



*Simulation for
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Cloud Based Workflow for Open-Source CFD & FEA Solver Technology

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Partner profiles



ProcEng Moser: SME CFD service provider:

- Broad range of offers, e.g.:
 - Spray tower, dryers
 - Multiphase flow
 - Pumps and ventilators
- Using OpenFOAM® for almost all services



DHCAE Tools: SME software and service provider:

- **Workflow tools for open-source solver technology:**
 - CAD model based meshing
 - Windows usage
 - Monitoring etc.
- **Simulation services for CFD/FEA:**
For customers: Smooth transition from services to inhouse solutions
- **Training, Support, Solver adaptations**



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Open-Source solver



Particular advantages of Open-source solver technology for cloud applications:

- No license costs (cost advantage, important for SMEs)
- No license server issues
- Developed on Linux -> simplified deployment
- OpenFOAM®: Designed for parallel processing

Why combining Open-source solver technology with proprietary tools:

- Simplifies life: No text file editing, detail keyword knowledge etc.
- Allows usage of CAD kernel based data
- CFD/FEA meshing
- Provides extension to user systems: Windows usage etc.
- Extension to other options: Combining CFD with FEA solver technology



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Use case overview



- Use case started January 2015
- Medium sized model helicopters
- Analysis with numerical methods:
Computational fluid dynamics and
structural analysis
- Use of open-source solver technology
- Need of cloud resources: Larger amount of
variants for fundamental database



Simulation software:

Local Desktop: Pre-Processing: DHCAE Tools' CastNet

Monitoring/Cloud setup and communication: DHCAE Tools' runGui

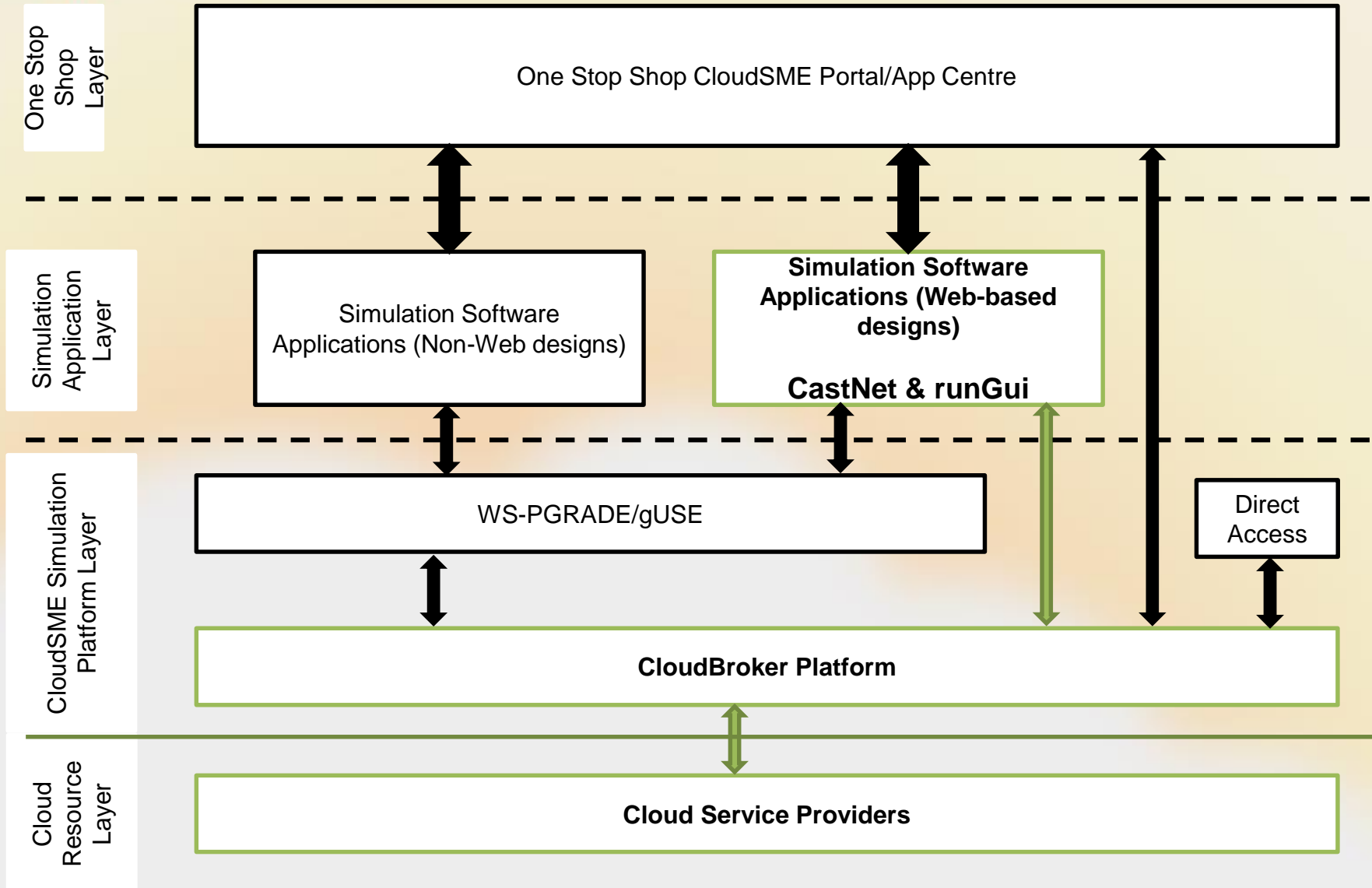
Cloud: Solver: OpenFOAM®/CFD toolbox – CalculiX: Structural analysis

Local Desktop: Post-Processing: ParaView



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Use case implementation: Software deployment





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Achievements and results: Simulation software

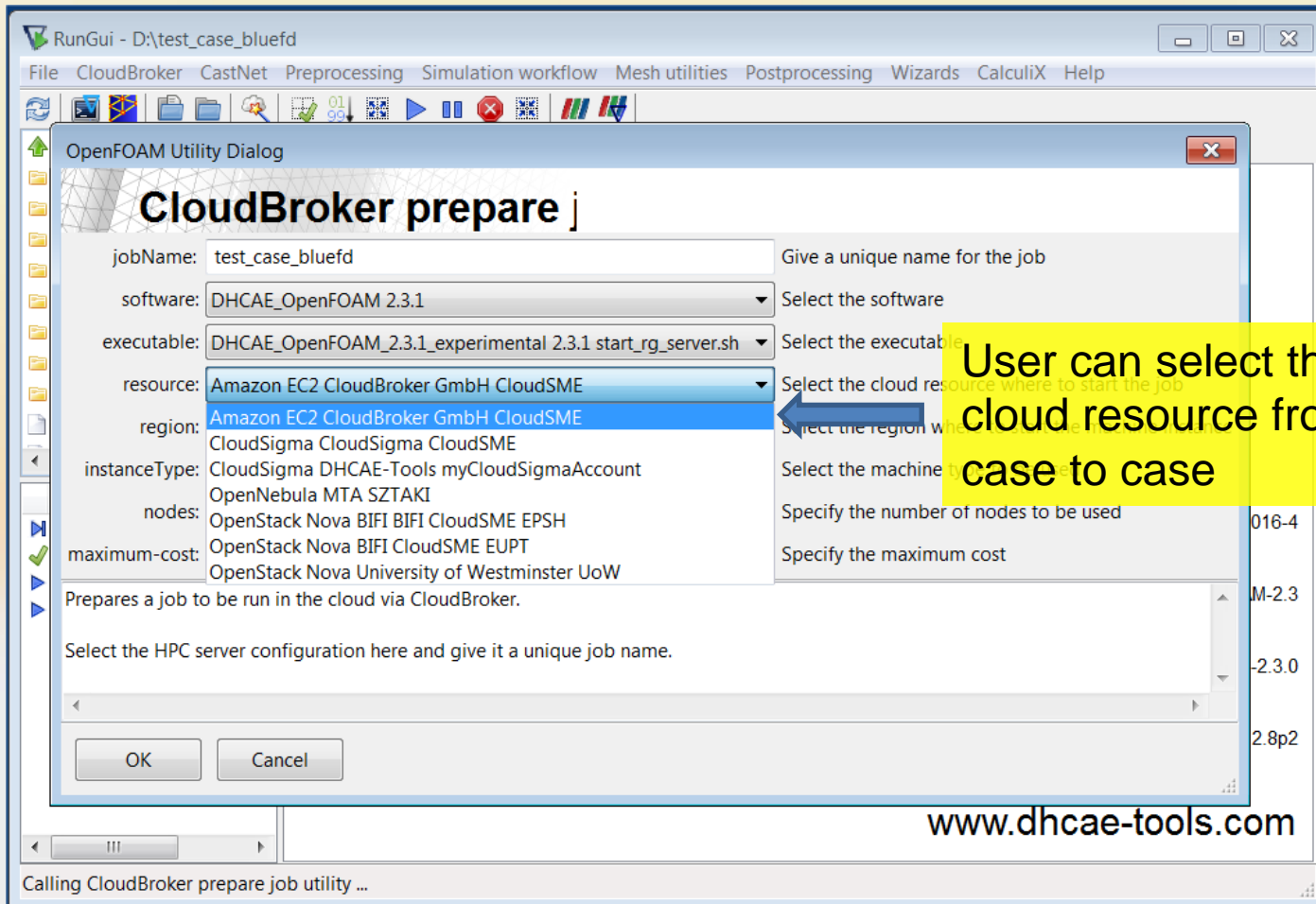


Software implementation done so far:

- Extensions for the monitoring tool “runGui”
 - REST API from CloudBroker: Cloud instance selection, job creation, file transfer etc.
 - Scripts modifications for batch-style workflow of the cloud
- Installation scripts for deployment generation
- Performance tests:
 - Amazon Cloud (via CloudBroker Platform), single node/ multiple nodes
 - CloudSigma platform (via CloudSigma web interface and CloudBroker)

Software implementation completed:

Run-ready environment for Windows and Linux using OpenFOAM[®]/CalculiX in the cloud based on DHCAE Tools' GUI environment





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Advantage for user



RunGui - D:\test_case_bluefd

File CloudBroker CastNet Preprocessing Simulation workflow Mesh utilities Postprocessing Wizards CalculiX Help

OpenFOAM Utility Dialog

CloudBroker prepare]

jobName: test_case_bluefd Give a unique name for the job

software: DHCAE_OpenFOAM 2.3.1 Select the software

executable: DHCAE_OpenFOAM_2.3.1_experimental 2.3.1 start_rg_server.sh Select the executable

resource: Amazon EC2 CloudBroker GmbH CloudSME Select the cloud resource where to start the job

region: US Standard Select the region where to start the machine instance

instanceType: 8xlarge 244.0GB : b29cdf28-6295-48d7-b9bc-... **User can select the cloud instance type**

nodes: 1 1

maximum-cost: 10.0 1.0 Specify the maximum cost

Prepares a job to be run in the cloud via CloudBroker.

Select the HPC server configuration here and give it a unique job name.

OK Cancel

Calling CloudBroker prepare job utility ...



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Advantage for user/ ISV



End User benefit:

- **Flexible usage of cloud resources from case to case fits into different scenarios:**
 1. Scenario: Needs: Results direct, interactive case monitoring (kill if diverges)
 2. Scenario: Needs: Case can run overnight, best price
 3. Scenario: Needs: High resources-> HPC center
- **Access to different cloud resources from a single partner (e.g. ISV)**

ISV benefit:

- **Only a single deployment is needed**
CloudBroker/CloudSME UG takes care of the rest if new resources are added
- **Simplifies integration into ISV's software**
Access to different resources by a single API
- **Flexible options for business models and extending business**
- **Allows fast deployment and software integration**

Demonstration video





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Impacts for DHCAE



DHCAE Tools customers benefit from the CloudSME project:

- Customers can use “unlimited” computational resources in the cloud
- System administration is significantly simplified on the users’ site:
 - No OpenFOAM® installation and administration necessary
 - No Linux system necessary on users’ site to have optimal performance
 - Lower entry barrier into advanced CFD
- On demand cloud usage fits perfectly into the flexible usage concept of DHCAE Tools’ software extension for open-source solver
 - No workflow enforced: Small jobs or confidential data -> local machine(s)
Larger jobs/case variants -> cloud

Impact:

- Significantly more customers
- Extending services for existing customers
- Reduced effort for installation guidance etc.



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Planned works: simulation software



DHCAE Tools:

- Implementation almost completed
- Slight adaptations according the feedback of ProcEng Moser
- Use case support
- Support for CloudBroker for including HPC Stuttgart
- Promotion activities:
 - ISC Cloud & Big Data Conference: Presentation: September 2015, Frankfurt
 - OpenFOAM[®] Conference 2015: Booth: October 2015, Stuttgart
 - NAFEMS-CFD-Conference: Booth/presentation: December 2015, Munich

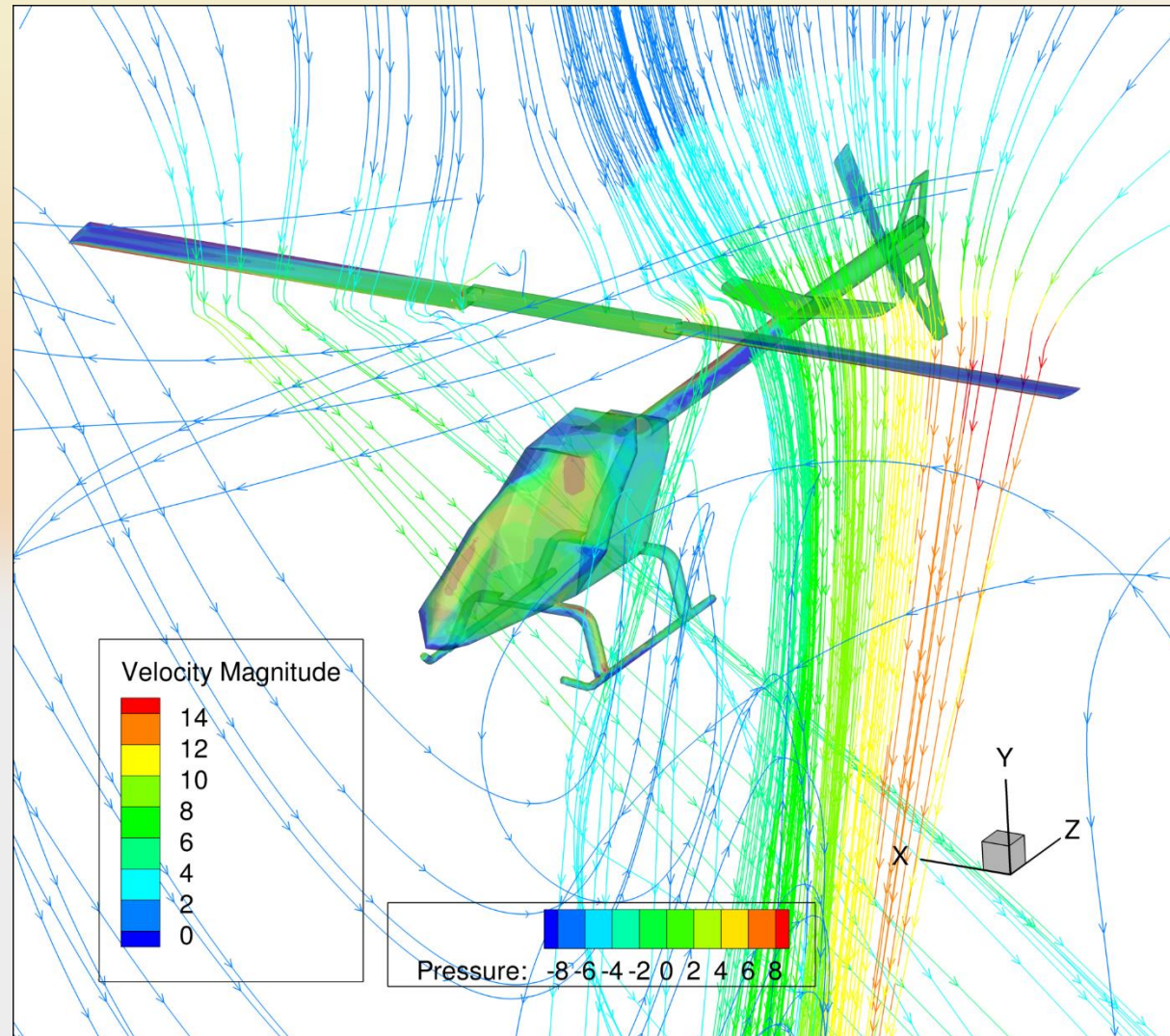


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Achievements and results: Helicopter simulation



- First helicopter simulations already completed on Amazon cloud
- Real model size (7,5 -20 Mio cells) for typical CFD applications





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Impacts ProcEng Moser



Impact and benefit ProcEng Moser

- Extension of business line “Technical configuration and optimisation of model helicopters”: From 10% to 25% expected.
- With the development of a market for “Unmanned aerial vehicle systems and drones”, a new business area can be opened up.
- Better understanding of the complex fluid flows, and interactions between fluid and moving rotors is deepened.



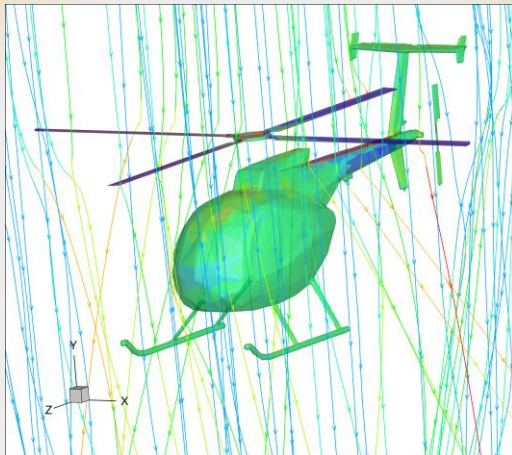
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Planned works: modelling helicopters



ProcEng Moser GmbH

- More case variants are actually running
- Comparison with measurements
- Semester thesis starting now till end of December
- Structural analysis





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Next requirements



Post-processing option in the cloud

- Transient cases 1-2 order of magnitude higher data volume
- Download times may become extremely high
- Larger models (high number of cells): User still needs powerful machine locally for visualisation

Improved performance at cloud providers for CFD

- Faster interconnects (InfiniBand)

Higher flexibility in cost models at cloud providers

- CFD jobs may run several days or weeks
- Volume discounts



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Thank you for your attention!

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