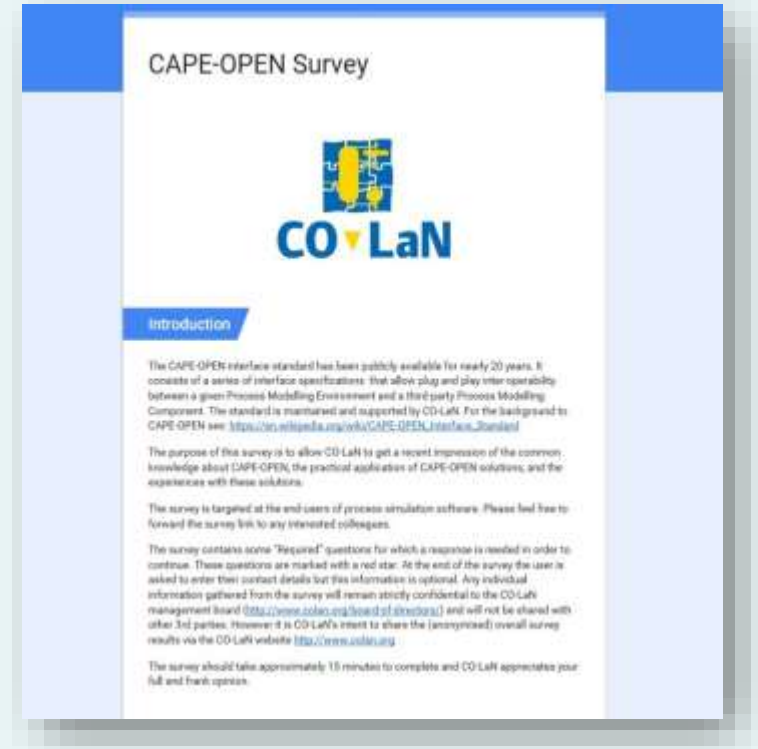


CAPE-OPEN Survey

**Preliminary findings on needs and usage of
CAPE software tools**

CAPE-OPEN Survey - Objectives

- ❑ Assess awareness/visibility of CAPE-OPEN and CO-LaN within the chemical engineering community
- ❑ Prioritise the work of CO-LaN and the future development of the CAPE-OPEN standard
- ❑ Identify interest and stimulate participation in SIGs
- ❑ Identify potential new CO-LaN members



CAPE-OPEN Survey - Status

- ❑ Distributed in June 2018 to all CO-LaN members with added request to forward the survey to end-users
- ❑ Difficulties encountered engaging major software vendors to forward survey link to their users
- ❑ This report is based on 76 responses from
 - CO-LaN managed mailing lists
 - COCO mailing list

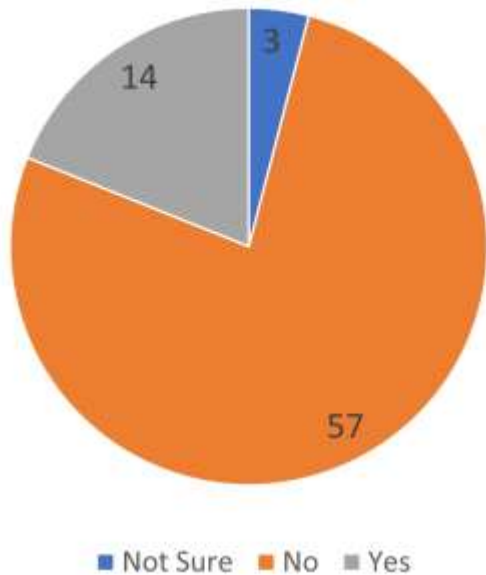
→ *the respondents appear to have an affinity to CAPE-OPEN*

Survey remains open; we are looking for additional channels for distribution

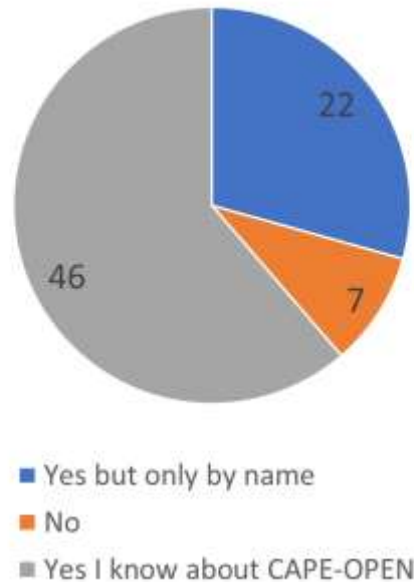
Please help to distribute the survey

CAPE-OPEN Survey - Feedback

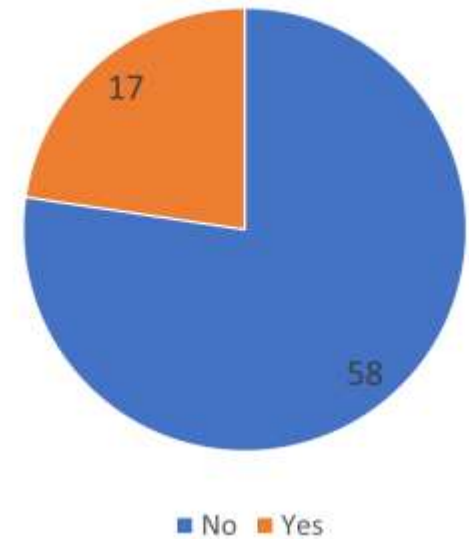
Do you know about CO-LaN



Do you know about CAPE-OPEN?



Respondents previous contact with CO-LaN

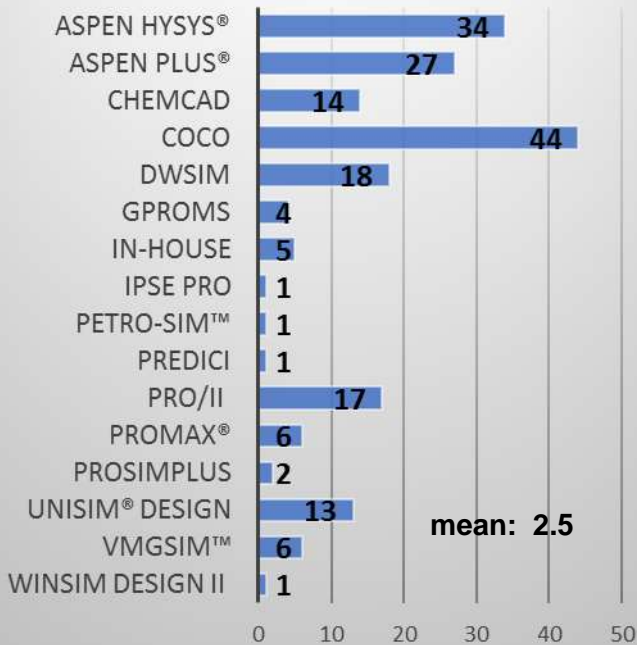


There is a significant opportunity for CO-LaN to follow up on potential new members and end-users.

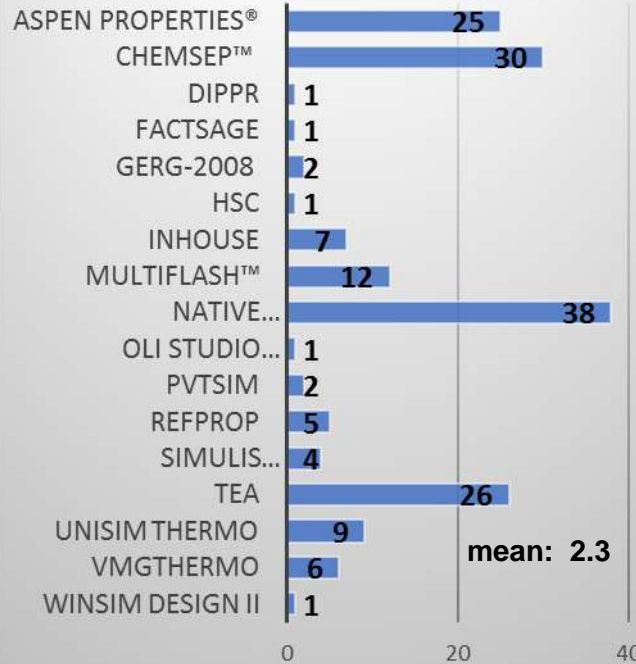
**The areas of simulation interest
&
interoperability experiences
with process simulation tools**

CAPE-OPEN Survey - Feedback

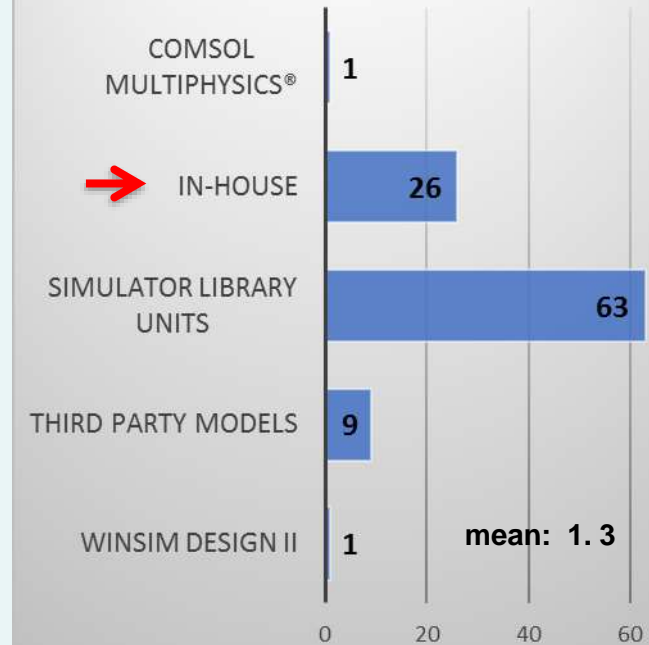
PME Usage



Thermodynamics Used



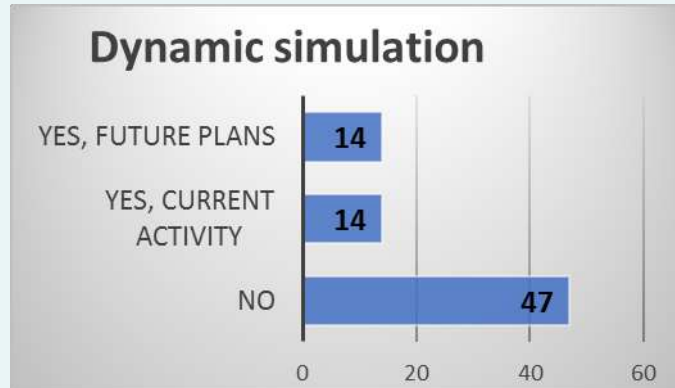
Unit Operations Used



- ❑ Respondents exposed to range of PMEs & thermo packages*.
- ❑ Native library PMCs are predominantly used
- ❑ Interoperability of in-house UOs is important to the respondents

*Distribution not representative of the full market

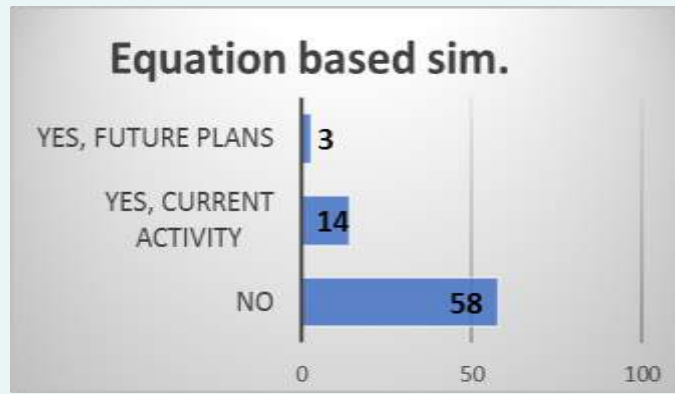
Areas of interest: dynamic simulations



Advanced energy systems
Batch processes
Chemical and Polymer Reaction Kinetics
Process Control
Control Valve sizing
Digital twin
Distillation column Design and Operation
Engineering dynamic simulators
Peak electric power production
Plant wide ethylene model
Process startups and shutdowns
Risk analysis
FEA modelling
Vessel Depressurisation and control
Well start up

- Interest in dynamic simulation.
- Operation Training Systems not explicitly mentioned; i.e. is there limited interest in the dynamic unit operation specification? Is due to the sample?

Areas of interest: equation based modelling



- Most respondents are interested in EO for modelling non-standard processes.
- Is there limited interest in EO based optimizer or dynamic simulators?

Academic studies of how a flowsheet process simulator works

Advanced energy systems

Complex kinetics

In-house processes and tools

Metalurgical processes, overall mass balances of biorefinery processes

Biorefinery processes

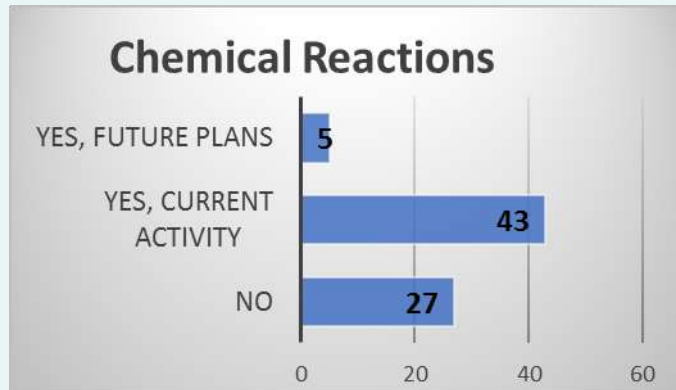
Implementing models of smaller unit operations / processes (Python)

Multiple-phase reactors linked to complex kinetics

New process development and scaling-up

Production Optimisation

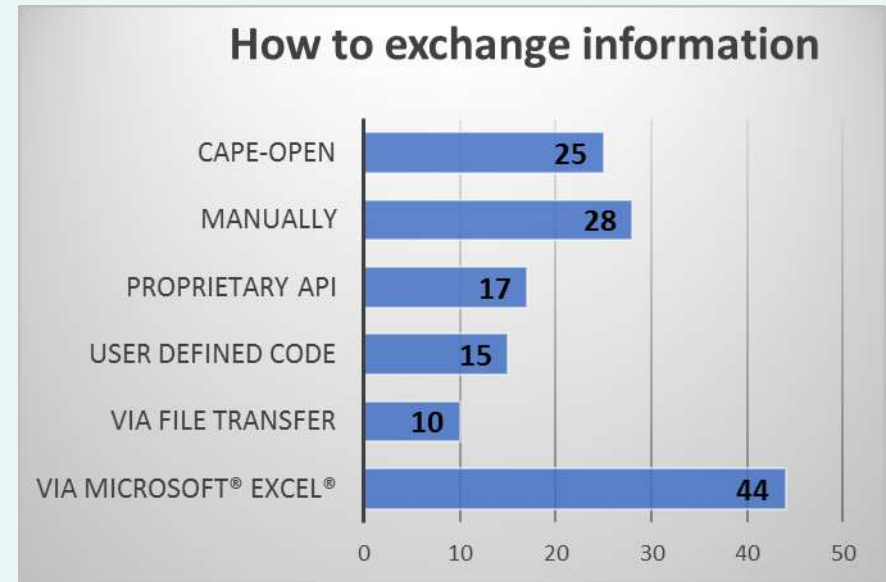
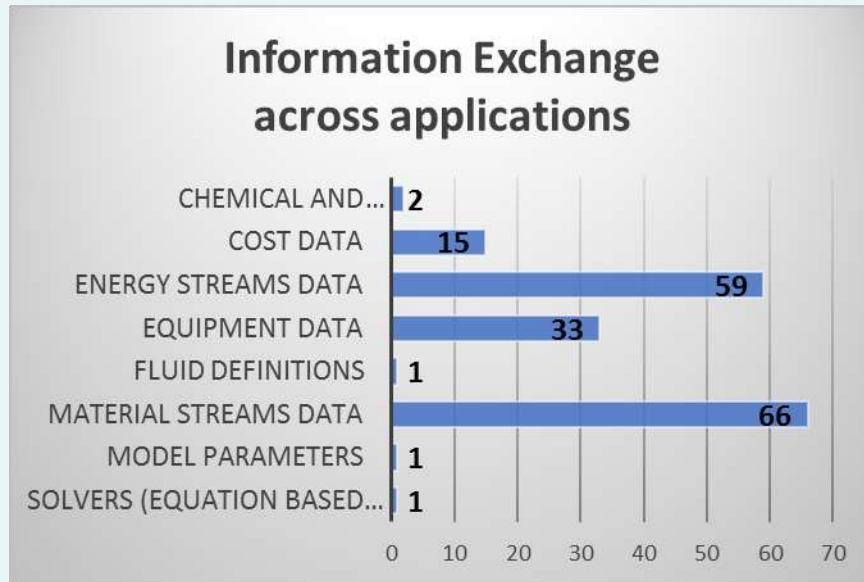
Areas of interest: equation based modelling



- Large interest in describing non-standard reactions
- Wide range of applications for reactions modelling
- What does this mean for the chemical reaction interface?

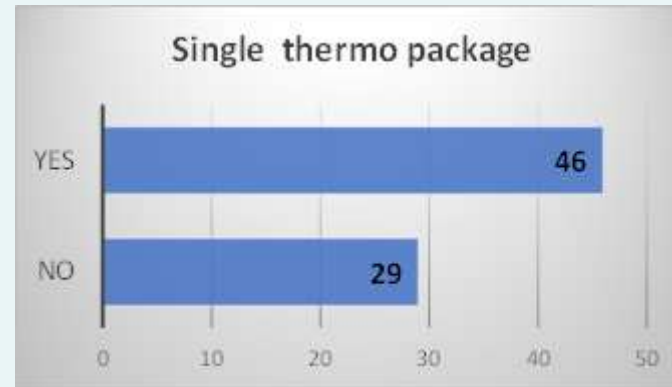
Advanced energy systems
Gas/liquid treating and trace component reactions
Amine systems
Ammonia synthesis
Biochemical reactions and organic reactions
Biodiesel production
Biorefinery processes
Chemical conversion processes
Chemical equilibrium calculations
Combustion
Fischer-Tropsch reactions
Levulinic acid production from biomass
Hydrotreating, FCC, Thermal cracking, Isomerization, Alkylation
Lead chemistry
Methanol production
Methane Cracking
Multi-phase reactors
Petrochemical, Fertilizer, Metallurgical
Polymerization Reactions
Process fermentation
Reactive distillation
Refinery studies
Reforming
Rubber pyrolysis

Information Exchange across applications



- Opportunity for Flowsheet Monitoring; e.g. access to H&M balances across applications
- Would interfaces for cost & equipment be useful?
- Only 1/3 of the respondents use CAPE-OPEN

Thermodynamic consistency

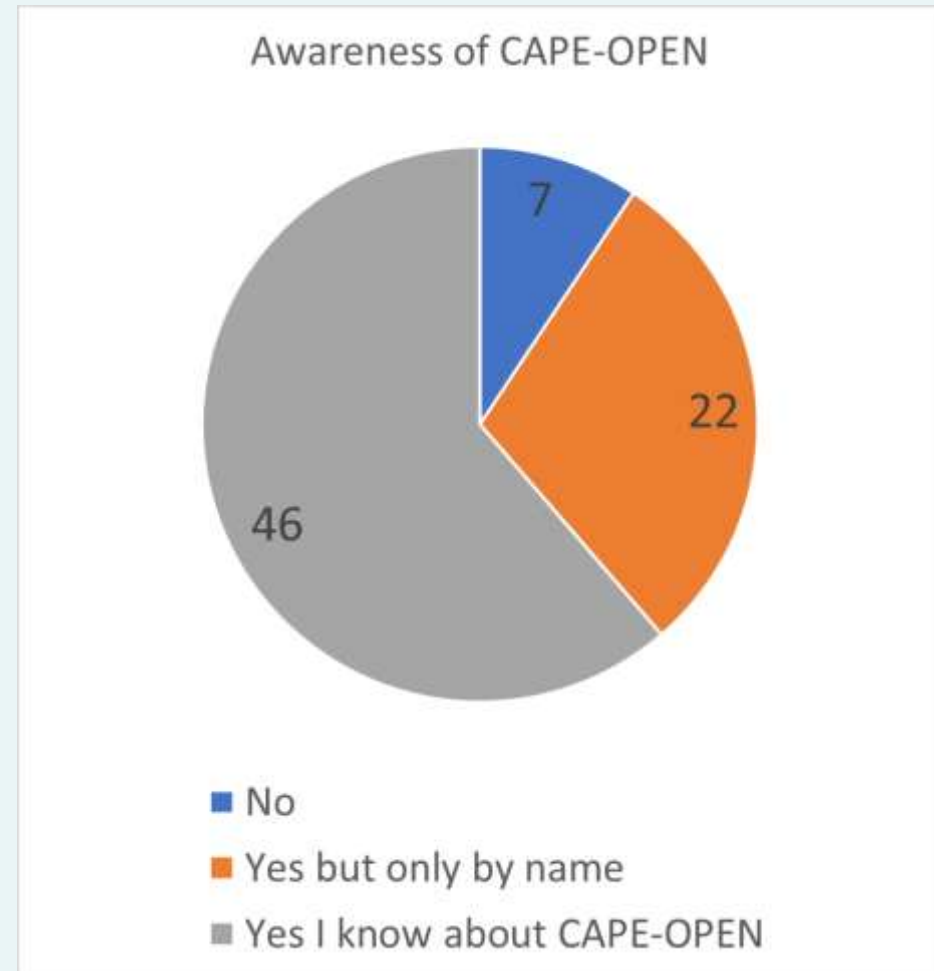


- ❑ A majority reports using same thermo over different PMEs
- ❑ Reported issues with thermodynamic consistency:
 - Difficult to diagnose
 - Quality Assurance of results is time consuming
 - Some users feel that total consistency not possible
 - Significant opportunity for improvement
 - Especially across discipline tools (e.g. reservoir/production/process)

Experience with CAPE-OPEN

CAPE-OPEN Survey - Feedback

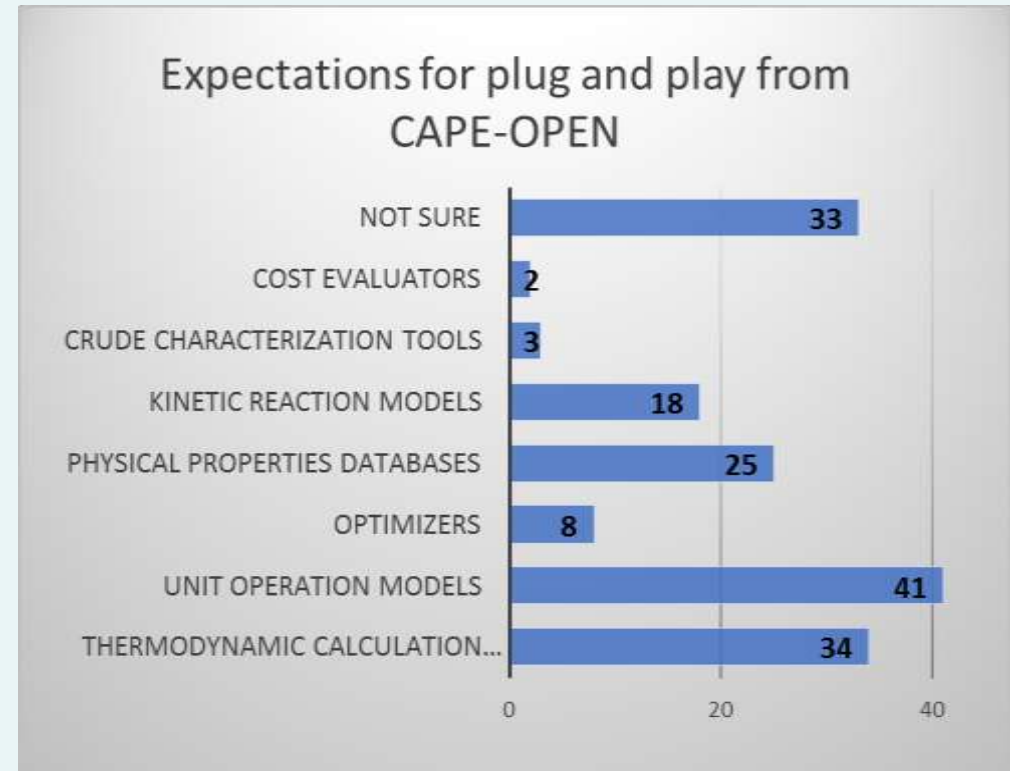
CAPE-OPEN is known to the majority of the respondents.



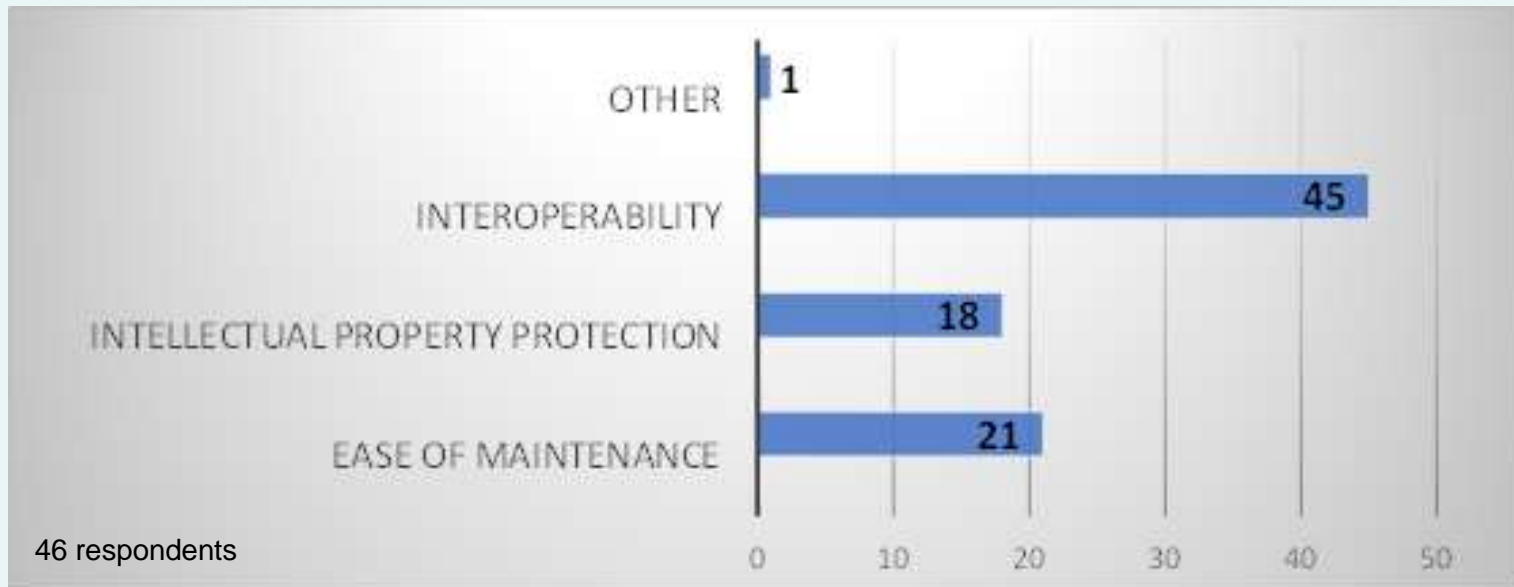
User Expectations from CAPE-OPEN

□ Interoperability needed for:

- Thermodynamics
- Unit operations
- Property databases
- Reactions



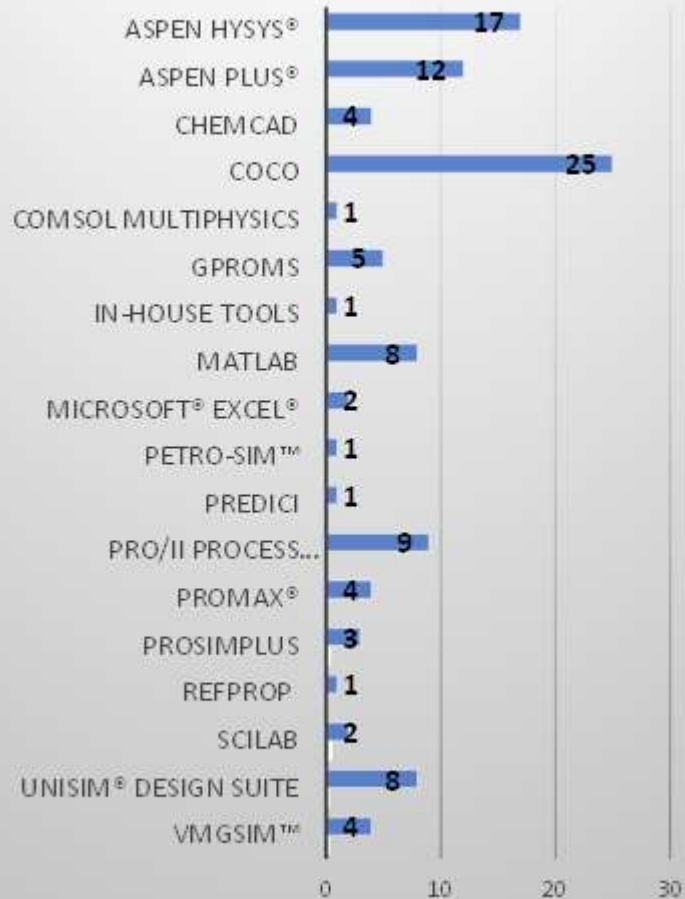
Expected benefits from CAPE-OPEN



- ❑ Strong emphasis on interoperability

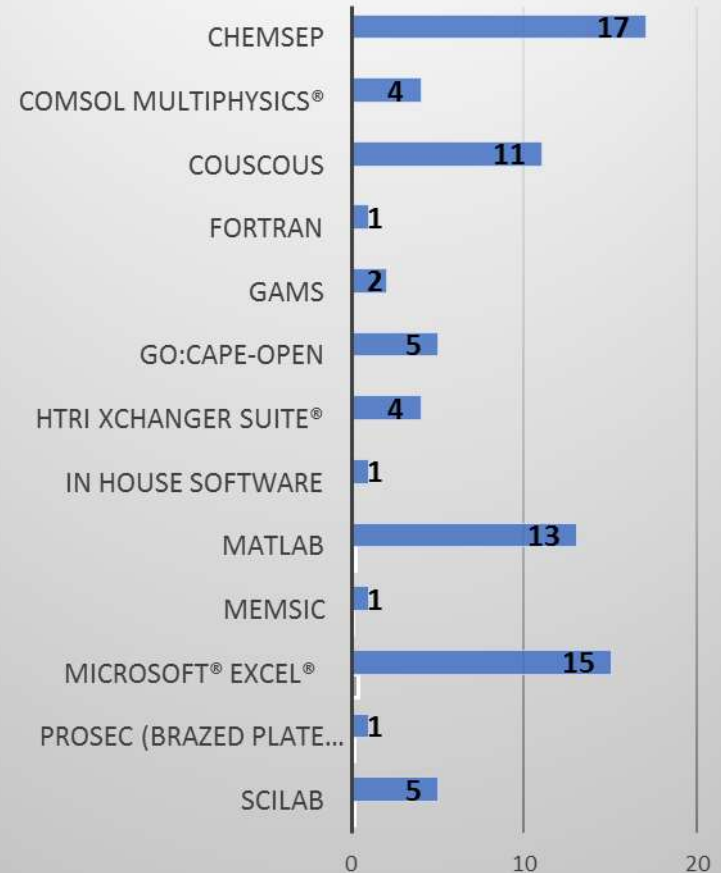
Using CAPE-OPEN compliant software

Environments



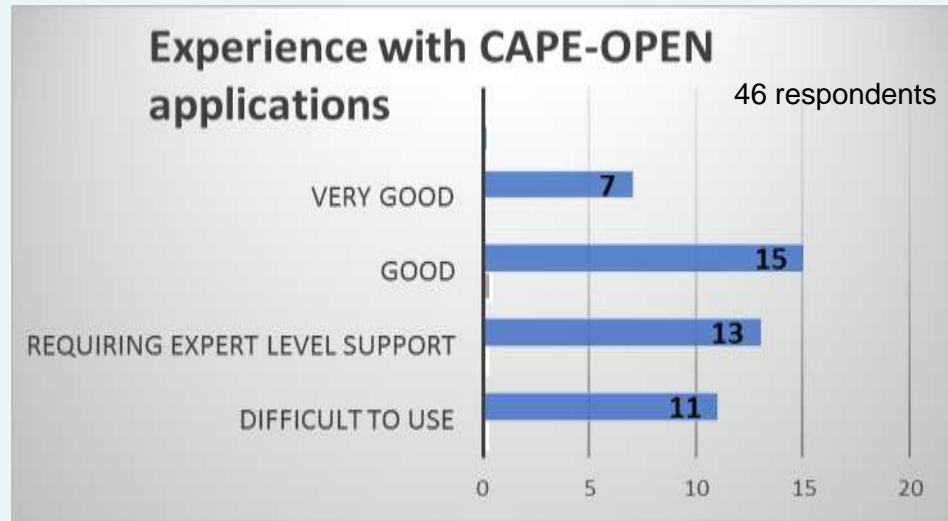
46 respondents

CO Units



46 respondents

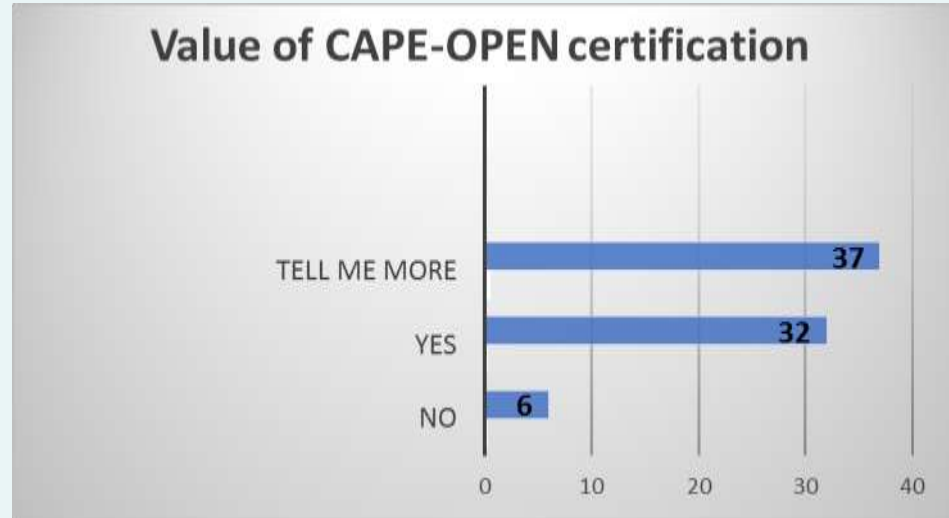
Ease of use



- ❑ 50% had a Good or Very Good experience with CAPE-OPEN:
 - Encouraging – the technology delivers what they expect
- ❑ 50% found CAPE-OPEN difficult to use or requiring expert-level support: need to lower the entrance level?
 - CO-LaN (and software vendors) needs to follow up on user's issues

Answers from end-users and developers!

Perceived benefit of certification

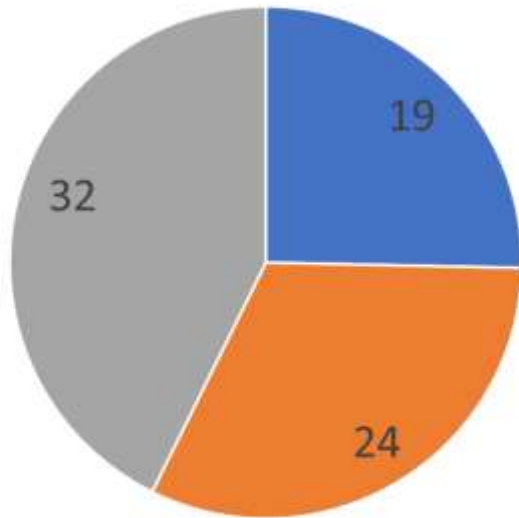


- ❑ Strong user support for Certification
- ❑ Significant proportion of respondents needing/wishing to know more

Interest in CO-LaN

CO-LaN and its missions

Do you know CO-LaN ?



- No
- Yes, but only by name
- Yes I understand what CO-LaN does

Understanding of CO-LaN missions

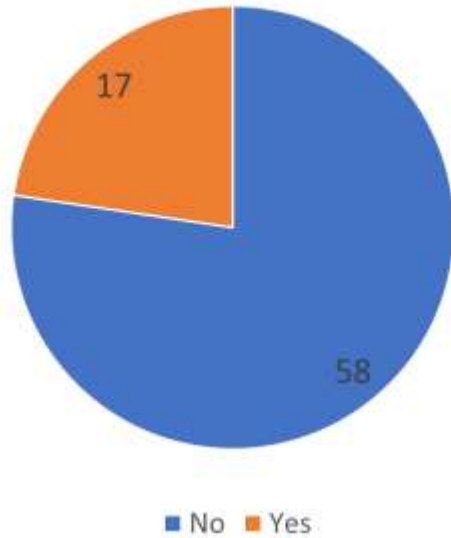


of 32 respondents

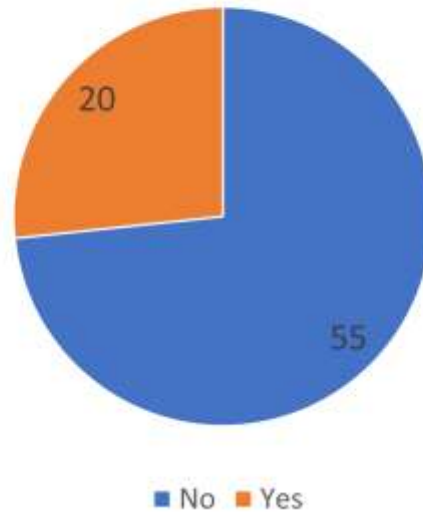
- The awareness around CO-LaN can be improved!
- Fairly good understanding of CO-LaN's missions

Interest in CO-LaN

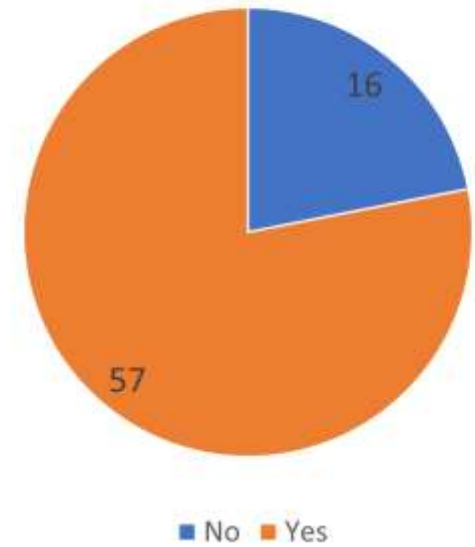
Respondents previous contact with CO-LaN



Awareness of ability to participate in CO-LaN annual meeting



Happy for further contact from CO-LaN



Majority of respondents are interested in CO-LaN and CAPE-OPEN

Conclusions

- ❑ The survey is not yet representative of end-users in the process simulation market.
- ❑ Respondents appear to have an affinity to CAPE-OPEN

Hence, the results should not be generalized.

Conclusions

- ❑ Awareness/visibility of CAPE-OPEN and CO-LaN
 - CAPE-OPEN is better known than CO-LaN.

- ❑ Mixed experience with CAPE-OPEN
 - CAPE-OPEN technology is mature
 - Ease to apply and implement: room for improvement

- ❑ Areas for CO-LaN & CAPE-OPEN to expand or strengthen
 - Strong user support & interest for Certification
 - High interest in interoperability of reactions, equipment & cost data.

- ❑ Identified interest and potential additional members
 - Many respondents show interest and want to be contacted by CO-LaN