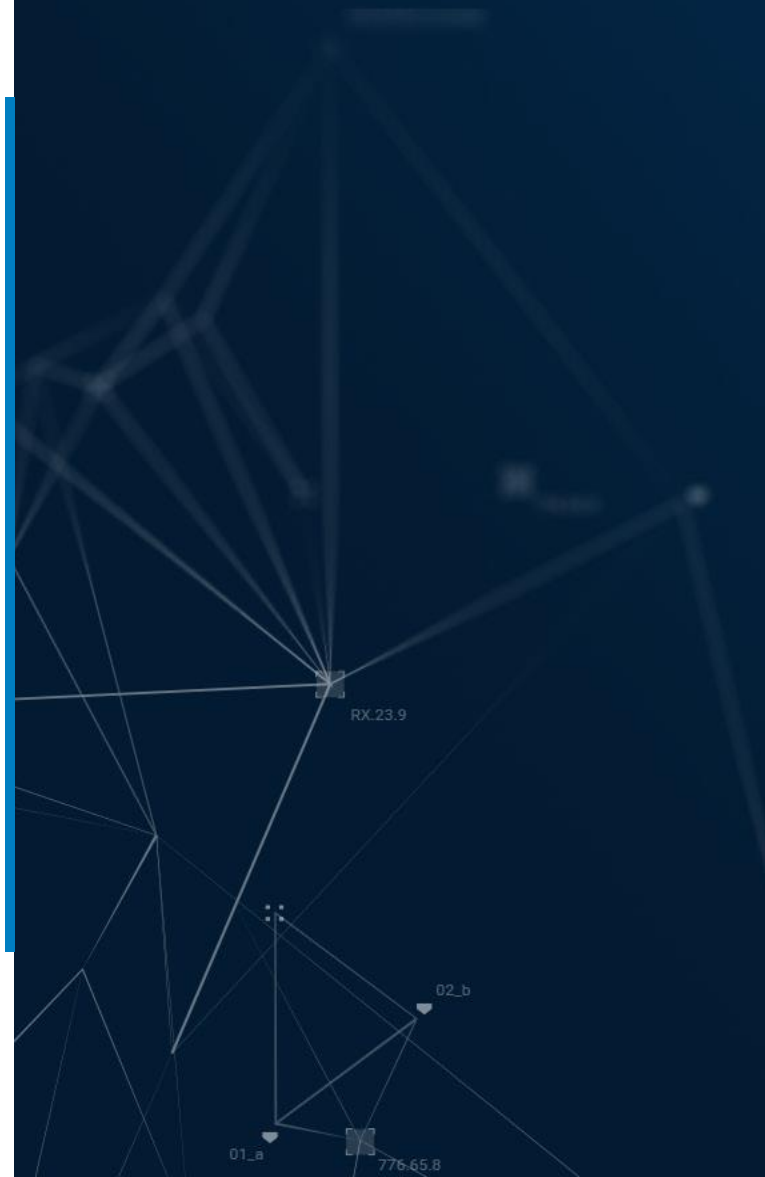
968 MioEUR
EBIT PRE PPA*, 2023
(2022: 747 MioEUR)

174
LOCATIONS WOLRDWIDE

918 MioEUR
OPERATING RESULT, 2023
(2022: 769 MioEUR)

>33,700
EMPLOYEES

* ppa = purchase price allocation



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CAE Democratization…

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CAE Democratization…

NAFEMS Definition of "CAE Democratization“

„**Democratization:**

A solution delivery approach which enables individuals who are not simulation specialists

to execute simulations

and obtain valid results

within specified ranges of parameters

in a managed, traceable environment,

built by a simulation engineer

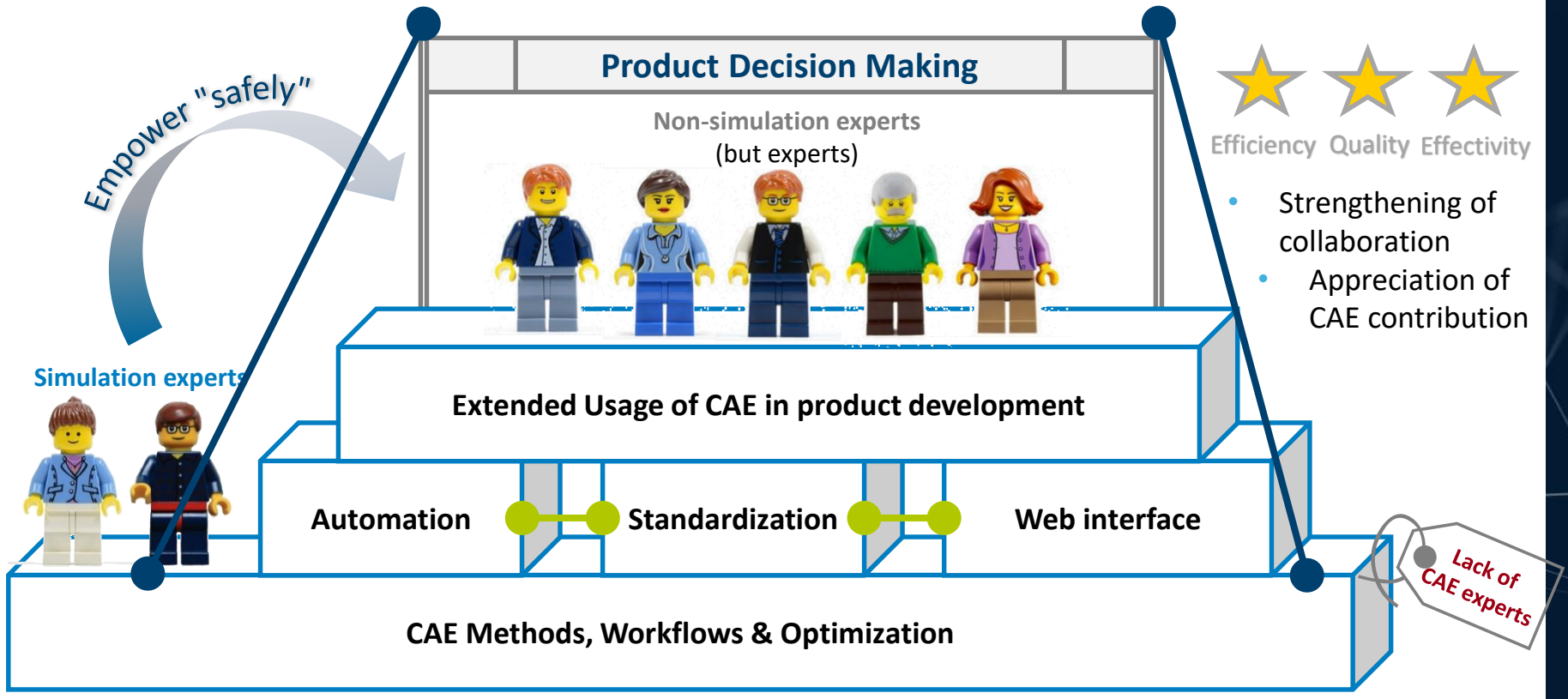
who is responsible for the results obtained.“

Non-simulation experts execute simulation

Simulation engineer is responsible for the results

Source: Glossary entry “Democratisation”; https://www.nafems.org/publications/glossary/terms_d-i/ (October 1st 2024)

The Concept of "CAE Democratization"



Efficiency Quality Effectivity

- Strengthening of collaboration
- Appreciation of CAE contribution

This visualization is inspired by Bosch WOST presentation 2019
("Democratization of CAE Workflows with optiSLang at Bosch", D. Krätschmer et. al.)

Best-in-Class

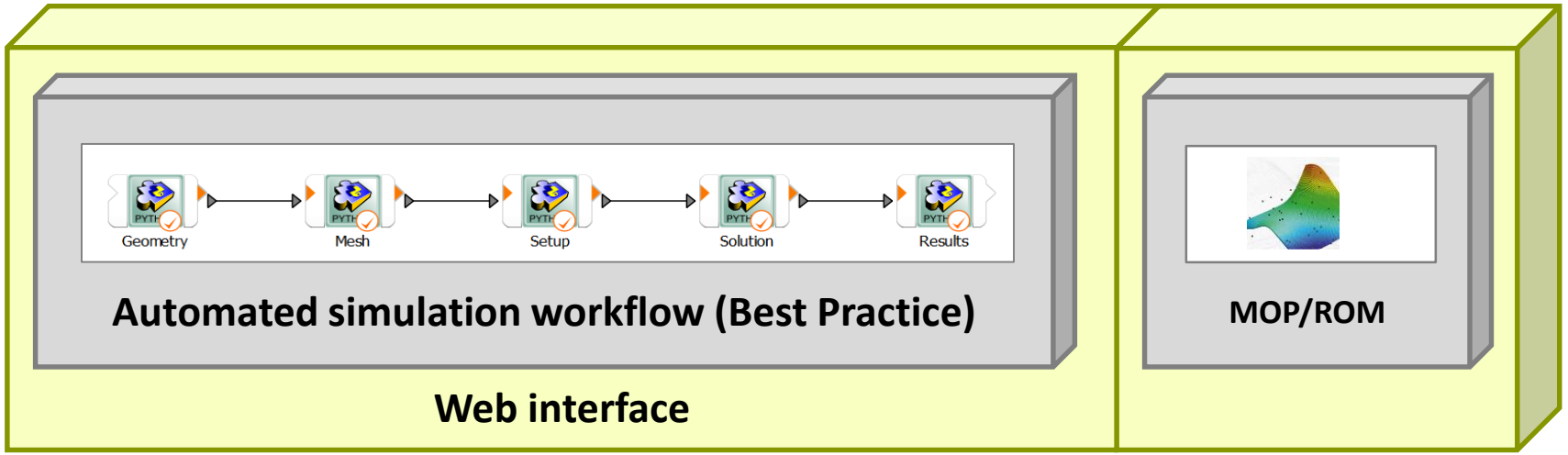
- Corporate initiative
- Company simulation best practice is captured in CAE democratization tools

Lego Characters: www.brick-shop.de

CAE Democratization – How?

- Cover automated workflow with web interface = best practice inside web application.
- Strongly guided CAE workflow can be safely used by non-simulation experts (i.e. designers).
- Use web interface also for product knowledge transfer → query MOP/ROM.

- High level of simulation quality as early as possible in development projects.



P-CT-S Best Practices:

- Validation with measurement data
- Standardization of simulation tasks
- Automation of CAE workflows

… ensure high level of simulation quality.

Enabler for high-quality non-expert simulation.

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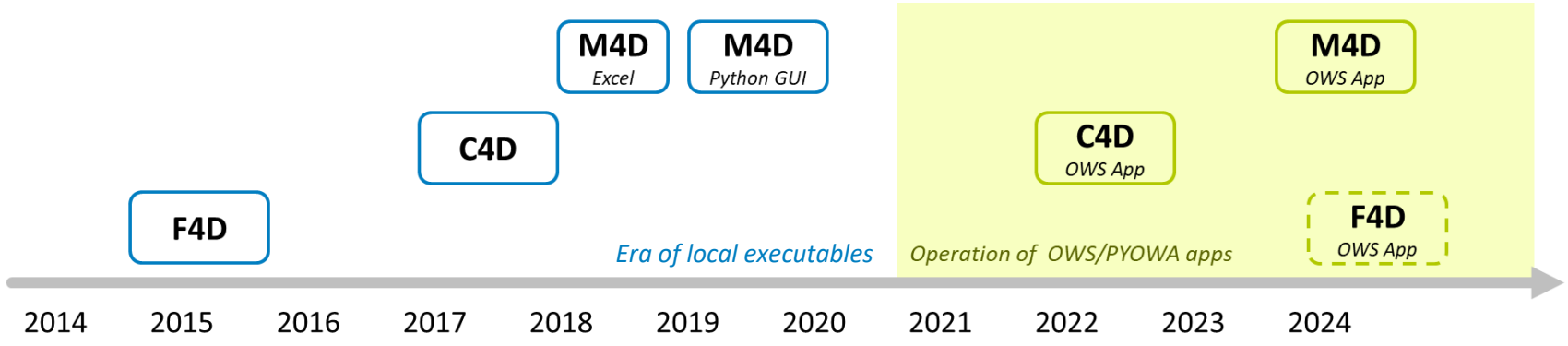
CAE Democratization…

“CAE tools for designers” @ P-CT-S

Development History and Expansion

- Decades of successful simulation history at Rheinmetall Division Power Systems (former Pierburg GmbH)
- Start of CAE democratization with F4D in 2015 (development together with CADFEM)
- C4D and M4D development initiated by former BU Solenoid Valves
- Tools initially developed and distributed as “local executables”
- Operation of optiSLang web service (OWS) beginning in 2020



F4D = FEA for Designers
C4D = CFD for Designers
M4D = Maxwell for Designers

Problems with local executables:

- decentralized solution: difficult administration/ maintenance
- Limited ease of use (e.g. no disconnection of the notebook from the network while solver job is running on cluster)
- …

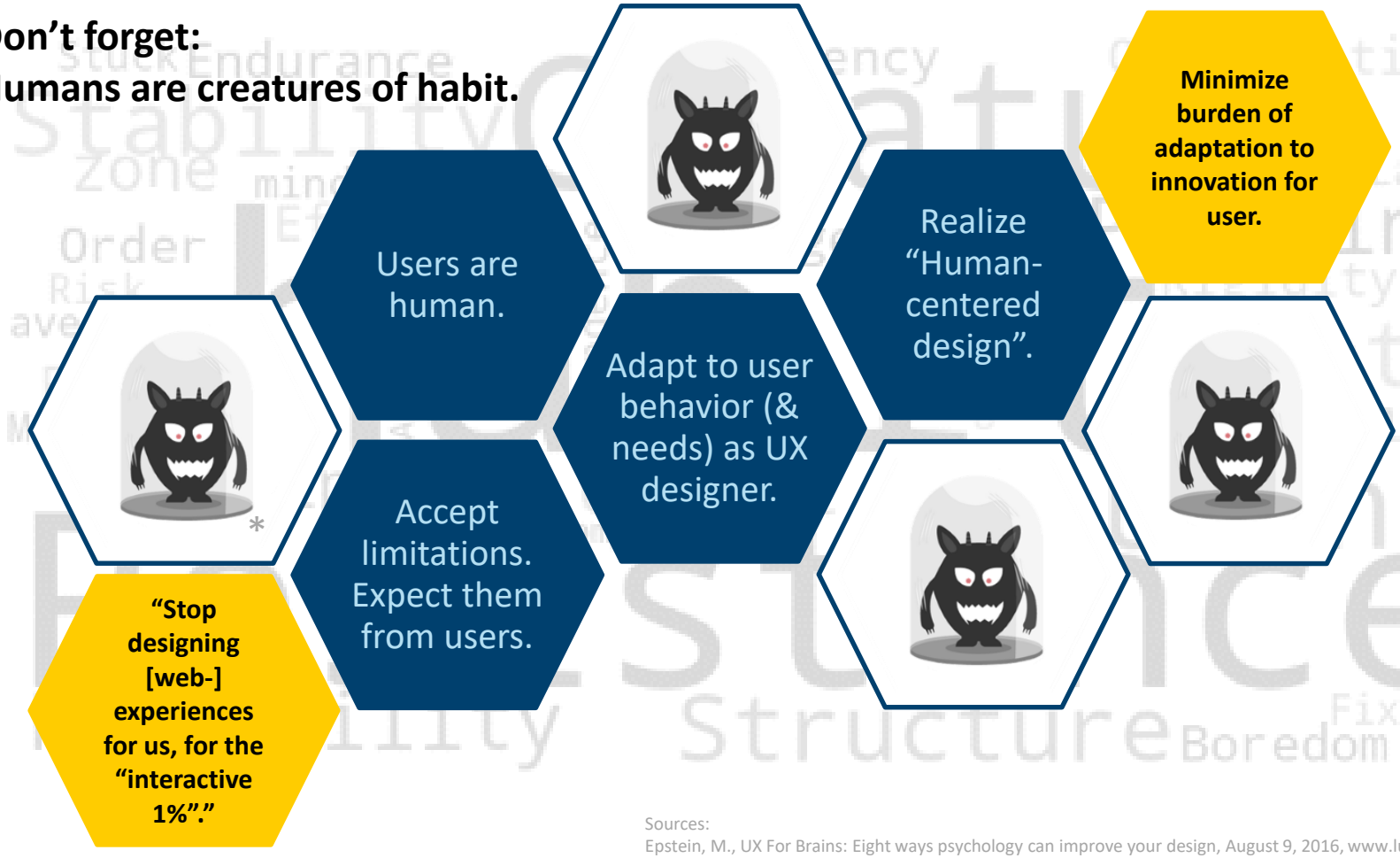
P-CT-S Observation

Increase in number of users (and number of non-expert simulations) only after improvement in ease of use

Excursion into psychology

The thing about dealing with “creatures of habit”…

Don’t forget:
Humans are creatures of habit.



Sources:
Epstein, M., UX For Brains: Eight ways psychology can improve your design, August 9, 2016, www.lullabot.com
Norman, D. et al., User Centered System Design: New Perspectives on Human-computer Interaction (1986)
Weddehage J., Psychologie im UX-Design: alles Routine?, August 30, 2016, www.entwickler.de

* www.creaturesofhabit.me

You:

“Do you know any creatures of habit?”

ChatGPT:

“Yes, the term “creature of habit” describes people who are strongly attached to their **routines** and habits. These people tend to prefer fixed patterns in everyday life and feel uncomfortable when they are torn out of their **comfort zone** or when sudden changes occur.

The term is derived from the observation that many animals also develop fixed behaviors and routines when they live in a **stable environment**.

Humans, known as “creatures of habit”, exhibit similar behaviors by sticking to routines in order to **feel secure** and in **control**. This can have both positive and negative sides: On the one hand, it creates structure and stability; on the other, it can make people less open to new things or harder to deal with change.”

Change Management Aspects

The topic of CAE democratization implies that established workflows are changing.

In the end, you want to get someone to do something different who wouldn't necessarily change anything intrinsically (due to established job profile, workload, habits…).

→ ***Change management is relevant!***

How to succeed?

Change Management Goal

"The aim is to successfully implement changes,

minimize resistance

and promote acceptance

among the employees affected

in order to ensure positive results in the long term."

Heiko Höbbel
Senior Expert Technology and Transformation
Rheinmetall AG

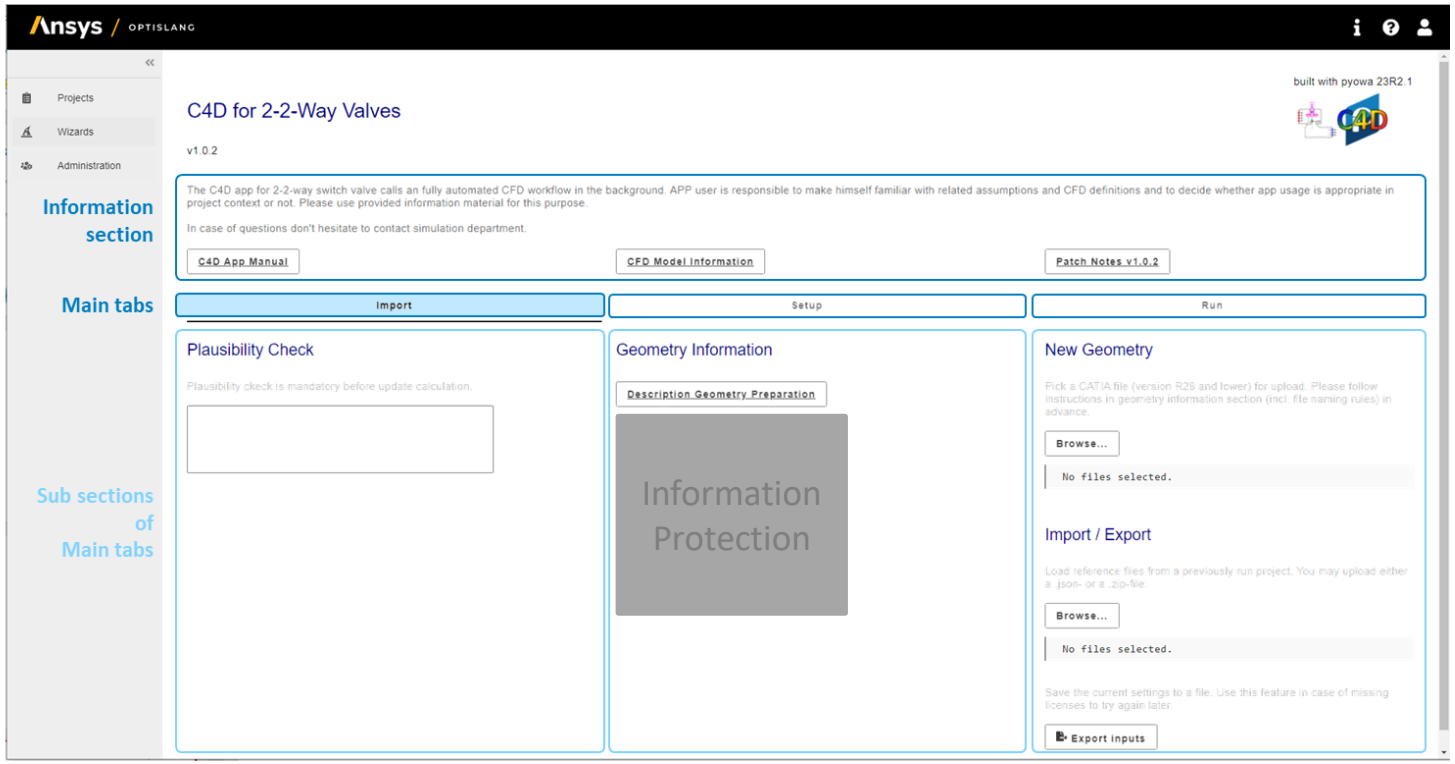
By the way…
Works council is involved when changing job profiles.
→ For example, wage increase for designers could be discussed as soon as they simulate on their own responsibility.

* ChatGPT

GUI Customization using PyOWA @ P-CT-S

Key to success

- Focus on avoiding nasty situations while using web-app → intuitivity + plausibility check
- Provide a good first impression → tidy and inviting GUI
- Similar „look & feel“ in tools/apps → minimize entry barriers to the use of other apps



GUI Example:
C4D Wizard Page
(IP cleansed)

Simple design,
clarity,
intuitivity.

Well-structured user interface
- 1 information section
- few main tabs
- max. 3 sub sections

Simple rules of use
- from left to right
- from top to bottom

Helpful short descriptions at the place of need

Direct access to app manual and modeling information

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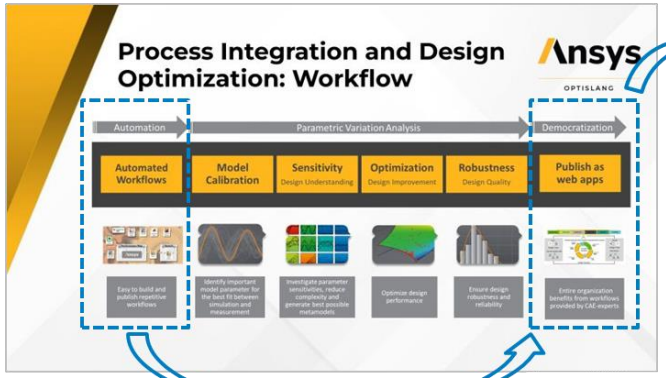
CAE Democratization…

CAE Democratization Tools

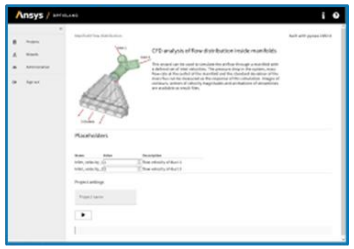
Requirements and Market Solutions

- Software does not require any special simulation knowledge
- Model setup and simulation run quickly
- High tolerance to “bad” CAD geometries
- Simulation quality is good

ANSYS optiSLang



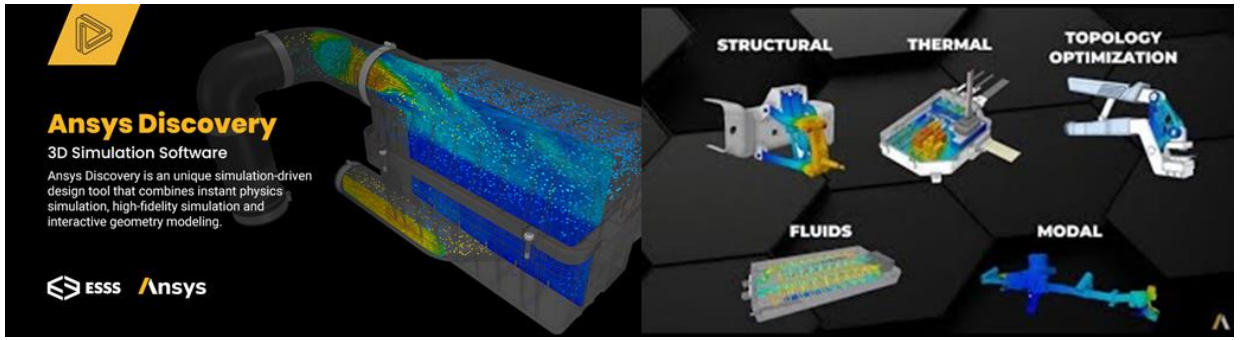
Auto-app feature or customized



App-access via browser

User

ANSYS Discovery



Locally installed on users (remote) workstation

Market Solutions:
(here: focus on ANSYS software)

Guided simulation processes
→ ANSYS optiSLang
→ template-based customizations/apps
→ High-level simulation quality ensured
→ Simulation engineer is responsible for simulation result

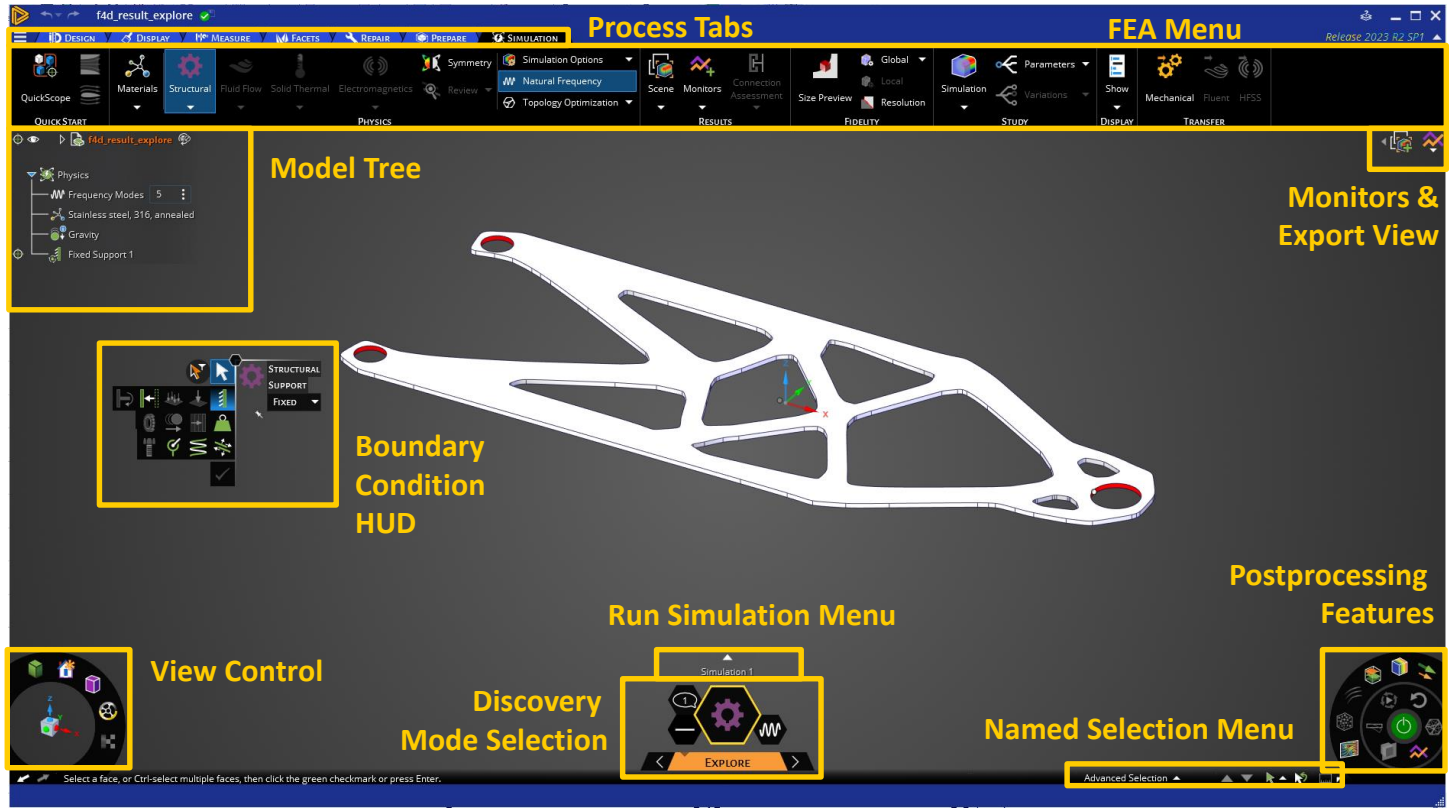
Newer/automated simulation tools → ANSYS Discovery
→ no use of company best-practices/simulation templates
→ Simulation quality not defined
→ Non-simulation expert is responsible for simulation result

Sources (whole slide):
ANSYS.com (optiSLang, Discovery)
Paßmann, R., Zur Demokratisierung der Simulation, Hannover Messe 2024 “CAE Forum”

ANSYS Discovery: newer/automated Simulation Tool

Features and Risks

- ANSYS Discovery is designed to be operated 100% interactive
- Lots of menus, tabs, HUDs + model tree
- Predefined setups and default values to support user in simulation setup
- Scripts execution is supported but process manipulation by user could not be blocked



How to keep track?
…especially for non-daily use.

All defaults suitable for your simulation task?
…not always obvious where defaults have been applied.

How to enforce Simulation Best Practice?
…It will be difficult to recognize in which cases best practice has been deviated from.

Possible Risk Reduction
Intense simulation training and personnel-intensive support (and control) for users by simulation expert.

→ Well done by BOGE (CASCON 2024)

ANSYS Discovery: Pro‘s & Con‘s (2023 R2)

…from P-CT-S Perspective.

Pro‘s

- Improved Geometry Core
- Geometry Check and Auto-Fix
- Improved Scripting Features and Access to Software Functions (all Python)
- Fast new solver technology (Explore Mode)
- GLB-File Export (with Results)
- Multiphysics Simulation
- …

Con‘s

- Missing Documentation for new solver technology
- Complex GUI with risk to overstain non-simulation experts or non-daily users
- Missing option to implement strongly guided workflows
- …

ANSYS Discovery is contrasting to guided simulation processes i.e. web-app approach.

ANSYS Discovery is currently more simulation expert tool than non-simulation-expert tool.

Why not taking advantage of ANSYS Discovery in guided simulation processes for non-simulation experts?

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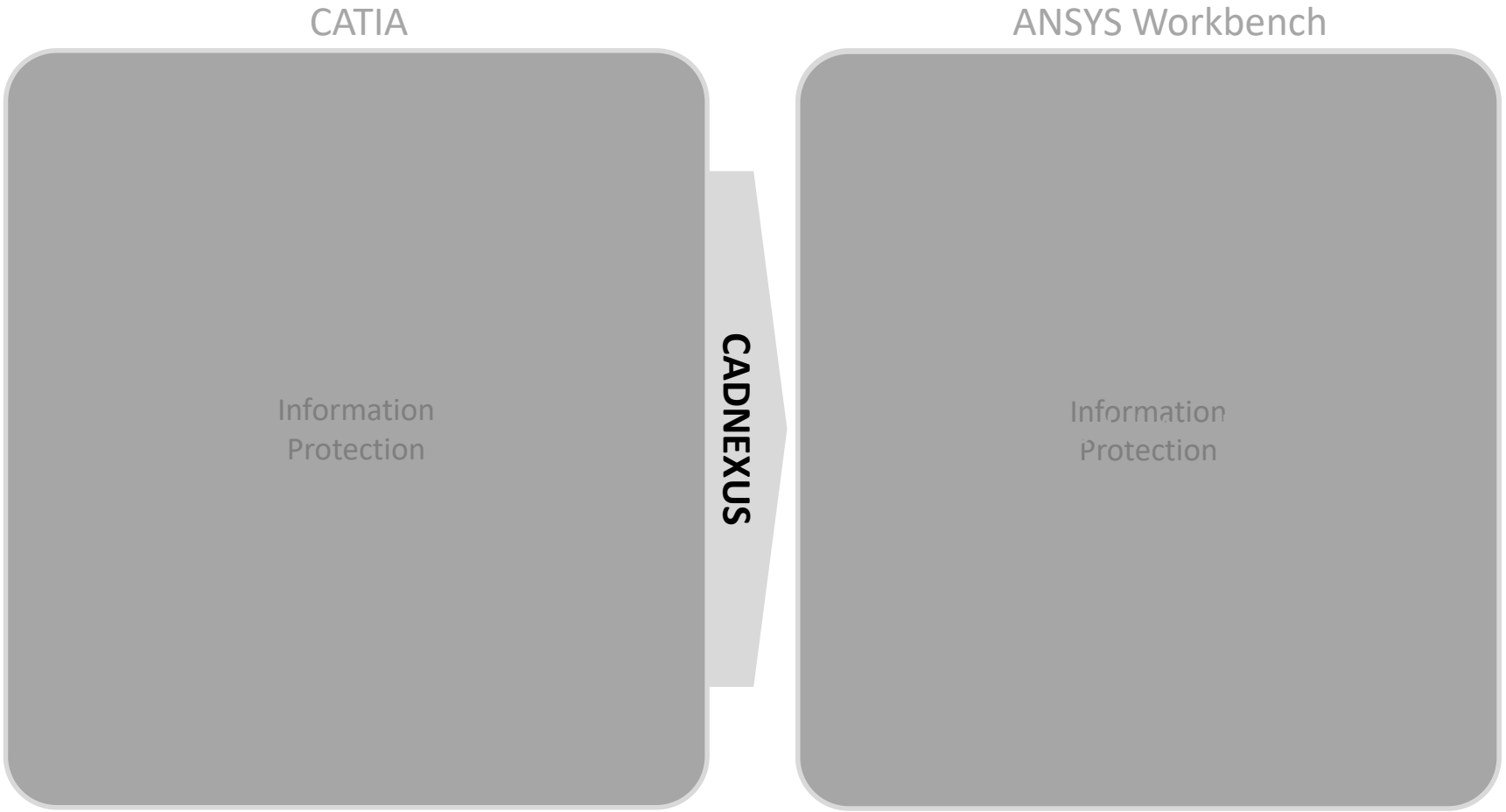
CAE Democratization…

“FEA for Designers” (F4D)

…developed in 2015 in collaboration with CADFEM



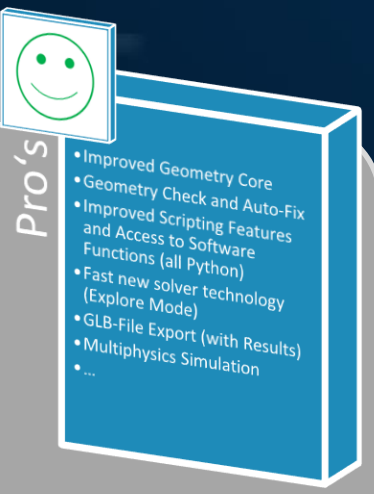
Problems & Improvement Potential

- CADNexus configuration
- Process upgrade to newer ANSYS versions
- PC performance losses due to local simulation
- Late detection of problems with CAD → repeat complete process = go back to CATIA
- Loophole: access to all simulation functions and features (outside of best practice)

Acknowledgement to **Martin Husek (ANSYS)** for first class support.

F4D App Concept

2024ff



Information Protection

Demo Videos

Information
Protection

User Feedback

…this is what our non-simulation experts told us.

Most relevant results at a glance.
I don't need any special knowledge in the operation of simulation software and can still find all relevant result views and values easily.

Fast Results.
I get the simulation results faster than with the old F4D concept, where the simulations were run locally on my computer. And what's more, my computer is no longer under simulation load.

Implemented check features.
I appreciate the integrated support features & checks. I don't have problems to define and start simulation successfully.

GUI similarity of apps.
This helps me to start using new apps because I find my way through it quickly and easily.

High User satisfaction level.

But it's not a just rose-tinted world either.

Negative feedback, constructive criticism, suggestions with regard to…

- → Lacking network stability and performance
- → Need for further apps and features
- → Need for advanced user and project management (→ collaboration scenario)

Some non-simulation experts still want to simulate "everything".

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CAE Democratization…

Summary & Conclusion

CAE democratization challenge

Non-simulation experts execute simulation BUT simulation engineer is responsible

P-CT-S need: high-quality non-expert simulation (capture best practices)

- Operation of optiSLang web service (OWS) @ P-CT-S beginning in 2020 → transfer existing tools to OWS and create new tools/apps
- "FEA for Designers" (F4D) developed in 2015 (together with CADFEM): Transfer and extension

Increase in CAE democratization tool usage only after improvement in ease of use

- Consider aspects of psychology and change management → minimize resistance and support/promote acceptance of users
- P-CT-S key to success: GUI design with PyOWA follows guiding principle "Simplicity, clarity, intuitivity."

P-CT-S perpective: ANSYS Discovery provides some interesting features and technologies …but:

- is contrasting to guided simulation processes (like app approach)
- is currently more simulation expert tool than non-simulation expert tool

P-CT-S apps

- Fulfill user requirements and P-CT-S app design & development principles → high user satisfaction
- F4D: successful transfer to OWS app with significant improvements – thanks to ANSYS Discovery.

Combining of ANSYS PyOWA and ANSYS Discovery works and is benefitial.

User profits.

- CAD check
- speed-up
- 3D viewer
- …

Development projects profit.

P-CT-S likes seeing **ANSYS Discovery at backend** of CAE democratization tools

– but not in direct use of non-simulation experts (until further notice).

TAKING RESPONSIBILITY IN A CHANGING WORLD

Thank you for your attention.
Questions?

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