
7th Annual OpenModelica Workshop

Feb 2, 2015

Workshop Opening

OpenModelica – Status and Directions

Peter Fritzson

To All Participants!

**Very Welcome to this
Seventh Annual OpenModelica Workshop!**

Goals for the OpenModelica Effort

- Comprehensive **modeling, simulation and systems engineering** environment for research, teaching, and industrial usage
- **Open-source** for both **industrial** and **academic** usage
- Invitation for **open-source cooperation** around OpenModelica, tools, and applications
- **Increased** emphasis on **industrial** usage

Two Technical Milestones Achieved 2014

- Update to a **new** OpenModelica Compiler frontend **flattening architecture**
 - Achieved in OM 1.9.1 release, October 2015
 - Needed to handle some difficult cases of flattening, e.g. for the Fluid library
 - Work on this during approximately 2 years
- **Deployment of bootstrapped** OpenModelica Compiler
 - Achieved in November 2014. All development switched to this compiler
 - Bootstrapping = OMC compiler used to develop and compile itself
 - Advantages in terms of better programmability, maintenance, debugging and performance analysis, modularity and current/future performance increases
 - OpenModelica 1.9.2, February 2015, first release based on this platform
 - Work on this during approximately 9 years, 2005 to 2014

Main Releases 2014 and January 2015

- **OpenModelica 1.9.1 final release** (October 25, 2014)
 - Release with **new** OM Compiler flattening architecture, giving improved coverage of the Fluid library and some difficult models in other libraries.
 - Generally improved compilation and simulation library coverage
 - The last release based on the old MetaModelica 1.0 (MMC) compiler
- **OpenModelica 1.9.2 beta1 release** (January 31, 2015)
 - The first release based on the **bootstrapped** OpenModelica compiler
 - Further improved **support** for a number of **libraries** including MSL 3.2.1, ModelicaTest 3.2.1, ThermoSysPro, ThermoPower, Buildings, and more
 - Further enhanced compiler scalability, speed, and memory
 - Significantly **improved interactive speed, factor 3-5**, of **OMEdit** graphical connection editor, made possible by the bootstrapped compiler direct linking as a DLL to OMEdit, avoiding most previous Corba and text message conversion overhead
 - Further improved ease of use of graphical user interface in OMEdit

Improved Simulation Coverage in OpenModelica 1.9.2 compared to OpenModelica 1.9.1

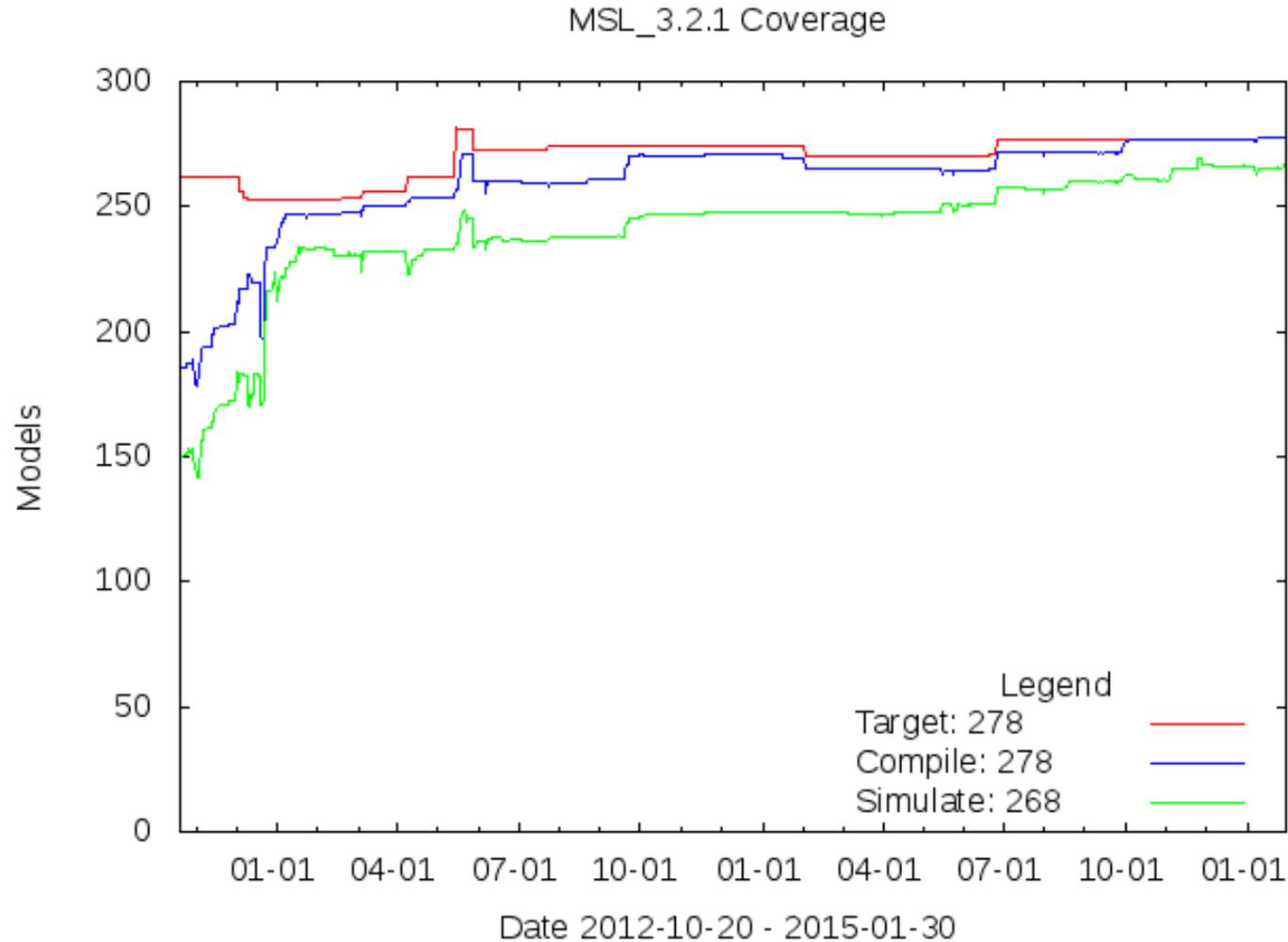
New release, OpenModelica 1.9.2, Beta1 available January 31, 2015
Final version of OpenModelica 1.9.2 planned 2nd week of February 2015.

Further improved OpenModelica 1.9.2 compilation and simulation coverage:

- MSL 3.2.1 100% compilation, 97% simulation (3% increase)
- MSL Trunk 99% compilation (1% increase), 93% simulation (3% increase)
- ModelicaTest 3.2.1 99% compilation (2% increase), 95% simulation (6% increase)
- ThermoSysPro 100% compilation, 80% simulation (17% increase)
- ThermoPower 97% compilation (5% increase), 85% simulation (5% increase)
- Buildings 80% compilation (1% increase), 73% simulation (1% increase)
- ...

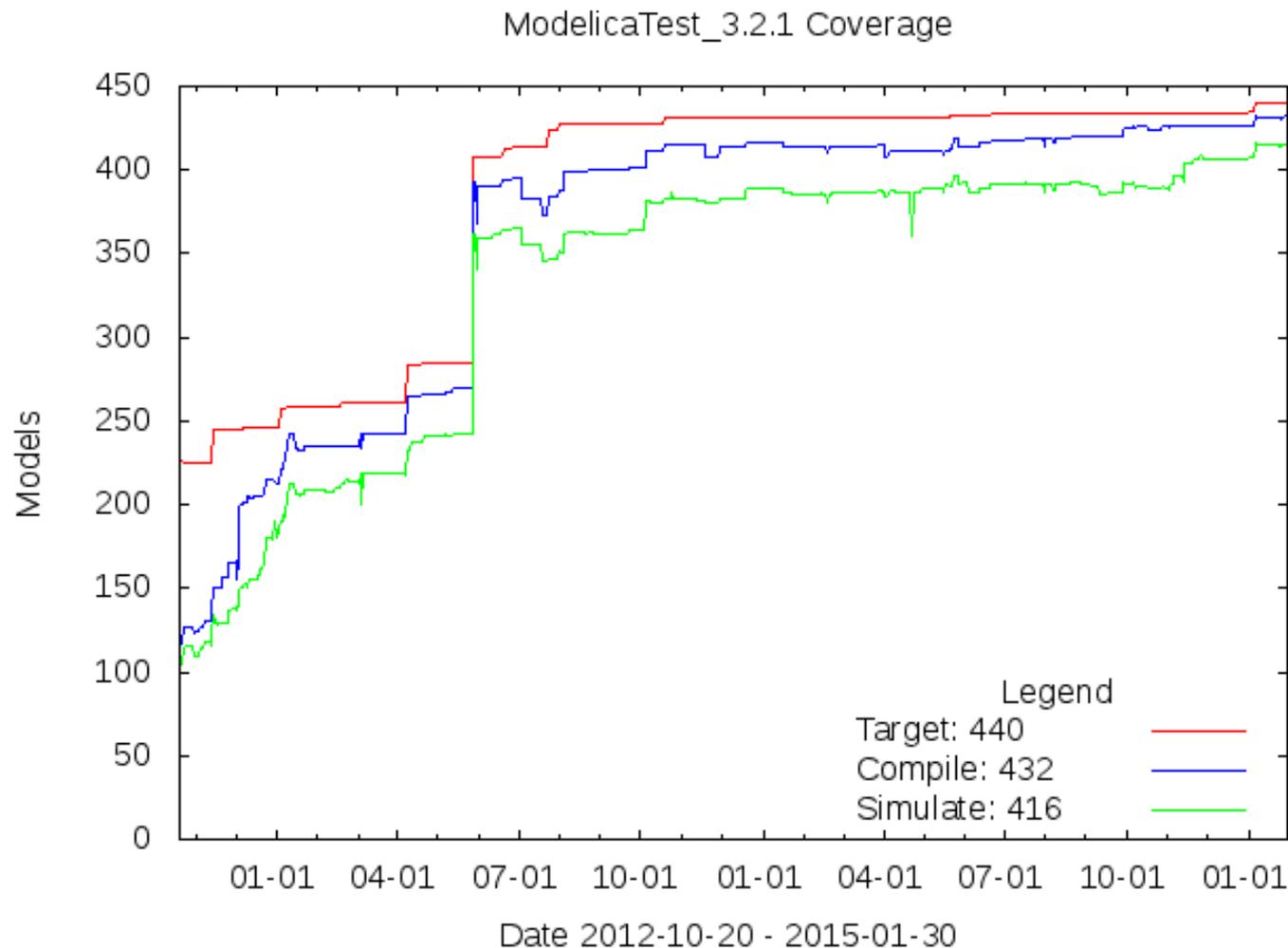
Improved MSL 3.2.1 Library Coverage

100% compilation, 97% simulation (3% increase)



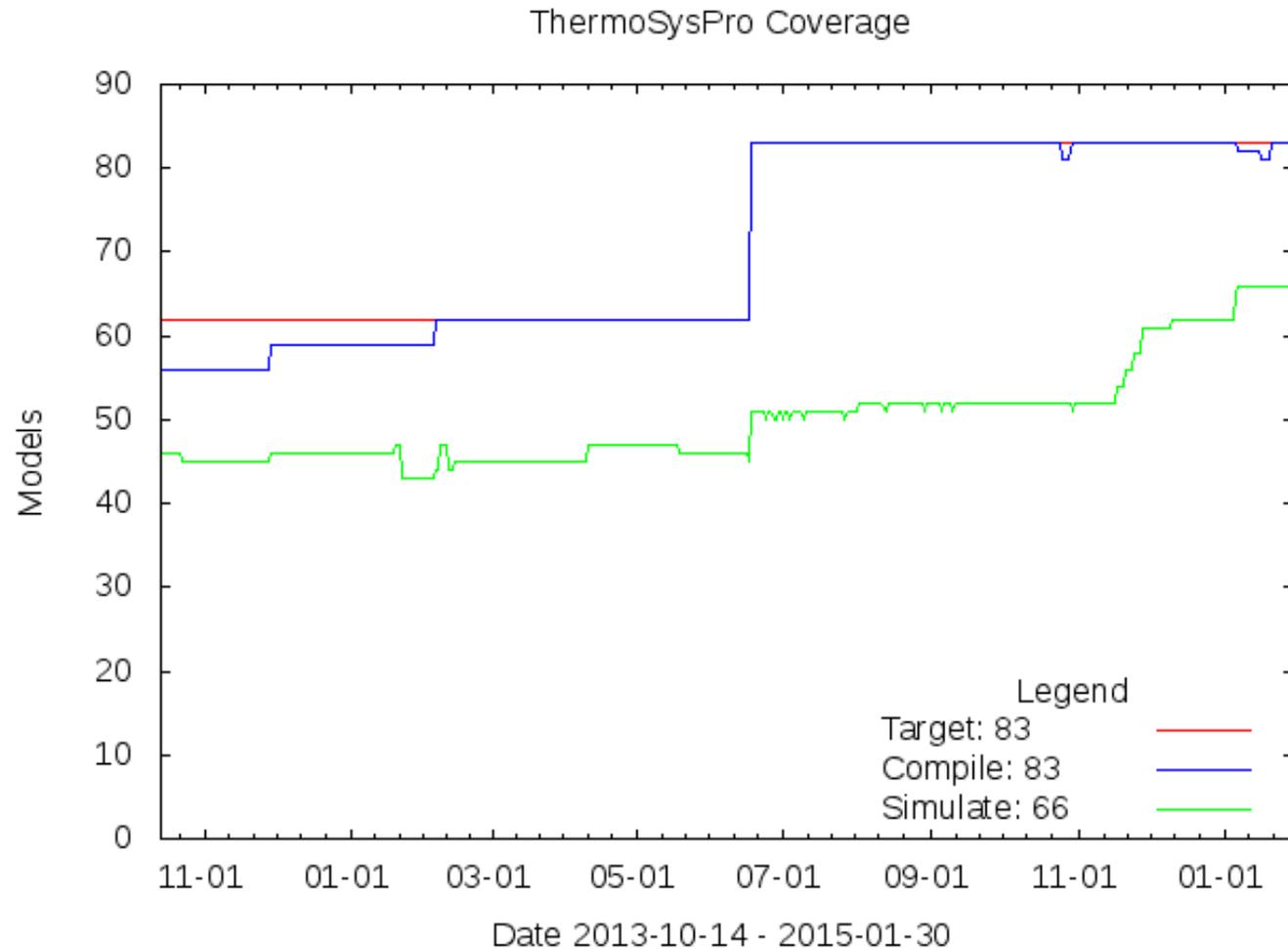
Improved ModelicaTest 3.2.1 Library Coverage

99% compilation (2% increase), 95% simulation (6% increase)



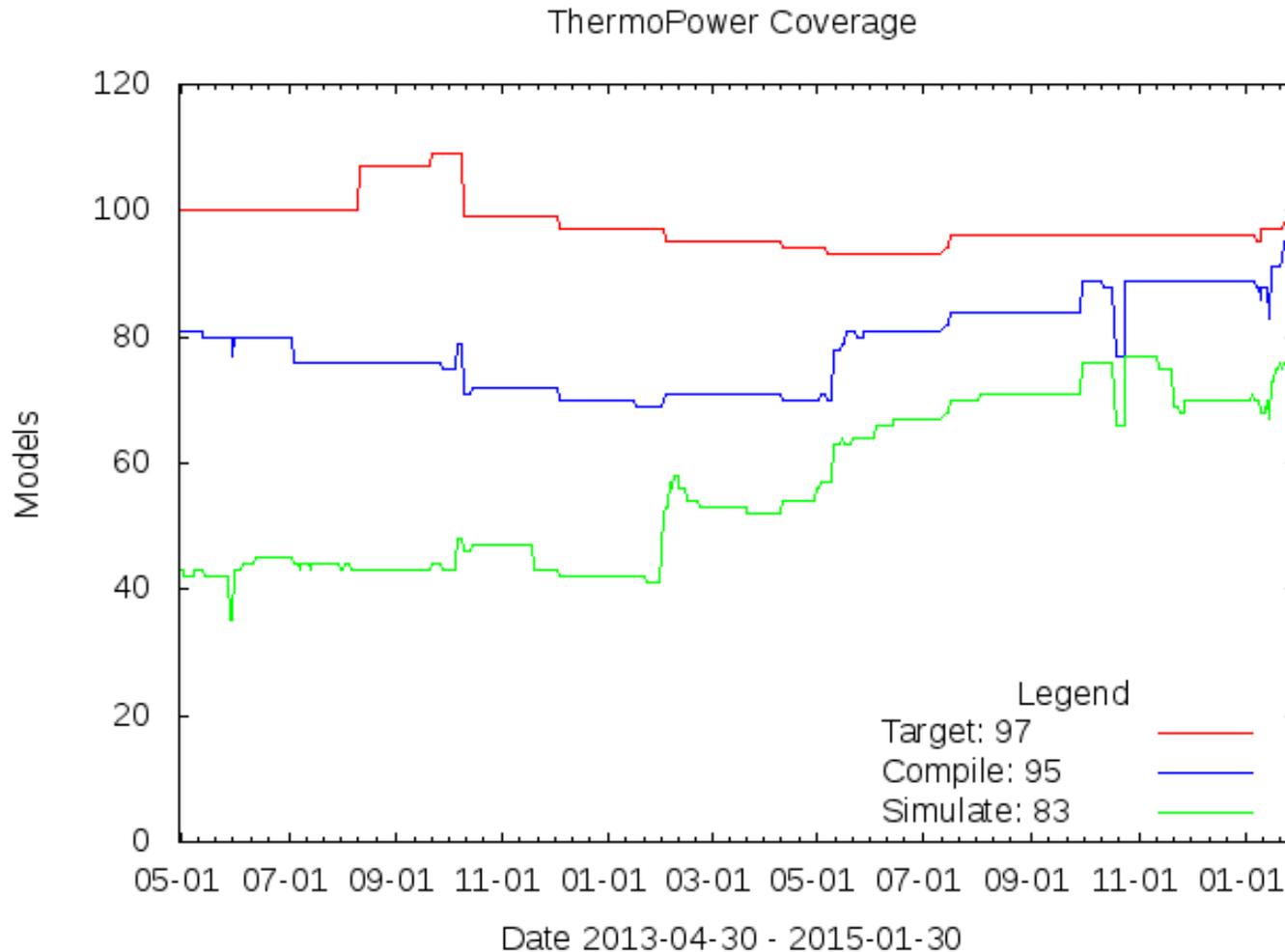
Improved ThermoSysPro Library Coverage

100% compilation, 80% simulation (17% increase)



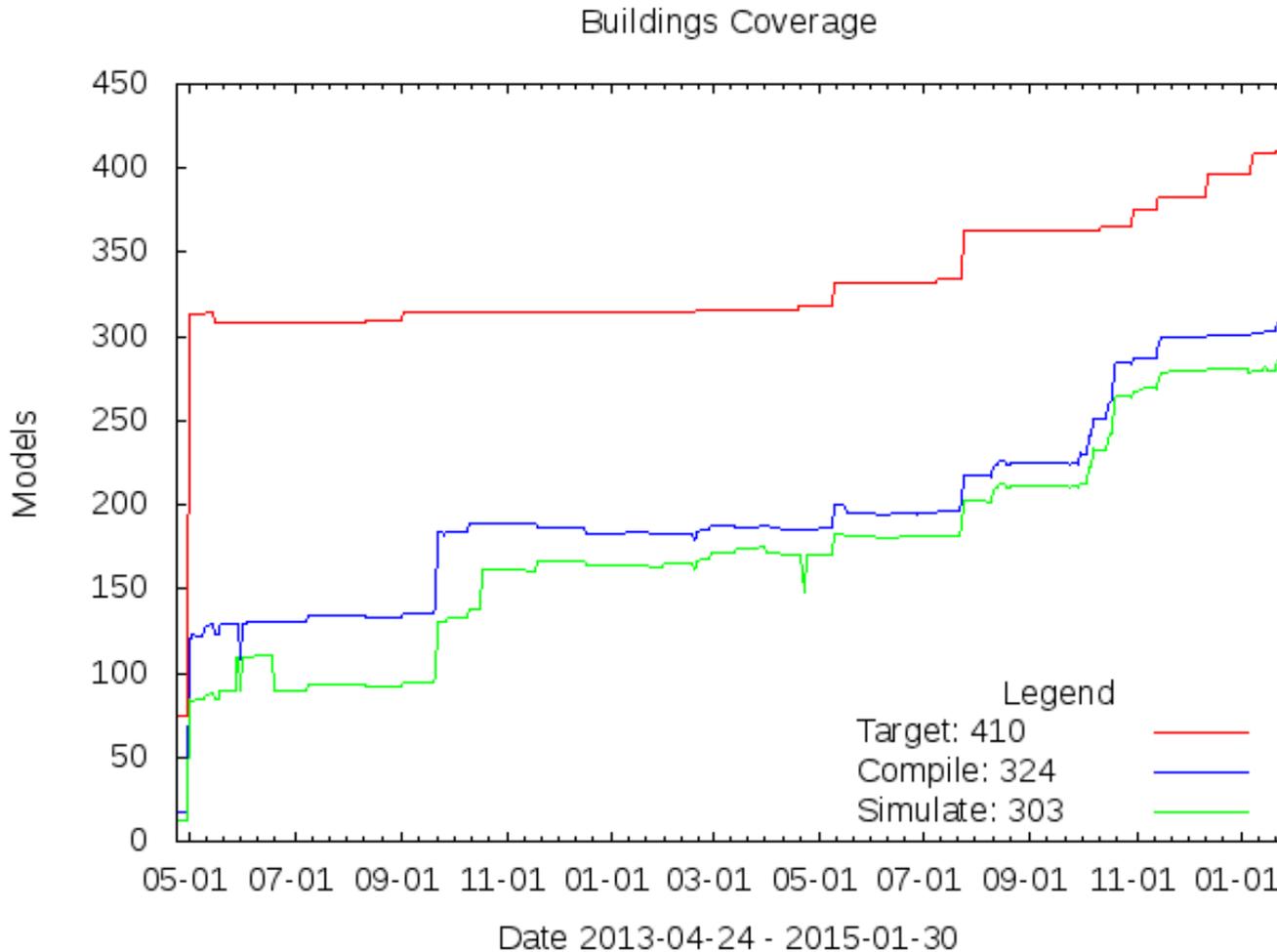
Improved ThermoPower Library Coverage

97% compilation (5% increase), 85% simulation (5% increase)



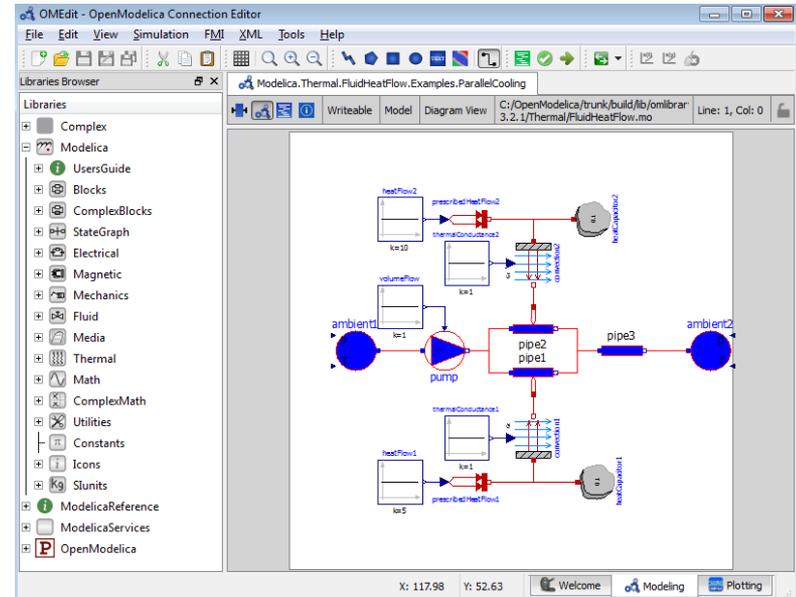
Improved Buildings Library Coverage

80% compilation (1% increase), 73% simulation (1% increase)



In OpenModelica 1.9.2 – Further Enhanced OMEdit Including Improved Ease of Use

- A factor of 3-5 **faster** interactive performance
- Enhanced simulation **setup**, e.g. including better support for integration methods and dassl options.
- Support for running **multiple simultaneous simulations**
- Improved handling of **modifiers**.
- **Re-simulate** with changed/edited options, including **history** support
- More **user friendly**, e.g. by improved connection line drawing, added snap to grid for icons, conversion of icons from PNG to SVG, etc.



FMI in OpenModelica

- Model Exchange implemented (FMI 1.0 and FMI 2.0)
- FMI 2.0 Co-simulation is under development. A prototype of FMI 2.0 including tool co-simulation is available
- Ongoing work to support full FMI 2.0
- (Demos and exercises in tutorial tomorrow tuesday)

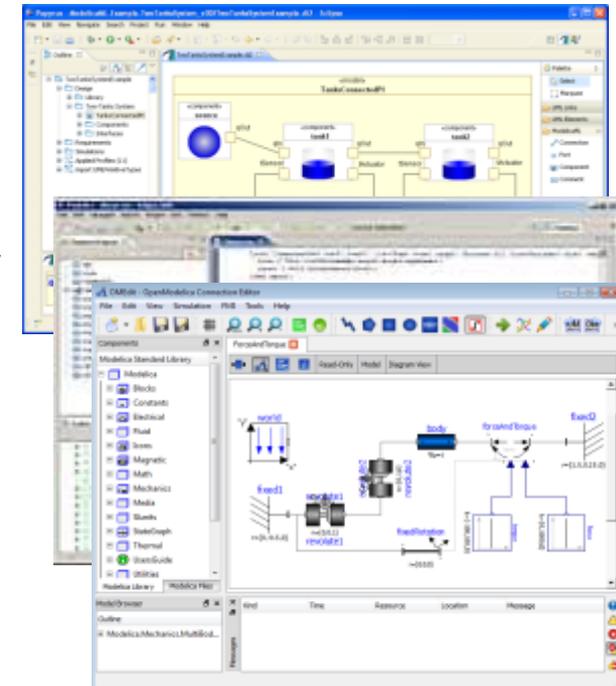
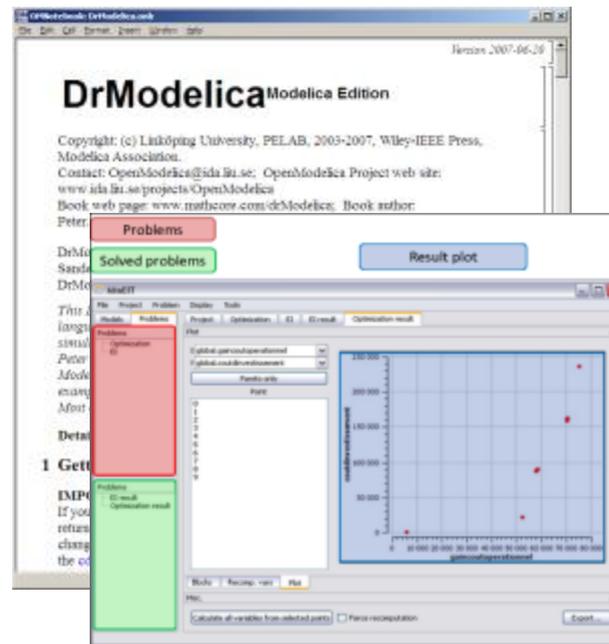
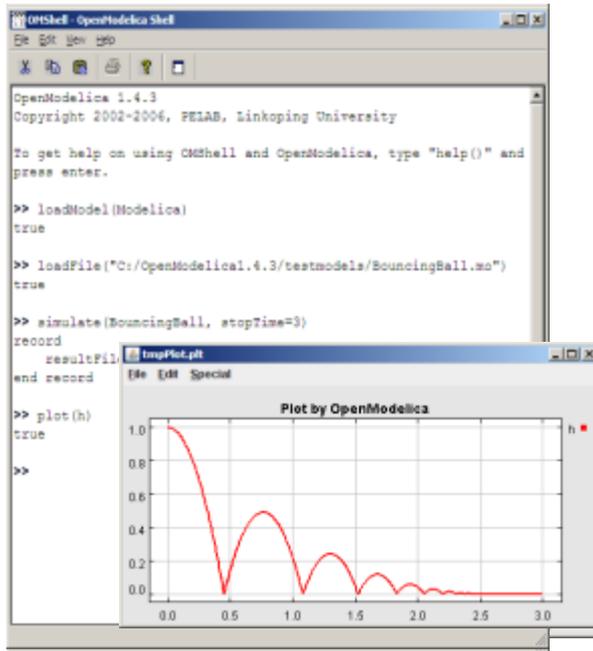
OpenModelica – Outlook for 2015

- Whole 2015. Continued **high priority** on better coverage for Modelica **libraries** including MSL 3.2.1, ModelicaTest 3.2.1, PetriNet, Buildings, PowerSystems, OpenHydraulics, ThermoPower, ThermoSysPro, etc.
- Whole 2015. Further improved compiler and simulation **performance** and **coverage**
- Whole 2015. Development of more **Industrial Use Cases**
- Spring 2015. OM Version 1.9.3. **GUI** support for **replaceable** in libraries
- Spring 2015. Complete the **FMI 2.0** co-simulation implementation
- Spring 2015. Partial support for Modelica 3.3 **clock-based synchronous** and **state machine** features
- End of 2015. Almost complete support for Modelica 3.3 clock-based synchronous and state machine features

The OpenModelica Open Source Environment

www.openmodelica.org

- **Advanced Interactive Modelica compiler (OMC)**
 - Supports most of the Modelica Language
 - **Modelica and Python scripting**
- **Basic environment for creating models**
 - **OMShell** – an interactive command handler
 - **OMNotebook** – a literate programming notebook
 - **MDT** – an advanced textual environment in Eclipse
- **OMEdit** graphic Editor
- **OMDebugger** for equations
- **OMOptim** optimization tool
- **OM Dynamic optimizer** collocation
- **ModelicaML** UML Profile
- **MetaModelica** extension
- **ParModelica** extension

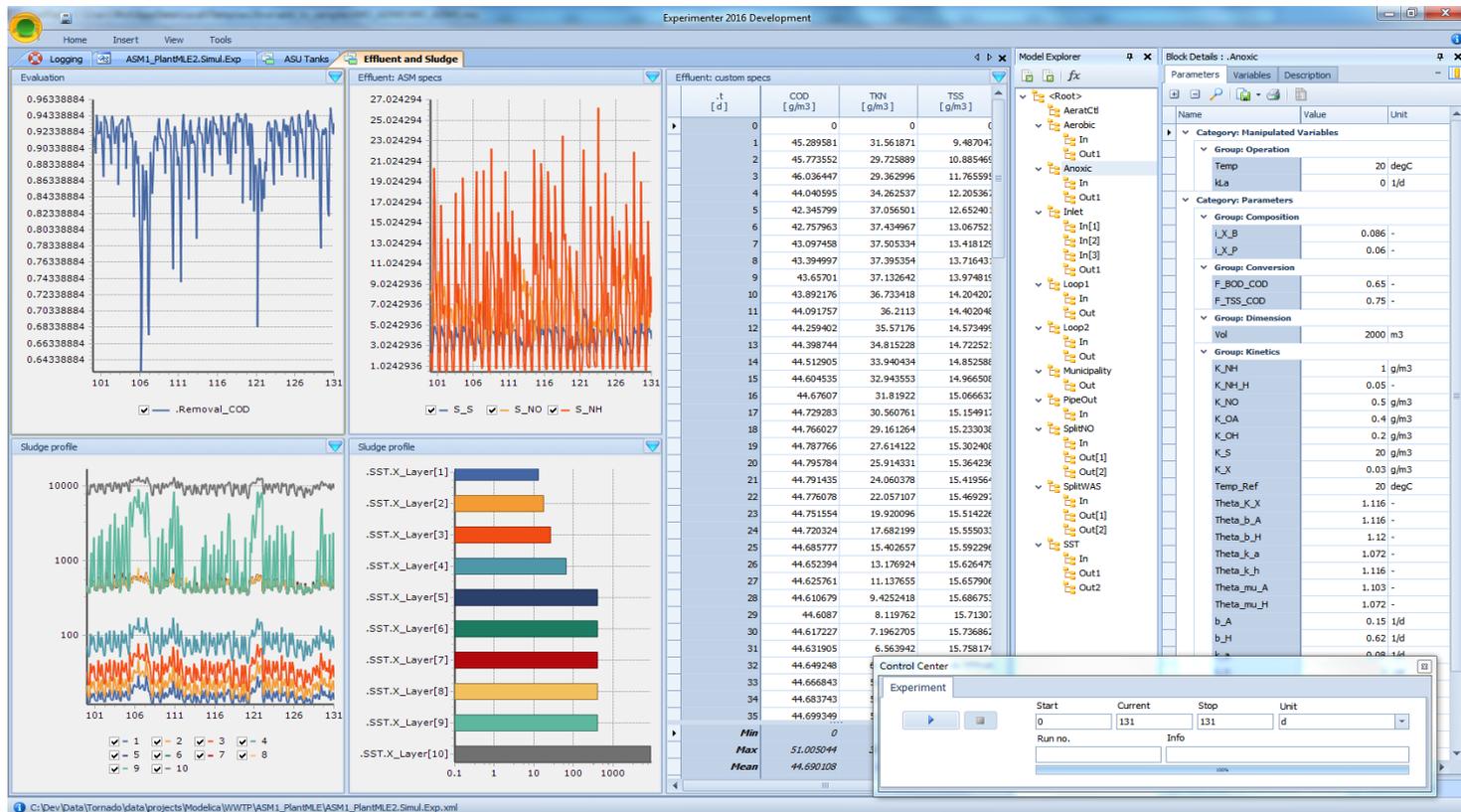


Current Main Industrial OpenModelica Usage (not including research usage)

- Wolfram-MathCore, OEM usage of OM compiler frontend in Wolfram SystemModeler product
- DHI, OEM usage of OM compiler frontend in DHI product
- Bosch-Rexroth, inhouse product usage for Modelica model import and simulation
- EDF – ThermoSysPro Library and Applications
- STEAG Energy Services – Process applications
- New Industrial use case: ABB OPTIMAX – Process control

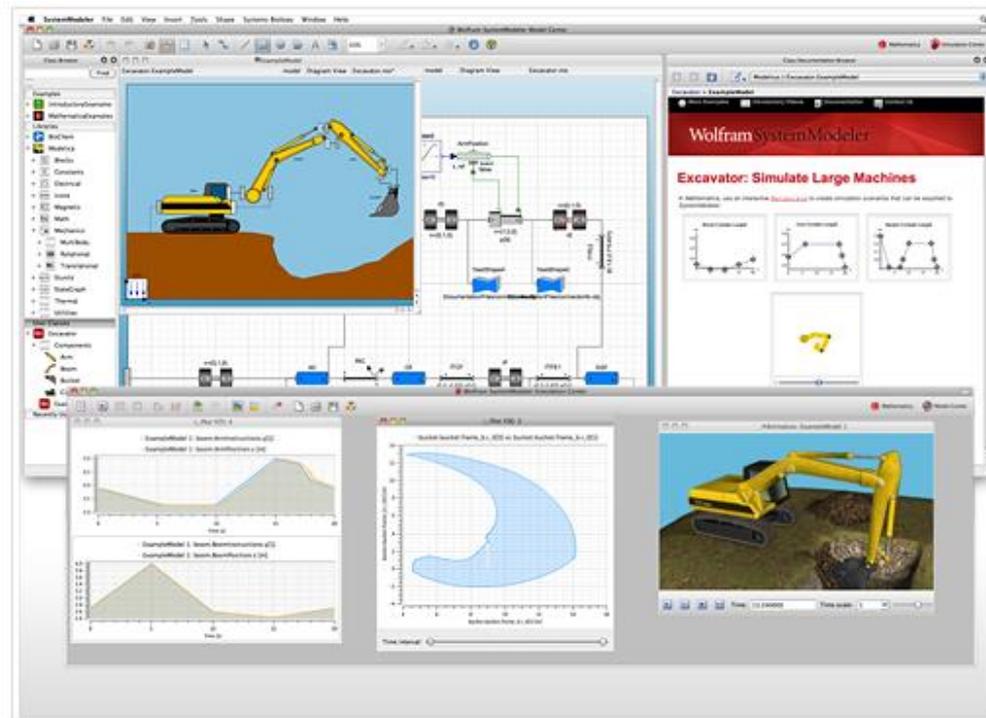
MIKE by DHI, www.mikebydhi.com, WEST Water Quality Product

- The MIKE by DHI, www.mikebydhi.com, WEST Water Quality modeling and simulation environment includes a large part of the OpenModelica compiler using the OEM license.



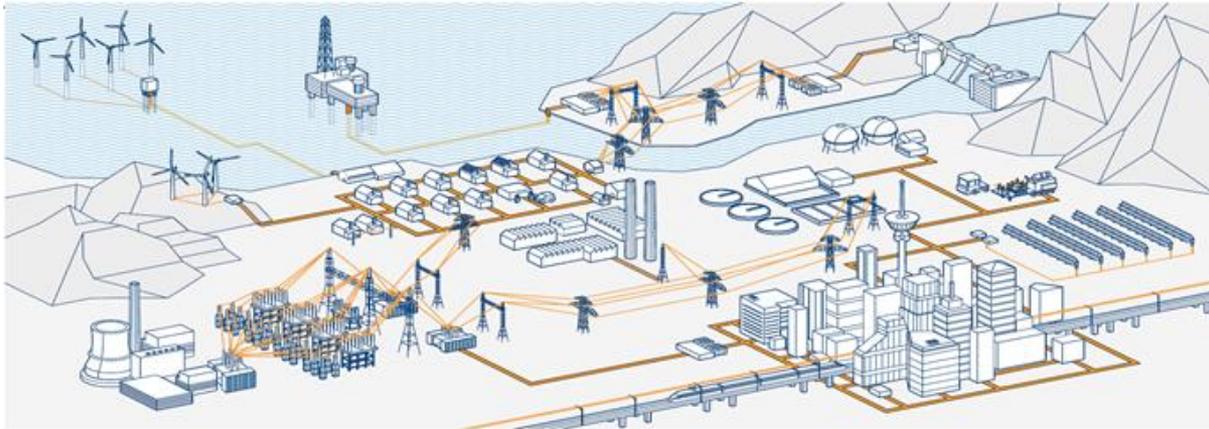
Wolfram SystemModeler Industrial Product – from Wolfram MathCore

- Wolfram SystemModeler product includes the OpenModelica compiler frontend
- Wolfram /SystemModeler/ is modeling and simulation environment using versatile symbolic components and computation to drive design efficiency and innovation. It integrates with the Wolfram technology platform to enable modeling, simulation, and analysis (of many types).



New OpenModelica Industrial Use Case: ABB Industry Use of OpenModelica FMI 2.0 and Debugger

- ABB OPTIMAX® provides advanced model based control products for power generation and water utilities



- ABB: *“ABB uses several compatible Modelica tools, including OpenModelica, depending on specific application needs.”*
- ABB: *“OpenModelica provides outstanding debugging features that help to save a lot of time during model development.”*

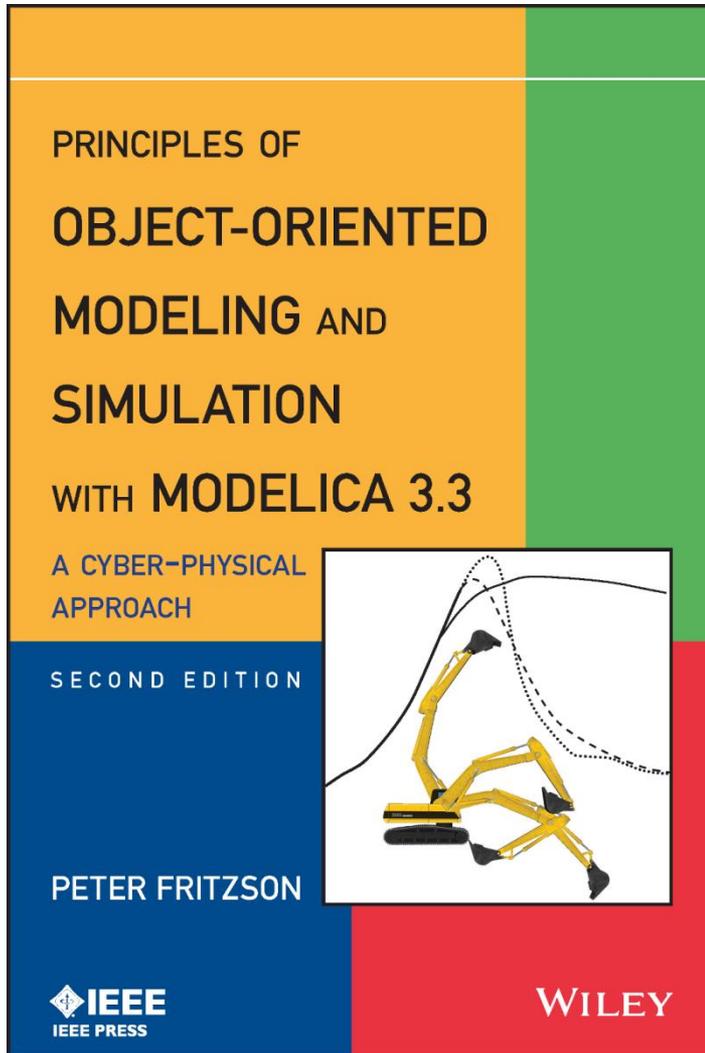
The Open Source Modelica Consortium

Purpose of the Consortium

- The Open Source Modelica Consortium, created the 4th of December 2007 in Linköping, Sweden, in the following called OSMC, is a non-profit, non-governmental organization with the aim of developing and promoting the development and usage of the **OpenModelica open source implementation of the Modelica computer language** (also named Modelica modeling language) and **OpenModelica associated open-source tools and libraries**, collectively named the OpenModelica Environment, in the following referred to as OpenModelica.
- OpenModelica is **available for commercial and non-commercial usage under the conditions of the OSMC Public License**. It is the aim of OSMC, within the limitations of its available resources, to provide **support and maintenance of OpenModelica**, to support its publication on the web, and to **coordinate** contributions to OpenModelica.

New Big Modelica Book, 2014

(Peter Fritzson's own release)



Peter Fritzson Principles of Object Oriented Modeling and Simulation with Modelica 3.3 A Cyber-Physical Approach

Can be ordered from Wiley or Amazon

Wiley-IEEE Press, 2014, 1250 pages

- OpenModelica
 - www.openmodelica.org

Open Source Modelica Consortium

Originally Created Dec 4, 2007

7 Founding Organizational Members

- Bosch-Rexroth AG, Germany
- Equa Simulation AB, Sweden
- TLK Thermo, Germany
- VTT, Finland
- Linköping University, Sweden
- Hamburg University of Technology/TuTech, Institute of Thermo-Fluid Dynamics, Germany
- Technical University of Braunschweig, the Institut of Thermodynamik, Germany

OSMC – Open Source Modelica Consortium

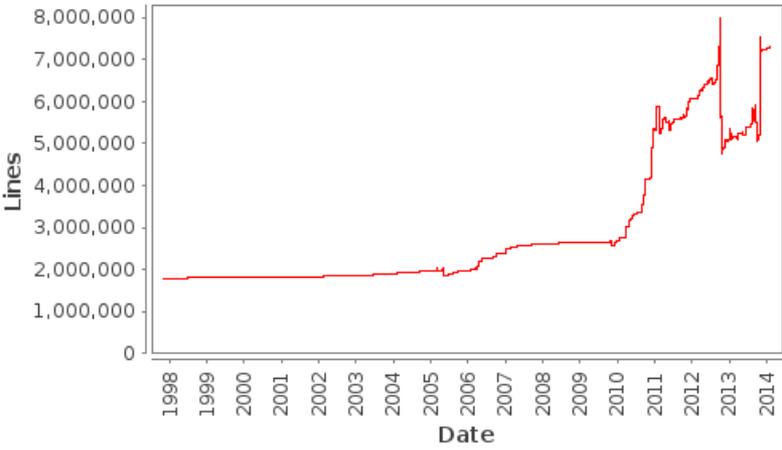
Founded Dec 4, 2007

Open-source community services

- Website and Support Forum
- Version-controlled source base
- Bug database
- Development courses
- www.openmodelica.org

Code Statistics

/trunk: Lines of Code



OSMC 42 Organizational Members, Feb 2015

(initially 7 members, 2007)

Companies and Institutes (20 members)

- Bosch Rexroth AG, Germany
- Siemens PLM, California, USA
- Siemens Turbo Machinery AB, Sweden
- CDAC Centre for Advanced Compu, Kerala, India
- Creative Connections, Prague, Czech Republic
- DHI, Aarhus, Denmark
- EDF, Paris, France
- Equa Simulation AB, Sweden
- Fraunhofer IWES, Bremerhaven, Germany
- Frontway AB, Sweden
- IFP, Paris, France
- ISID Dentsu, Tokyo, Japan
- ITI, Dresden, Germany
- Maplesoft, Canada
- RTE, France
- TLK Thermo, Germany
- Sozhou Tongyuan Software and Control, China
- VTI, Linköping, Sweden
- VTT, Finland
- Wolfram MathCore, Sweden

Universities (22 members)

- Austrian Inst Tech, Energy Dept, Vienna, Austria
- TU Berlin, Inst. UEBB, Germany
- FH Bielefeld, Bielefeld, Germany
- TU Braunschweig, Germany
- University of Calabria, Italy
- TU Dortmund, Germany
- TU Dresden, Germany
- Ghent University, Belgium
- Halmstad University, Sweden
- Heidelberg University, Germany
- TU Hamburg/Harburg Germany
- KTH, Stockholm, Sweden
- Université Laval, Canada
- Linköping University, Sweden
- Univ of Maryland, Syst Eng USA
- Univ of Maryland, CEEE, USA
- Politecnico di Milano, Italy
- Ecoles des Mines, CEP, France
- Mälardalen University, Sweden
- Univ Pisa, Italy
- Univ StellenBosch, South Africa
- Telemark Univ College, Norway

Open Source Modelica Consortium

Individual Members

(67 individual members, 2 February 2015)

- Peter Fritzson, Adrian Pop, Martin Sjölund, Per Östlund, Peter Aronsson, Adeel Asghar, Mikael Axin, Bernhard Bachmann, Vasile Baluta, Adam Bergmark, Robert Braun, Willi Braun, David Broman, Stefan Brus, Francesco Casella, Filippo Donida, Atiyah Elsheikh, Jens Frenkel, Mahder Gebremedhin, Pavel Grozman, Daniel Hedberg, Michael Hanke, Zoheb Hossain, Alf Isaksson, Kim Jansson, Daniel Kanth, Tommi Karhela, Juha Kortelainen, Abhinn Kothari, Petter Krus, Alexey Lebedev, Oliver Lenord, Ariel Liebman, Rickard Lindberg, Håkan Lundvall, Abhi Raj Metkar, Eric Meyers, Tuomas Miettinen, Afshin Moghadam, Kenneth Nealy, Maroun Nemer, Hannu Niemistö, Peter Nordin, Kristoffer Norling, Lennart Ochel, Arunkumar Palanisamy, Karl Pettersson, Pavol Privitzer, Reino Ruusu, Per Sahlin, Wladimir Schamai, Gerhard Schmitz, Alachew Shitahun, Magnus Sjöstrand, Anton Sodja, Ingo Staack, Kristian Stavåker, Sonia Tariq, Mohsen Torabzadeh-Tari, Parham Vasaiely, Niklas Worschech, Robert Wotzlaw, Björn Zackrisson, Azam Zia

Open Source Modelica Consortium – OSMC

Board of Directors 2014

- **Oliver Lenord**, OSMC Chairman; Manager, Siemens PLM, USA
- **Per Sahlin**, OSMC Vice Chairman; CEO, Equa Simulation AB
- **Peter Fritzson**, OSMC Director; Prof, Linköping Univ, Sweden
- **Juha Kortelainen**, Manager, VTT, Finland
- **Gerhard Schmitz**, Prof, Univ. Hamburg, Germany
- **Francesco Casella**, Prof, Politecnico di Milano, Italy
- **Jan Brugård**, CEO, Wolfram MathCore AB, Sweden
- **Kilian Link**, Manager, Siemens, Germany (and Sweden)
- **Lars Mikelsons**, Manager, Bosch-Rexroth, Germany.
- **Daniel Bouskela**, Manager, EDF, France
- **Bernhard Bachmann**, Prof, FH Bielefeld, Germany

OSMC Board – 4 Meetings Jan 1 2014 – Dec 31 2014

Meeting dates

- 140304
- 140520
- 140902
- 141209

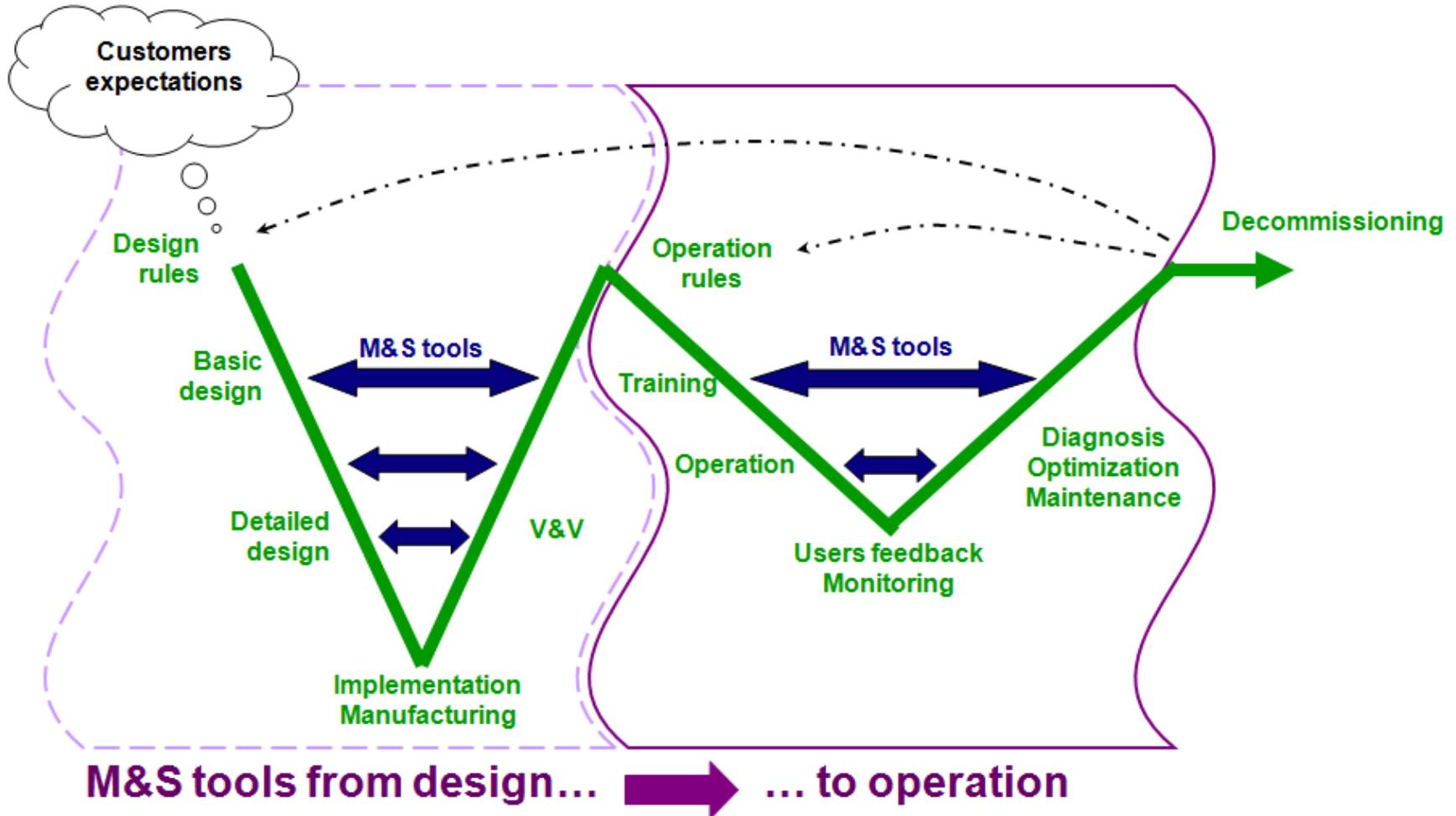
Board Work

- Planning and prioritizing the OSMC work
- Admitting new members
- Planning the workshop
- Budget
- etc.

Some Supporting Research Projects 2014

- ITEA2 MODRIO Project
- Simovate, national Swedish project
- STREAM, national Swedish project
- EU project PyModSimA – collaboration with DLR
- AVM project, collaboration with Vanderbilt, Xerox Parc
- German national project with Bosch-Rexroth and TU Dresden

MODRIO-Model Driven Physical Systems Operation



Special Thanks

- The developers who worked very hard during 2014 and modelers who tested and gave important feedback
- The OpenModelica consortium organizational members for support including Bosch-Rexroth, Wolfram-MathCore, Siemens Turbo Machinery, Siemens PLM, EDF, Ricardo, etc...
- Master students and PhD students who made important contributions.

Conclusions and Summary 2014/Jan 2015

- October 2014. **Milestone.** Moved to new OpenModelica flattening architecture for better coverage
- October 25, 2014. OpenModelica **1.9.1** final **release**
- November, 2014. **Milestone.** All OM development moved to bootstrapped compiler
- February 1, 2014. OpenModelica **1.9.2** beta **release.** First release based on bootstrapped compiler platform
- 2015. Good prospects for the future – towards a standard high quality compliant open source Modelica implementation in Modelica, increased tool support for integrated systems engineering.

Questions?

www.openmodelica.org