

OpenM++ wiki

Table of contents

[Home](#)

Getting Started

- [Windows: Quick Start for Model Users](#)
- [Windows: Quick Start for Model Developers](#)
- [Linux: Quick Start for Model Users](#)
- [Linux: Quick Start for Model Developers](#)
- [MacOS: Quick Start for Model Users](#)
- [MacOS: Quick Start for Model Developers](#)
- [Model Run: How to Run the Model](#)
- [MIT License, Copyright and Contribution](#)

Model development in OpenM++

- [Model Code: Programming a model](#)
- [Windows: Create and Debug Models](#)
- [Linux: Create and Debug Models](#)
- [MacOS: Create and Debug Models](#)
- [Modgen: Convert case-based model to openM++](#)
- [Modgen: Convert time-based model to openM++](#)
- [Modgen: Convert Modgen models and usage of C++ in openM++ code](#)
- [Model Localization: Translation of model messages](#)

Using OpenM++

- [How To: Set Model Parameters and Get Results](#)
- [Model Run: How model finds input parameters](#)
- [Model Output Expressions](#)
- [Model Run Options and ini-file](#)
- [OpenM++ Compiler \(omc\) Run Options](#)
- [OpenM++ ini-file format](#)
- [Ompp-UI: openM++ user interface](#)
- [Ompp-UI Localization: Translation of openM++ UI](#)

How to Use OpenM++ from other software: JSON web-service and Go

- [Oms: openM++ web-service](#)
- [Oms: openM++ web-service API](#)
- [Oms: How to prepare model input parameters](#)

Using OpenM++ from Python and R

- [Run model from Python: simple loop over model parameter](#)
- [Run RiskPaths model from Python: advanced parameters scaling](#)
- [Run model from R: simple loop over model parameter](#)
- [Run RiskPaths model from R: advanced parameters scaling](#)

OpenM++ Docker images

- [Windows: Use Docker to get latest version of OpenM++](#)
- [Linux: Use Docker to get latest version of OpenM++](#)
- [CentOS 8: Use Docker to get latest version of OpenM++](#)

OpenM++ Development

[Quick Start for OpenM++ Developers](#)
[Setup Development Environment](#)
[OpenM++ HPC cluster: Test Lab](#)
[Development Notes: Defines, UTF-8, Databases, etc.](#)

OpenM++ Design, Roadmap and Status

[2012, December: OpenM++ Design](#)
[2012, December: OpenM++ Model Architecture, December 2012](#)
[2012, December: Roadmap, Phase 1](#)
[2013, May: Prototype version](#)
[2013 September: Alpha version](#)
[2014 March: Project Status, Phase 1 completed](#)
[2016 December: Task List](#)
[2017 January: Design Notes. Subsample As Parameter problem. Completed](#)

OpenM++ web-service API

GET Model Metadata

[GET model list](#)
[GET model list including text \(description and notes\)](#)
[GET model definition metadata](#)
[GET model metadata including text \(description and notes\)](#)
[GET model metadata including text in all languages](#)

GET Model Extras

[GET model languages](#)
[GET model language-specific strings](#)
[GET model profile](#)
[GET list of profiles](#)

GET Model Run results metadata

[GET list of model runs](#)
[GET list of model runs including text \(description and notes\)](#)
[GET status of model run](#)
[GET status of model run list](#)
[GET status of first model run](#)
[GET status of last model run](#)
[GET status of last completed model run](#)
[GET model run metadata and status](#)
[GET model run including text \(description and notes\)](#)
[GET model run including text in all languages](#)

GET Model Workset metadata: set of input parameters

[GET list of model worksets](#)
[GET list of model worksets including text \(description and notes\)](#)
[GET workset status](#)
[GET model default workset status](#)

[GET workset including text \(description and notes\)](#)

[GET workset including text in all languages](#)

Read Parameters or Output Tables values

[Read parameter values from workset](#)

[Read parameter values from workset \(enum id's\)](#)

[Read parameter values from model run](#)

[Read parameter values from model run \(enum id's\)](#)

[Read output table values from model run](#)

[Read output table values from model run \(enum id's\)](#)

GET Parameters or Output Tables values

[GET parameter values from workset](#)

[GET parameter values from model run](#)

[GET output table expression\(s\) from model run](#)

[GET output table accumulator\(s\) from model run](#)

[GET output table all accumulators from model run](#)

GET Parameters or Output Tables values as CSV

[GET csv parameter values from workset](#)

[GET csv parameter values from workset \(enum id's\)](#)

[GET csv parameter values from model run](#)

[GET csv parameter values from model run \(enum id's\)](#)

[GET csv output table expressions from model run](#)

[GET csv output table expressions from model run \(enum id's\)](#)

[GET csv output table accumulators from model run](#)

[GET csv output table accumulators from model run \(enum id's\)](#)

[GET csv output table all accumulators from model run](#)

[GET csv output table all accumulators from model run \(enum id's\)](#)

GET Modeling Task metadata and task run history

[GET list of modeling tasks](#)

[GET list of modeling tasks including text \(description and notes\)](#)

[GET modeling task input worksets](#)

[GET modeling task run history](#)

[GET status of modeling task run](#)

[GET status of modeling task run list](#)

[GET status of modeling task first run](#)

[GET status of modeling task last run](#)

[GET status of modeling task last completed run](#)

[GET modeling task including text \(description and notes\)](#)

[GET modeling task text in all languages](#)

Update Model Profile: set of key-value options

[POST create or replace profile](#)

[DELETE profile](#)

[POST create or replace profile option](#)

DELETE profile option

Update Model Workset: set of input parameters

[POST](#) update workset read-only status

[PUT](#) create new workset

[PUT](#) create or replace workset

[PATCH](#) create or merge workset

[DELETE](#) workset

[DELETE](#) parameter from workset

[PATCH](#) update workset parameter values

[PATCH](#) update workset parameter values (enum id's)

[PUT](#) copy parameter from model run into workset

[PUT](#) copy parameter from workset to another

Update Model Runs

[PATCH](#) update model run text (description and notes)

[DELETE](#) model run

Update Modeling Tasks

[PUT](#) create or replace modeling task

[PATCH](#) create or update modeling task

[DELETE](#) modeling task

Run Models: run models and monitor progress

[POST](#) a request to run the model

[GET](#) state of current model run

User: manage user settings and data

[GET](#) user views for the model

[PUT](#) user views for the model

[DELETE](#) user views for the model

Administrative: manage web-service state

[GET](#) web-service configuration

[GET](#) web-service state

[POST](#) a request to refresh models catalog

[POST](#) a request to close models catalog

[PUT](#) a request to shutdown web-service

Home

OpenM++: open source microsimulation platform

OpenM++ is an open source microsimulation platform inspired by and compatible with [Modgen](#). OpenM++, compared to its closed source predecessor, has many advantages like portability, scalability and open source. It is **not** a copy of Modgen, but rather a new, functionally equivalent implementation of the publicly available specification of the Modgen language, with optional enhancements. OpenM++ does not depend on Modgen, does not use Modgen and does not share any source code with Modgen. On the other hand, you can compile and run Modgen models by using OpenM++. Some changes may be required to make a Modgen model buildable on either Modgen or OpenM++ from the same model source code.

Getting Started

- [Download OpenM++ for Windows, Linux or MacOS](#)
- **Windows:** [Quick Start for Model Users](#)
- **Windows:** [Quick Start for Model Developers](#)
- **Linux:** [Quick Start for Model Users](#)
- **Linux:** [Quick Start for Model Developers](#)
- **MacOS:** [Quick Start for Model Users](#)
- **MacOS:** [Quick Start for Model Developers](#)
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- **Linux:** [Create and Debug Models](#)
- **MacOS:** [Create and Debug Models](#)
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- **Modgen:** [Convert time-based model to openM++](#)
- **Modgen:** [Convert Modgen models and usage of C++ in openM++ code](#)
- [Model Localization: Translation of model messages](#)

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- [How To: Set Model Parameters and Get Results](#)
- [Model Data Import-Export: How to Use dbcopy](#)
- [Model Run: How model finds input parameters](#)
- [Model Output Expressions](#)
- [Model Run Options and ini-file](#)
- [OpenM++ Compiler \(omc\) Run Options](#)
- [OpenM++ ini-file format](#)
- [Ompp-UI: openM++ user interface](#)
- [Ompp-UI Localization: Translation of openM++ UI](#)

How to Use OpenM++ from other software: JSON web-service and Go

- Oms: openM++ web-service
- Oms: openM++ web-service API
- Oms: How to prepare model input parameters
- Documentation and source code: Go library and tools

Using OpenM++ from Python and R

- Run model from Python: simple loop over model parameter
- Run RiskPaths model from Python: advanced parameters scaling
- Run model from R: simple loop over model parameter
- Run RiskPaths model from R: advanced parameters scaling
- OpenMpp R package documentation

OpenM++ Docker images

- Windows: Use Docker to get latest version of OpenM++
- Linux: Use Docker to get latest version of OpenM++
- CentOS 8: Use Docker to get latest version of OpenM++
- DockerHub: image to run openM++ models
- DockerHub: image to build latest openM++ version

OpenM++ Development

- Quick Start for OpenM++ Developers
- Setup Development Environment
- OpenM++ HPC cluster: Test Lab
- Development Notes: Defines, UTF-8, Databases, etc.

OpenM++ Design, Roadmap and Status

Project Status: production stable since February 2016

- 2012, December: OpenM++ Design
- 2012, December: OpenM++ Model Architecture, December 2012
- 2012, December: Roadmap, Phase 1
- 2013, May: Prototype version
- 2013 September: Alpha version
- 2014 March: Project Status, Phase 1 completed
- 2016 December: Task List
- 2017 January: Design Notes. Subsample As Parameter problem. Completed

OpenM++ Source Code

- GitHub: Run-time and compiler c++ Source code
- Source code documentation: Runtime library
- Source code documentation: Compiler

- GitHub: Go library, web-service and db tools Source Code
- Source code documentation: Go library and tools
- GitHub: openMpp R package
- Source code documentation: openMpp R package
- GitHub: Source code to build Docker images
- GitHub: OpenM++ UI frontend

Contact Us

- OpenM++ web-site
- E-mail: openmpp.org@gmail.com
- License, Copyright and Contribution: OpenM++ is Open Source and Free
- MIT License
- OpenM++ on GitHub
- OpenM++ on DockerHub

Windows: Quick Start for Model Users

Where is OpenM++

- Download:
 - desktop version: [binary files and source code openmpp_win_YYYYMMDD.zip](#)
 - cluster version: [binary files and source code openmpp_win_mpi_YYYYMMDD.zip](#)
 - Docker image to run openM++ models: [openmpp/openmpp-run](#)
- Documentation: this wiki

It is recommended to start from desktop version of openM++.

You need to use cluster version of openM++ to run the model on multiple computers in your network, in cloud or HPC cluster environment. OpenM++ is using [MPI](#) to run the models on multiple computers. Please check [Model Run: How to Run the Model](#) page for more details.

You can use Docker containers to avoid installation of multiple additional components in your host computer. Because all necessary software will be installed in container your host system will be clean.

Run on Windows computer

- download and unzip [Windows desktop binaries openmpp_win_YYYYMMDD.zip](#) into C:\SomeDir\
• run modelOne model with single subsample on local machine:

```
C:  
cd \SomeDir\openmpp_win_20180205\models\bin  
modelOne.exe
```

```
2014-03-17 17:14:24.0023 Model: modelOne  
2014-03-17 17:14:24.0070 Reading Parameters  
2014-03-17 17:14:24.0085 Running Simulation  
2014-03-17 17:14:24.0101 Writing Output Tables  
2014-03-17 17:14:24.0179 Done.
```

- run modelOne model with 16 subsamples and 4 threads:

```
modelOne.exe -OpenM.Subvalues 16 -OpenM.Threads 4
```

```
2017-06-06 17:35:29.0421 modelOne  
2017-06-06 17:35:29.0435 One-time initialization  
2017-06-06 17:35:29.0454 Run: 106  
2017-06-06 17:35:29.0456 Reading Parameters  
2017-06-06 17:35:29.0460 Running Simulation  
2017-06-06 17:35:29.0464 Writing Output Tables  
.....  
2017-06-06 17:35:29.0870 Done.
```

- run other models (i.e. NewCaseBased, NewTimeBased, RiskPaths):

```
NewCaseBased.exe -OpenM.Subvalues 8 -OpenM.Threads 2
```

- run RiskPaths model with new parameter value `CanDie = true` and all other parameter values the same as in previous model run:

```
RiskPaths.exe -Parameter.CanDie true -OpenM.BaseRunId 102
```

```
2020-08-14 17:27:48.574 RiskPaths  
2020-08-14 17:27:48.610 Run: 103  
2020-08-14 17:27:48.618 Sub-value: 0  
2020-08-14 17:27:48.628 member=0 Simulation progress=0% cases=0  
.....  
2020-08-14 17:27:54.883 Done.
```

- run modelOne to compute modeling task "taskOne":

```
modelOne.exe -OpenM.Subvalues 16 -OpenM.Threads 4 -OpenM.TaskName taskOne
```

```
2017-06-06 17:39:24.0757 modelOne
2017-06-06 17:39:24.0782 One-time initialization
2017-06-06 17:39:24.0800 Run: 107
2017-06-06 17:39:24.0802 Reading Parameters
2017-06-06 17:39:24.0807 Running Simulation
.....
2017-06-06 17:39:25.0232 Run: 108
2017-06-06 17:39:25.0234 Reading Parameters
.....
2017-06-06 17:39:25.0661 Done.
```

- in case if previous model run fail, for example, due to power outage, then it can be "restarted":

```
modelOne.exe -OpenM.RestartRunId 1234
```

output may vary depending on the stage where previous modelOne run failed, but still similar to above.

Note: We recommend to use normal Windows command line cmd.exe. If you are using Windows PowerShell then it may be necessary to put "quotes" around command line options, e.g.:

```
model.exe "-OpenM.Subvalues" 16
```

Run on multiple computers over network, in HPC cluster or cloud

- download and unzip [Windows cluster binaries openmpp_win_mpi_YYYYMMDD.zip](#) into C:\AnyDir. Please notice name of cluster version archive has **mpi** in it, i.e. [openmpp_win_mpi_20180205.zip](#) and is located in a subdirectory **mpi**.
- if you are using regular Windows computers in your organization network (like Windows 7 or 10 and not MS HPC servers or Azure) then:
 - make sure you have latest version of [Microsoft MPI Redistributable](#) installed.
 - or pull Docker image [docker pull openmpp/openmpp-run:windows-1903](#) to run models inside the container (see below).
- run modelOne model with single subsample on local machine:

```
C:
cd \AnyDir\openmpp_win_mpi_20180205\models\bin
modelOne_mpi.exe
```

```
2014-03-17 17:14:24.0023 Model: modelOne
2014-03-17 17:14:24.0070 Reading Parameters
2014-03-17 17:14:24.0085 Running Simulation
2014-03-17 17:14:24.0101 Writing Output Tables
2014-03-17 17:14:24.0179 Done.
```

- run two instances of modelOne to compute 16 subsamples and 4 threads:

```
mpiexec -n 2 modelOne_mpi.exe -OpenM.Subvalues 16 -OpenM.Threads 4
```

```
2017-06-06 17:52:06.0143 modelOne
2017-06-06 17:52:06.0145 modelOne
2017-06-06 17:52:06.0179 Parallel run of 2 modeling processes, 4 thread(s) each
2017-06-06 17:52:06.0179 One-time initialization
2017-06-06 17:52:06.0179 One-time initialization
2017-06-06 17:52:06.0192 Run: 106
2017-06-06 17:52:06.0192 Run: 106
2017-06-06 17:52:06.0192 Reading Parameters
.....
2017-06-06 17:52:06.0532 Writing Output Tables
2017-06-06 17:52:06.0599 Done.
2017-06-06 17:52:06.0599 Done.
```

- run other models (i.e. NewCaseBased, NewTimeBased, RiskPaths):

```
mpiexec -n 8 NewCaseBased_mpi.exe -OpenM.Subvalues 64 -OpenM.Threads 4
```

Microsoft recommends to install HPC Pack which simplifies your computational resources management rather than using `mpiexec` as above. It is also possible to use Microsoft Azure cloud where compute nodes available for you on demand.

Run models using Docker container

- download and unzip [openmpp_win_YYYYMMDD.zip](#) into C:\AnyDir.
- make sure you have [Docker for Windows](#) installed, see [Microsoft documentation](#) for more details.
- pull Docker image:

```
docker pull openmpp/openmpp-run:windows-1903
```

- run modelOne model with single subsample:

```
docker run --isolation process -v C:\AnyDir\models\bin:C:\ompp openmpp/openmpp-run:windows-1903 modelOne.exe
```

```
2014-03-17 17:14:24.0023 Model: modelOne
2014-03-17 17:14:24.0070 Reading Parameters
2014-03-17 17:14:24.0085 Running Simulation
2014-03-17 17:14:24.0101 Writing Output Tables
2014-03-17 17:14:24.0179 Done.
```

- run two instances of modelOne to compute 16 subsamples and 4 threads:

```
docker run --isolation process -v C:\AnyDir\models\bin:C:\ompp openmpp/openmpp-run:windows-1903 mpiexec -n 2 modelOne_mpi.exe -OpenM.Subvalues 16 -OpenM.Threads 4
```

```
2017-06-06 17:52:06.0143 modelOne
2017-06-06 17:52:06.0145 modelOne
2017-06-06 17:52:06.0179 Parallel run of 2 modeling processes, 4 thread(s) each
2017-06-06 17:52:06.0179 One-time initialization
2017-06-06 17:52:06.0179 One-time initialization
2017-06-06 17:52:06.0192 Run: 106
2017-06-06 17:52:06.0192 Run: 106
2017-06-06 17:52:06.0192 Reading Parameters
.....
2017-06-06 17:52:06.0532 Writing Output Tables
2017-06-06 17:52:06.0599 Done.
2017-06-06 17:52:06.0599 Done.
```

- run other models (i.e. NewCaseBased, NewTimeBased, RiskPaths):

```
docker run --isolation process -v C:\AnyDir\models\bin:C:\ompp openmpp/openmpp-run:windows-1903 mpiexec -n 8 NewCaseBased_mpi.exe -OpenM.Subvalues 64 -OpenM.Threads 4
```

Windows: Quick Start for Model Developers

Step by Step

- Download desktop version zip archive: [openmpp_win_YYYYMMDD.zip](#) binary files and source code
- Extract zip archive to C:\SomeDir\
- Build the example RiskPaths model and run the Default scenario
 - Open C:\SomeDir\models\RiskPaths\RiskPaths-ompp.sln using Visual Studio 2019
 - 'Rebuild' in Visual Studio 2019 to build the model and run the Default scenario
 - (optional) Enable in project Properties -> OpenM++ -> "Run scenario after build" to examine model run results
 - (optional) Enable "Export model run results into csv files" to create CSV files containing values of model parameters and output tables
 - (optional) Enable "Open model web UI" to modify parameters, run the model and view model results
- (optional) set the OM_ROOT environment variable to enable model development from any directory
 - Open a Command Prompt window
 - type the command `setx OM_ROOT C:\SomeDir`
- How to: [create and debug models on Windows](#)

OpenM++ Models: desktop? clusters? MPI?

It is recommended to start from desktop version of openM++.

You need to use cluster version of openM++ to run the model on multiple computers in your network, in cloud or HPC cluster environment. OpenM++ is using [MPI](#) to run the models on multiple computers. Please check [Model Run: How to Run the Model](#) page for more details.

Build on Windows

Tested platforms:

- Windows 7 (64 and 32 bits), Windows 10, 2016 (64 bit)
- Visual Studio 2019, including Community Edition
- (optional) Microsoft MPI SDK Redistributable Package

Note: It does work on any Windows 7 and above or 2008R2 and above, 32 and 64 bits, we just simply not testing it regularly on every possible Windows version.

Build debug version of the model

You can use any of test models solution, except of modelOne, as starting point to develop your own model. Below we are using NewCaseBased model as example.

To build and run **debug version** of the model use desktop (non-MPI) version of openM++:

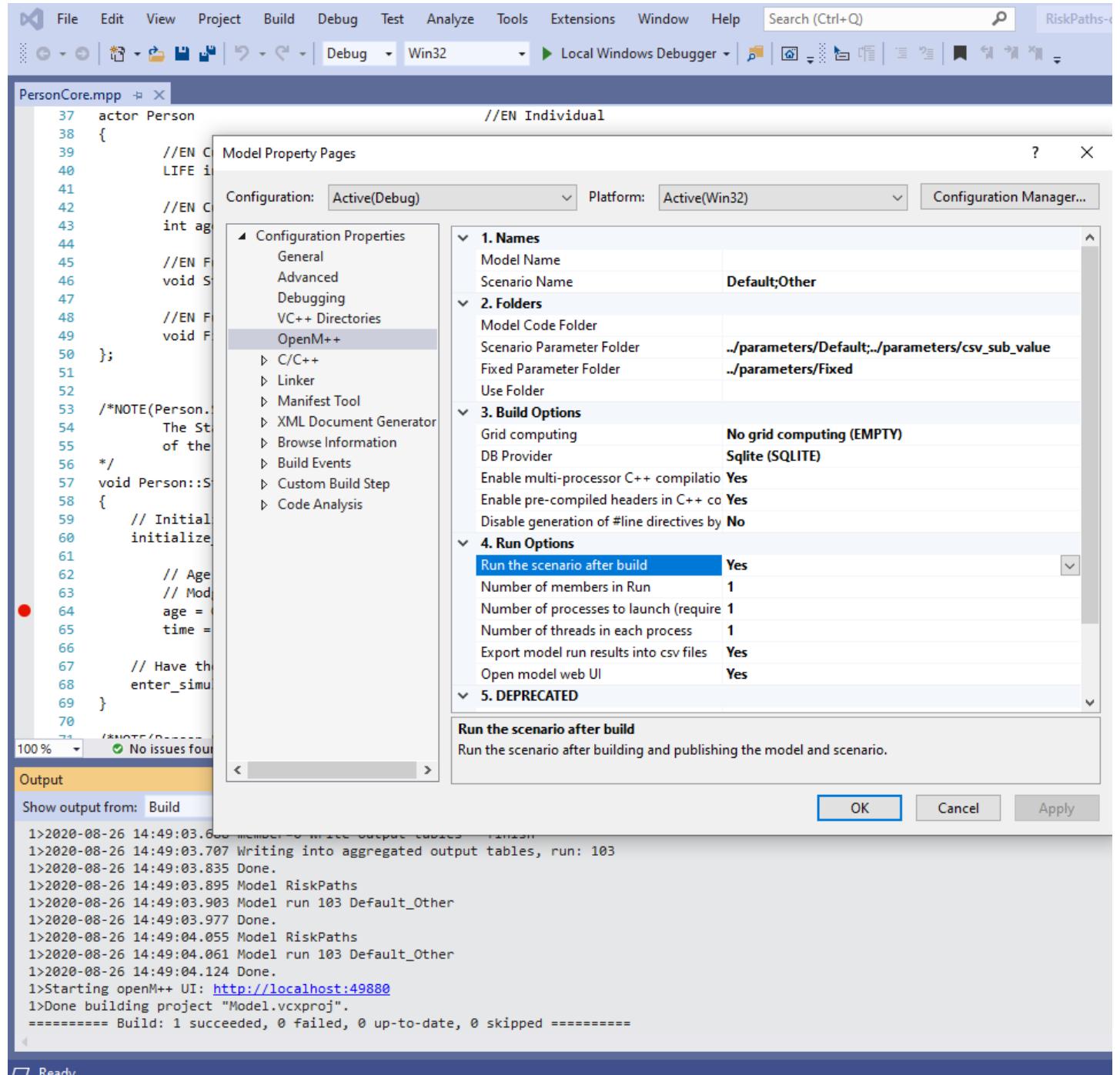
- download and unzip [openmpp_win_YYYYMMDD.zip](#) Windows desktop binaries into C:\SomeDir\
- build Debug version of the model using solution: `C:\SomeDir\models>NewCaseBased>NewCaseBased-ompp.sln`
- (optional) Rebuild the model and run it:
 - go to menu: Project -> Properties -> Configuration Properties -> OpenM++
 - change: Run Options -> Run the scenario after build -> Yes
 - Rebuild project

At bottom Output window of Visual Studio you will see something like:

```

1>Model.vcxproj -> C:\SomeDir\models\NewCaseBased\ompp\bin//NewCaseBasedD.exe
1>2017-06-06 18:21:08.0092 NewCaseBased
1>2017-06-06 18:21:08.0160 Run: 102
1>2017-06-06 18:21:08.0163 Get fixed and missing parameters
1>2017-06-06 18:21:08.0166 Get scenario parameters
1>2017-06-06 18:21:08.0172 Sub-value 0
1>2017-06-06 18:21:08.0175 compute derived parameters
1>2017-06-06 18:21:08.0177 Initialize invariant entity data
1>2017-06-06 18:21:08.0180 Member=0 simulation progress=0%
.....
1>2017-06-06 18:21:08.0688 member=0 write output tables - finish
1>2017-06-06 18:21:08.0697 Writing Output Tables Expressions
1>2017-06-06 18:21:08.0727 Done.
1>Done building project "Model.vcxproj".
===== Build: 1 succeeded, 0 failed, 0 up-to-date, 0 skipped =====

```



If you getting build error MSB8036:

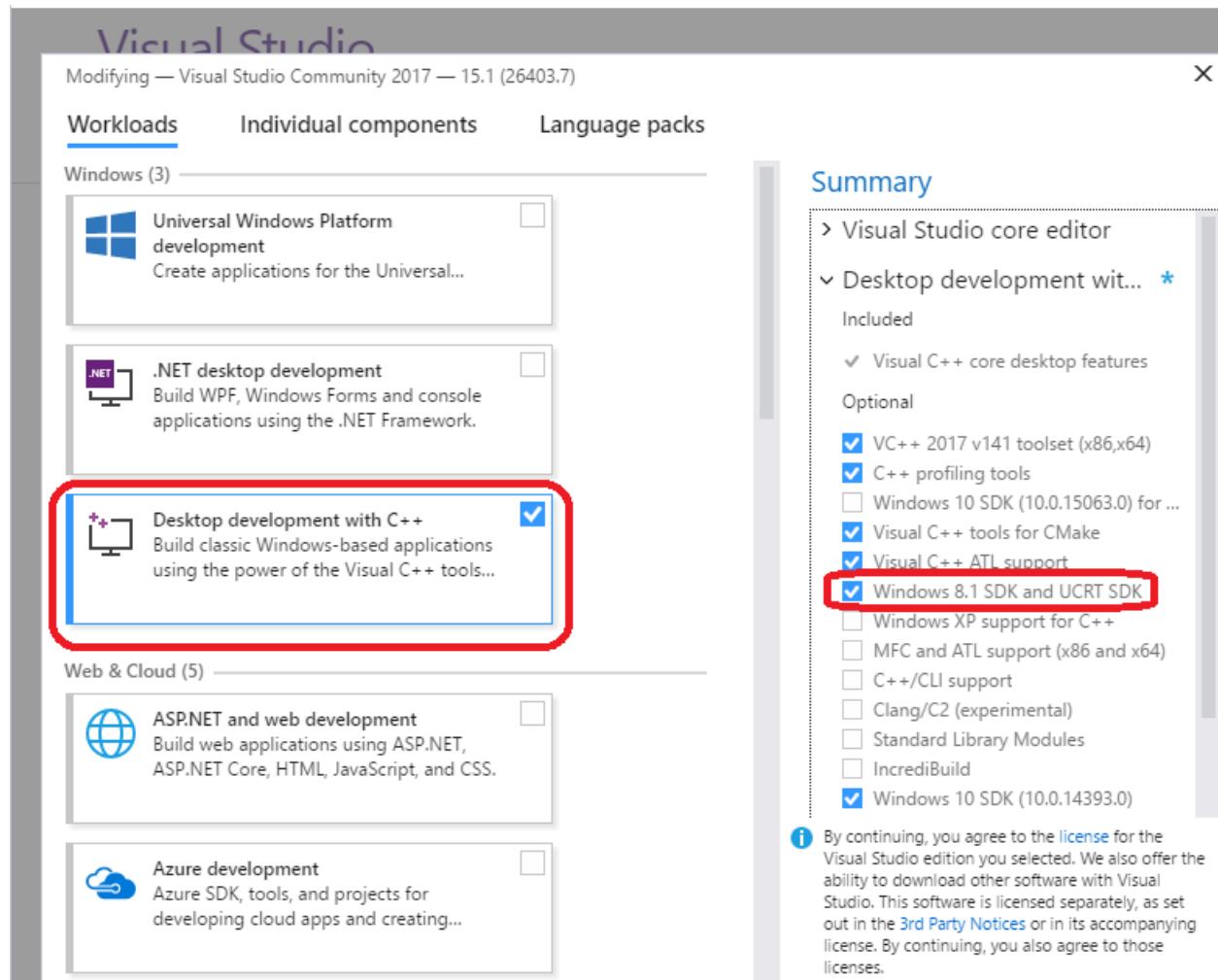
```

C:\Program Files (x86)\Microsoft Visual Studio\2017\Community\Common7\IDE\VC\VCTargets\Platforms\Win32\PlatformToolsets\v141\Toolset.targets(34,5):
error MSB8036: The Windows SDK version 10.0.14393.0 was not found.
Install the required version of Windows SDK or change the SDK version in the project property pages or by right-clicking the solution and selecting "Retarget solution".

```

then do one of:

- "Retarget solution"
- use Visual Studio 2019
- install Windows 8.1 SDK and UCRT SDK:



Build cluster version of the model to run on multiple computers over network

Make sure you have latest version of [Microsoft MPI SDK](#) and [MPI Redistributable](#) installed.

- download and unzip [openmpp_win_mpi_YYYYMMDD.zip](#) Windows cluster binaries into C:\AnyDir. Please notice name of cluster version archive has *mpi* in it, i.e. [openmpp_win_mpi_20180205.zip](#).
- use Notepad to open [C:\AnyDir\models\NewCaseBased\Model.props](#) and make sure you have:

```
.....
<GRID COMPUTING>MPI</GRID COMPUTING>
.....
```

- open model solution: [C:\AnyDir\models\NewCaseBased\NewCaseBased-ompp.sln](#)
- make sure you Release Configuration selected to build
- build model solution

Note: you can build Debug version of the model and run it on cluster, but actual debugging on cluster is far from being trivial.

Linux: Quick Start for Model Users

Where is OpenM++

- Download:
 - desktop version: [binary files and source code openmpp_debian_YYYYMMDD.tar.gz](#)
 - cluster version: [binary files and source code openmpp_debian_mpi_YYYYMMDD.tar.gz](#)
 - Docker image to run openM++ models: [openmpp/openmpp-run:debian](#)
- Documentation: this wiki

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You can use Docker containers to avoid installation of multiple additional components in your host computer. Because all necessary software will be installed in container your host system will be clean.

Run on Linux computer

- download and unpack openM++, i.e.:

```
wget https://github.com/openmpp/main/releases/download/v1.2.0/openmpp_debian_20190508.tar.gz
tar xzf openmpp_debian_20190508.tar.gz
```

- run modelOne model with single subsample on local machine:

```
cd openmpp_debian_20190508/models/bin/
./modelOne
```

```
2017-06-06 19:24:53.0747 modelOne
2017-06-06 19:24:53.0763 Run: 105
2017-06-06 19:24:53.0763 Reading Parameters
2017-06-06 19:24:53.0764 Running Simulation
2017-06-06 19:24:53.0765 Writing Output Tables
2017-06-06 19:24:53.0790 Done.
```

- run modelOne model with 16 subsamples and 4 threads:

```
./modelOne -OpenM.Subvalues 16 -OpenM.Threads 4
```

```
2017-06-06 19:25:38.0721 modelOne
2017-06-06 19:25:38.0735 Run: 106
2017-06-06 19:25:38.0735 Reading Parameters
.....
2017-06-06 19:25:38.0906 Done.
```

- run other models (i.e. NewCaseBased, NewTimeBased, RiskPaths):

```
./NewCaseBased -OpenM.Subvalues 32 -OpenM.Threads 4
```

- run RiskPaths model with new parameter value `CanDie = true` and all other parameter values the same as in previous model run:

```
RiskPaths -Parameter.CanDie true -OpenM.BaseRunId 102
```

```
2020-08-14 17:27:48.574 RiskPaths
2020-08-14 17:27:48.610 Run: 103
2020-08-14 17:27:48.618 Sub-value: 0
2020-08-14 17:27:48.628 member=0 Simulation progress=0% cases=0
.....
2020-08-14 17:27:54.883 Done.
```

- run modelOne to compute modeling task "taskOne":

```
./modelOne -OpenM.Subvalues 16 -OpenM.Threads 4 -OpenM.TaskName taskOne
```

```
2017-06-06 19:27:08.0401 modelOne
2017-06-06 19:27:08.0421 Run: 107
2017-06-06 19:27:08.0421 Reading Parameters
.....
2017-06-06 19:27:08.0593 Run: 108
2017-06-06 19:27:08.0593 Reading Parameters
.....
2017-06-06 19:27:08.0704 Writing Output Tables
2017-06-06 19:27:08.0812 Done.
```

- in case if previous model run fail, for example, due to power outage, then it can be "restarted":

```
./modelOne -OpenM.RestartRunId 1234
```

output may vary depending on the stage where previous modelOne run failed, but still similar to above.

Run on multiple computers over network, in HPC cluster or cloud

- make sure you have MPI run-time installed and ready to use. For example, on RedHat (CentOS) you may need to load it by following commands:

```
module load mpi/openmpi-x86_64
```

As an alternative to MPI installation you can pull Docker image `docker pull openmpp/openmpp-run:debian` to run models inside the container (see below).

- download and unpack cluster version of openM++, i.e.:

```
wget https://github.com/openmpp/main/releases/download/v1.2.0/openmpp_debian_mpi_20190508.tar.gz
tar xzf openmpp_debian_mpi_20190508.tar.gz
```

please notice name of cluster version archive has *mpi* in it, i.e. `openmpp_debian_mpi_20190508.tar.gz`

- run modelOne model with single subsample on local machine:

```
cd openmpp_debian_mpi_20190508/models/bin/
./modelOne_mpi
```

```
2017-06-06 19:30:52.0690 Run: 105
2017-06-06 19:30:52.0690 Reading Parameters
2017-06-06 19:30:52.0691 Running Simulation
2017-06-06 19:30:52.0691 Writing Output Tables
2017-06-06 19:30:52.0716 Done.
```

- run two instances of modelOne to compute 16 subsamples and 4 threads:

```
mpiexec -n 2 modelOne_mpi -OpenM.Subvalues 16 -OpenM.Threads 4
```

```
2017-06-06 19:43:01.0486 modelOne
2017-06-06 19:43:01.0487 modelOne
2017-06-06 19:43:01.0742 Parallel run of 2 modeling processes, 4 thread(s) each
2017-06-06 19:43:01.0750 Run: 106
2017-06-06 19:43:01.0750 Reading Parameters
2017-06-06 19:43:01.0750 Run: 106
2017-06-06 19:43:01.0750 Reading Parameters
.....
2017-06-06 19:43:01.0800 Writing Output Tables
2017-06-06 19:43:01.0878 Done.
2017-06-06 19:43:01.0880 Done.
```

- run other models (i.e. NewCaseBased, NewTimeBased, RiskPaths):

```
mpiexec -n 8 NewCaseBased_mpi -OpenM.Subvalues 64 -OpenM.Threads 4
```

It is recommended to install SLURM or Torque to simplify your computational resources management rather than using `mpiexec` as above. It is also possible to use Google Cloud, Amazon or even Microsoft Azure cloud where compute nodes available for you on demand.

Run models using Docker container

- make sure you have Docker installed, for example, on Ubuntu: `sudo apt-get install docker`.
- pull Docker image:

```
docker pull openmpp/openmpp-run:debian
```

- image build for user `ompp, UID=1999, GID=1999` and you may need to do one of:
 - add same user `ompp, UID=1999, GID=1999` to your host system and login as user `ompp`
 - or as shown below use environment variables `OMPP_*` to map your current user name, UID, GID, HOME to container user
- download and unpack cluster version of openM++, i.e.:

```
wget https://github.com/openmpp/main/releases/download/v1.2.0/openmpp_debian_mpi_20200621.tar.gz  
tar xzf openmpp_debian_mpi_20200621.tar.gz
```

please notice name of cluster version archive has `mpi` in it, i.e. `openmpp_debian_mpi_20200621.tar.gz`

- run modelOne model with single subsample on local machine:

```
docker run \  
-v $HOME/models/bin:/home/models \  
-e OMPP_USER=models -e OMPP_GROUP=models -e OMPP_UID=$UID -e OMPP_GID=`id -g` \  
openmpp/openmpp-run:debian \  
../modelOne_mpi
```

```
2017-06-06 19:30:52.0690 Run: 105  
2017-06-06 19:30:52.0690 Reading Parameters  
2017-06-06 19:30:52.0691 Running Simulation  
2017-06-06 19:30:52.0691 Writing Output Tables  
2017-06-06 19:30:52.0716 Done.
```

For explanation of:

```
-v $HOME/models/bin:/home/models \  
-e OMPP_USER=models -e OMPP_GROUP=models -e OMPP_UID=$UID -e OMPP_GID=`id -g` \  

```

please take a look at [User, group, home_directory](#) topic.

- run two instances of modelOne to compute 16 subsamples and 4 threads:

```
docker run \  
-v $HOME/models/bin:/home/models \  
-e OMPP_USER=models -e OMPP_GROUP=models -e OMPP_UID=$UID -e OMPP_GID=`id -g` \  
openmpp/openmpp-run:debian \  
mpiexec -n 2 modelOne_mpi -OpenM.Subvalues 16 -OpenM.Threads 4
```

```
2017-06-06 19:43:01.0486 modelOne  
2017-06-06 19:43:01.0487 modelOne  
2017-06-06 19:43:01.0742 Parallel run of 2 modeling processes, 4 thread(s) each  
2017-06-06 19:43:01.0750 Run: 106  
2017-06-06 19:43:01.0750 Reading Parameters  
2017-06-06 19:43:01.0750 Run: 106  
2017-06-06 19:43:01.0750 Reading Parameters  
.....  
2017-06-06 19:43:01.0800 Writing Output Tables  
2017-06-06 19:43:01.0878 Done.  
2017-06-06 19:43:01.0880 Done.
```

- run other models (i.e. NewCaseBased, NewTimeBased, RiskPaths):

```
docker run \
....user, UID, GID, HOME.... \
openmpp/openmpp-run:debian \
mpiexec -n 8 NewCaseBased_mpi -OpenM.Subvalues 64 -OpenM.Threads 4
```

Linux: Quick Start for Model Developers

Where is OpenM++

- Download:
 - desktop version: [binary files and source code openmpp_debian_YYYYMMDD.tar.gz](#)
 - cluster version: [binary files and source code openmpp_debian_mpi_YYYYMMDD.tar.gz](#)
- How to: [create and debug models on Linux](#)

It is recommended to start from desktop version of openM++.

You need to use cluster version of openM++ to run the model on multiple computers in your network, in cloud or HPC cluster environment. OpenM++ is using [MPI](#) to run the models on multiple computers. Please check [Model Run: How to Run the Model](#) page for more details.

Build on Linux

Tested platforms:

- Debian 10, MX Linux 19, Ubuntu 20.04, RedHat (CentOS) 8
- g++ >= 8.3
- (optional) MPI, i.e.: OpenMPI >= 3.1 or MPICH (other MPI implementations expected to work but not tested)
- (optional) OpenMPI >= 4.0 on RedHat (CentOS) >= 8.3 (OpenMPI was broken on CentOS 8.1)

It is also occasionally tested on openSUSE, Mint, Manjaro, Solus and others.

It is not supported, but may also work on older versions, for example Ubuntu 18.04 and RedHat 7 with devtolset-7 module enabled.

Build on Ubuntu 20.04

There is a minor incompatibility of shared libraries between Ubuntu 20.04 and Debian 10. As result you need to rebuild our model run-time libraries before building your own model:

- download and unpack openM++ into any folder:

```
wget https://github.com/openmpp/main/releases/download/v1.8.6/openmpp_debian_20210415.tar.gz
tar xzf openmpp_debian_20210415.tar.gz
```

- rebuild model run-time libraries:

```
cd openmpp_debian_20210415/openm
wget https://github.com/openmpp/main/releases/download/v1.8.6/openmpp_debian_20210415.tar.gz
tar xzf openmpp_debian_20210415.tar.gz
```

Build debug version of the model

You can use any of test models makefile, except of modelOne, as starting point to develop your own model. Below we are using NewCaseBased model as example.

To build and run **debug version** of the model use desktop (non-MPI) version of openM++:

- check your g++ --version:

```
g++ (Debian 8.3.0-6) 8.3.0
g++ (Ubuntu 9.3.0-10ubuntu2) 9.3.0
g++ (GCC) 8.3.1 20191121 (Red Hat 8.3.1-5)
```

- download and unpack openM++

```
wget https://github.com/openmpp/main/releases/download/v1.8.3/openmpp_debian_20210304.tar.gz
tar xzf openmpp_debian_20210304.tar.gz
```

- build debug version of NewCaseBased model and "publish" it ("publish" do create NewCaseBased.sqlite database with default input data set)

```
cd openmpp_debian_20210304/models/NewCaseBased/
make all publish
```

- run the model

```
cd ompp-linux/bin
./NewCaseBasedD
```

```
2017-06-06 19:59:12.0429 NewCaseBased
2017-06-06 19:59:12.0449 Run: 103
2017-06-06 19:59:12.0449 Get fixed and missing parameters
2017-06-06 19:59:12.0449 Get scenario parameters
2017-06-06 19:59:12.0450 Sub-value 0
2017-06-06 19:59:12.0450 compute derived parameters
2017-06-06 19:59:12.0450 Initialize invariant entity data
2017-06-06 19:59:12.0450 Member=0 simulation progress=0%
.....
2017-06-06 19:59:12.0505 member=0 write output tables - finish
2017-06-06 19:59:12.0508 Writing Output Tables Expressions
2017-06-06 19:59:12.0520 Done.
```

Build release version of the model

Make executable, "publish" and run NewCaseBased test model:

```
cd openmpp_debian_20210304/models/NewCaseBased/
make RELEASE=1 cleanall
make RELEASE=1 all publish
cd ompp-linux/bin
./NewCaseBased
```

Rebuild all test models

Make executables, "publish" (create model.sqlite database file) and run all test models:

```
cd openmpp_debian_20210304/models/
make RELEASE=1 cleanall
make RELEASE=1 all publish run
```

results are in `openmpp_debian_20210304/models/bin` directory

Build cluster version of the model to run on multiple computers over network

Make sure you have MPI installed and configured. For example, on RedHat (CentOS) you may need to load MPI module: `module load mpi/openmpi-x86_64`

- download and unpack cluster version of openM++, i.e.:

```
wget https://github.com/openmpp/main/releases/download/v1.8.3/openmpp_debian_mpi_20210304.tar.gz
tar xzf openmpp_debian_mpi_20210304.tar.gz
```

please notice name of cluster version archive has `mpi` in it, i.e. `openmpp_debian_mpi_20210304.tar.gz`

- make executable and "publish" (create model.sqlite database file) of NewCaseBased test model:

```
cd openmpp_debian_mpi_20210304/models/NewCaseBased/
make RELEASE=1 OM_MSG_USE=MPI all publish
```

- run 3 instances of NewCaseBased on 3 hosts to compute 16 subsamples using 4 threads

```
cd ompp-linux/bin
mpirun -n 3 -H omm,om1,om2 NewCaseBased_mpi -OpenM.Subvalues 16 -OpenM.Threads 4
```

```
2017-06-06 20:15:12.0050 NewCaseBased
2017-06-06 20:15:12.0173 NewCaseBased
2017-06-06 20:15:12.0200 NewCaseBased
2017-06-06 20:15:13.0148 Parallel run of 3 modeling processes, 4 thread(s) each
2017-06-06 20:15:13.0162 Run: 102
2017-06-06 20:15:13.0163 Get fixed and missing parameters
2017-06-06 20:15:13.0163 Get scenario parameters
2017-06-06 20:15:13.0164 compute derived parameters
2017-06-06 20:15:13.0164 Initialize invariant entity data
2017-06-06 20:15:13.0161 Run: 102
.....
2017-06-06 20:15:13.0224 member=0 write output tables - finish
2017-06-06 20:15:13.0354 Done.
2017-06-06 20:15:13.0352 Done.
2017-06-06 20:15:13.0353 Done.
```

You can use any of test models makefile, except of modelOne, as starting point to develop your own model.

MacOS: Quick Start for Model Users

Where is OpenM++

- Download latest binary files and source code: [openmpp_mac_YYYYMMDD.tar.gz](#)
- Documentation: this wiki

You can have multiple versions of openM++ installed on your computer. OpenM++ distributed as tar.gz archive, you can unpack into any directory and it is ready to use. In the documentation that directory called OM_ROOT.

OpenM++ does not update any system shared resources and you can remove it any time by simply deleting openM++ directory.

It is possible to run openM++ models:

- from terminal command line as described below
- using openM++ UI on your local computer: [Ompp-UI: openM++ user interface](#)
- from Xcode model debug session: [MacOS: Quick Start for Model Developers](#)

On Linux and/or Windows you also can run model in cloud or on high performance cluster (HPC). Please also check [Model Run: How to Run the Model](#) page for more details.

Run openM++ models from terminal command line

- download and unpack openM++ using Safari or, for example, curl:

```
curl -L -o om.tar.gz https://github.com/openmpp/main/releases/download/v1.6.0/openmpp_mac_20200621.tar.gz  
tar xzf om.tar.gz
```

- run modelOne model with single sub-sample on local machine:

```
cd openmpp_mac_20200621/models/bin/  
./modelOne
```

```
2017-06-06 19:24:53.0747 modelOne  
2017-06-06 19:24:53.0763 Run: 105  
2017-06-06 19:24:53.0763 Reading Parameters  
2017-06-06 19:24:53.0764 Running Simulation  
2017-06-06 19:24:53.0765 Writing Output Tables  
2017-06-06 19:24:53.0790 Done.
```

- run modelOne model with 16 sub-samples and 4 threads:

```
./modelOne -OpenM.Subvalues 16 -OpenM.Threads 4
```

```
2017-06-06 19:25:38.0721 modelOne  
2017-06-06 19:25:38.0735 Run: 106  
2017-06-06 19:25:38.0735 Reading Parameters  
.....  
2017-06-06 19:25:38.0906 Done.
```

- run other models (i.e. NewCaseBased, NewTimeBased, RiskPaths):

```
./NewCaseBased -OpenM.Subvalues 32 -OpenM.Threads 4
```

- run RiskPaths model with new parameter value `CanDie = true` and all other parameter values the same as in previous model run:

```
RiskPaths -Parameter.CanDie true -OpenM.BaseRunId 102
```

```
2020-08-14 17:27:48.574 RiskPaths
2020-08-14 17:27:48.610 Run: 103
2020-08-14 17:27:48.618 Sub-value: 0
2020-08-14 17:27:48.628 member=0 Simulation progress=0% cases=0
.....
2020-08-14 17:27:54.883 Done.
```

- run modelOne to compute modeling task "taskOne":

```
./modelOne -OpenM.Subvalues 16 -OpenM.Threads 4 -OpenM.TaskName taskOne
```

```
2017-06-06 19:27:08.0401 modelOne
2017-06-06 19:27:08.0421 Run: 107
2017-06-06 19:27:08.0421 Reading Parameters
.....
2017-06-06 19:27:08.0593 Run: 108
2017-06-06 19:27:08.0593 Reading Parameters
.....
2017-06-06 19:27:08.0704 Writing Output Tables
2017-06-06 19:27:08.0812 Done.
```

- in case if previous model run fail, for example, due to power outage, then it can be "restarted":

```
./modelOne -OpenM.RestartRunId 1234
```

output may vary depending on the stage where previous modelOne run failed, but still similar to above.

MacOS: Quick Start for Model Developers

Where is OpenM++

- Download: [latest binary files and source code](#)
- How to: [create and debug models on MacOS](#)

Also, please check [Model Run: How to Run the Model](#) page for more details.

Prerequisites

- Tested on: MacOS 10.15 Catalina And Big Sur >= 11.1.
- Install Xcode and command line developer tools, if not installed already by Xcode: `xcode-select --install`.
- (optional) Install Visual Studio Code for cross-platform development: <https://code.visualstudio.com/docs/?dv=osx>
- Check if clang, make and sqlite3 are installed on your computer:

```
g++ --version
...
Apple clang version 11.0.0 (clang-1100.0.33.12)

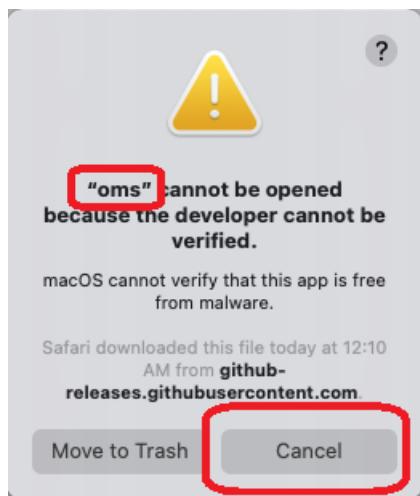
make --version
...
GNU Make 3.81

sqlite3 --version
...
3.28.0 2019-04-15 14:49:49
```

MacOS security issue

Make sure you are using tight security settings on your Mac and antivirus software, if necessary. We are trying our best to keep development machines clean, but cannot provide any guarantee.

On Big Sur it is very likely to get an security error when you are trying to run any downloaded executable:



- please reply "Cancel" to that question (click "Cancel" button).
- remove quarantine attribute from openM++ installation directory, for example:

```
xattr -r -d com.apple.quarantine ~/openmpp_mac_20200621
```

Build debug version of the model from terminal command line

You can use any of test models makefile, except of modelOne, as starting point to develop your own model. Below we are using NewCaseBased model as example.

To build and run **debug version** of the model:

- download and unpack latest openM++ release using Safari or curl:

```
curl -L -o om.tar.gz https://github.com/openmpp/main/releases/download/v1.6.0/openmpp_mac_20200621.tar.gz
tar -xzf om.tar.gz
```

- remove quarantine attribute from openM++ installation directory:

```
xattr -r -d com.apple.quarantine openmpp_mac_20200621
```

- build debug version of NewCaseBased model and "publish" it ("publish" do create NewCaseBased.sqlite database with default input data set)

```
cd openmpp_mac_20200621/models/NewCaseBased/
make all publish
```

- run the model

```
cd ompp-mac/bin
./NewCaseBasedD
```

```
2017-06-06 19:59:12.0429 NewCaseBased
2017-06-06 19:59:12.0449 Run: 103
2017-06-06 19:59:12.0449 Get fixed and missing parameters
2017-06-06 19:59:12.0449 Get scenario parameters
2017-06-06 19:59:12.0450 Sub-value 0
2017-06-06 19:59:12.0450 compute derived parameters
2017-06-06 19:59:12.0450 Initialize invariant entity data
2017-06-06 19:59:12.0450 Member=0 simulation progress=0%
.....
2017-06-06 19:59:12.0505 member=0 write output tables - finish
2017-06-06 19:59:12.0508 Writing Output Tables Expressions
2017-06-06 19:59:12.0520 Done.
```

- you can also build and run the model using make:

```
make all publish run
.....
2017-06-06 19:59:12.0429 NewCaseBased
2017-06-06 19:59:12.0449 Run: 103
.....
2017-06-06 19:59:12.0508 Writing Output Tables Expressions
2017-06-06 19:59:12.0520 Done.
```

Build release version of the model from terminal command line

Make executable, "publish" and run NewCaseBased test model:

```
cd openmpp_mac_20200621/models/NewCaseBased/
make RELEASE=1 cleanall
make RELEASE=1 all publish
cd ompp-mac/bin
./NewCaseBased
```

Rebuild all test models

Make executables, "publish" (create model.sqlite database file) and run all test models:

```
cd openmpp_mac_20200621/models/
make RELEASE=1 cleanall
make RELEASE=1 all publish run
```

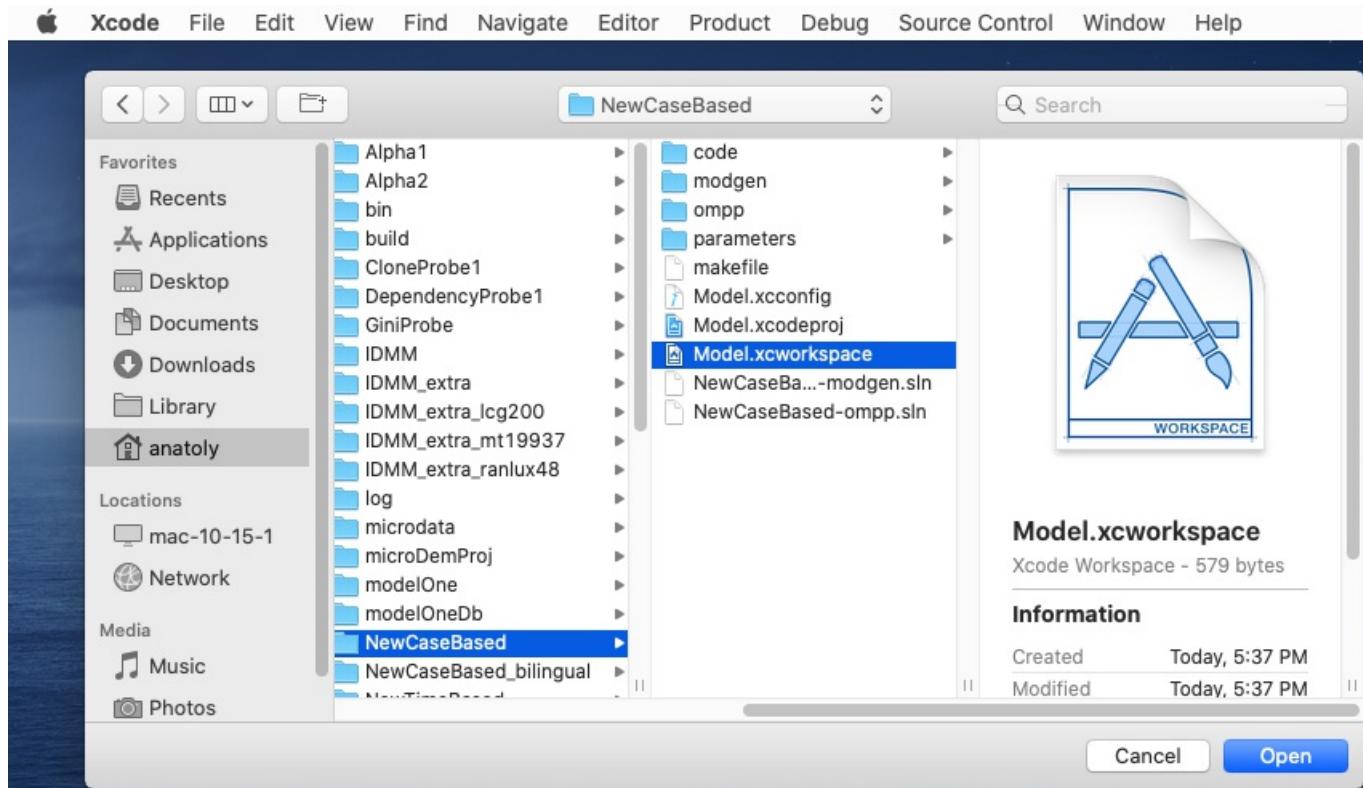
results are in `openmpp_mac_20200621/models/bin` directory

Build openM++ examples model using Xcode

Download and unpack latest openM++ release using Safari or curl:

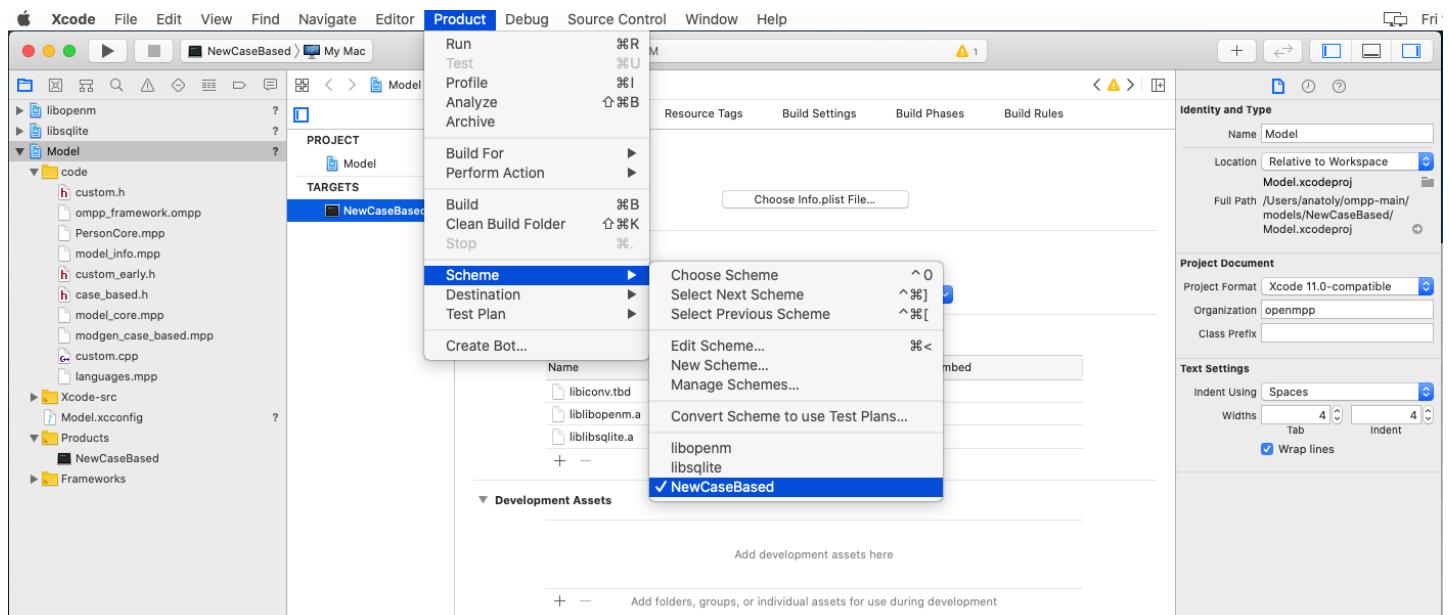
```
curl -L -o om.tar.gz https://github.com/openmpp/main/releases/download/v1.6.0/openmpp_mac_20200621.tar.gz
tar xzf om.tar.gz
```

Start Xcode and open any example model workspace, for example: ~/openmpp_mac_20200621/models/NewCaseBased/Model.xcworkspace



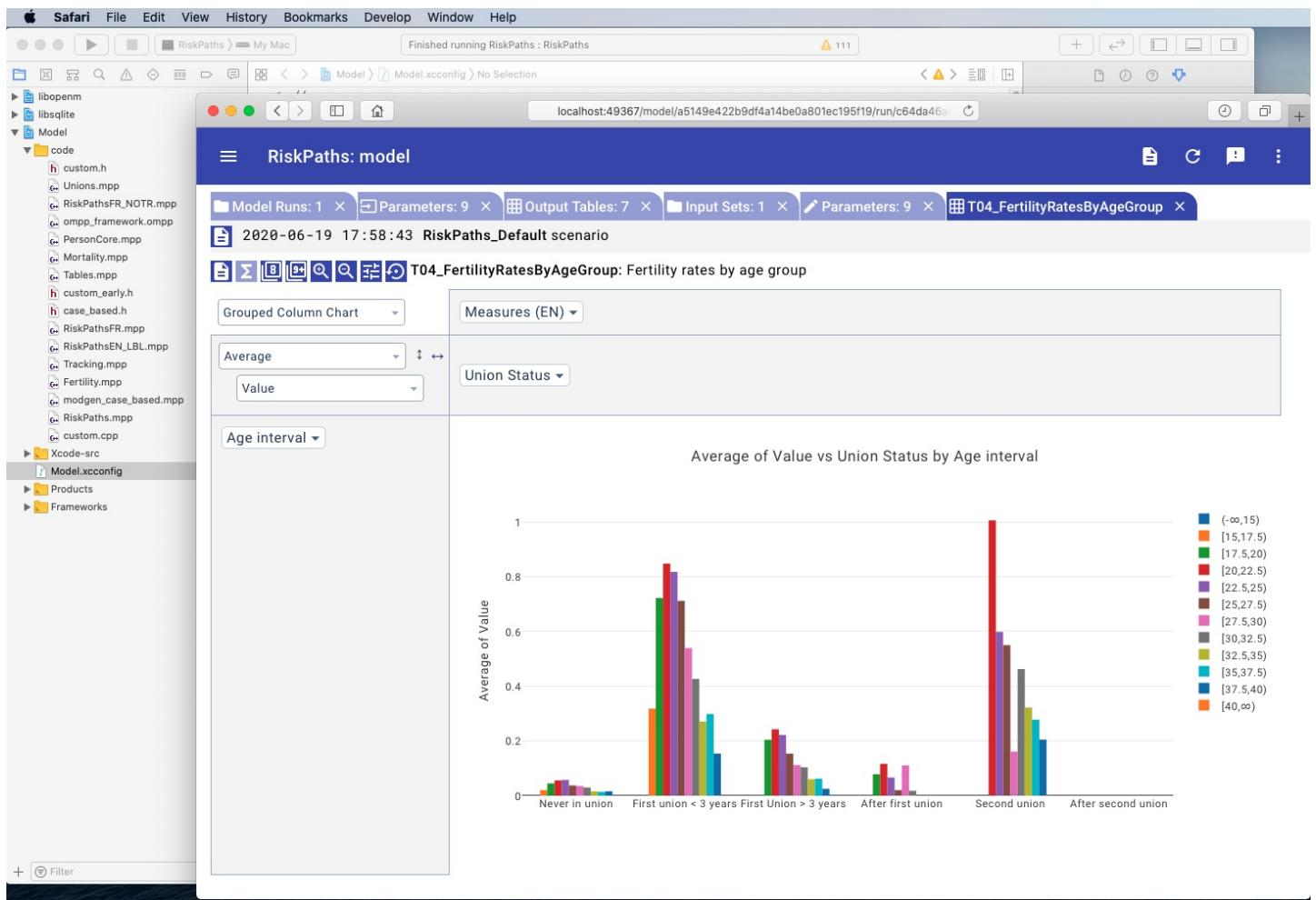
Use menu to select Product -> Scheme -> NewCaseBased:

Known issue: Xcode UI may not update check mark on selected scheme. To fix it go to Product -> Scheme -> Manage Schemes and use mouse to drag any scheme to move it up or down.



Build, debug and run openM++ example model(s) using Xcode.

Open model UI (beta) to update parameters, run the model and view results. To start model UI after build completed please change Model.xconfig variable START_OMPP_UI to "1" or "true" or "yes" (case-sensitive). Please see details at: [Start model UI on MacOS from Xcode](#)

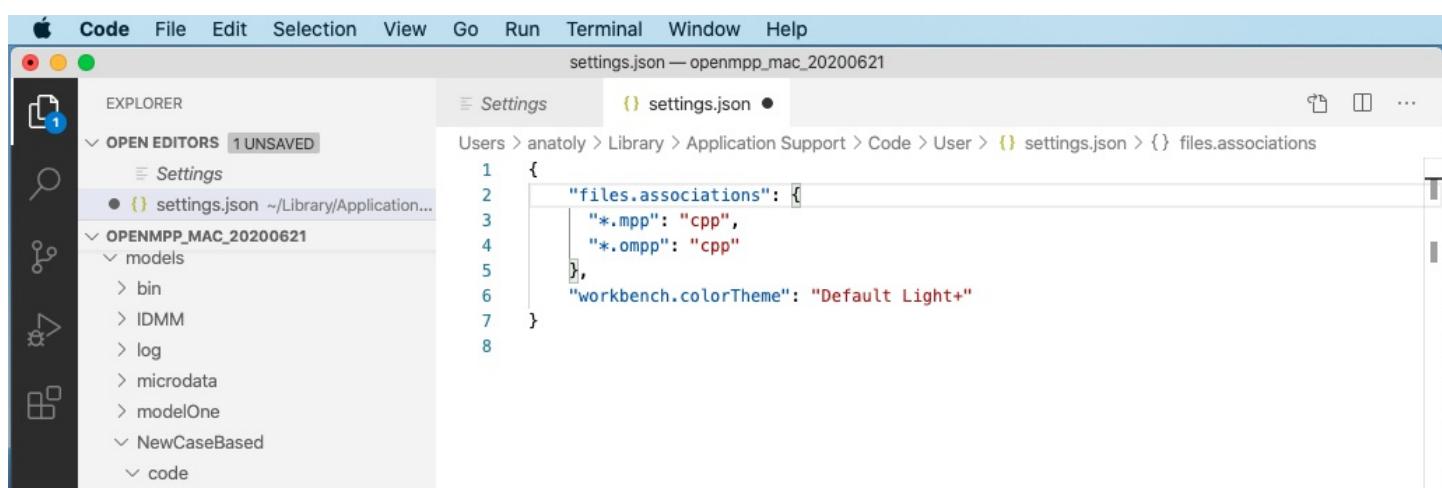
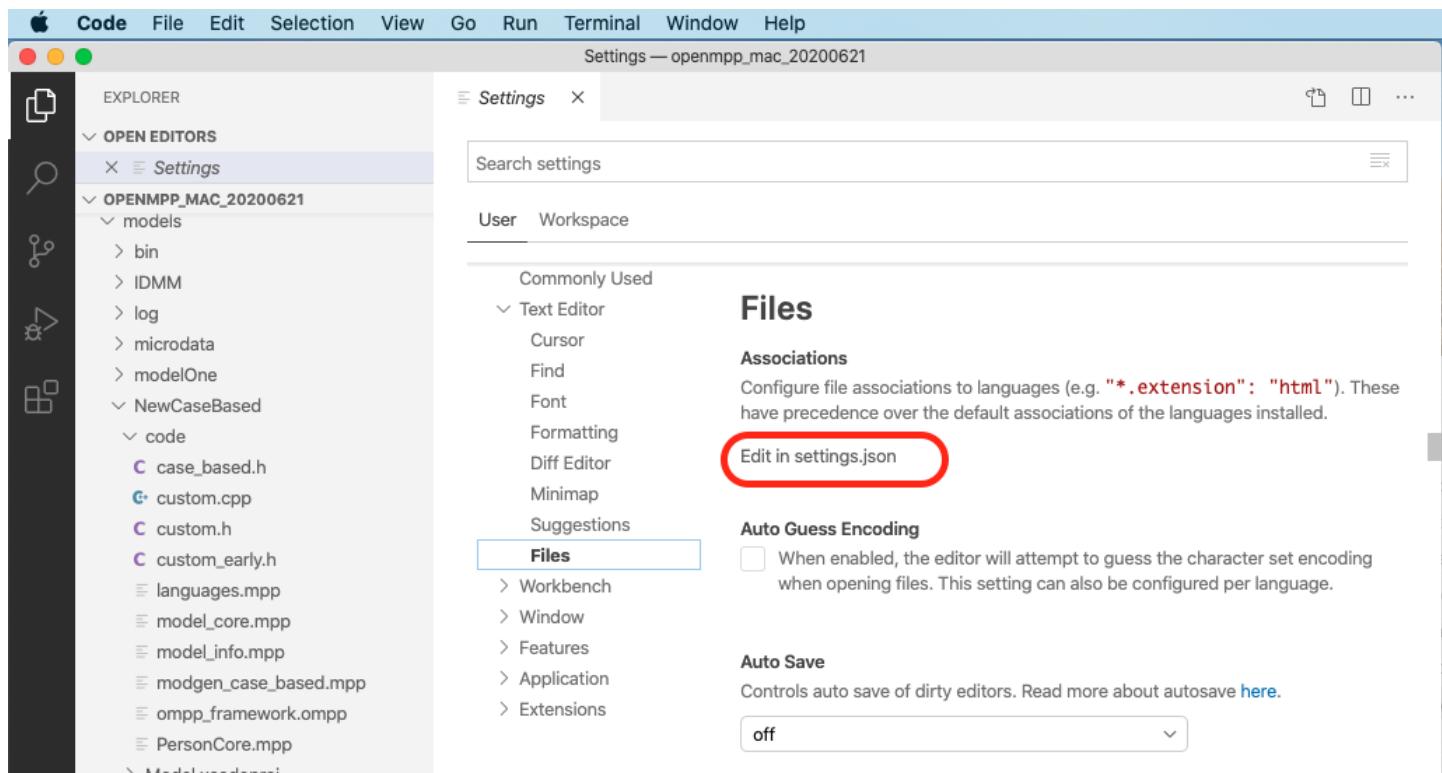


Install VSCode

It is convenient to use the same Visual Studio Code IDE if you need to develop on openM++ models on multiple platforms (Linux, MacOS and Windows). To install VSCode on MacOS and configure for openM++ development do following:

- Download it from: <https://code.visualstudio.com/docs/?dv=osx>
- Start Visual Studio Code.app and install extension `ms-vscode.cpptools` : C/C++ for Visual Studio Code (Microsoft)
- Define `.ompp` and `.mpp` file extensions as `c++` files by using menu: Code -> Preferences -> Settings -> Text Editor -> Files -> Associations -> Edit in settings.json:

```
{
  "files.associations": {
    "*.mpp": "cpp",
    "*.ompp": "cpp"
  }
}
```



Model Run: How to Run the Model

OpenM++ model run overview

It is recommended to start from single desktop version of openM++.

OpenM++ models can be run on Windows and Linux platforms, on single desktop computer, on multiple computers over network, in HPC cluster or cloud environment (i.e. Google Cloud, Microsoft Azure, Amazon,...).

You need to use cluster version of openM++ to run the model on multiple computers in your network, in cloud or HPC cluster environment. OpenM++ is using [MPI](#) to run the models on multiple computers.

By default openM++ model runs with one sub-value and in single thread, which is convenient to debug or study your model. There are following options to run openM++ model:

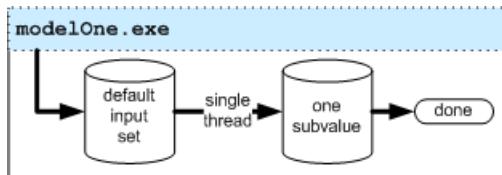
- "default" run: one sub-value and single thread
- "desktop" run: multiple sub-values and multiple threads
- "restart" run: finish model run after previous failure (i.e. power outage)
- "task" run: multiple input sets of data (a.k.a. multiple "scenarios" in Modgen), multiple sub-values and threads
- "cluster" run: multiple sub-values, threads and model process instances runs on LAN or cloud (**required MPI**)
- "cluster task" run: same as "cluster" plus multiple input sets of data (**required MPI**)

Please also check [Model Run: How model finds input parameters](#) for more details.

Sub-values: sub-samples, members, replicas

Following terms: "simulation member", "replica", "sub-sample" are often used in micro-simulation conversations interchangeably, depending on context. To avoid terminology discussion openM++ uses "sub-value" as equivalent of all above and some older pages of that wiki may contain "sub-sample" in that case.

Default run: simplest



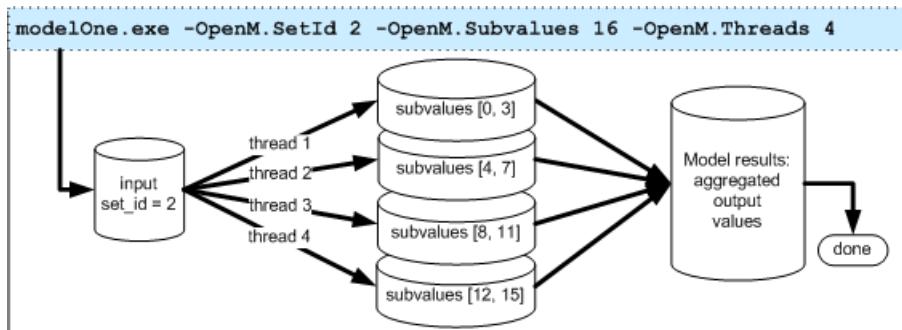
If no any options specified to run the model then

- all parameters are from default input data set
- single thread is used for modeling
- only one sub-value calculated

```
modelOne.exe
```

It is most simple way to debug your model.

Desktop run: model run on single computer



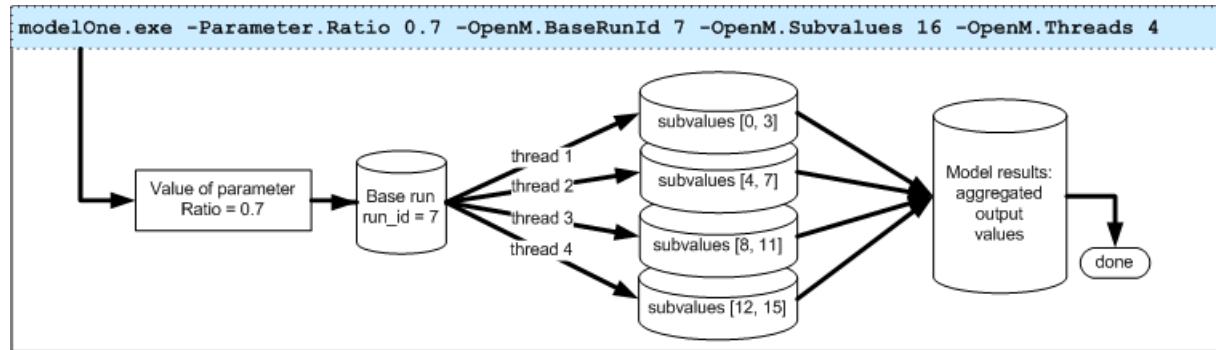
If only single computer available then

- user can specify which set of input data to use (by set name or id)
- number of sub-values to calculate
- number of modeling threads to use

```
modelOne.exe -OpenM.SetName modelOne -OpenM.SubValues 16 -OpenM.Threads 4
```

After model run completed user can repeat it with modified parameter(s) values:

```
model.exe -Parameter.Ratio 0.7 -OpenM.BaseRunId 7 -OpenM.SubValues 16 -OpenM.Threads 4
```



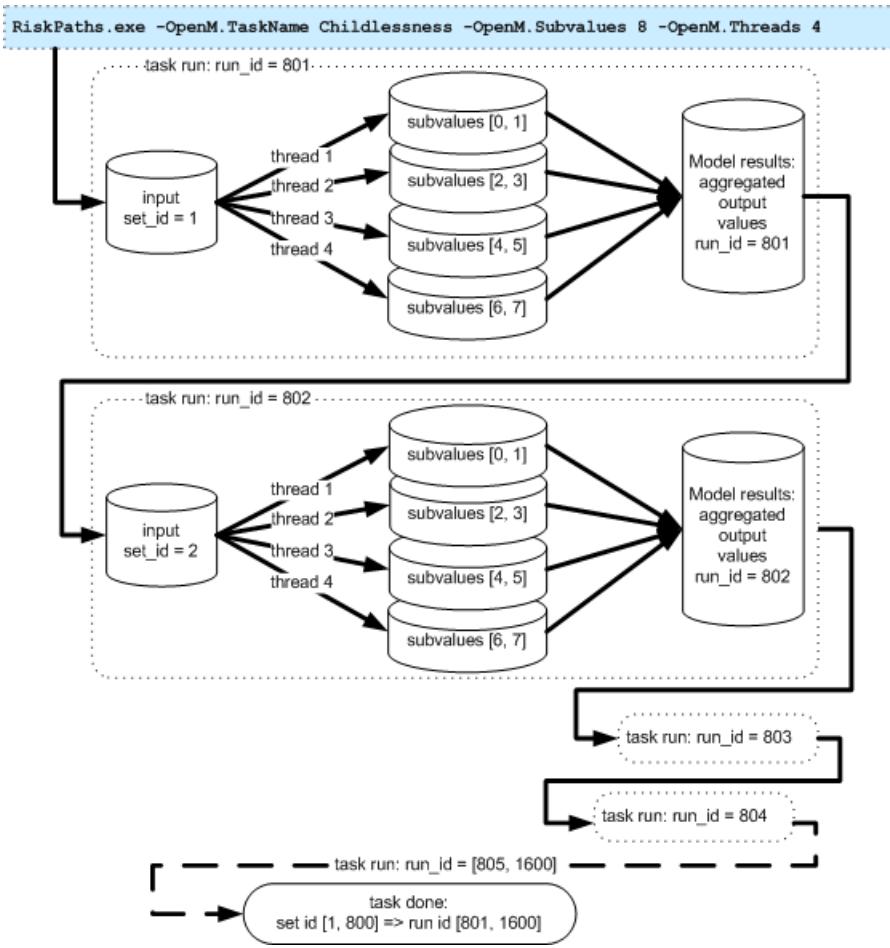
Command above will run the model with new value for parameter `Ratio = 0.7` and use the rest of parameters from previous model run (a.k.a. "base" run). Base run can be identified by run id, which is 7 in example above, by run digest or run name. Please see [Model Run: How model finds input parameters](#) for more details.

Restart run: finish model run after previous failure

If previous model run was not completed (i.e. due to power failure or insufficient disk space) you can restart it by specifying run id:

```
modelOne.exe -OpenM.RestartRunId 11
```

Task run: multiple sets of input data



Modeling task consists of multiple sets of input data and can be run in batch mode. For example, it is make sense to create modeling task to [Run RiskPaths model from R](#) with 800 sets of input data to study Childlessness by varying

- Age baseline for first union formation
- Relative risks of union status on first pregnancy

RiskPaths.exe -OpenM.TaskName Childlessness -OpenM.SubValues 8 -OpenM.Threads 4

Run of such modeling task will read 800 input sets with set id [1, 800] and produce 800 model run outputs with run id [801, 1600] respectively.

Dynamic task run: wait for input data

It is possible to append new sets of input data to the task as it runs. That allow you to use some optimization methods rather than simply calculate all possible combinations of input parameters. In that case modeling task does not completed automatically but wait for external "task can be completed" signal. For example:

```

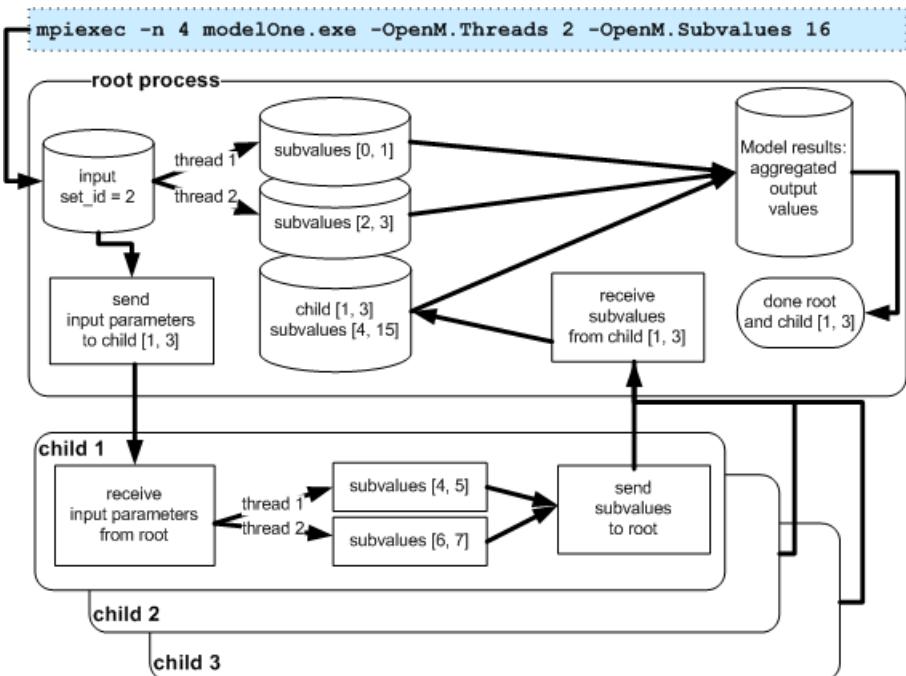
#
# pseudo script to run RiskPaths and find optimal solution for Childlessness problem
# you can use R or any other tools of your choice
#
# # create Childlessness task
# # run loop until you satisfied with results

RiskPaths.exe -OpenM.TaskName Childlessness -OpenM.TaskWait true

# # find your modeling task run id, i.e.: 1234
# # analyze model output tables
# # if results not optimal
#   # then append new set of input data into task "Childlessness" and continue loop
#   # else signal to RiskPaths model "task can be completed":
#   #     UPDATE task_run_1st SET status = 'p' WHERE task_run_id = 1234;
#
# Done.
#

```

Cluster run: model run on multiple computers



You use [MPI](#) to run the model on multiple computers over network or in cloud or on HPC cluster. For example, to run 4 instances of modelOne.exe with 2 threads each and compute 16 sub-values:

```
mpiexec -n 4 modelOne.exe -OpenM.Threads 2 -OpenM.SubValues 16
```

Please notice, usage of `"mpiexec -n 4"` as above is suitable for test only and you should use your cluster tools for real model run.

Cluster task: run modeling task on multiple computers

Modeling task with 1000x input data sets can take long time to run and it is recommended to use cluster (multiple computers over network) or cloud, such as Google Compute Engine, to do that. For example, RiskPaths task above can be calculated much faster if 200 servers available to run it:

```
mpiexec -n 200 RiskPaths.exe -OpenM.TaskName Childlessness -OpenM.SubValues 16 -OpenM.Threads 4
```

Please notice, usage of `"mpiexec -n 200"` as above is suitable for test only and you should use your cluster tools for real model run.

Dynamic task: you can use `-OpenM.TaskWait true` argument as described above to dynamically change task as it runs.

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OpenM++ is currently in an intensive foundational development phase of (mostly) full-time developers, which precludes most independent incremental fixes or enhancements. Nevertheless, if you or your organization would like to join and contribute to OpenM++ in this phase, please contact us at openmpp99@gmail.com.

To contribute to OpenM++, we also require that you send us an email indicating that you accept the Developer's Certificate of Origin (DCO). Basically, the DCO affirms that you have the right to make contributions under the open source license of OpenM++. For more information on DCO's see [Contributor Agreements](#). Here's the text of the DCO used for OpenM++ (taken from the [Linux DCO](#)).

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Version 1.1

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- (c) The contribution was provided directly to me by some other person who certified (a), (b) or (c) and I have not modified it.
- (d) I understand and agree that this project and the contribution are public and that a record of the contribution (including all personal information I submit with it, including my sign-off) is maintained indefinitely and may be redistributed consistent with this project or the open source license(s) involved.

The email must contain the DCO text above and indicate your acceptance. Also include the Source Forge user name you will be using for your contributions to OpenM++. If you are contributing as an employee, use your organizational email address and ensure that your hierarchical supervisor(s) are on the CC. If you are not the IP owner of your contributions, provide the name of the organization which is, e.g. Government of Canada.

Your email will be archived and a copy will be placed in the project repository to document the provenance of the contributions you make using your GitHub user ID. Your name will be added to the AUTHORS.txt file of the project. If applicable, the AUTHORS.txt will also indicate that your organization is a contributor and holds copyright to portions of OpenM++.

Usage of other software in OpenM++

As any other product openM++ is using software libraries licensed under different terms. For example, if you choose to use SQLite as openM++ embedded database then SQLite Public Domain license is applied to SQLite portion of openM++. Or, in case of [libiconv library](#), openM++ is using it under LGPL v3.0 license.

Build Files

Some intermediate development files used as part of openM++ build process also fall under other licenses. For example, Microsoft Visual Studio project files or GNU make files. Nothing from such intermediate files ever reaches the final openM++ deliverable and the licenses associated with those building tools should not be a factor in assessing your rights to copy and use openM++.

Model Code: Programming a model

This page contains general information about the source code of an OpenM++ model. It describes model source code in broad terms, the contents of the model source code folder, and the Default scenario. It also briefly outlines the build process which transforms model source code and a Default scenario into an executable and accompanying database.

Related topics

- [OpenM++ Language Reference](#)
- [OpenM++ Framework Library](#)
- [OpenM++ Function Library](#)
- [OpenM++ language and C++](#)
- [Naming conventions in model code](#)
- *Modgen-specific:* [Cross-compatible models](#)

Contents

- [Coding in OpenM++](#)
- [Model code folder and model source files](#)
- [Content of model source files](#)
- [Model Default scenario](#)
- [Model build process](#)
- [Hiding syntactic islands from the C++ compiler or IDE](#)

Modgen-specific: References to Modgen in this documentation refer to the Statistics Canada [Modgen](#) platform. Models with common source code from which either a Modgen executable or an OpenM++ executable can be built are called cross-compatible models. While Modgen may be mentioned in this documentation, Modgen is not required to develop an OpenM++ model.

Coding in OpenM++

OpenM++ models are written in two languages: the OpenM++ language and the C++ language. The OpenM++ language is used to specify the *declarative* aspects of a model, for example the model's classifications, parameters, entities, attributes, events, tables, labels, and notes. The C++ language is used to specify the *procedural* aspects of a model, for example the sequentially executed statements which change an entity's attributes when an event occurs in the simulation.

The OpenM++ language

The OpenM++ language consists of declarative statements. The location and ordering of those statements in model source code files is arbitrary and has no effect on the model specification. This provides a high level of modularity which can be particularly useful in large, complex models.

A statement in the OpenM++ language starts with an opening keyword which specifies the nature of the declaration and ends with a closing `;`. The syntax between the opening keyword and the closing `;` depends on the nature of the declaration.

For example, the `classification` keyword is used to declare a named ordered list of symbolic values:

```
classification SEX //EN Sex
{
    //EN Male
    MALE,
    //EN Female
    FEMALE
};
```

This example declares an OpenM++ `classification` named `SEX`. It has two possible values `MALE` and `FEMALE`. The declaration of `SEX` means that `SEX` can be used as the dimension of a parameter or table, or as the type (characteristic) of an attribute of an entity in the simulation.

The OpenM++ language also recognizes specially formatted `//` and `/* ... */` comments. Recognized comments are optional and do not affect the model specification. They contain textual information stored with the model which can be used to produce more human-readable input and output and a generated user interface for the model. OpenM++ is multilingual, and the human language of the textual information is specified inside the comment using a two-letter code.

The `//EN` comments in the example provide English-language labels for the `SEX` classification and its values. These labels will appear in the user interface of the model, for example as row or column headings and labels of multi-dimensional parameters and tables.

The C++ language in model code

The C++ language portion of model code consists mostly or entirely of C++ function definitions. Here's an example:

```
// The implement function of MortalityEvent
void Person::MortalityEvent()
{
    alive = false;

    // Remove the entity from the simulation.
    Finish();
}
```

This C++ model code defines the function which implements mortality in the simulation. The `Person` entity, its attribute `alive`, its event `MortalityEvent`, and the helper function `Finish` are all declared elsewhere in the OpenM++ language code of the model.

Typically only a small, limited portion of the C++ language is used in model code. Note that it is usually neither useful nor recommended for a model developer to create C++ classes and class hierarchies in model code. All simulation-related C++ classes and objects are pre-generated by OpenM++ using the model specification given in the OpenM++ language.

The C++ language elements most used in model code are [expressions](#) to compute values, [assignments](#) to store those values, [if statements](#) to implement branching logic, and [for statements](#) or [range for](#) statements for iteration. [C++ functions](#) are used to specify when events occur and what happens when they do. Functions are also used to compute derived parameters and derived tables. Functions can also be used facultatively to organize code in complex models.

The C++ standard library can be used in model code. It includes useful and powerful components such as [array](#) and [vector](#) in the [containers](#) library, and supports string operations.

The limited dialect of C++ used for coding models is perhaps best explored by perusing the source code of existing models and referring to [comprehensive C++ documentation](#) when necessary, or to the many C++ tutorials available on the web.

Modgen-specific: Unlike Modgen, OpenM++ does not modify the C++ language portions of model code. This provides logical clarity and allows an IDE and other tools to function as intended with the C++ code of a model.

Model symbols in OpenM++ and C++

Many of the named symbols declared in the OpenM++ code of a model are transformed by OpenM++ into identically named C++ symbols for use in the C++ code of the model. The `alive` attribute of the `Person` entity in the previous example is such a symbol. These C++ symbols can usually be used transparently in C++ model code even though they may be implemented as more complex C++ objects 'under the hood'. So, when `alive` is assigned the value `false` in the example, the C++ symbol `alive` will silently implement side-effects to update any tables, derived attributes, or events which depend on the change in its value.

Model functions in OpenM++ and OpenM++

OpenM++ ignores the functions defined in the C++ language portions of model code, with several exceptions:

- Event time function definitions in model code are parsed by OpenM++ to determine which attributes can affect the event time. An event time function will be called to recompute the event time if any of those attributes change value.
- `PreSimulation` function definitions are recognized by OpenM++ and will be called before the simulation starts. `PreSimulation` functions are used to validate input parameters and assign values to derived parameters.
- `UserTables` function definitions are recognized by OpenM++ and will be called after the simulation completes. `UserTables` functions are used to compute the values of derived tables.

[\[back to contents\]](#)

Model code folder and model source files

The source code of an OpenM++ model is in one or more source files (also called modules) located in a single model code folder, eg `Alpha2/code` for the Alpha2 model. Each model source file has a name and extension which determine its language and role when the model is built, as follows:

- `*.h` C++ header files included by other source files.
- `*.cpp` C++ source files, can also contain OpenM++ code **NOT YET IMPLEMENTED**
- `*.mpp` OpenM++ source files, can also contain C++ code
- `*.ompp` OpenM++ source files, can also contain C++ code
- *Modgen-specific:* `modgen_* .ompp` Modgen source files explicitly ignored by OpenM++

Modgen-specific: Only model source files with the `.mpp` extension are recognized by Modgen. The names and extensions `*.ompp` and `modgen_* .mpp` allow selected model source code files to be processed exclusively by OpenM++ or exclusively by Modgen. This can be useful in cross-compatible models. For example, tables which use the median statistic (which is not supported by Modgen) could be declared in a model source file named `OrdinalStatistics.ompp`. Those tables would be present in the OpenM++ version of the model, but absent in the Modgen version. Declaring those tables in a file with extension `.ompp` means that they will not cause Modgen to stop with a syntax error when building the Modgen version of the model.

The following model-specific source files must be present:

- `custom.h` C++ header file containing model-specific declarations.
- `custom_early.h` C++ header file containing model-specific declarations early in header file inclusion order.

The following model source file is present, by convention:

- `ompp_framework.ompp` Model-specific source file containing `use` statements which specify the names of framework source code modules to be incorporated when the model is built. Framework source code modules are supplied with OpenM++ and are located in the `OM_ROOT/use` folder. For more information, see [OpenM++ Framework Library](#).

Some source files in the OpenM++ model code folder have fixed names and fixed content. Typically a model developer copies them to the model `code` folder from an example model in the OpenM++ distribution, for example from `OM_ROOT/models/NewCaseBased/code` or `OM_ROOT/models/NewTimeBased/code`. They are:

- `case_based.h` Model-independent declaration of a structure present in case-based models, included in `custom.h`.
- *Modgen-specific:* `modgen_case_based.mpp` Model-independent implementation of the simulation core of a case-based Modgen model.
- *Modgen-specific:* `modgen_time_based.mpp` Model-independent implementation of the simulation core of a time-based Modgen model.

[\[back to contents\]](#)

Content of model source files

A model source file can contain only C++ content, only OpenM++ language content, or a mixture of both. OpenM++ uses keywords at the outermost level of code to recognize OpenM++ *syntactic islands* which contain declarative information about the model. Here's an example of an OpenM++ syntactic island in a model source file:

```
parameters
{
    //EN Annual hazard of death
    double MortalityHazard;
    /* NOTE(MortalityHazard, EN)
       A constant hazard of death results in an exponential
       survival function.
    */
};
```

This syntactic island starts with the OpenM++ keyword `parameters` and ends with the terminating `;`.

All code outside of a syntactic island is C++ code. When processing `.mpp` and `.ompp` model code files, OpenM++ extracts all C++ code found outside of syntactic islands and assembles it into the single C++ file `src/om_developer.cpp` for subsequent processing by the C++ compiler. By default, OpenM++ inserts [#line directives](#) into this file so that any errors or warnings from the C++ compiler will refer back to the original model source file and line rather than to the assembled file `src/om_developer.cpp`.

When processing a `.cpp` model code file, OpenM++ processes any syntactic islands, but does not extract C++ code outside of syntactic islands. This lets one organize all model code into `.cpp` files in the model code folder, and pass those files directly to the C++ compiler in Step 2 of the model build process (see below). Alternatively one could organize all OpenM++ language content in `.ompp` files, and all C++ language content in `.cpp` files. **NOT YET IMPLEMENTED**

Modgen-specific: Modgen only processes `.mpp` files, not `.cpp` files.

[\[back to contents\]](#)

Model Default scenario

The model build process requires a starting scenario with a complete set of values for all input parameters. This design enables OpenM++ users to create a new scenario by modifying an existing scenario. By convention, the starting scenario is named `Default`. Files containing the values of all input parameters are usually in the subfolder `parameters/Default` of the model folder. It is possible to publish multiple scenarios when a model is built. For more information, see [Model Run: How model finds input parameters](#). It is also possible to specify that some parameters be treated as invariant and incorporated directly into the model executable. This can be done either by placing those parameters into a distinct model subfolder, typically `parameters/Fixed`, or by using the OpenM++ language statements `parameters_retain` or `parameters_suppress` in model code.

The following file types for input parameters are recognized:

- `.dat` Contains values for one or more parameters in Modgen format
- `.odat` Contains values for one or more parameters in Modgen format
- `.csv` Contains values for one parameter in csv format
- `.tsv` Contains values for one parameter in tsv format

Modgen-specific: Only parameter files with the `.dat` extension are recognized by Modgen. The `.odat` extension lets a selected parameter file be processed only by OpenM++. This can be useful in cross-compatible models. It is used in OpenM++ sample cross-compatible models to provide values for parameters which are implemented by scenario properties in Modgen. For example, for the NewCaseBased model, the parameter input file `OM_ROOT/models/NewCaseBased/parameters/Default/Framework.odat` provides values for the `SimulationSeed` and `SimulationCases` parameters. The file `OM_ROOT/models/NewCaseBased/parameters/Default/scenario_info.odat` contains no parameters but provides a label and note for the scenario, comments which would otherwise generate an error in Modgen.

[\[back to contents\]](#)

Model build process

The model build process uses the model source code and the Default scenario to construct an executable and accompanying database which implement the model. The model build process can be launched by issuing a command inside an Integrated Development Environment (IDE) such as Visual Studio on Windows, or Visual Studio Code on Linux or MacOS. The build process can also be launched by a command line utility such as `msbuild` on Windows or `make` in Linux. For more information please see [Model development in OpenM++](#). The model build process consists of two steps. Each step can produce warning and error messages which usually refer to model source code by file and line number. In an IDE, these error messages can usually be clicked to navigate directly to the associated file and line in the IDE code editor.

Step 1: OpenM++ build

OpenM++ reads and parses the files in the model source folder and the files for the Default scenario, checks for errors, and performs the following steps:

- Extracts the C++ portions of model code from all `.mpp` and `.ompp` files and assembles them into a single C++ source file.
- Generates several C++ header files and a C++ source file which implements the model specification.
- Generates a C++ source file which contains the values of invariant parameters.
- Creates a new empty database for the model if needed.
- Publishes the model's metadata to the database, including classifications, parameter properties, table properties, parameter and table hierarchies, labels and notes, etc.
- Publishes the Default scenario to the database, consisting of the values of all modifiable parameters in the Default scenario. Also publishes additional scenarios if requested.

Step 2: C++ build

After Step 1 completes, the C++ compiler is invoked. The input to the C++ compiler consists of all C++ files in the model source code folder (*.cpp, *.h), together with the C++ files generated by OpenM++ in Step 1. Additional general purpose code is included from the OpenM++ distribution and from the C++ standard library.

The results of the C++ compilation are linked with standard C++ libraries and an OpenM++ support library to create the model executable. Because OpenM++ integrates with C++, it is possible to link in other components such as a math library, or even a complete additional model, possibly written in a different language like Fortran.

[\[back to contents\]](#)

Hiding syntactic islands from the C++ compiler or IDE

Modern IDEs have powerful abilities to navigate C++ code, eg context sensitive popup menus which identify all uses of a symbol. However, these abilities require that the project consist of valid C++. OpenM++ syntactic islands are not valid C++, and will produce errors if processed by a C++ compiler or an IDE. Syntactic islands can be hidden from a C++ compiler or IDE by using C++ preprocessor [conditional inclusion](#) directives. Here's an example showing how the syntactic island in the earlier example can be hidden from the C++ compiler or IDE.

```
#if 0 // Hide from C++ compiler or IDE
parameters
{
    //EN Annual hazard of death
    double MortalityHazard;
    /* NOTE(MortalityHazard, EN)
       A constant hazard of death results in an exponential
       survival function.
    */
};
#endif // Hide from C++ compiler or IDE
```

OpenM++ will still process the syntactic island because it ignores C++ preprocessor statements.

C++ code in model code files will not be considered valid by a C++ compiler or IDE if a required master header file is missing. That's because C++ requires that a symbol be declared before being used in code. That requirement can be met by including the master header file at the top of the model code file, as follows:

```
#include "omc/omSimulation.h" // For C++ compiler or IDE
```

Modgen-specific: In cross-compatible models one may want to disable this `#include` when compiling in the Modgen environment, to avoid passing erroneous declarations to the IDE in the Modgen project and getting spurious error messages referring to OpenM++ constructs. Here's how:

```
#if defined(OPENM)
#include "omc/omSimulation.h" // For C++ compiler or IDE
#endif
```

This works because the manifest constant `OPENM` is always defined in the OpenM++ build environment, and is not defined in the Modgen build environment.

[\[back to contents\]](#)

Windows: Create and Debug Models

Where is OpenM++

- Download desktop version: [openmpp_win_YYYYMMDD.zip](#) binary files and source code
- Documentation: [Windows: Quick Start for Developers](#)

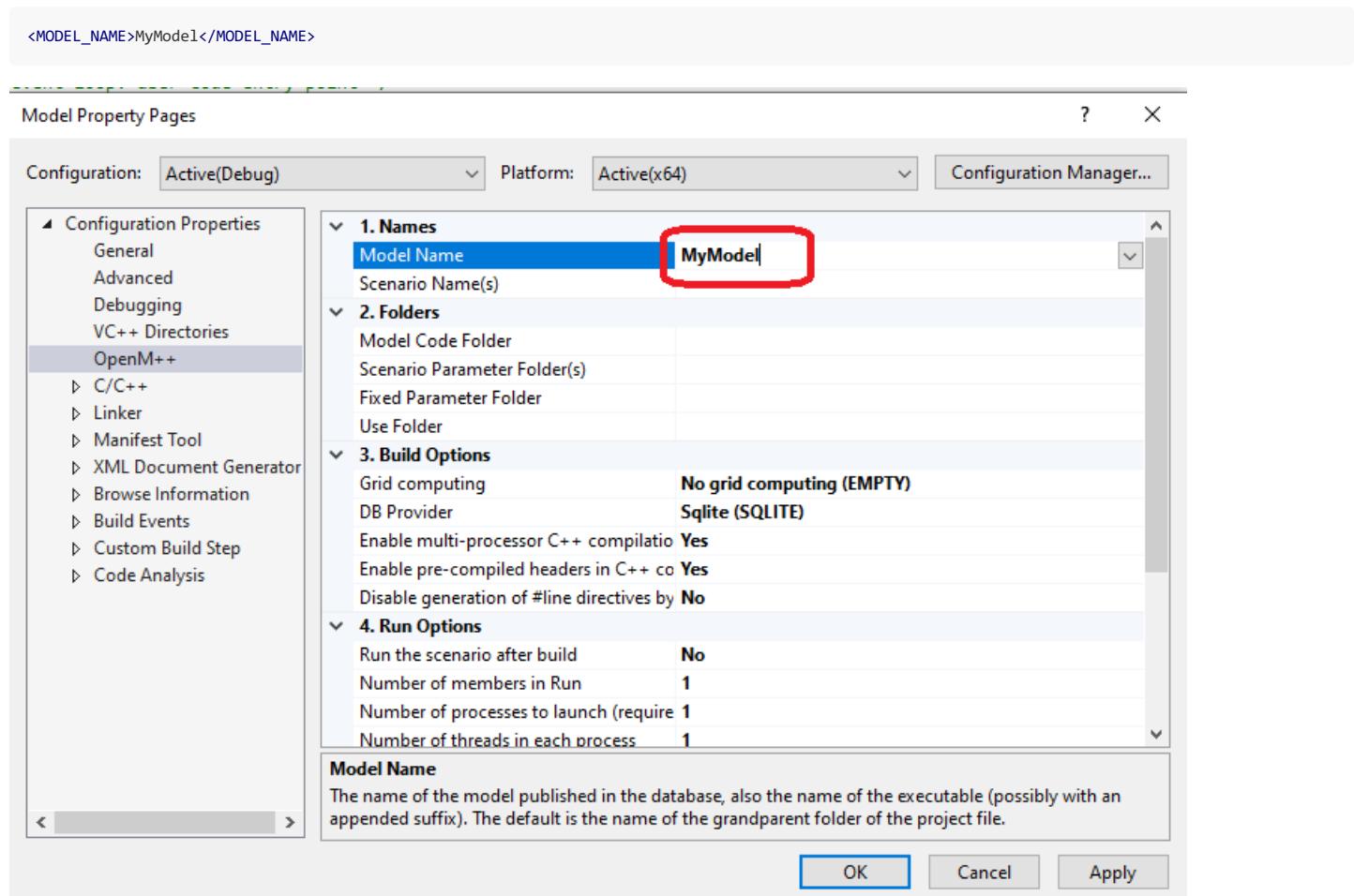
Before you begin

Download and unzip openM++ [Windows desktop binaries](#) into any directory, for example: `C:\openmpp_win_20210112\`

Create New Model

- create new directory for your model under models subfolder i.e.: `C:\openmpp_win_20210112\models\MyModel`. It is not required, but recommended to have folder name same as your model name.
- copy one of the test model VC++ project files into your model subfolder, i.e.: from `C:\openmpp_win_20210112\models\NewCaseBased\ompp*` into `C:\openmpp_win_20210112\models\MyModel\ompp`
- copy your model files `*.ompp *.mpp` and `custom.h` files into `C:\openmpp_win_20210112\models\MyModel\code\` subfolder
- copy your data files `*.odat *.dat` files into `C:\openmpp_win_20210112\models\MyModel\parameters\Default\` subfolder
- start Visual Studio and open `C:\openmpp_win_20210112\models\MyModel\ompp\Model.vcxproj` project
- save your new `Model.sln` solution
- build your model

You can set model name of your new model using Visual Studio menu: Project -> Properties -> Configuration Properties -> OpenM++ -> Name -> Model Name: MyModel or by editing `C:\openmpp_win_20210112\models\MyModel\ompp\Model.props` in Notepad:



Create multiple input sets of parameters (multiple scenarios)

In example above we were creating only one "Default" scenario for our model from *.dat files in `parameters/Default` directory. It is also possible to create multiple input sets of parameters (multiple scenarios) when you are building the model:

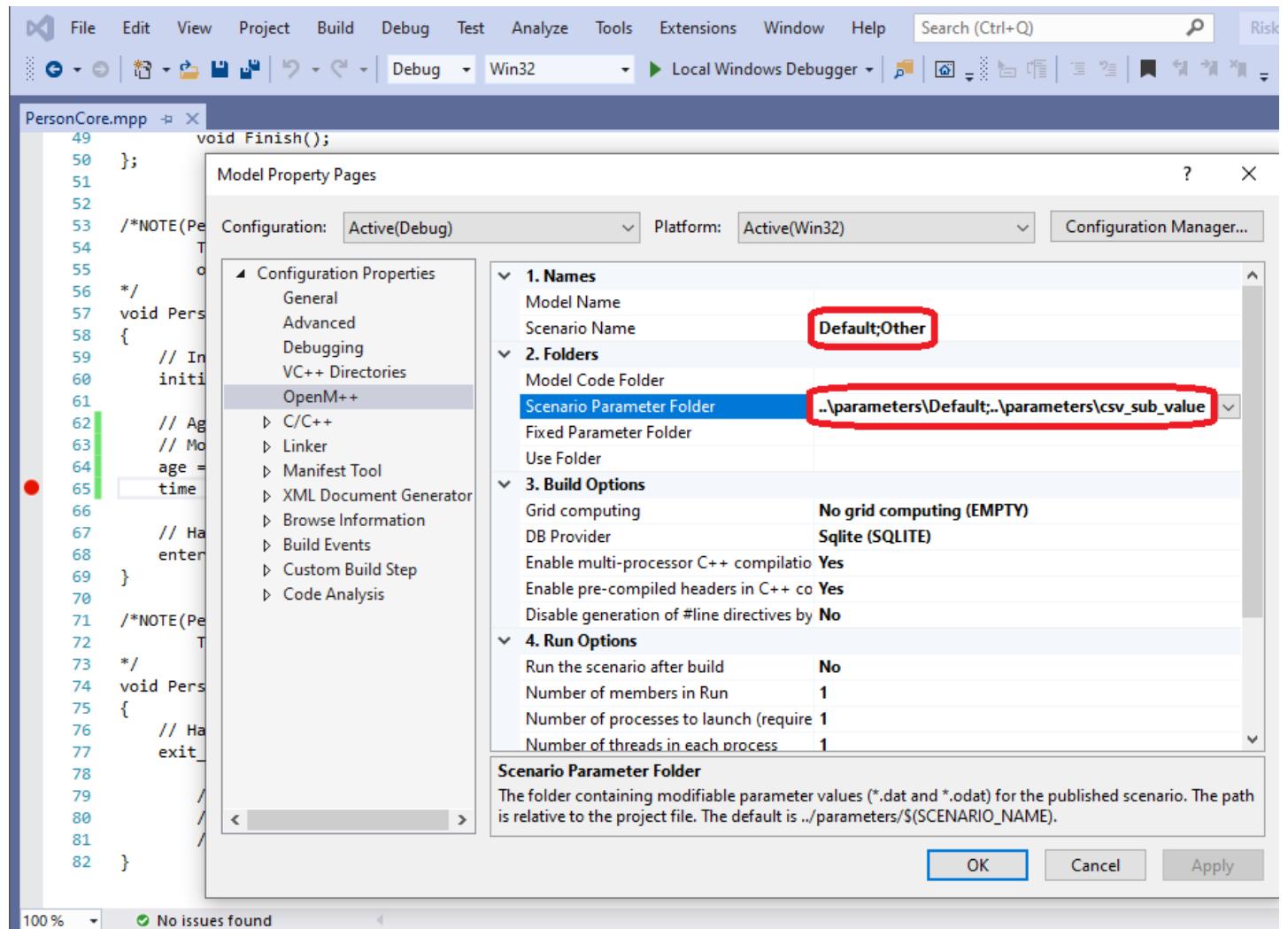
- go to menu: Project -> Properties -> Configuration Properties -> OpenM++
- change: Names -> Scenario Names -> Default;Other
- change: Folders -> Scenario Parameter Folders -> ..\parameters\Default;..\parameters\Other
- Rebuild the project

As result you will create two input sets of parameters in the model.sqlite database:

- scenario "Default" from `.dat`, `.odat`, `.csv` and `.tsv` files in `..\parameters\Default` directory
- scenario "Other" from `.csv` and `.tsv` files in `..\parameters\Other` directory

Please notice: additional scenario directory can contain only CSV or TSV files and not `.dat` or `.odat` files.

To find out more about CSV and TSV parameter files please read: [How to use CSV or TSV files for input parameters values](#)



Debug your Model

- build your model as described above
- open any model.omp or *.mpp file and put breakpoint in it
- start debugger
- to inspect model parameters go to Watch tab and do "Add item to watch"

```

177  TIME Person::timeUnion1DissolutionEvent()
178  {
179      double dHazard = 0;
180      TIME event_time = TIME_INFINITE;
181
182      if ((union_status == US_FIRST_UNION_PERIOD1 ||
183          union_status == US_FIRST_UNION_PERIOD2) && parity_status == PS_CHILDLESS)
184      {
185          dHazard = UnionDurationBaseline[U0_FIRST][union_duration];
186          if (dHazard > 0) ≤2ms elapsed
187          {
188              event_time = WAIT(-log(RandUniform(5)) / dHazard);
189          }
190      }
191      return event_time;
192  }
193
194 void Person::Union1DissolutionEvent()

```

100 % No issues found

Watch 1		
Search (Ctrl+E)		Search Depth: 3
Name	Value	Type
SimulationCases	5000	const __int64 &
UnionDurationBaseline	0x013f3278 {0x013f3278 {0.009601699999999995, 0.019999400000000001, 0....	const double[2][6] &
[0]	0x013f3278 {0.009601699999999995, 0.01999940000000001, 0.0199994000...	const double[6]
[0]	0.00960169999999995	const double
[1]	0.019999400000000001	const double
[2]	0.019999400000000001	const double
[3]	0.021317200000000001	const double

Autos Locals Watch 1

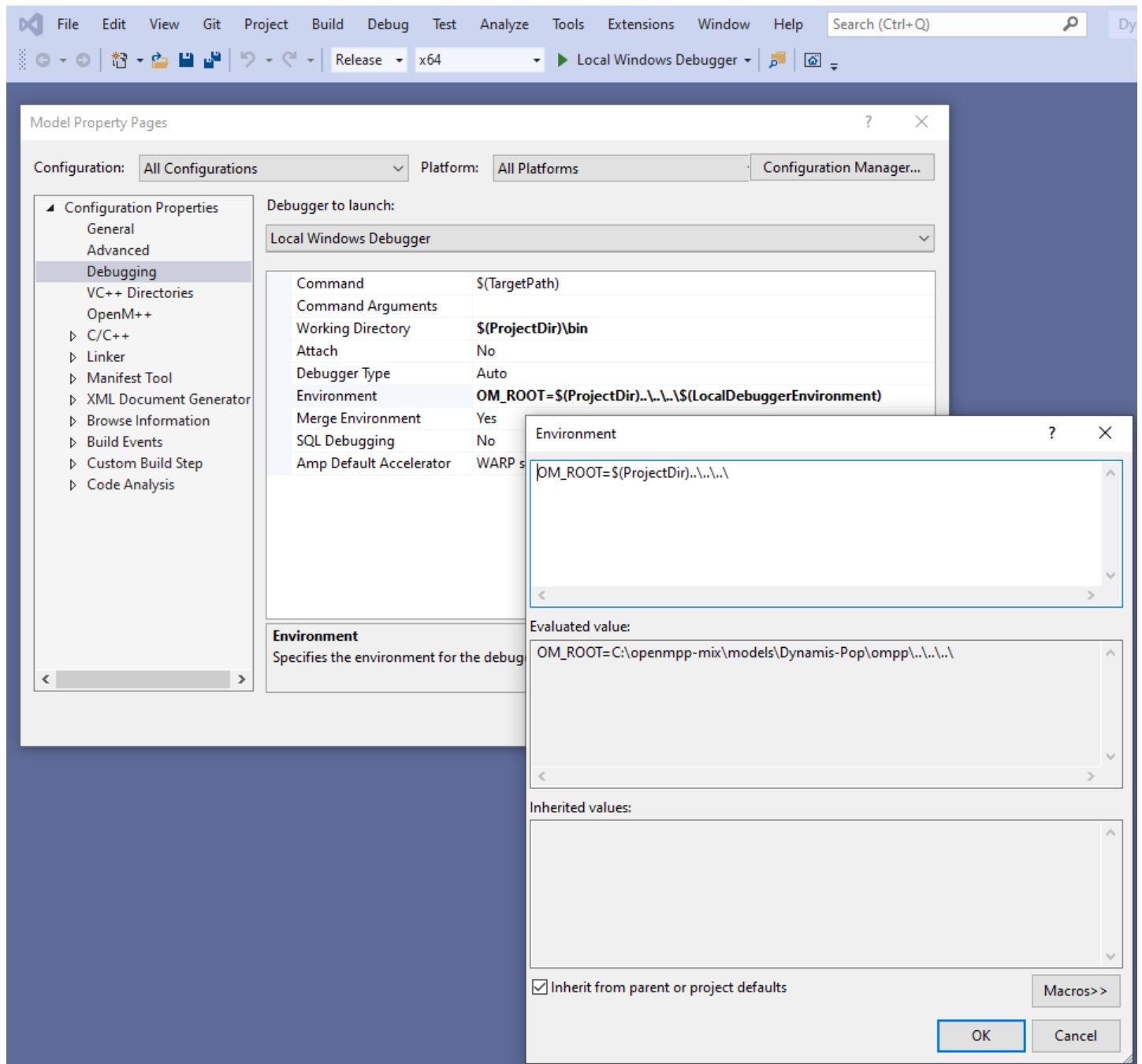
Debug Model with microdata files

If your model using microdata file(s) and in the model code you do open microdata file using environment variable path:

```

input_csv in_csv;
in_csv.open("$OM_ROOT/models/microdata/StartingPopulation_SI_2018.csv");
.....
```

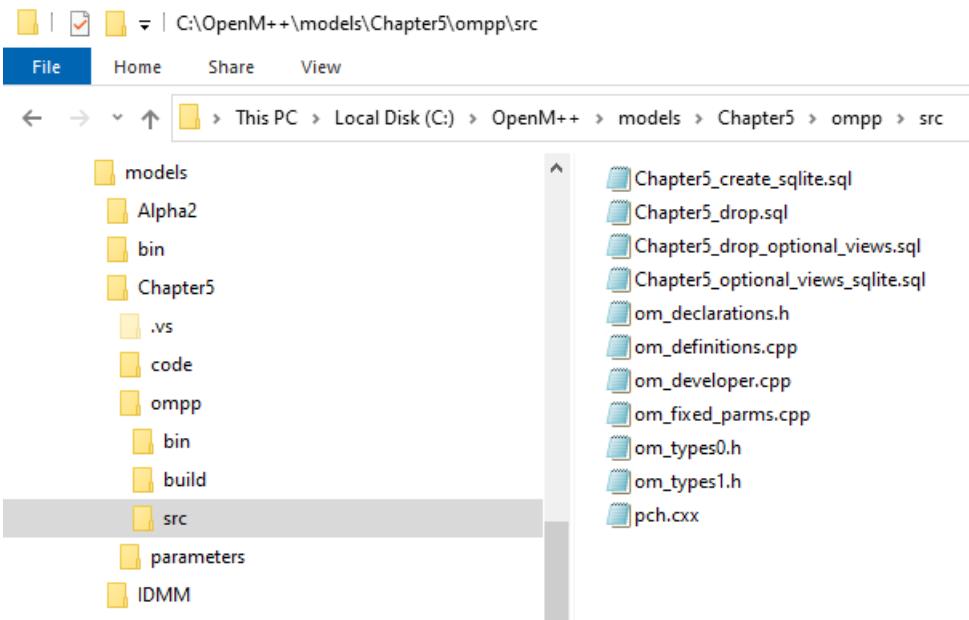
then you need to export environment variable `OM_ROOT` into your debugging environment. For example, if your openM++ location is: `C:\openmpp-mix` then: `OM_ROOT=C:\openmpp-mix`. Or, to make it independent from hard coded openM++ installation path, you can set it relative to your project directory: `OM_ROOT=$(ProjectDir)..\..\..\`:



The screenshot shows the Microsoft Visual Studio interface with the 'TablesPopulation.mpp' project selected. A 'Model Property Pages' dialog is open, specifically the 'Configuration Properties' section under 'Debugging'. The 'Environment' entry in the list is highlighted with a red box, containing the value 'OM_ROOT=C:\om_git\LocalDebuggerEnvironment'. The 'Microsoft Visual Studio Debug Console' window below shows a log of simulation progress from January 25, 2021, at 15:22:47, with various simulation metrics like progress percentages and times.

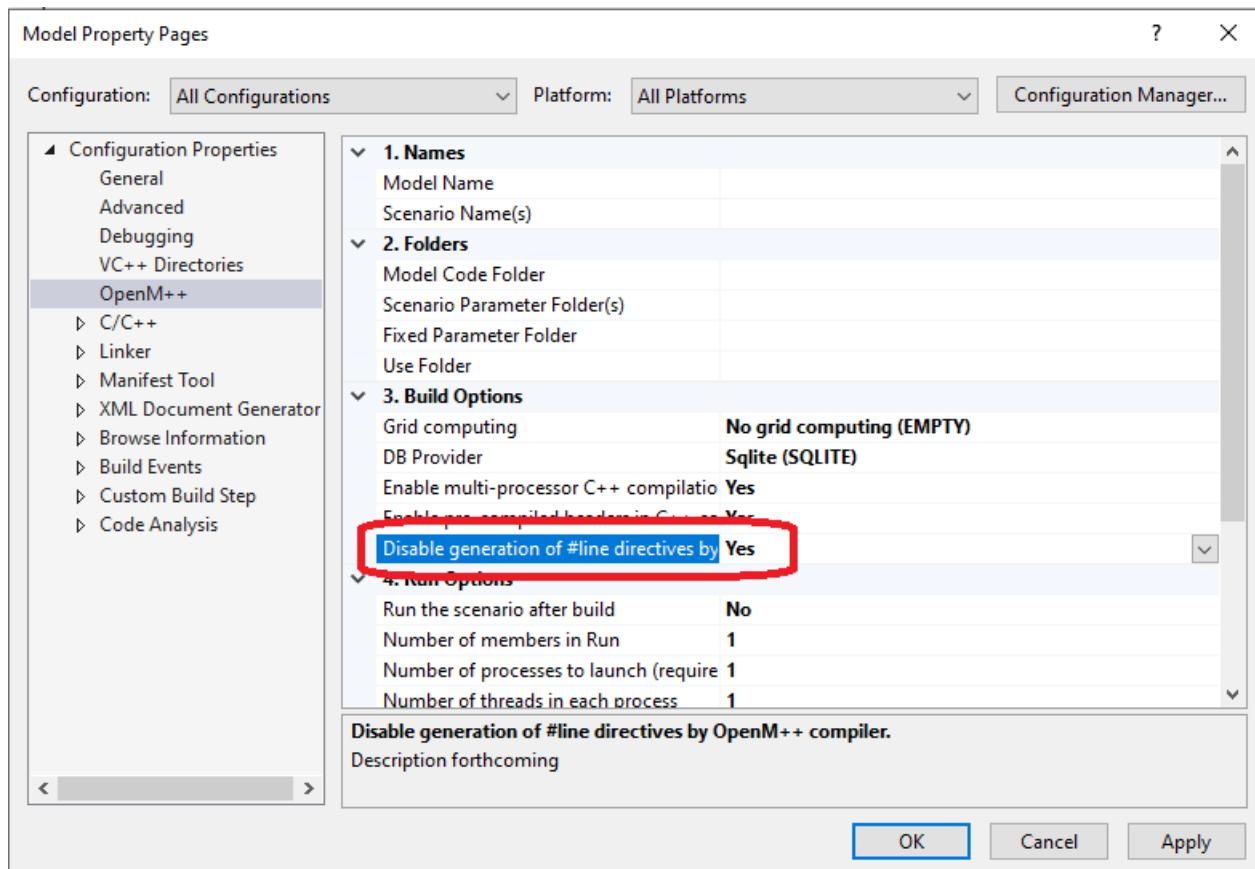
Debug model c++ code

By default model compiled to debug only .ompp and .mpp source files, not a model c++ code. Assuming you have openM++ installed in C:\openmpp_win_20210112 directory then model [Chapter5](#) .cpp and .h source files are located in C:\openmpp_win_20210112\models\Chapter5\ompp\src folder:

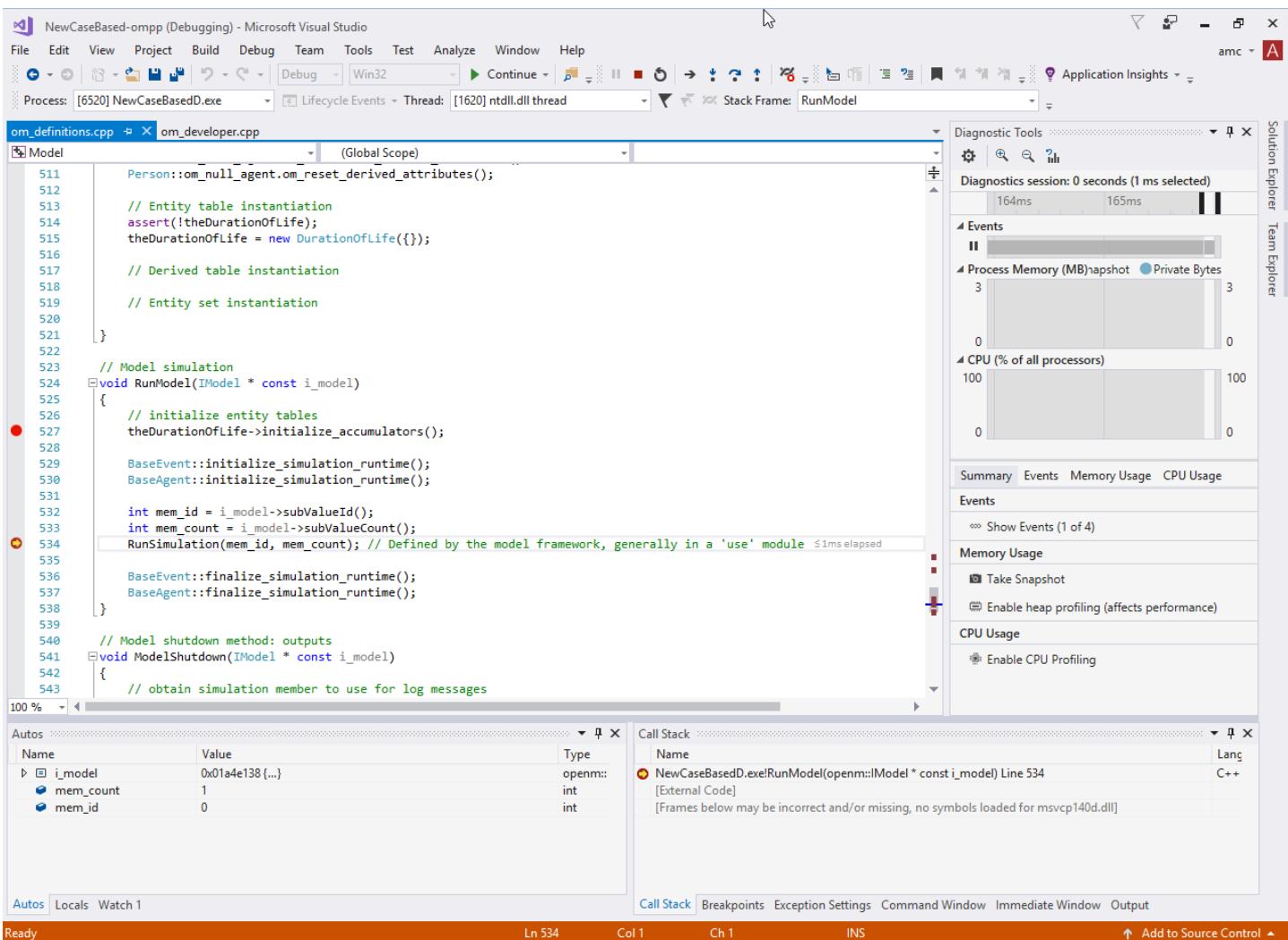


In order to debug model c++ code do following:

- go to menu: Project -> Properties -> Configuration Properties -> OpenM++ -> Disable generation of #line directives = Yes



- Rebuild the model project by going to menu Build -> Rebuild Solution
- put debug breakpoints at the `om_developer.cpp RunSimulation()` or other entry points of your choice, e.g.: `om_definitions.cpp RunModel()`
- start debugger

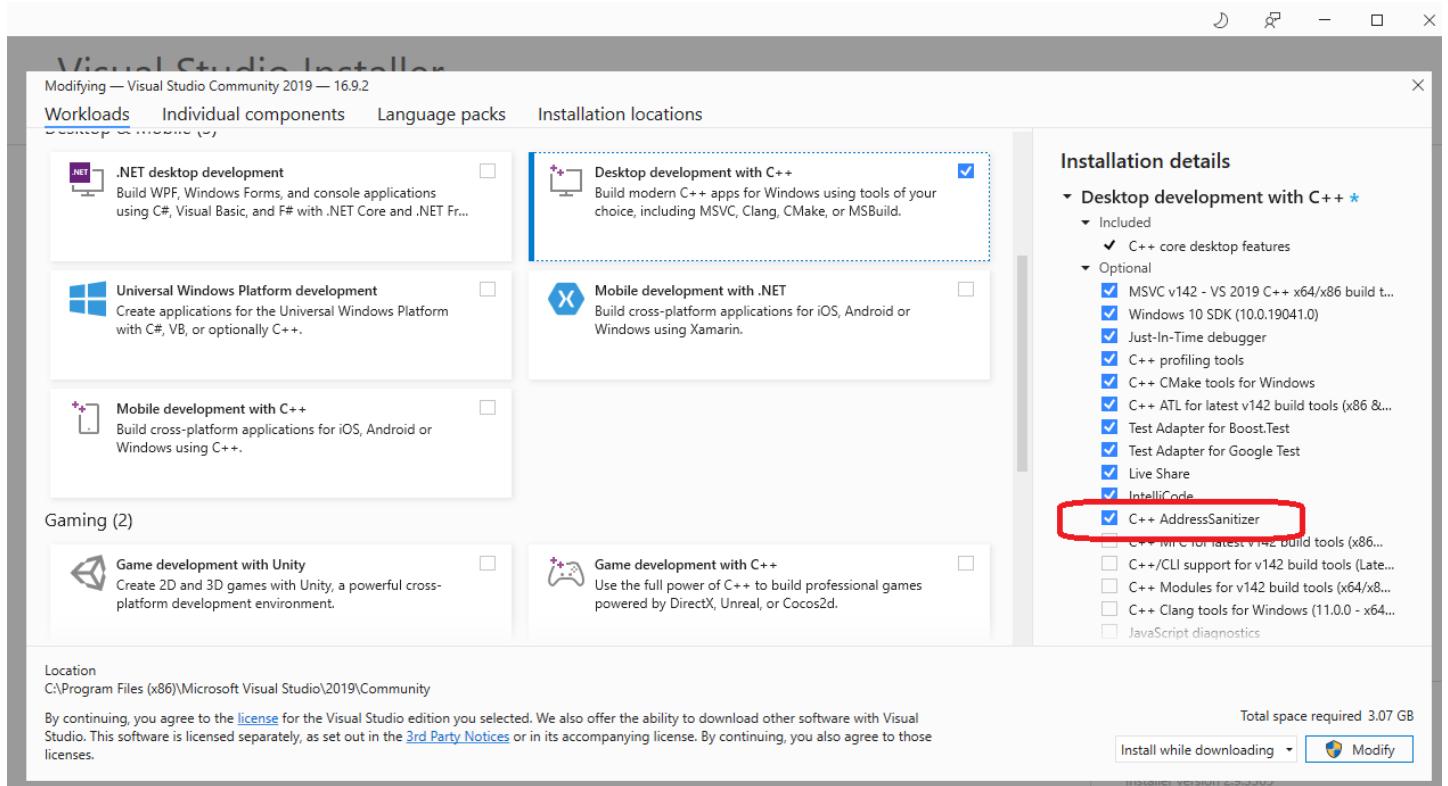


Use AddressSanitizer to catch memory violation bugs

Starting from version 16.9 Visual Studio include [AddressSanitizer](#) tool which allow to catch most of memory violation bugs. For example:

```
int x[10];
int main (int argc, char ** argv)
{
    x[20] = 20; // error: global buffer overflow
    .....
}
```

If you want to add AddressSanitizer to your existing pre-version 16.9 Visual Studio installation start Visual Studio Installer, choose **Modify** and select "C++ AddressSanitizer":



To build your model with AddressSanitizer do following:

- exit from Visual Studio
- copy your existing model project to some backup location:

```
copy C:\openmpp_win_20210112\models\MyModel\ompp\Model.vcxproj* C:\my\safe\place\
```

- copy AddressSanitizer version of model project. For example if openM++ installed into `C:\openmpp_win_20210112` directory and your model directory is `MyModel` then do:

```
copy C:\openmpp_win_20210112\props\ompp-asan\Model.vcxproj C:\openmpp_win_20210112\models\MyModel\ompp\
copy C:\openmpp_win_20210112\props\ompp-asan\Model.vcxproj.filters C:\openmpp_win_20210112\models\MyModel\ompp\
```

- start Visual Studio, open your model openM++ solution `C:\openmpp_win_20210112\models\MyModel\MyModel-ompp.sln`
- **Important: clean existing model build.** You can do it by Menu -> Build -> Clean Solution
- build your model

Now you can run your model from Visual Studio as usually, with or without debugger.

To run model.exe with AddressSanitizer from command line (outside of Visual Studio) use VS 2019 Native Tools command prompt:

- open command line prompt
- set 64 or 32 bit environment:
 - "C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\Auxiliary\Build\vcvars64.bat"
 - "C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\Auxiliary\Build\vcvars32.bat"
- run your model.exe:

```
cd \openmpp_win_20210112\models\MyModel\ompp\bin
MyModel64D.exe
```

Restore your original Model project from `C:\my\safe\place\Model.vcxproj*` after you done with AddressSanitizer.

Linux: Create and Debug Models

What do you need

- Download: [latest binary files and source code](#)
- Documentation: [Linux Quick Start for Developers](#)

Before you begin

- check your g++ --version:

```
g++ (Debian 8.3.0-6) 8.3.0
g++ (Ubuntu 9.3.0-10ubuntu2) 9.3.0
g++ (GCC) 8.3.1 20191121 (Red Hat 8.3.1-5)
```

Optional:

If you want to debug your model then you will need to rebuild openM++ runtime library first as described at [Linux Quick Start for Developers](#)

To build and run **debug version** of the model use desktop (non-MPI) version of openM++:

```
wget https://github.com/openmpp/main/releases/download/v1.8.3/openmpp_debian_20210304.tar.gz
tar xzf openmpp_debian_20210304.tar.gz
cd openmpp_debian_20210304/openm/
make libopenm
```

Create new Model

- create new directory for your model under models subfolder i.e.: `models/MyModel`
- copy other test model makefile into your model folder, copy your model files and data files:

```
cd openmpp_debian_20210304/models/
mkdir MyModel
cd MyModel
cp ../NewCaseBased/makefile .
mkdir code
cp ~/my_model_sources/*mpp code
cp ~/my_model_sources/*.cpp code
cp ~/my_model_sources/*.h code
mkdir -p parameters/Default
cp ~/my_model_data/*dat parameters/Default
```

- build your model and "publish" it:

```
make all publish
```

- run the model:

```
cd ompp-linux/bin
./MyModelD
cd ..
```

Please note: It is recommended (not required) to have directory name exactly the same as model name. Linux file and directory names are case-sensitive and `myModel` is **not** the same as `MyModel`

Create multiple input sets of parameters (multiple scenarios)

In example above we were creating only one "Default" scenario for our model from *.dat files in `parameters/Default` directory. It is also possible to create multiple input sets of parameters (multiple scenarios) when you are building the model:

```
make SCENARIO_NAME=Default,Other OMC_SCENARIO_PARAM_DIR=parameters/Default,parameters/SomeOther all publish
```

Above command will create two input sets of parameters:

- scenario "Default" from `.dat`, `.odat`, `.csv` and `.tsv` files in `parameters/Default` directory

- scenario "Other" from .csv and .tsv files in parameters/SomeOther directory

Please notice: additional scenario directory can contain only CSV or TSV files and not .dat or .odat files.

To find out more about CSV and TSV parameter files please read: [How to use CSV or TSV files for input parameters values](#)

Use AddressSanitizer to catch memory violation bugs

There is an excellent [AddressSanitizer](#) tool which allow to catch most of memory violation bugs. For example:

```
int x[10];
int main (int argc, char ** argv)
{
    x[20] = 20; // error: global buffer overflow
    .....
}
```

It is not recommended to use AddressSanitizer in production, it slows down model code execution approximately by 70% and double memory usage. For that reason openM++ binary release does not enable AddressSanitizer by default and you will need to re-build openM++ run-time libraries to use it for your models testing.

To enable AddressSanitizer for your developement do:

- unpack openM++ release in separate folder, for example: [~/openmpp-asan](#). It is not recommended to use it in your main development folder
- re-build openM++ run-time library: bash cd ~/openmpp-asan rm -rf lib rm -rf build

cd openm make USE_ASAN=1 libopenm make USE_ASAN=1 RELEASE=1 libopenm

```
* rebuild your model with AddressSanitizer, for example if your model name is `RiskPaths` you can build Debug and Release model versions by:
```
bash
cd ~/ompp-main/models/RiskPaths
make cleanall
make USE_ASAN=1 all publish
make USE_ASAN=1 RELEASE=1 all publish
```

- and now you can run Debug or Release version of your model:

```
cd ompp-linux/bin
./RiskPathsD
./RiskPaths
```

Please notice, Debug version of the model executable is always significantly slower than Release. It is recommended to prepare smaller version of your test scenario to run it with Debug model. Or, maybe adjust some parameters from default scenario, for example:

```
cd ompp-linux/bin
./RiskPathsD -Parameter.SimulationCases 1234
```

## Debug your Model using Visual Studio Code

### Prerequisites:

- install [Visual Studio Code](#)
- follow steps described above to [create new model](#)

*Note: In example below we are using RiskPaths demo model, please replace "RiskPaths" with your actual model name.*

Make sure you have GDB, g++, make and other build tools installed on your system, for example on RedHat (CentOS):

```
dnf install gcc-c++
dnf install make
dnf install bison flex
dnf install git
dnf install sqlite
dnf install gdb
```

Start Visual Studio Code and go to: File -> Open Folder... -> `~/openmpp_debian_20210304/models/RiskPaths`

Create build task for your model using menu: Terminal -> Configure Tasks...

```
{
 // See https://go.microsoft.com/fwlink/?LinkId=733558
 // for the documentation about the tasks.json format
 "version": "2.0.0",
 "tasks": [
 {
 "label": "build-RiskPaths",
 "type": "shell",
 "command": "make all publish run",
 "problemMatcher": "$gcc",
 "group": {
 "kind": "build",
 "isDefault": true
 },
 "dependsOrder": "sequence",
 "dependsOn": [
 "build-libopenm",
 "stop-ui-RiskPaths"
]
 },
 {
 "label": "start-ui-RiskPaths",
 "type": "shell",
 "command": "./start-ompp-ui-linux.sh",
 "problemMatcher": []
 },
 {
 "label": "stop-ui-RiskPaths",
 "type": "shell",
 "command": "./stop-ompp-ui-linux.sh",
 "problemMatcher": []
 },
 {
 "label": "clean-RiskPaths",
 "type": "shell",
 "command": "make cleanall",
 "group": "build",
 "problemMatcher": []
 },
 {
 "label": "build-libopenm",
 "type": "shell",
 "command": "make libopenm",
 "options": {
 "cwd": "../../openm"
 },
 "problemMatcher": "$gcc",
 "group": "build"
 }
]
}
```

Create model debug configuration using menu: Debug -> Add Configuration...:

```
{
 // Use IntelliSense to learn about possible attributes.
 // Hover to view descriptions of existing attributes.
 // For more information, visit: https://go.microsoft.com/fwlink/?LinkId=830387
 "version": "0.2.0",
 "configurations": [
 {
 "name": "debug_RiskPaths",
 "type": "cppdbg",
 "request": "launch",
 "program": "${workspaceFolder}/ompp-linux/bin/RiskPathsD",
 "args": [],
 "stopAtEntry": false,
 "cwd": "${workspaceFolder}/ompp-linux/bin",
 "environment": [],
 "externalConsole": false,
 "MIMode": "gdb",
 "setupCommands": [
 {
 "description": "Enable pretty-printing for gdb",
 "text": "-enable-pretty-printing",
 "ignoreFailures": true
 }
]
 }
]
}
```

In order to debug `.mpp` and `.ompp` files as C++ go to menu File -> Preferences -> Settings -> Text Editor -> Files -> Associations -> click on "Edit in settings.json" and add into `settings.json`:

```
{
 "files.associations": {
 "*.mpp": "cpp",
 "*.ompp": "cpp"
 }
}
```

Build your model using Terminal -> Run Build Task...

Start model debugging by using Run -> Start Debugging

- open any `model.ompp` or `*.mpp` file and put breakpoint in it
- (optional) add breakpoint(s) at `RunSimulation` entry point using File -> Open File... -> `use/case_based/case_based_common.ompp` -> `RunSimulation()`
- (optional) you may also add breakpoint(s) at `main` entry point: File -> Open File... -> `openm/libopenm/main.cpp`
- open model with UI by using Terminal -> Run Task... -> `start-ui-RiskPaths`. You can see UI screenshots at [Ompp-UI: openM++ user interface](#) page.

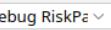
The screenshot shows the Visual Studio Code interface with the following details:

- Title Bar:** case\_based\_common.ompp - openmpp\_centos\_20200604 - Visual Studio Code
- File Menu:** File Edit Selection View Go Run Terminal Help
- Toolbar:** RUN (debug RiskPaths), Variables, Tasks, Launch, etc.
- Code Editor:** Shows a snippet of C++ code for `case_based_common.ompp`. Line 341 is highlighted with a yellow background.
- Sidebar:**
  - VARIABLES:** Shows Local variables (e.g., `thisCase`, `is_step_progress`) and Watch variables.
  - BREAKPOINTS:** Shows a single breakpoint at line 341 of `case_based_common.ompp`.
  - CALL STACK:** Shows the current call stack, including `RiskPathsD` and `RunSimulation`.
- Bottom Status Bar:** Shows 104△8, debug RiskPaths (openmpp\_centos\_20200604), Ln 341, Col 1, Spaces: 4, UTF-8, LF, C++, Linux, and other icons.

To inspect model parameters add Watch variable:

Unions.mpp - RiskPaths - Visual Studio Code

File Edit Selection View Go Run Terminal Help

R...         

VARIABLES

Locals

```
dHazard: 0.009601699999999995
> event_time: {...}
> this: 0x7fffc003fd0
```

WATCH

```
SimulationCases: 5000
UnionDurationBaseline: [2]
[0]: 0.00960169999999995
[1]: 0.019999400000000001
[2]: 0.019999400000000001
[3]: 0.021317200000000001
[4]: 0.015083600000000001
```

CALL STACK

```
RiskPathsD PAUSED
RiskPathsD PAUSED ON BREAKPOINT
Person::timeUnion1DissolutionEvent
Event<Person, 2, 0, 2, &Person:
BaseEvent::clean(BaseEvent * co...
BaseEvent::clean_all() Even...
BaseEvent::do_next_event() Ev...
SimulateEvents() case_based_...
CaseSimulation(case_info & ci)
```

BREAKPOINTS

- Unions.mpp code 186
- Unions.mpp code 211

code > Unions.mpp > Person::timeUnion1DissolutionEvent()

```
180 TIME event_time = TIME_INFINITE;
181
182 if ((union_status == US_FIRST_UNION_PERIOD1 ||
183 union_status == US_FIRST_UNION_PERIOD2) && parity_status == PS_CHILDLESS)
184 {
185 dHazard = UnionDurationBaseline[U0_FIRST][union_duration];
186 if (dHazard > 0)
187 {
188 event_time = WAIT(-log(RandUniform(5)) / dHazard);
189 }
190 }
191 return event_time;
192 }
193
194 void Person::Union1DissolutionEvent()
195 {
196 union_status = US_AFTER_FIRST_UNION;
197 }
198 /*NOTE(Person.Union2DissolutionEvent, EN)
The second union dissolution event. Union events are only simulated for
childless women, as pregnancy censors the union career.
202 */
203 TIME Person::timeUnion2DissolutionEvent()
```

PROBLEMS 46 OUTPUT DEBUG CONSOLE TERMINAL

```
Loaded '/lib/x86_64-linux-gnu/libc.so.6'. Symbols loaded.
Loaded '/lib/x86_64-linux-gnu/libpthread.so.0'. Symbols loaded.
Loaded '/lib/x86_64-linux-gnu/libc.so.6'. Symbols loaded.
[New Thread 0x7ffff3676700 (LWP 8065)]
[Switching to Thread 0x7ffff3676700 (LWP 8065)]

Thread 2 "RiskPathsD" hit Breakpoint 2, Person::timeUnion1DissolutionEvent (this=0x7fffc003fd0) :
me/anatoly/ompp-main/models/RiskPaths/code/Unions.mpp:186
186 if (dHazard > 0)
Execute debugger commands using "-exec <command>", for example "-exec info registers" will list regis...
ters in use (when GDB is the debugger)
```

Ln 186, Col 9 Tab Size: 4 UTF-8 CRLF C++ Linux

# MacOS: Create and Debug Models

## What do you need

- Download: [latest binary files and source code](#)
- Documentation: [MacOS Quick Start for Developers](#)

## Prerequisites

- Tested on: MacOS 10.15 Catalina And Big Sur >= 11.1.
- Install Xcode and command line developer tools, if not installed already by Xcode: `xcode-select --install`.
- (optional) Install Visual Studio Code for cross-platform development: [MacOS: Install VSCode](#)
- Check if clang, make and sqlite3 are installed on your computer:

```
g++ --version
...
Apple clang version 11.0.0 (clang-1100.0.33.12)

make --version
...
GNU Make 3.81

sqlite3 --version
...
3.28.0 2019-04-15 14:49:49
```

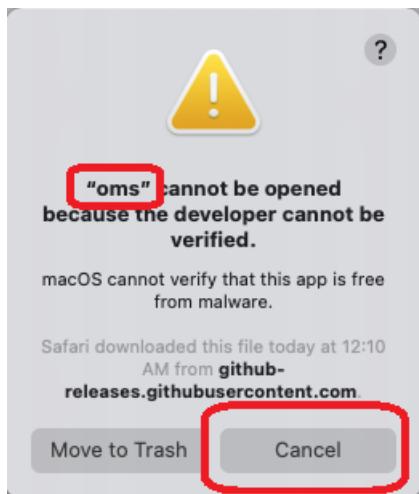
- Download and unpack latest openM++ release using Safari or curl:

```
curl -L -o om.tar.gz https://github.com/openmpp/main/releases/download/v1.6.0/openmpp_mac_20200621.tar.gz
tar xzf om.tar.gz
```

## MacOS security issue

**Make sure you are using tight security settings on your Mac and antivirus software, if necessary. We are trying our best to keep development machines clean, but cannot provide any guarantee.**

On Big Sur it is very likely to get an security error when you are trying to run any downloaded executable:



- please reply "Cancel" to that question (click "Cancel" button).
- remove quarantine attribute from openM++ installation directory, for example:

```
xattr -r -d com.apple.quarantine ~/openmpp_mac_20200621
```

## Create new Model

- create new directory for your model under models sub-folder: `models/MyModel` **Please note:** It is recommended (not required) to have directory name exactly the same as model name.

- copy other test model makefile into your model folder, copy your model files and data files:

```
cd openmpp_mac_20200621/models/
mkdir MyModel
cd MyModel
cp ../NewCaseBased/makefile .
mkdir code
cp ~/my_model_sources/*mpp code
cp ~/my_model_sources/*.cpp code
cp ~/my_model_sources/*.h code
mkdir -p parameters/Default
cp ~/my_model_data/*dat parameters/Default
```

- build your model:

```
make all publish
```

- run the model:

```
cd ompp-mac/bin
./MyModelD
cd ..
```

- you can also build and run the model using make:

```
make all publish run
```

## Create multiple input sets of parameters (multiple scenarios)

In example above we were creating only one "Default" scenario for our model from \*.dat files in `parameters/Default` directory. It is also possible to create multiple input sets of parameters (multiple scenarios) when you are building the model:

```
make SCENARIO_NAME=Default,Other OMC_SCENARIO_PARAM_DIR=parameters/Default,parameters/SomeOther all publish
```

Above command will create two input sets of parameters:

- scenario "Default" from `.dat`, `.odat`, `.csv` and `.tsv` files in `parameters/Default` directory
- scenario "Other" from `.csv` and `.tsv` files in `parameters/SomeOther` directory

**Please notice:** additional scenario directory can contain only CSV or TSV files and not `.dat` or `.odat` files.

To find out more about CSV and TSV parameter files please read: [How to use CSV or TSV files for input parameters values](#)

## Use AddressSanitizer to catch memory violation bugs

There is an excellent [AddressSanitizer](#) tool which allow to catch most of memory violation bugs. For example:

```
int x[10];
int main (int argc, char ** argv)
{
 x[20] = 20; // error: global buffer overflow

}
```

It is not recommended to use AddressSanitizer in production, it slows down model code execution approximately by 70% and double memory usage. For that reason openM++ binary release does not enable AddressSanitizer by default and you will need to re-build openM++ run-time libraries to use it for your models testing.

To enable AddressSanitizer for your developement do:

- unpack openM++ release in separate folder, for example: `~/openmpp-asan`. It is not recommended to use it in your main development folder
- re-build openM++ run-time library: `bash cd ~/openmpp-asan rm -rf lib rm -rf build`

```
cd openm make USE_ASAN=1 libopenm make USE_ASAN=1 RELEASE=1 libopenm
```

```
* rebuild your model with AddressSanitizer, for example if your model name is `RiskPaths` you can build Debug and Release model versions by:
```
cd ~/ompp-main/models/RiskPaths
make cleanall
make USE_ASAN=1 all publish
make USE_ASAN=1 RELEASE=1 all publish
```

- and now you can run Debug or Release version of your model:

```
cd ompp-mac/bin
./RiskPathsD
./RiskPaths
```

Please notice, Debug version of the model executable is always significantly slower than Release. It is recommended to prepare smaller version of your test scenario to run it with Debug model. Or, maybe adjust some parameters from default scenario, for example:

```
cd ompp-mac/bin
./RiskPathsD -Parameter.SimulationCases 1234
```

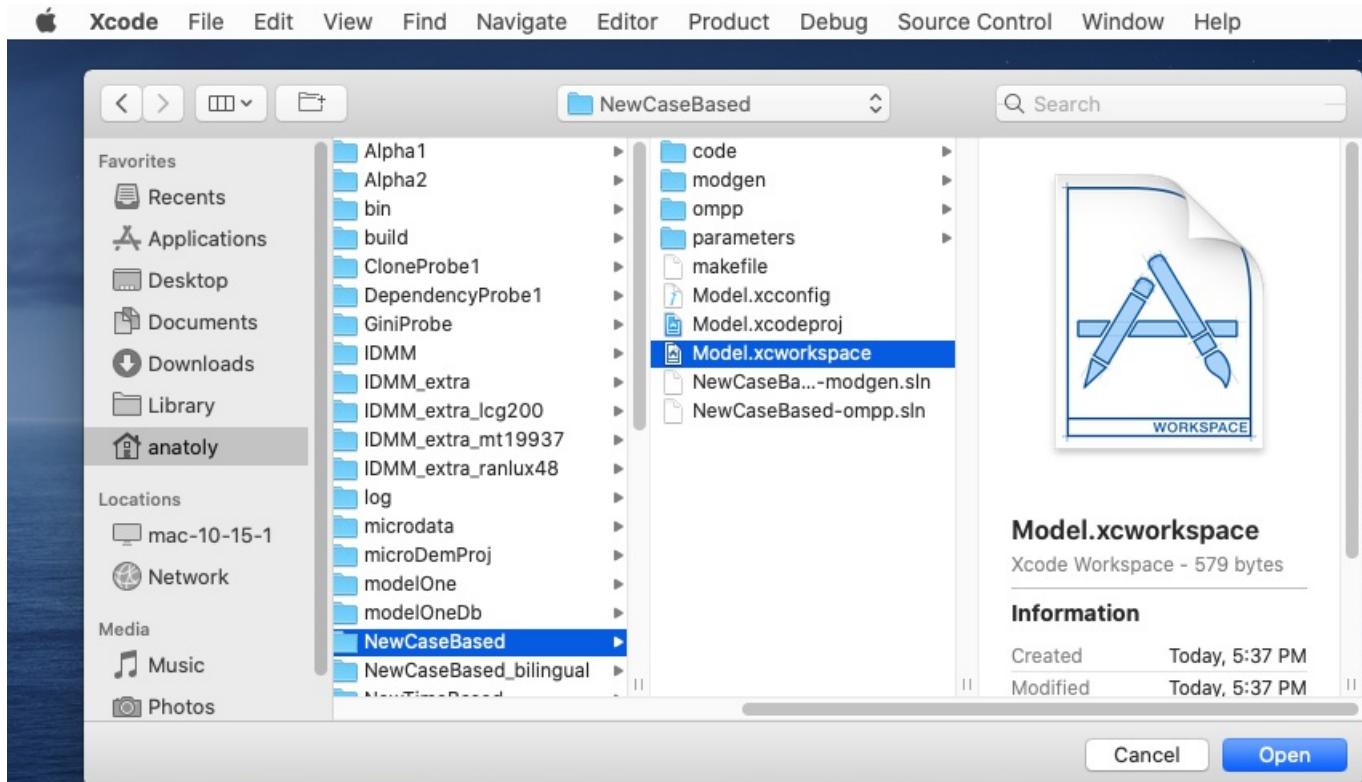
How to use Xcode

Create Xcode project for new Model

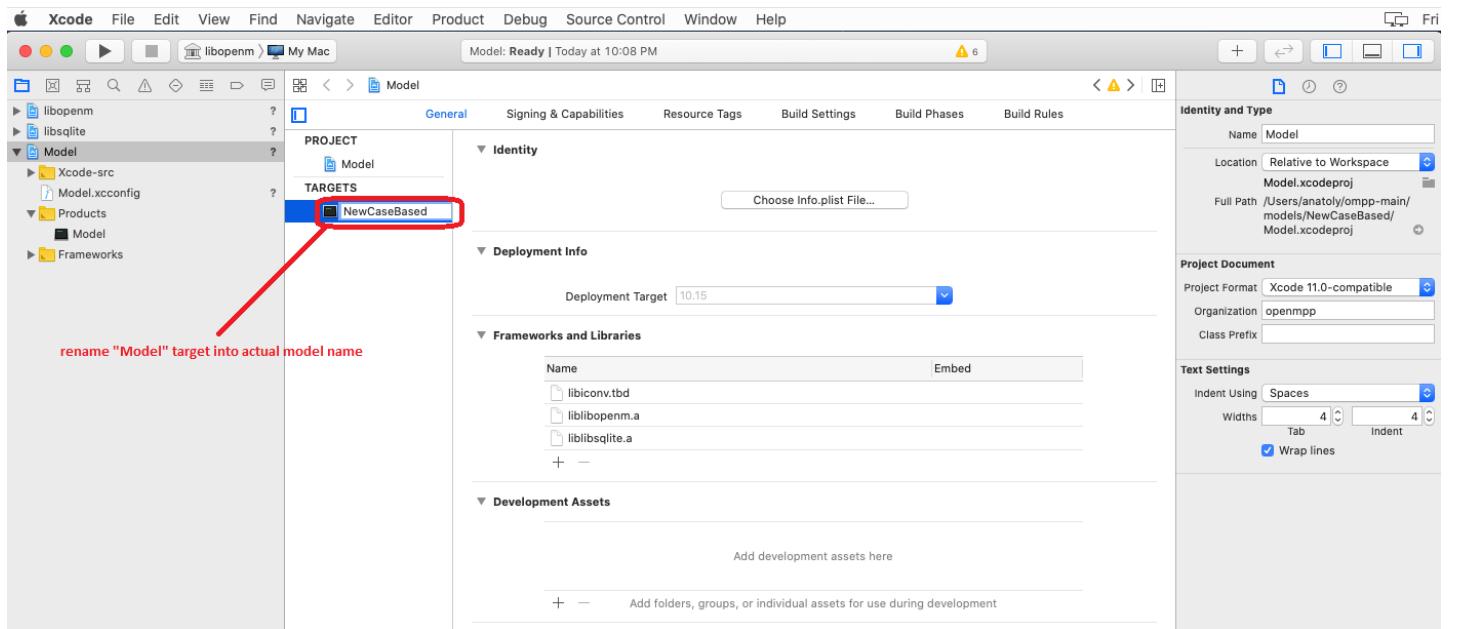
Copy model Xcode project files into your new "MyModel" directory, for example:

```
cd ~/openmpp_mac_20200621
cp -pr Xcode/Model.* models/MyModel/
```

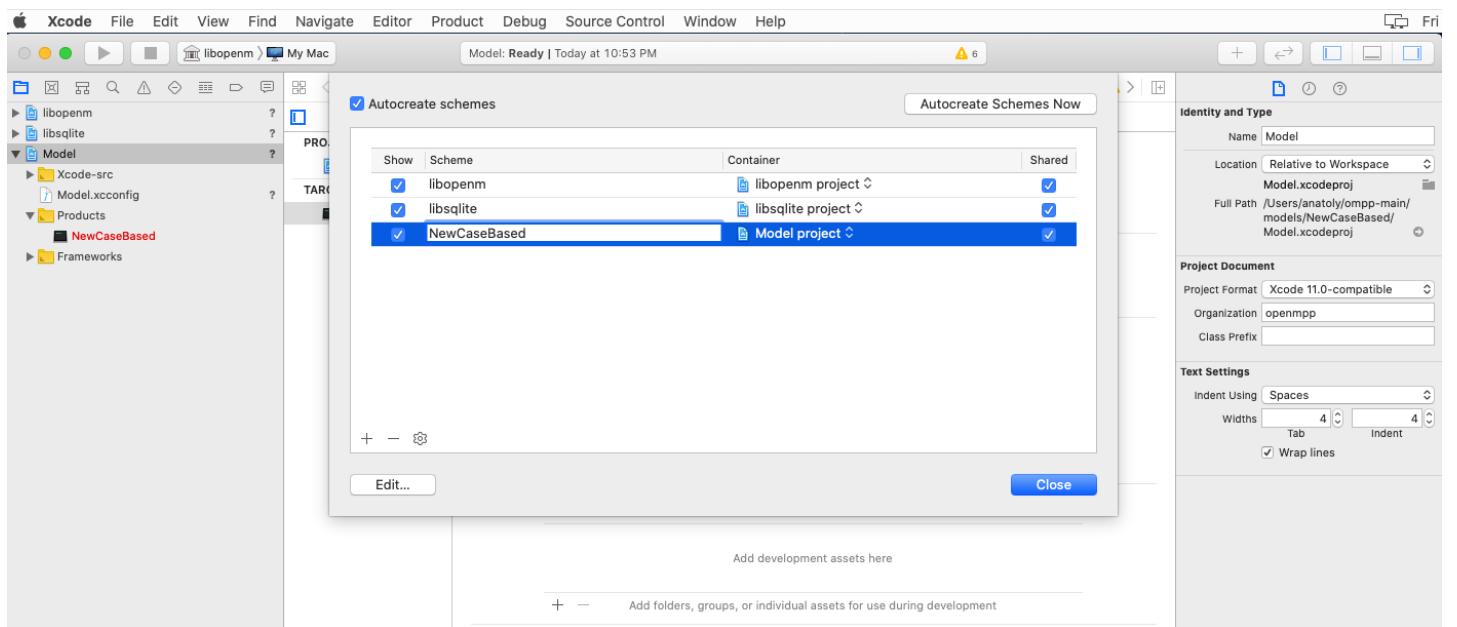
Start Xcode and open [~/openmpp_mac_20200621/models/MyModel/Model.xcworkspace](#):



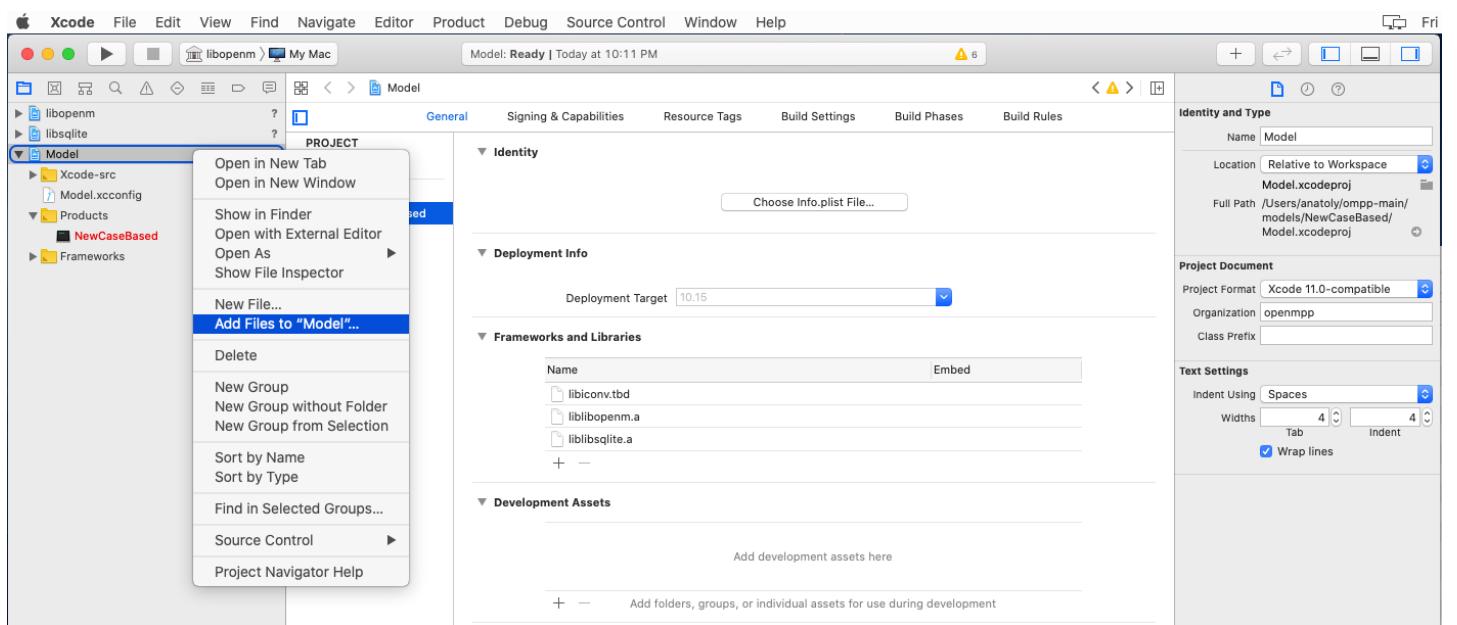
Rename model Project -> Targets -> click twice on target name -> and rename to MyModel

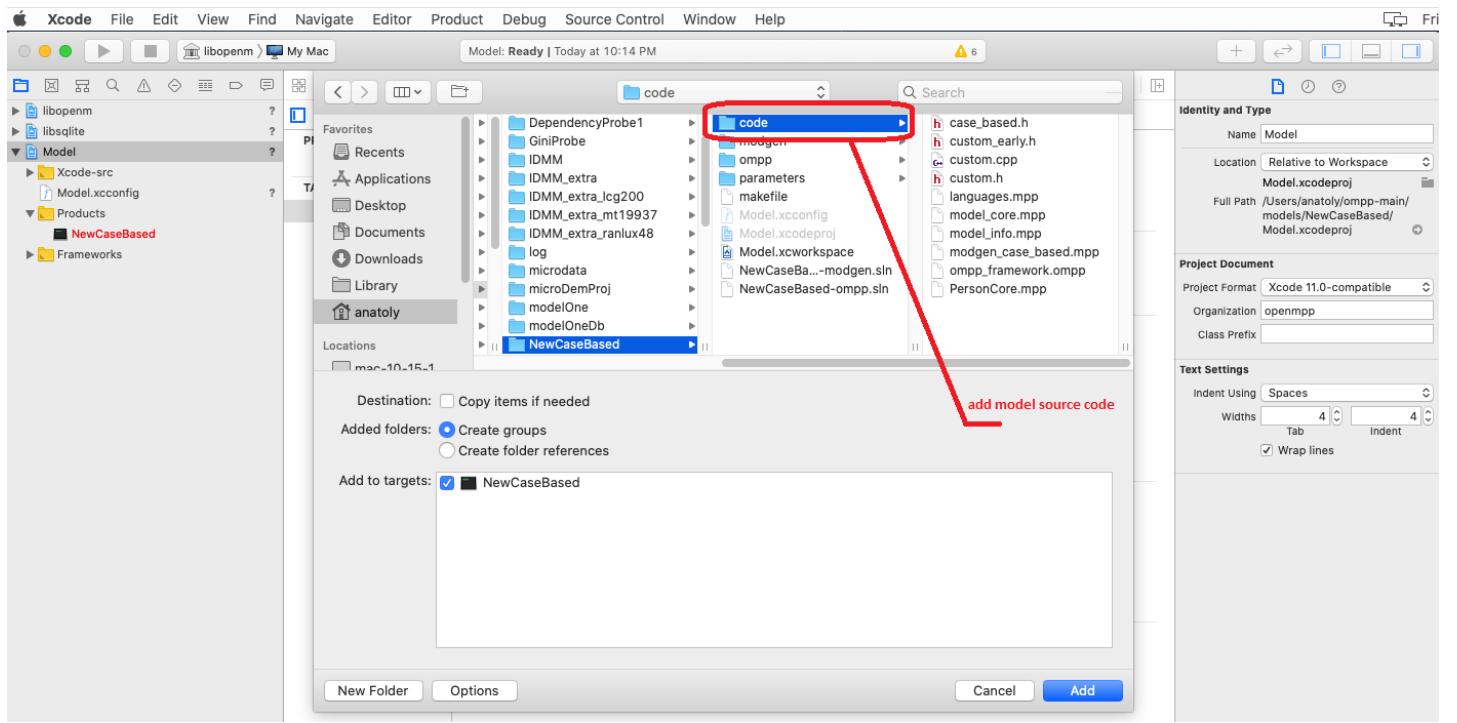


Rename model scheme using menu: Product -> Scheme -> Manage Schemes... -> click twice on "Model" scheme -> and rename to MyModel

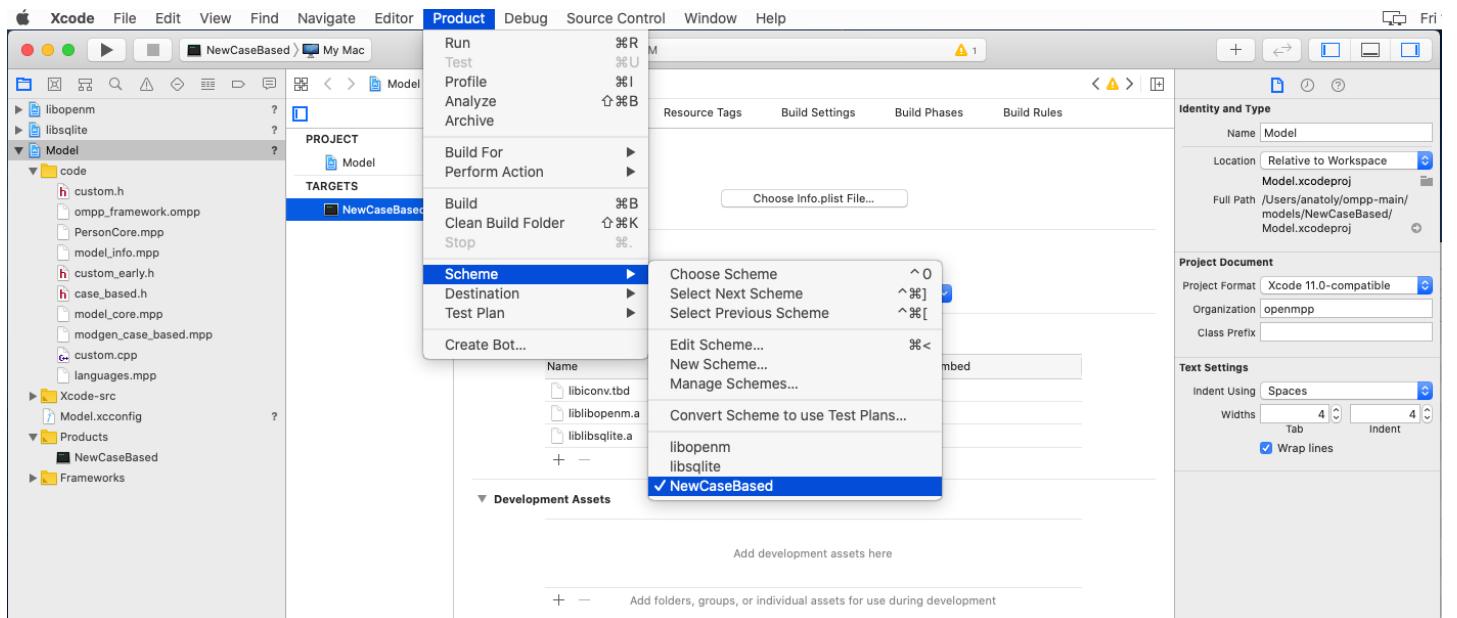


Add your model source code from `MyModel/code` folder:

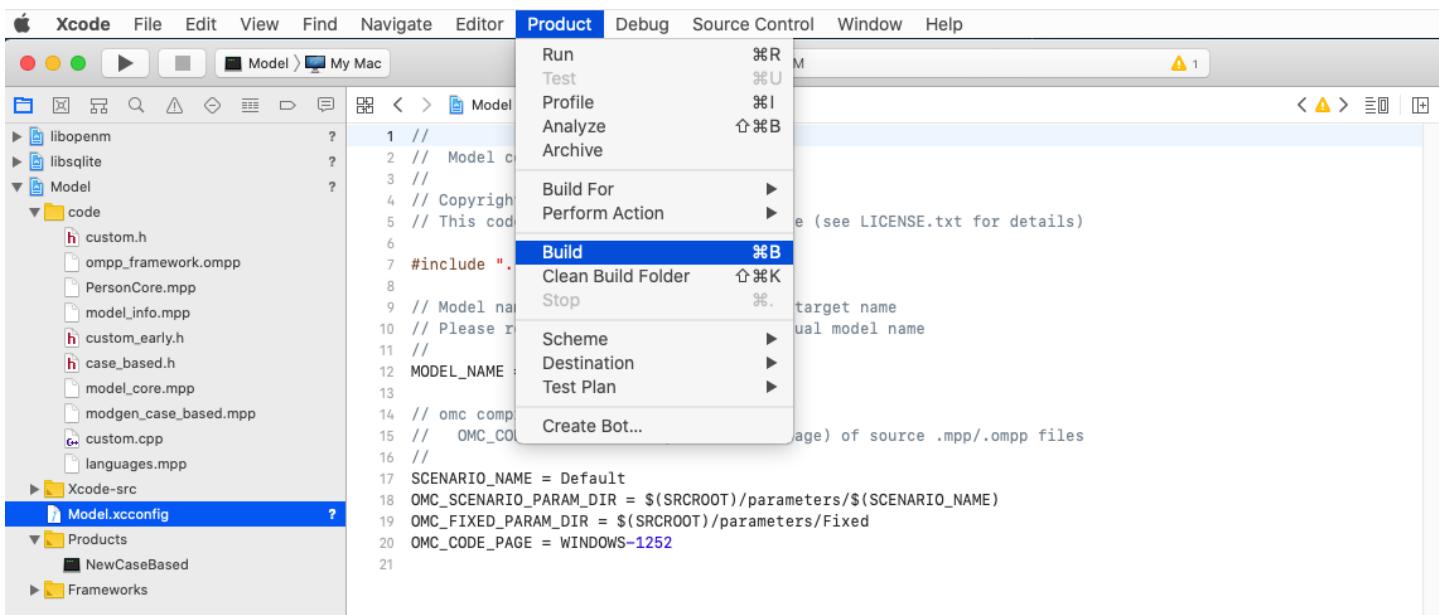




Make sure your model scheme selected by using menu: Product -> Scheme -> MyModel:

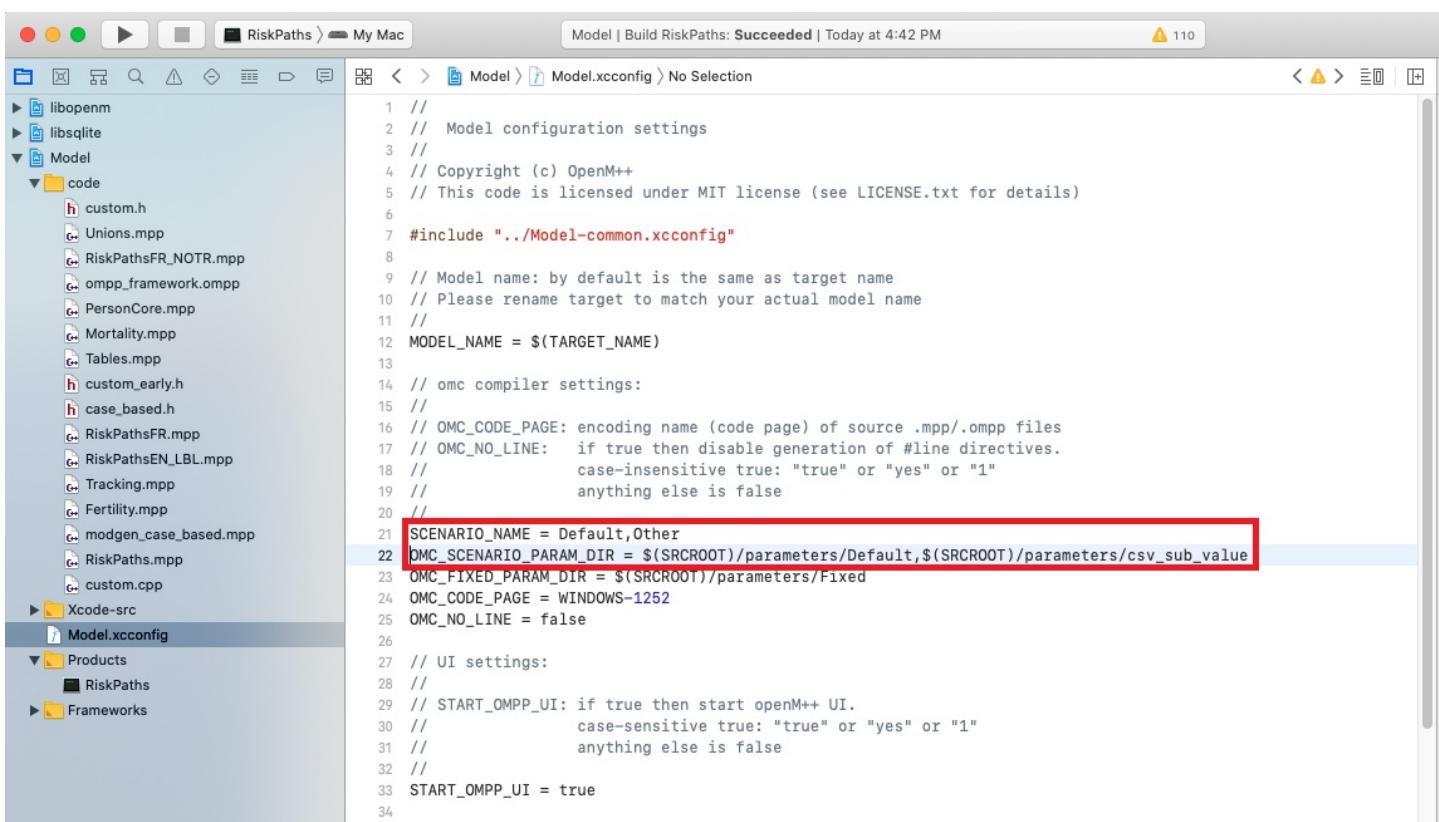


Build your model:



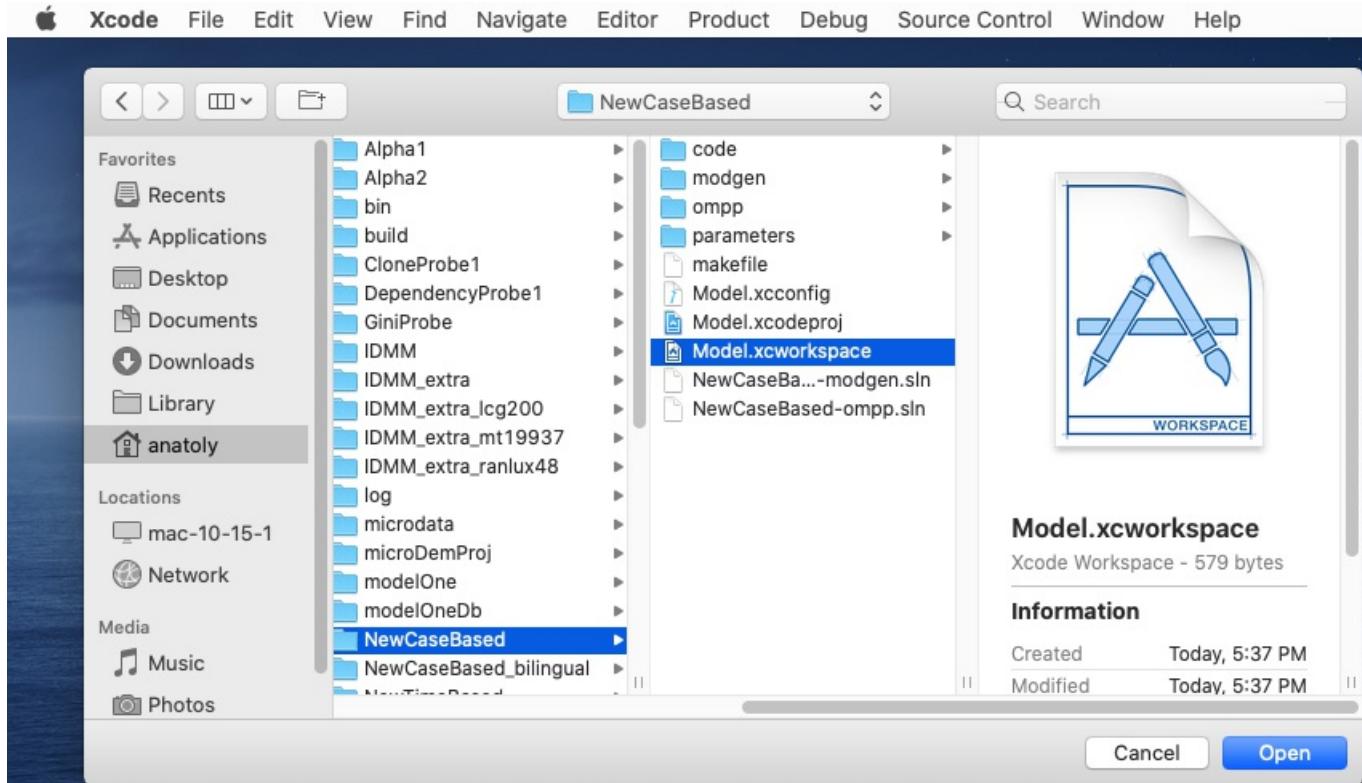
(Optional) Build the model with multiple scenarios:

- edit `Xcode-src/Model.xcconfig` and to specify additional scenario names and input directories, separated by comma. For example:
 - `SCENARIO_NAME = Default,Other`
 - `OMC_SCENARIO_PARAM_DIR = $(SRCROOT)/parameters/Default,$(SRCROOT)/parameters/SomeOther`



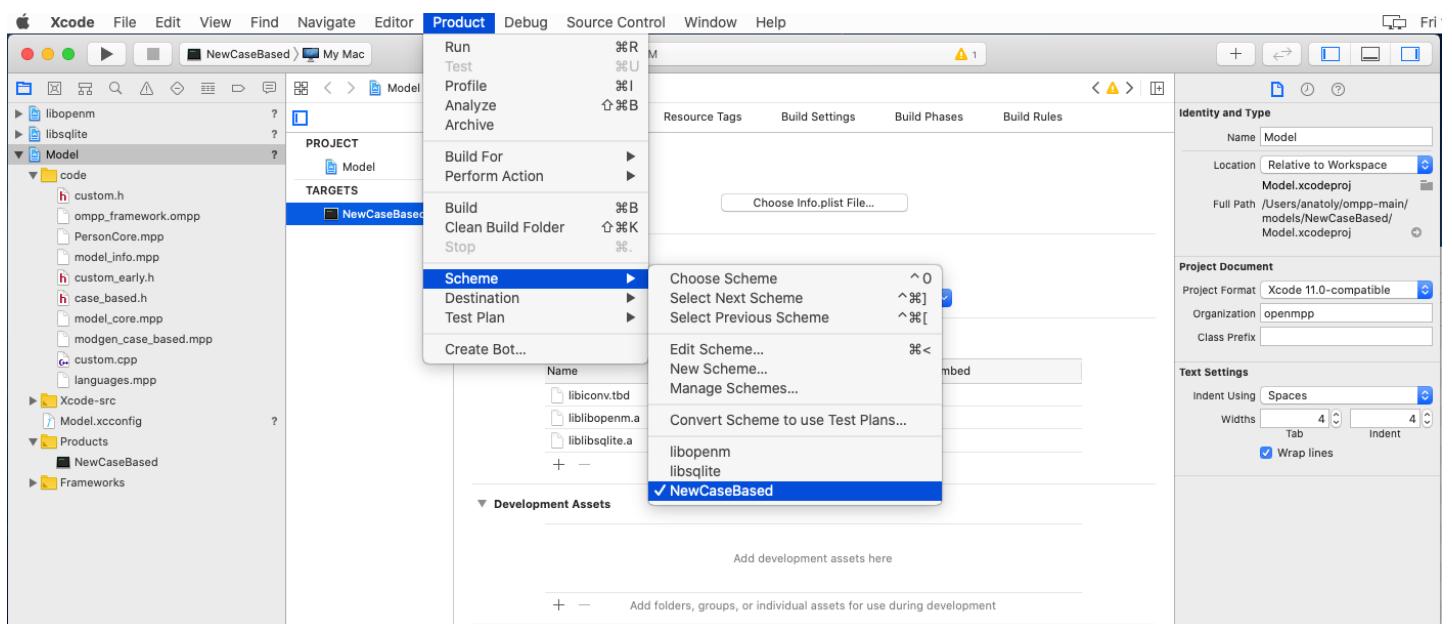
Debug openM++ Model using Xcode

Start Xcode and open your model workspace, for example: `~/openmpp_mac_20200621/models/MyModel/Model.xcworkspace`



Use menu to select your model scheme: Product -> Scheme -> MyModel:

Known issue: Xcode UI may not update check mark on selected scheme. To fix it go to Product -> Scheme -> Manage Schemes... and use mouse to drag any scheme to move it up or down.



(Optional) If you want to set breakpoints in any.*mpp* or .ompp files then tell to Xcode it is "C++ Source" file(s):

for each File.mpp and File.ompp set file type: C++

Identity and Type

- Name: PersonCore.mpp
- Type: C++ Source
- Location: Relative to Group
- PersonCore.mpp
- Full Path: /Users/anatoly/ompp-main/models/NewCaseBased/code/PersonCore.cpp

On Demand Resource Tags

Add to a target to enable tagging

Target Membership

Model

Text Settings

- Text Encoding: Unicode (UTF-8)
- Line Endings: No Explicit Line Endings
- Indent Using: Spaces
- Widths: Tab 4 Indent 4
- Wrap lines

Thread 2: breakpoint 16.2

Thread 2: 0 Person::Start()

(lldb) b -f case_based_common.ompp -l 256

Breakpoint 15: where = Model`RunSimulation(int, int, openm::IModel*) + 77 at case_based_common.ompp:256:25, address = 0x00000010001503d

2020-05-25 21:38:43.380 member=0 Simulation progress=0% cases=0

(lldb) b -l 94

Breakpoint 19: where = Model`Person::Start() + 111 at PersonCore.mpp:94:5, address = 0x000000100012a3f

(lldb)

it is also possible to use lldb commands to set breakpoints

Run and debug your openM++ model:

RiskPaths PID 7987

CPU 0%

Memory 7.2 MB

Energy Impact Zero

Disk Zero KB/s

Network Zero KB/s

Thread 1 Queue: com.apple/thread (serial)

Thread 2

0 RunSimulation(int, int, openm::IModel*)

1 RunModel(openm::IModel*)

2 modelThreadLoop(int, int, openm::IModel*)

3 decltype(std::forward<openm::IModel*>)

4 openm::ExitStatus std::async::asyn

5 std::async::async_func<openm::Exi...

6 std::async::async_assoc_state<open...

7 decltype(*std::forward<std::function<...>>)

8 void std::thread::execute<std::fu...

9 void* std::thread::proxy<std::fu...

10 __pthread_start

11 thread_start

Running RiskPaths : Model

315 // re-use case seed generators cyclically and increment the starting
316 // master_seed for the simulation of the sample.
317 fmk::master_seed = SimulationSeed + (int)simulation_member / max_case_seed_generators;
318 long case_seed_generator = case_seed_generators[simulation_member % max_case_seed_generators];
319
320 // Create stream generator objects
321 // new_streams is generator-specific - defined in random/random_YYY.ompp
322 new_streams();
323
324 for (long long thisCase = 0; thisCase < member_cases; thisCase++) {
325
326 initialize_model_streams(); //defined in common.ompp
327
328 // Initialize global time for the case (can override in StartSimulation)
329 BaseEvent::set_global_time(0);
330
331 // record the encoded case seed (case_seed + simulation_member in high order bits)
332 fmk::combined_seed = fmk::master_seed + simulation_member * ((long long)lcg_modulus + 1);
333
334 // record the case counter within the current simulation member
335 member_case_counter = thisCase;
336
337 // Reset the running event checksum
338 BaseEvent::event_checksum_reset();
339
340 // Simulate the case
341 caseSimulation(ci);

Thread 2: step over

is_percent_progress = [bool] true
percent_progress = (int) 1
next_step_progress = (long long) 0
next_percent_progress = (int) 1
is_100_percent_done = (bool) false
next_progress_beat = (int64_t) 0
next_ms_progress_beat = (int64_t) 1590192137563
ci (case_info) 470583131
case_seed_generator = (long) 470583131

2020-05-22 20:01:21.863 RiskPaths
2020-05-22 20:01:21.872 Prepare fixed and missing parameters
2020-05-22 20:01:21.883 Run: 102
2020-05-22 20:01:21.883 Get scenario parameters for process
2020-05-22 20:01:21.885 member=0 Bind scenario parameters
2020-05-22 20:01:21.885 member=0 Compute derived parameters
2020-05-22 20:01:21.885 member=0 Prepare for simulation
2020-05-22 20:02:16.516 member=0 Simulation progress=0% cases=0

(lldb)

To inspect model parameters go to Debug Area and Add Expression:

RiskPaths > My Mac

Running RiskPaths : RiskPaths

110

RiskPaths PID 4383

- CPU 0%
- Memory 7.8 MB
- Energy Impact Zero
- Disk Zero KB/s
- Network Zero KB/s
- Thread 1 Queue: com.apple.thread(serial)
- Thread 2

0 Person::timeUnion2DissolutionEvent()

```

184     {
185         dHazard = UnionDurationBaseline[U0_FIRST][union_duration];
186         if (dHazard > 0)
187         {
188             event_time = WAIT(-log(RandUniform(5)) / dHazard);
189         }
190     }
191     return event_time;
192 }
193
194 void Person::Union1DissolutionEvent()
195 {
196     union_status = US_AFTER_FIRST_UNION;
197 }
198
199 /*NOTE(Person.Union2DissolutionEvent, EN)
200     The second union dissolution event. Union events are only simulated for
201     childless women, as pregnancy censors the union career.
202 */
203 TIME Person::timeUnion2DissolutionEvent()
204 {
205     double dHazard = 0;
206     TIME event_time = TIME_INFINITE;
207
208     if (union_status == US_SECOND_UNION && parity_status == PS_CHILDLESS)
209     {
210         dHazard = UnionDurationBaseline[U0_SECOND][union_duration];
211         if (dHazard > 0)
212         {
213             event_time = WAIT(-log(RandUniform(6)) / dHazard);
214         }
215     }
216     return event_time;
217 }
218
219 void Person::Union2DissolutionEvent()
220 {
221     union_status = US_AFTER_SECOND_UNION;
222 }
```

Thread 2: breakpoint 2.1

Variables

- this = (Person *) 0x10117b7d0
- dHazard = (double) 0.0370541
- event_time (TIME)
- SimulationCases = (llong) 5000
- UnionDurationBaseline (const double [2][6])
 - [0] = (const double) 0.009601699999999994
 - [1] = (const double) 0.019999400000000001
 - [2] = (const double) 0.019999400000000001
 - [3] = (const double) 0.021317200000000001
 - [4] = (const double) 0.015083600000000001
 - [5] = (const double) 0.0110791

Output

```

2020-08-19 00:21:03.928 RiskPaths
2020-08-19 00:21:03.937 Prepare fixed and missing parameters
2020-08-19 00:21:03.944 Run: 102
2020-08-19 00:21:03.944 Get scenario parameters for process
2020-08-19 00:21:03.945 member=0 Bind scenario parameters
2020-08-19 00:21:03.945 member=0 Compute derived parameters
2020-08-19 00:21:03.945 member=0 Prepare for simulation
2020-08-19 00:21:03.945 member=0 Simulation progress=0%
cases=0
(lldb)
```

Start model UI on MacOS from Xcode

To start model UI after build completed please change `Model.xcconfig` variable `START_OMPP_UI` to "1" or "true" or "yes" (case-sensitive)

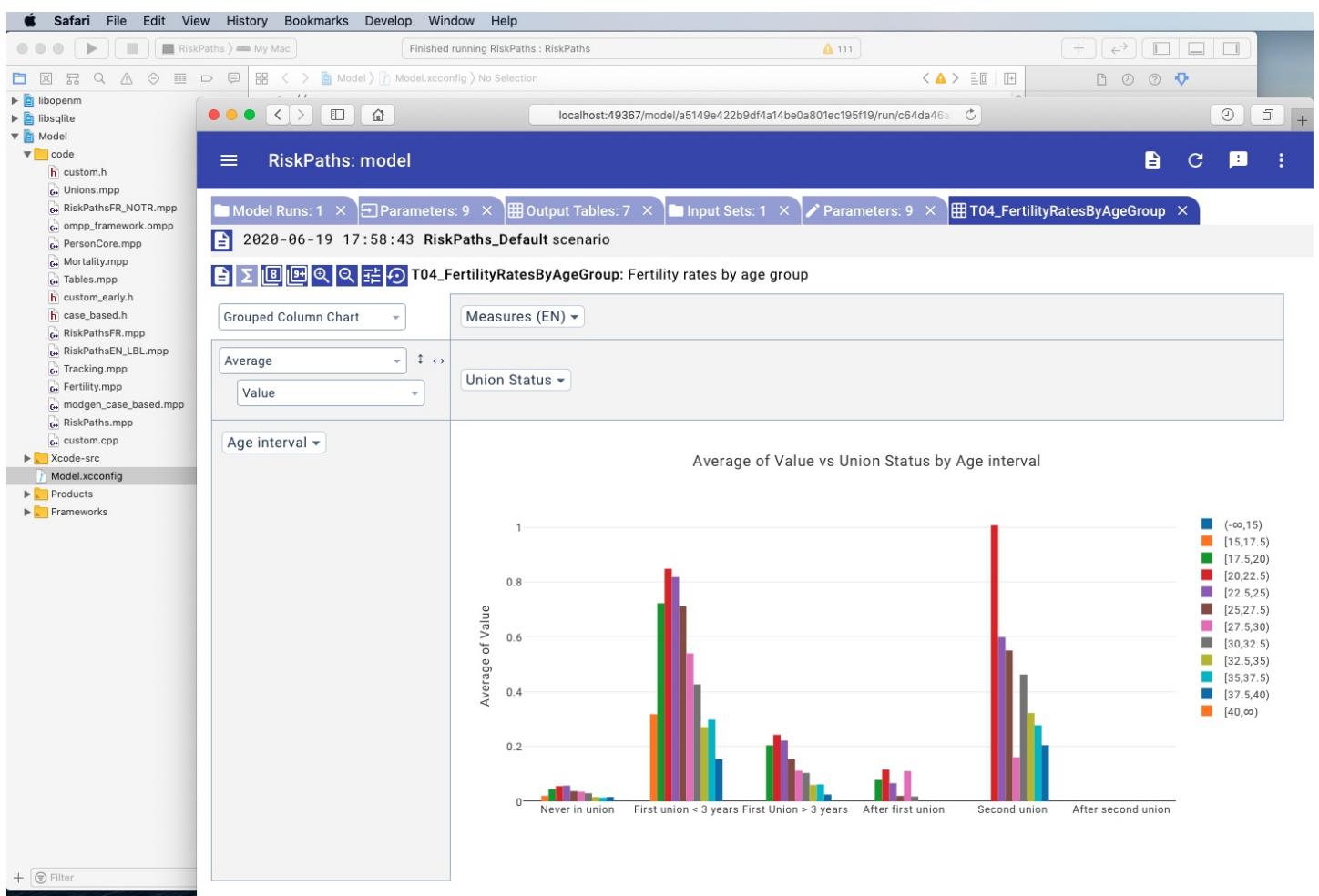
Safari File Edit View History Bookmarks Develop Window Help

RiskPaths > My Mac Model > Model.xcconfig > No Selection

```

1 // 
2 //   Model configuration settings
3 //
4 // Copyright (c) OpenM++
5 // This code is licensed under MIT license (see LICENSE.txt for details)
6
7 #include "../Model-common.xcconfig"
8
9 // Model name: by default is the same as target name
10 // Please rename target to match your actual model name
11 //
12 MODEL_NAME = $(TARGET_NAME)
13
14 // omc compiler settings:
15 //
16 // OMC_CODE_PAGE: encoding name (code page) of source .mpp/.ompp files
17 // OMC_NO_LINE: if true then disable generation of #line directives.
18 //               case-insensitive true: "true" or "yes" or "1"
19 //               anything else is false
20 //
21 SCENARIO_NAME = Default
22 OMC_SCENARIO_PARAM_DIR = $(SRCROOT)/parameters/$(SCENARIO_NAME)
23 OMC_FIXED_PARAM_DIR = $(SRCROOT)/parameters/Fixed
24 OMC_CODE_PAGE = WINDOWS-1252
25 OMC_NO_LINE = false
26
27 // UI settings:
28 //
29 // START_OMPP_UI: if true then start openM++ UI.
30 //               case-sensitive true: "true" or "yes" or "1"
31 //               anything else is false
32 //
33 START_OMPP_UI = 1

```



How to use Visual Studio Code

Build openM++ models using VSCode

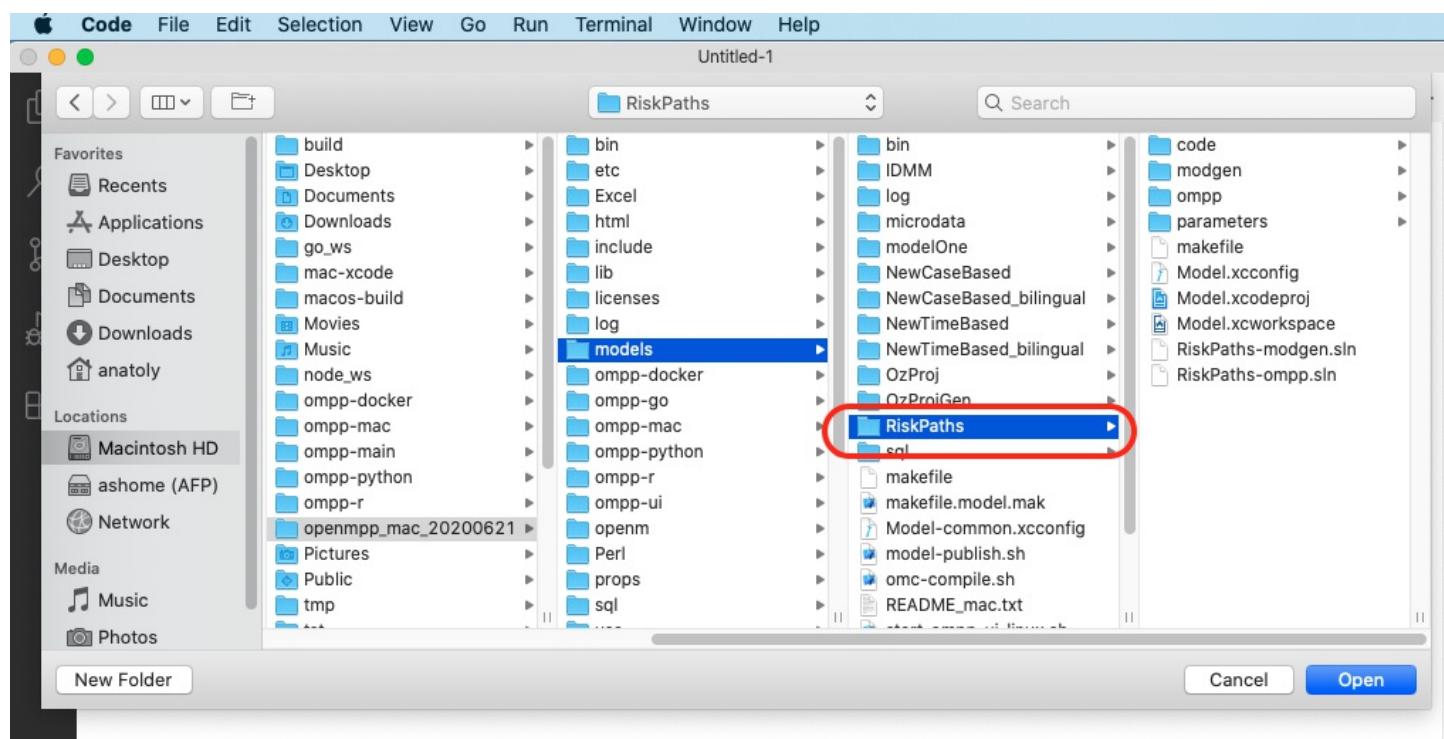
Prerequisites:

- install Visual Studio Code and configure it for openM++ model development: MacOS: Install VSCode

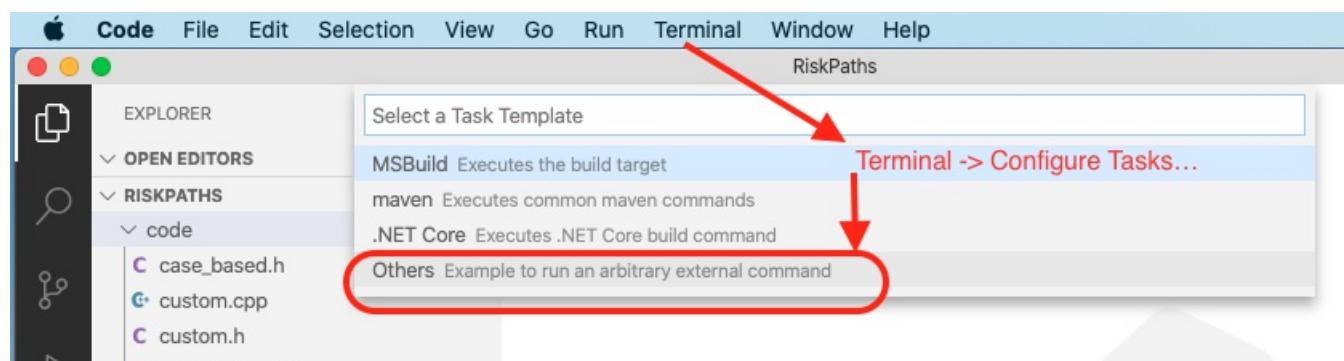
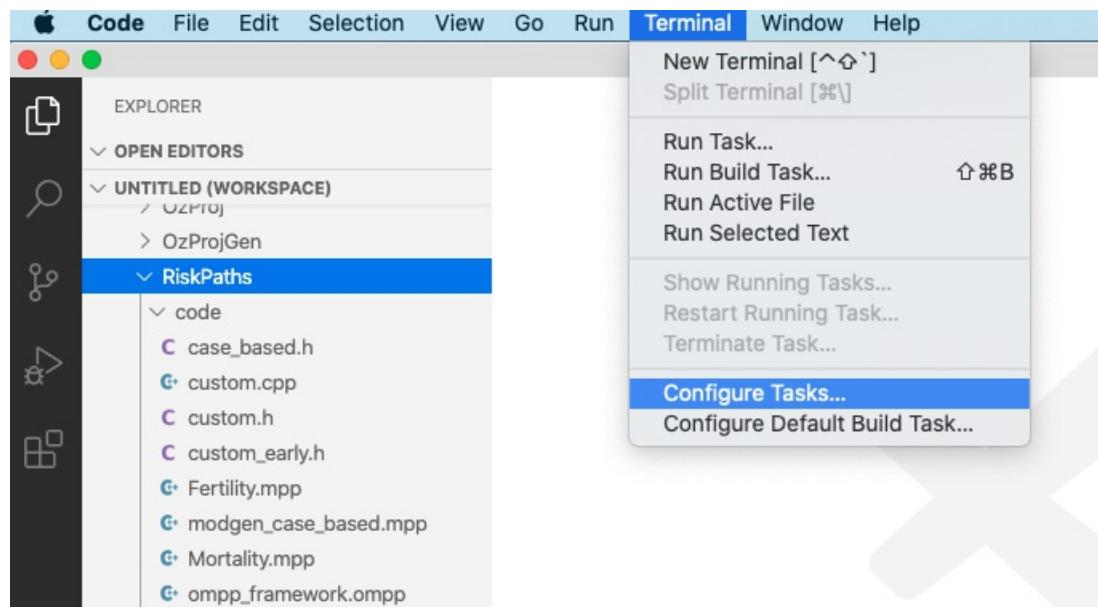
- follow steps described above to create new model

Note: In example below we are using RiskPaths demo model, please replace "RiskPaths" with your actual model name.

Start VSCode and use menu to File -> Open... -> ~/openmpp_mac_20200621/models/RiskPaths:



Configure build tasks by using menu: Terminal -> Configure Tasks...



```
{
  // See https://go.microsoft.com/fwlink/?LinkId=733558
  // for the documentation about the tasks.json format
  "version": "2.0.0",
  "tasks": [
    {
      "label": "build-RiskPaths",
      "type": "shell",
      "command": "make all publish run",
      "problemMatcher": "$gcc",
      "group": {
        "kind": "build",
        "isDefault": true
      },
      "dependsOrder": "sequence",
      "dependsOn": [
        "build-libopenm",
        "stop-ui-RiskPaths"
      ]
    },
    {
      "label": "start-ui-RiskPaths",
      "type": "shell",
      "command": "../start-ompp-ui-mac.sh",
      "problemMatcher": []
    },
    {
      "label": "stop-ui-RiskPaths",
      "type": "shell",
      "command": "../stop-ompp-ui-mac.sh",
      "problemMatcher": []
    },
    {
      "label": "clean-RiskPaths",
      "type": "shell",
      "command": "make cleanall",
      "group": "build",
      "problemMatcher": []
    },
    {
      "label": "build-libopenm",
      "type": "shell",
      "command": "make libopenm",
      "options": {
        "cwd": "../../openm"
      },
      "problemMatcher": "$gcc",
      "group": "build"
    }
  ]
}
```

Note Model build task `make all publish run` does:

- create model executable
- copy model SQLite database file into `ompp-mac/bin` "publish" folder
- run the model If you don't want to run model during the build then use: `make all publish`.

To build and run your model please use menu: Terminal -> Run Build Task...

The screenshot shows the VSCode interface with the Terminal menu open. The 'Run Build Task...' option is highlighted. The terminal window displays a portion of a JSON configuration file named 'tasks.json'.

```

{
  "version": "2.0.0",
  "tasks": [
    {
      "label": "build",
      "type": "shell",
      "command": "cmake --build . --config Release",
      "group": "build"
    },
    {
      "label": "start-ui-RiskPaths",
      "type": "shell",
      "command": "../start-ompp-ui-mac.sh",
      "problemMatcher": []
    },
    {
      "label": "stop-ui-RiskPaths",
      "type": "shell",
      "command": "../stop-ompp-ui-mac.sh",
      "problemMatcher": []
    },
    {
      "label": "clean-RiskPaths",
      "type": "shell",
      "command": "make cleanall",
      "group": "build"
    }
  ]
}

```

Debug openM++ model using VSCode

Create your model debug configuration by using menu Run -> Add Configuration...

The screenshot shows the VSCode interface with the Run and Debug menu open. The 'C++ (GDB/LLDB)' option is highlighted. A red arrow points from the 'Run and Debug' button in the sidebar to this option. The terminal window shows some C++ code.

```

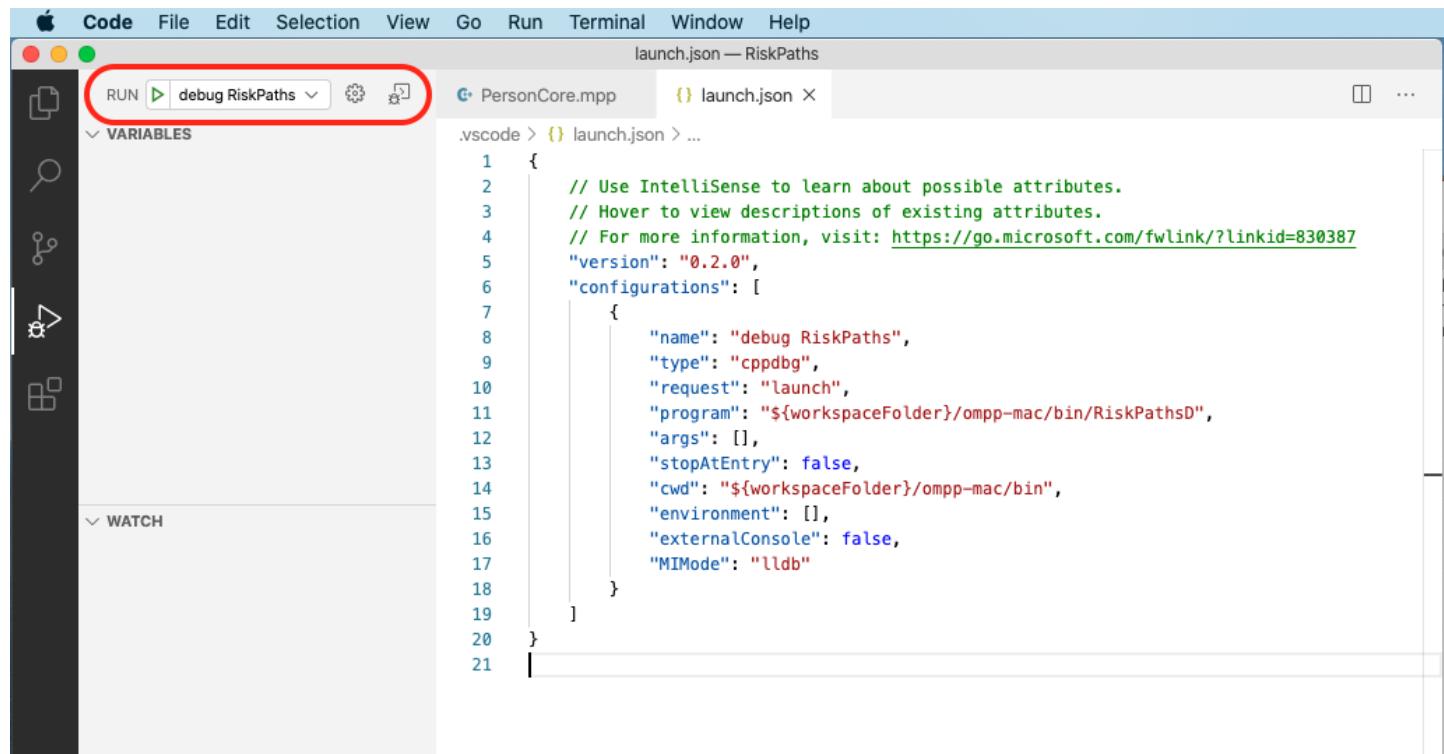
age = 0;
time = 0;

// Have the entity enter the simulation (OpenM++).
enter_simulation();
}

```

```
{
    // Use IntelliSense to learn about possible attributes.
    // Hover to view descriptions of existing attributes.
    // For more information, visit: https://go.microsoft.com/fwlink/?linkid=830387
    "version": "0.2.0",
    "configurations": [
        {
            "name": "debug RiskPaths",
            "type": "cppdbg",
            "request": "launch",
            "program": "${workspaceFolder}/ompp-mac/bin/RiskPathsD",
            "args": [],
            "stopAtEntry": false,
            "cwd": "${workspaceFolder}/ompp-mac/bin",
            "environment": [],
            "externalConsole": false,
            "MIMode": "lldb"
        }
    ]
}
```

Start model debugging by using menu Run -> Start Debugging or as shown below:



Set breakpoint(s):

- open any model.ompp or *.mpp file and put breakpoint in it
- (optional) RunSimulation entry point using File -> Open File... -> use/case_based/case_based_common.ompp -> RunSimulation()
- (optional) `main()` entry point: File -> Open File... -> openm/libopenm/main.cpp

The screenshot shows the RiskPaths IDE interface with the following details:

- Toolbar:** Code, File, Edit, Selection, View, Go, Run, Terminal, Window, Help.
- Project:** PersonCore.mpp — RiskPaths
- Code Editor:** Shows the `Person::Start()` function. Line 64, `age = 0;`, is highlighted in yellow, indicating it is the current instruction being executed.
- Sidebar:**
 - VARIABLES:** Shows declarations for `om_T03_FertilityByAge_incr`, `om_T04_FertilityRatesByAgeGrou...`, `om_T05_CohortFertility_incr`, `om_T06_BirthsByUnion_incr`, `om_T07_FirstUnionFormation_inc...`, `age` (with value `0`), `age_status`, and `case_id`.
 - WATCH:** Empty.
 - CALL STACK:** Shows two threads:
 - Thread #1: PAUSED
 - Thread #2: PAUSED ON BREAKPOINT (highlighted)
 - RiskPathsD!Person::Start() ...
 - RiskPathsD!CaseSimulation(case_in...
 - RiskPathsD!RunSimulation(int, int)
 - RiskPathsD!RunModel(openm::IModel)
 - RiskPathsD!modelThreadLoop(int, i...
 - BREAKPOINTS:** A single breakpoint is set at `PersonCore.mpp` line 64.- Bottom Status Bar:** Shows `Ln 64, Col 1`, `Tab Size: 4`, `UTF-8`, `CRLF`, `C++`, `Mac`.

To inspect model parameters add Watch variable:

VARIABLES

- Locals**
 - dHazard: 0.0370541
 - > event_time: {...}
 - > this: 0x000000100f06190

WATCH

- SimulationCases: 5000
- UnionDurationBaseline: [2]
- [0]: [6]
 - [0]: 0.009601699999999994
 - [1]: 0.019999400000000001
 - [2]: 0.019999400000000001
 - [3]: 0.021317200000000001
 - [4]: 0.015083600000000001

CALL STACK

- Thread #2 PAUSED ON BREAKPOINT
 - RiskPathsD!Person::timeUnion2DissolutionEvent()
 - RiskPathsD!BaseEvent::clean() E...
 - RiskPathsD!BaseEvent::clean_all()
 - RiskPathsD!BaseEvent::do_next_eventC
 - RiskPathsD!SimulateEvents() cas...
 - RiskPathsD!CaseSimulation(case_info&)
 - RiskPathsD!RunSimulation(int, int, or)
 - RiskPathsD!RunModel(openmm::IModel*)
 - DiskPathedIModel.ThreadConfig::int

BREAKPOINTS

- Unions.mpp code

PROBLEMS 265 OUTPUT DEBUG CONSOLE TERMINAL

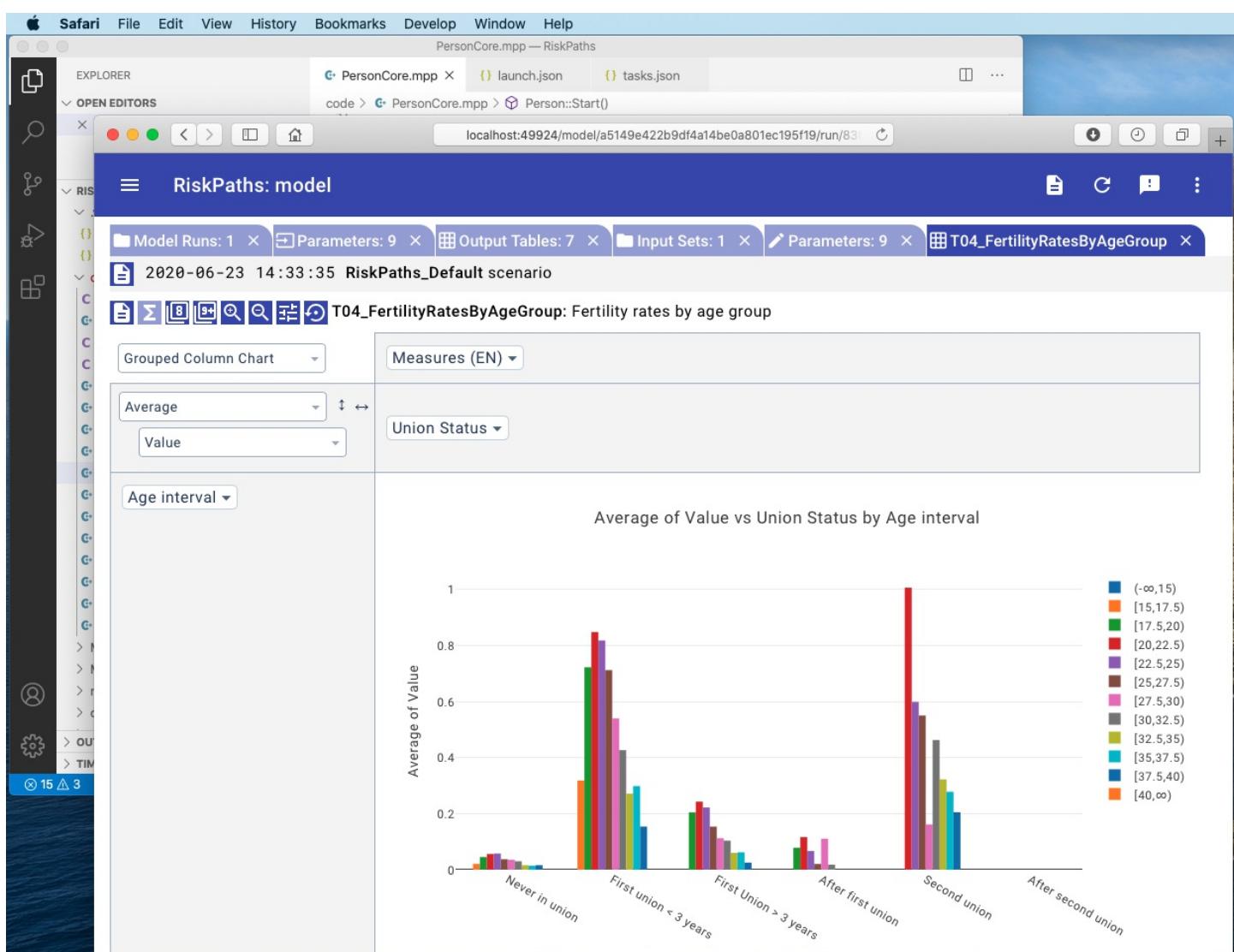
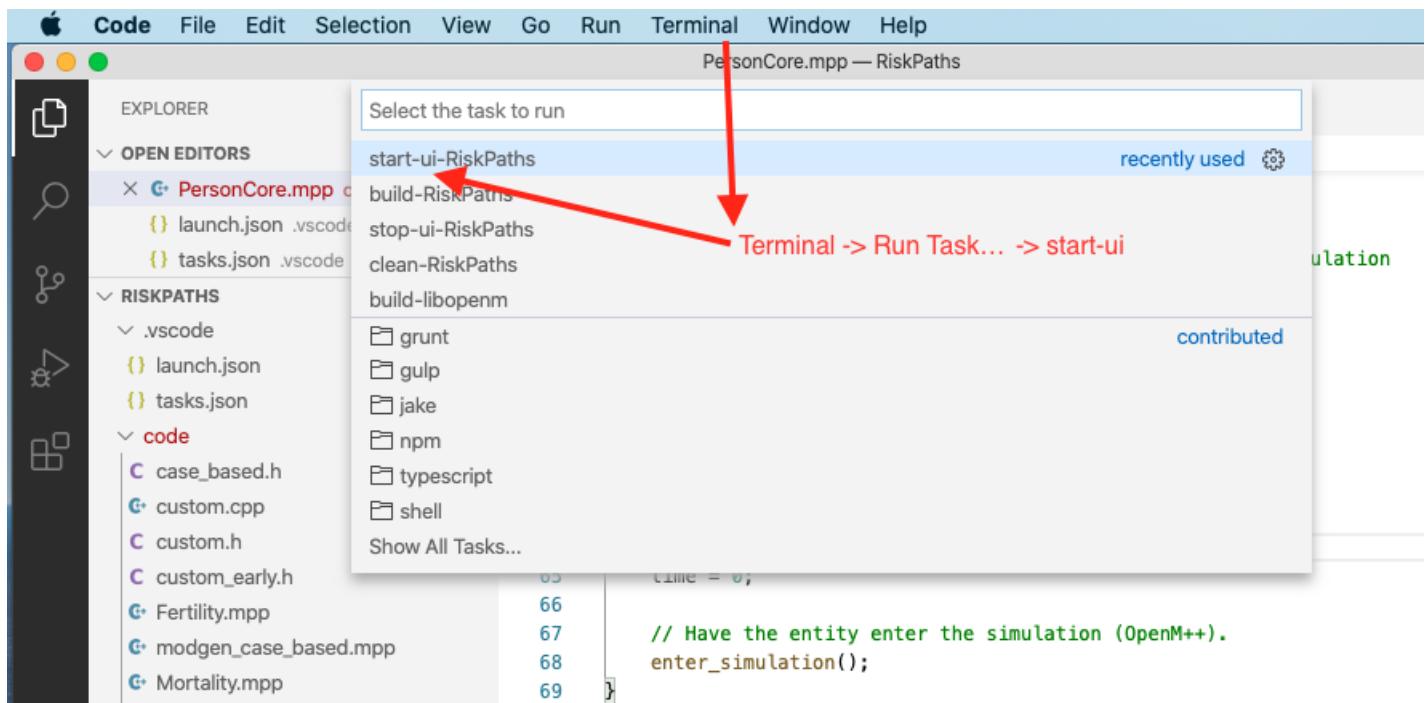
```

Loaded "/usr/lib/libcharset.l.dylib". symbols loaded.
@"2020-08-18 23:22:09.685 RiskPaths\r\n"
@"2020-08-18 23:22:09.689 Prepare fixed and missing parameters\r\n"
@"2020-08-18 23:22:09.693 Run: 103 \r\n"
@"2020-08-18 23:22:09.693 Get scenario parameters for process\r\n"
@"2020-08-18 23:22:09.693 Sub-value: 0\r\n"
@"2020-08-18 23:22:09.693 member=0 Bind scenario parameters\r\n"
@"2020-08-18 23:22:09.694 member=0 Compute derived parameters\r\n"
@"2020-08-18 23:22:09.694 member=0 Prepare for simulation\r\n"
@"2020-08-18 23:22:09.694 member=0 Simulation progress=0% cases=0\r\n"
Execute debugger commands using "-exec <command>", for example "-exec info registers"
UnionDurationBaseline
  
```

Start model UI on MacOS from VSCode

To start model UI from VSCode use menu: Terminal -> Run Tasks... -> start-ui-RiskPaths

To stop background `oms` web-service after you done with model UI use: Terminal -> Run Tasks... -> stop-ui-RiskPaths



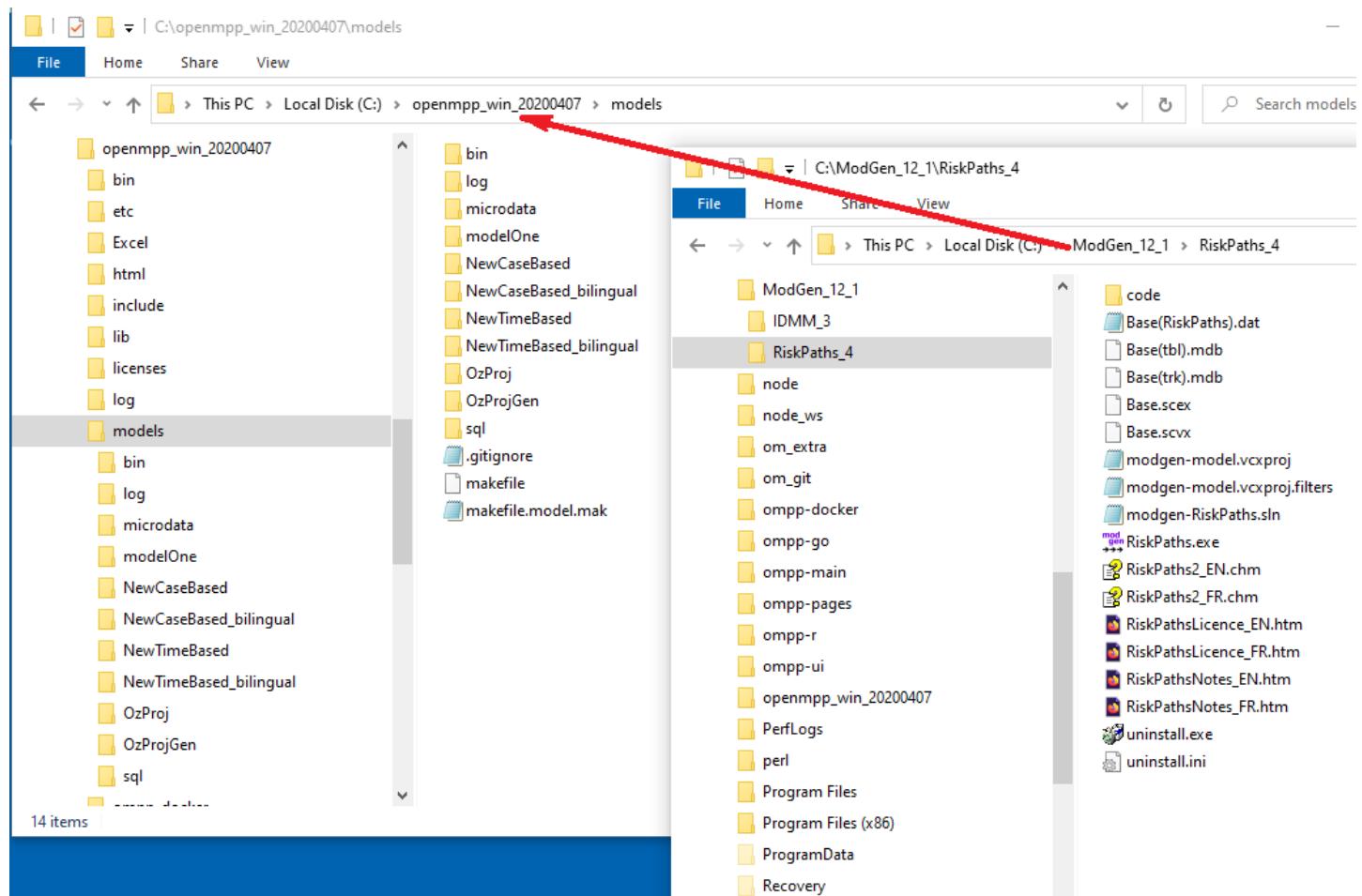
Modgen: Convert case-based model to openM++

Overview

OpenM++ provides superset of Modgen language specification and therefore able to compile Modgen source files. Conversion from Modgen include following:

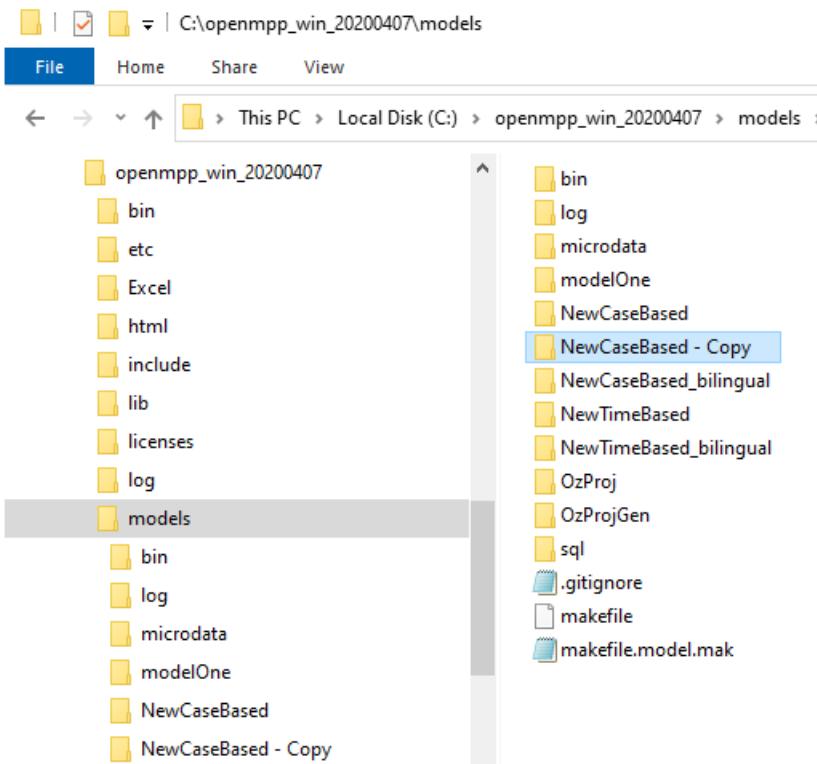
- Make sure you are done with: [Windows: Quick Start for Model Developers](#)
- Clone existing openM++ case-based model, for example: NewCaseBased
- Rename model directory and solution to YourModelName, for example: RiskPaths
- Replace NewCaseBased .mpp modules with your model RiskPaths .mpp files and inspect your code for any quirks (often none)
- Replace NewCaseBased .dat parameter data with your model RiskPaths .dat files
- Open Visual Studio, build the model and fix errors if necessary
- Run the model and verify simulation results

Below is step-by-step example how to convert RiskPaths model from Modgen 12.1 to openM++.



Clone existing openM++ model

As starting point please copy one of openM++ sample models, for case-based model we can start from NewCaseBased.

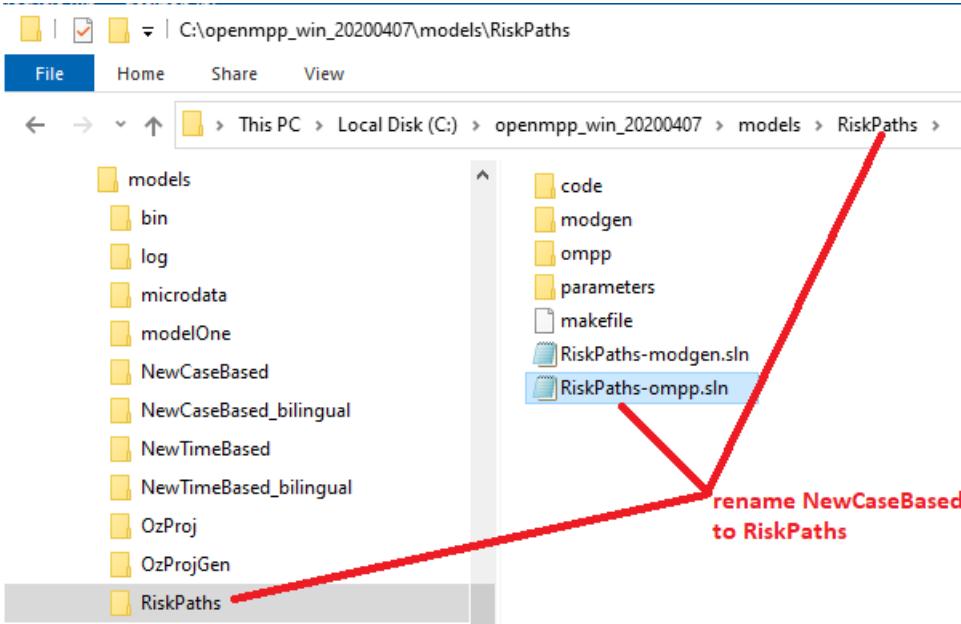


Rename model directory and solution

Rename directory and model solution into `YourModelName.sln`:

- rename `NewCaseBased - Copy` directory into `RiskPaths`
- rename `NewCaseBased-ompp.sln` into `RiskPaths-ompp.sln`
- (optional) rename `NewCaseBased-modgen.sln` into `RiskPaths-modgen.sln`

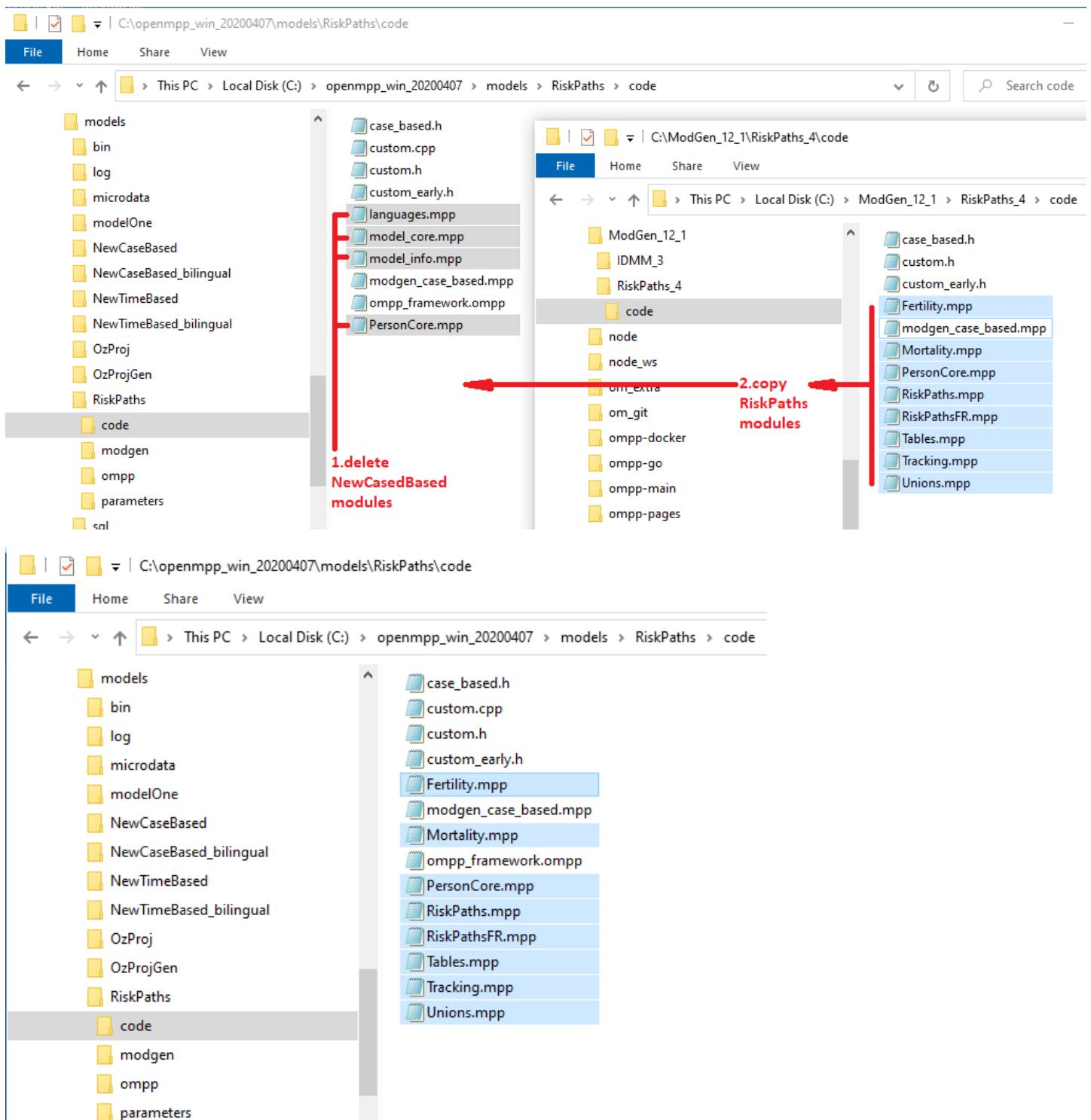
Note: It is not required to use model name as directory name and solution name, but it is openM++ convention and significantly simplifies model maintenance.



Replace sample model .mpp modules with your model .mpp files

Delete `NewCaseBased.mpp` modules and copy your model substantive `.mpp` files instead. For complex models with long maintenance history it may be not always easy to understand what `*.mpp` files are "substantive" and you may need to repeat this step multiple times.

It is also rare, but possible for some `*.mpp` modules to contain special quirky code in order to overcome issues in old version of Modgen or c++. Please inspect your code and adjust it, if necessary, to comply with c++17 standard.

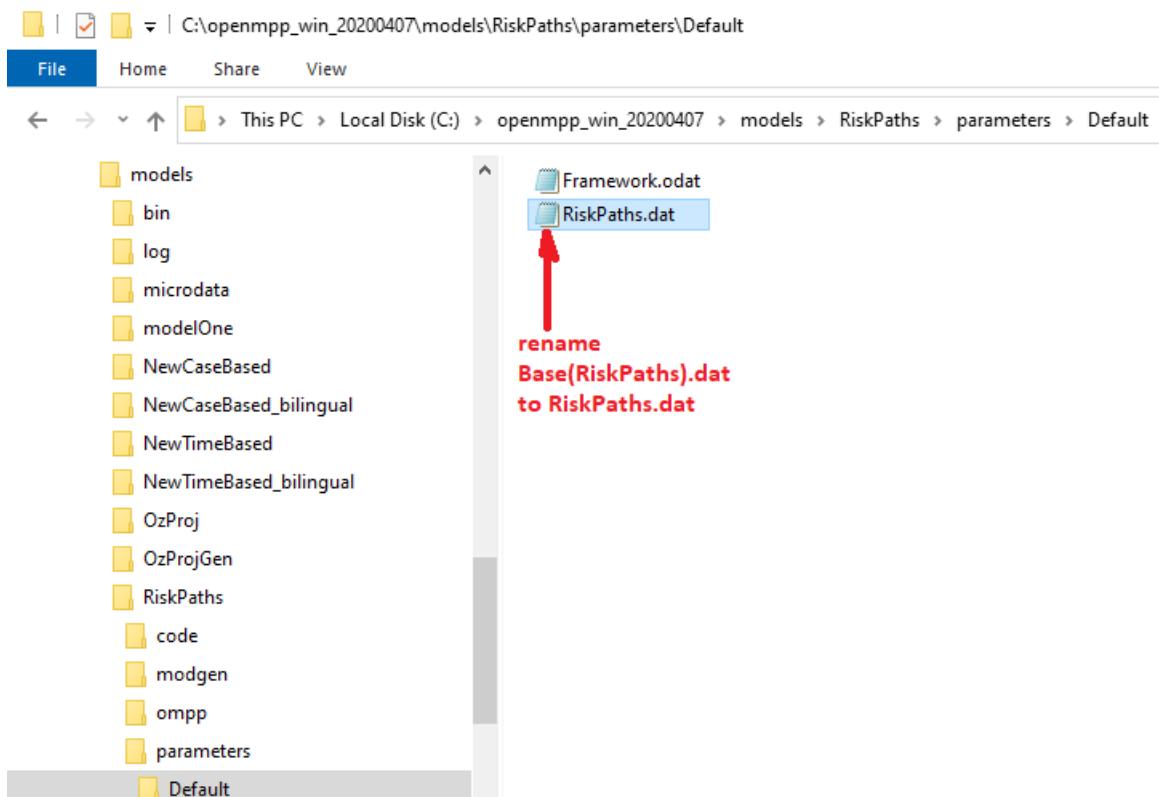
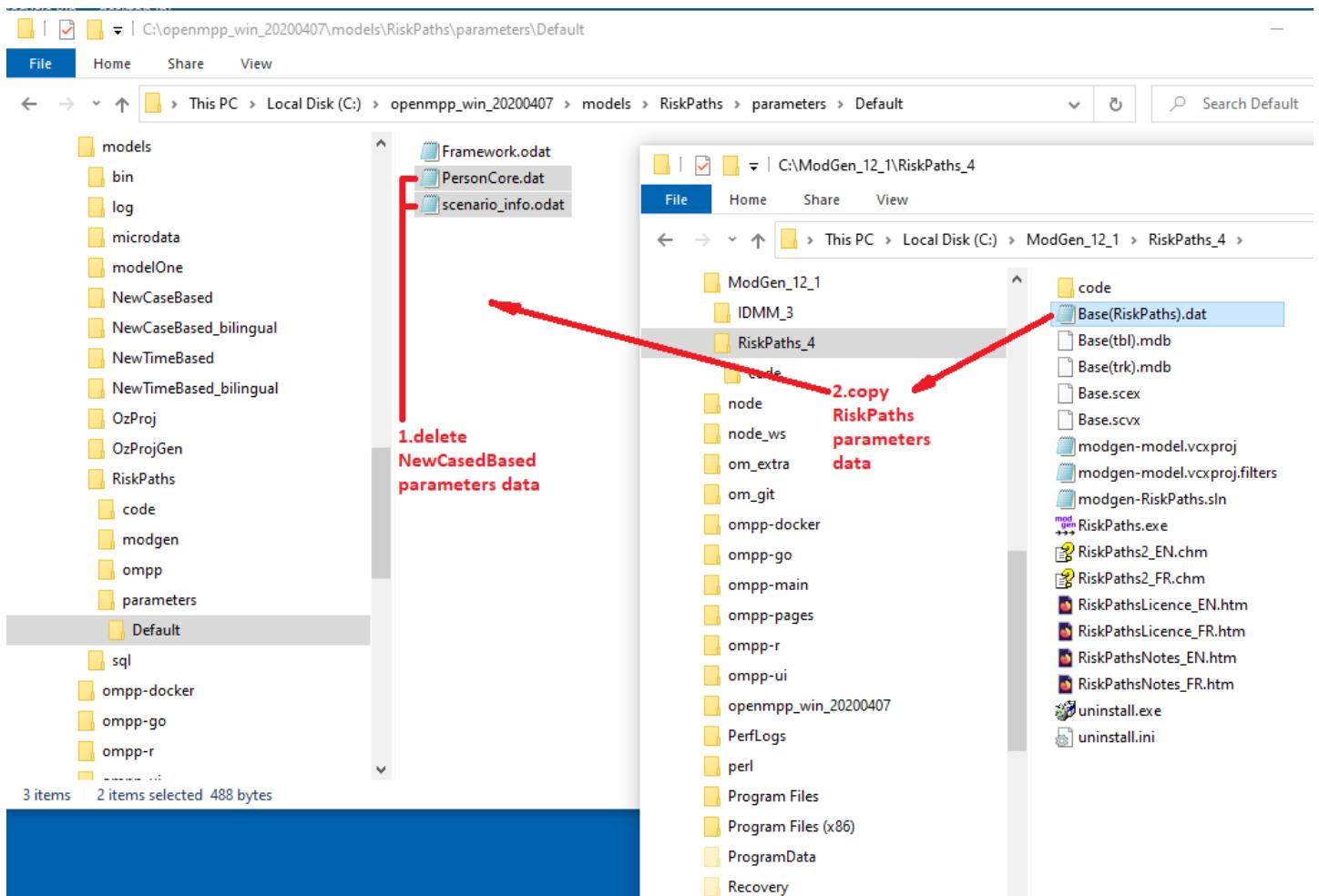


Replace sample model parameter data with your model *.dat files

For our example we need to:

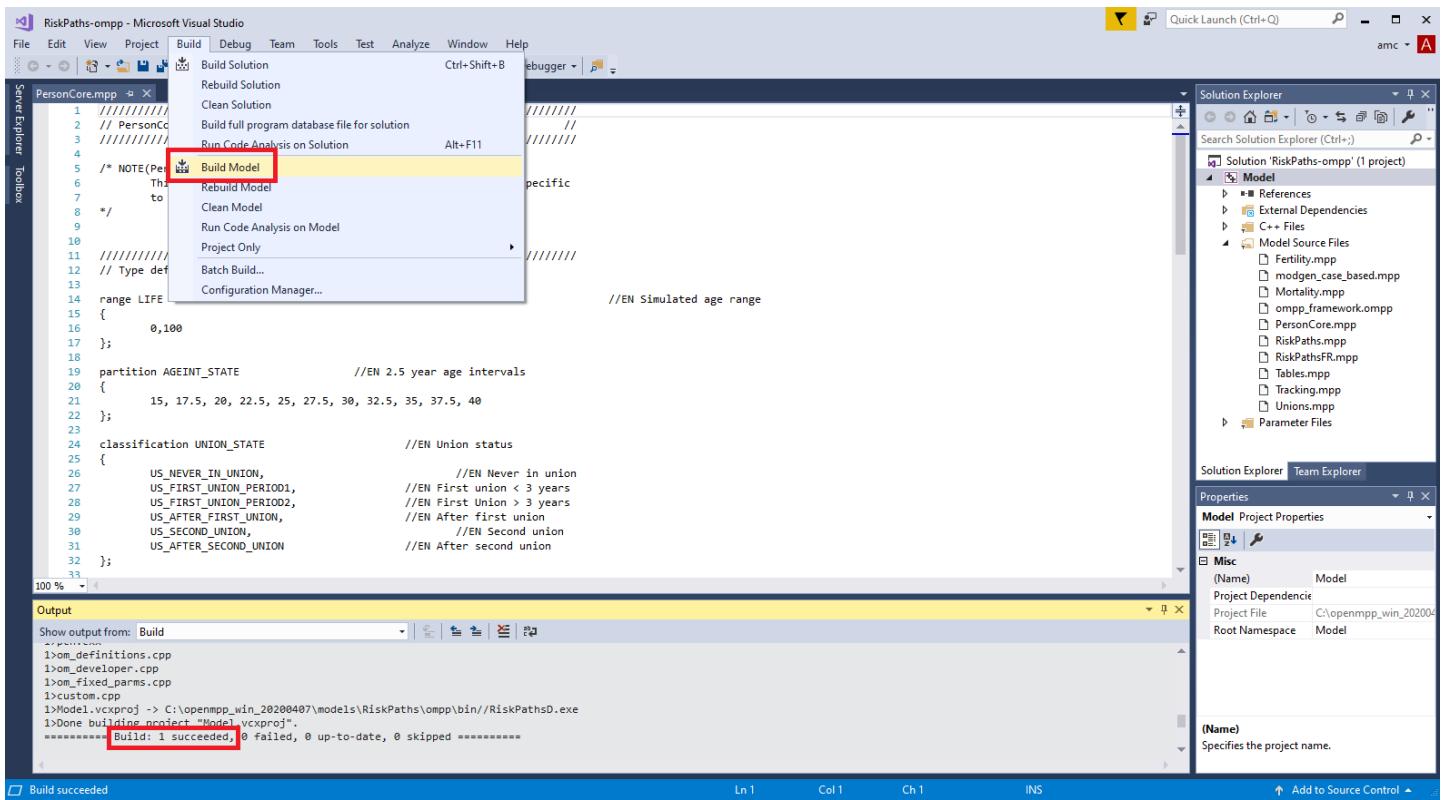
- delete NewCaseBased `parameters/Default/PersonCore.dat` and `parameters/Default/scenario_info.odat`
- copy `Base(RiskPaths).dat`
- (optional) rename it into `RiskPaths.dat`

For complex models it is also possible to have `Fixed` parameters data. Please copy it into `parameters/Fixed/` sub-folder.



Open Visual Studio solution and build the model

Open `RiskPaths-ompp.sln` solution in Visual Studio and build the model, fix errors, if necessary.



Run the model and verify simulation results

Last, but obviously very important step, is to run the model and compare Modgen and openM++ simulation results.

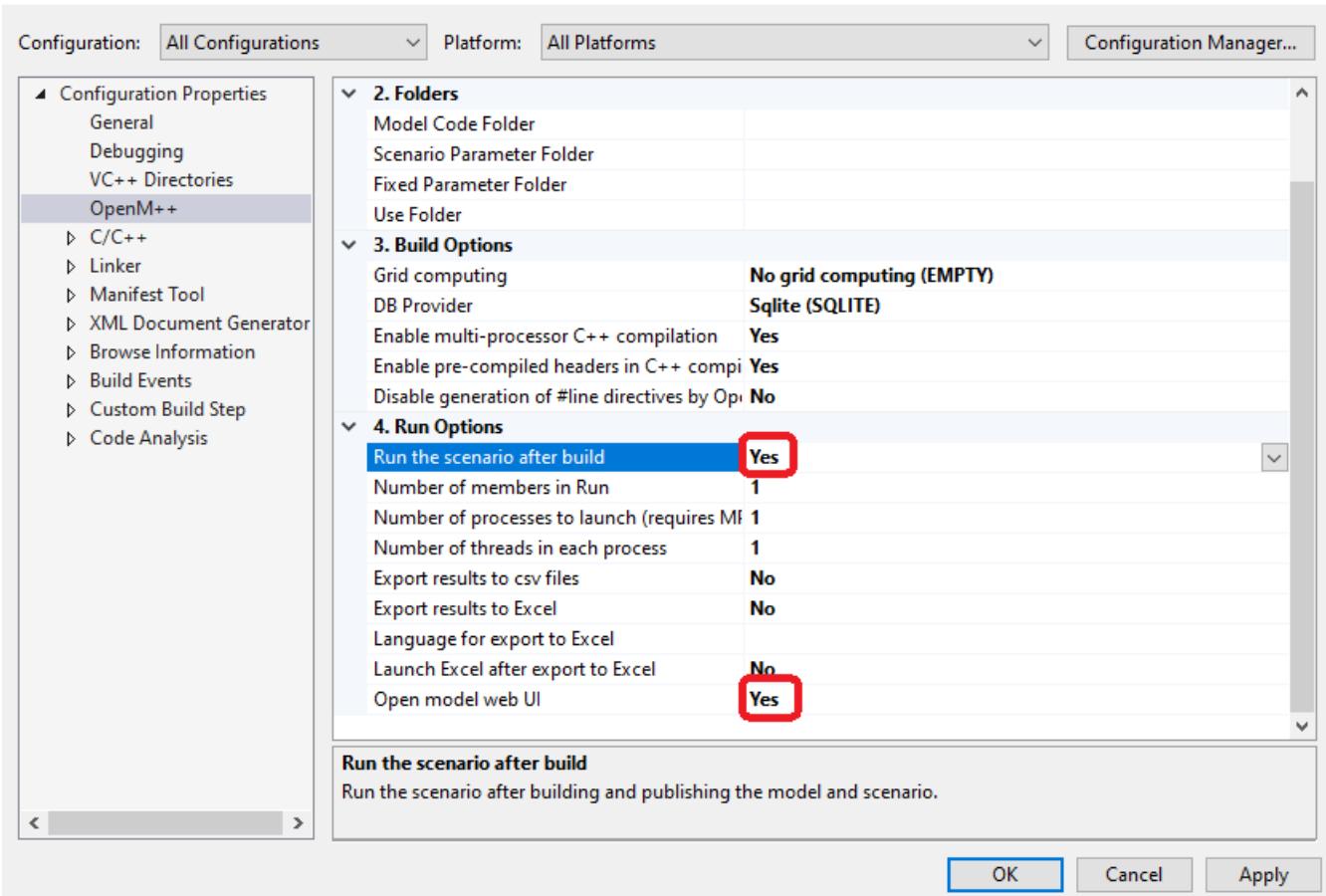
Check `parameters/Default/Framework.odat` values:

```
parameters {
    int SimulationSeed = 16807;
    long long SimulationCases = 5000;
};
```

and adjust number of simulation cases if required, re-build the model to update `SimulationCases` value in `RiskPaths.sqlite` model database.

You can run openM++ model from command line, or from Visual Studio by changing `Project -> Properties -> OpenM++ -> Run Options`:

Model Property Pages



It is possible to open model run results in openM++ UI (beta version) to examine model parameters and output results:

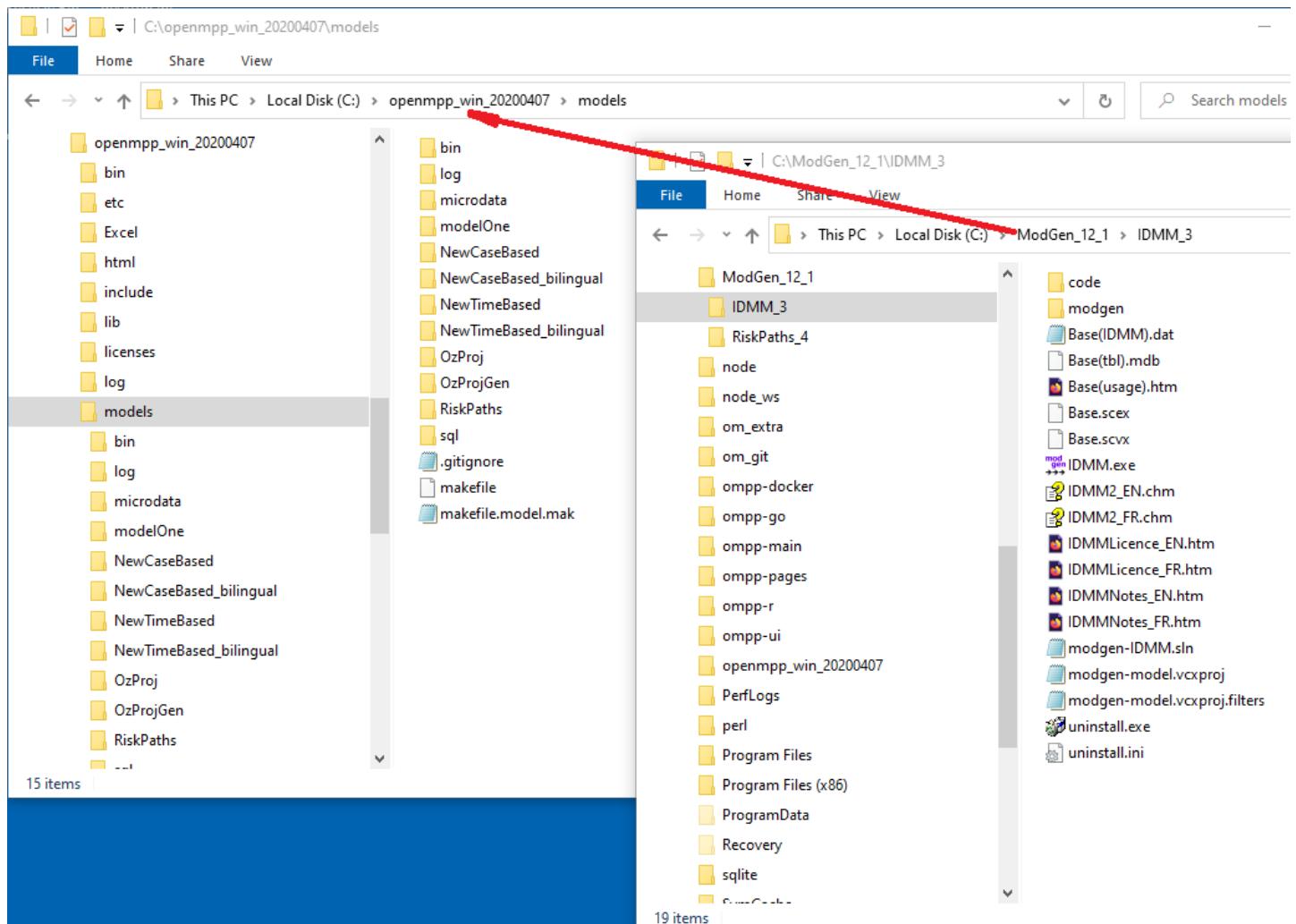
Modgen: Convert time-based model to openM++

Overview

OpenM++ provides superset of Modgen language specification and therefore able to compile Modgen source files. Conversion from Modgen include following:

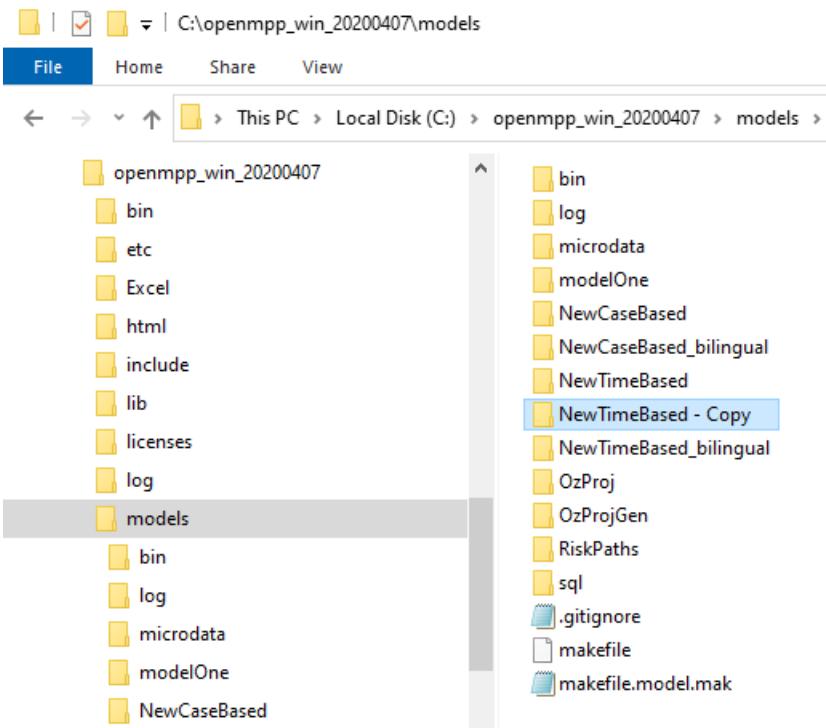
- Make sure you are done with: [Windows: Quick Start for Model Developers](#)
- Clone existing openM++ time-based model, for example: NewTimeBased
- Rename model directory and solution to YourModelName, for example: IDMM
- Replace NewTimeBased .mpp modules with your model IDMM .mpp files and inspect your code for any quirks (often none)
- Replace NewTimeBased .dat parameter data with your model IDMM .dat files
- Open Visual Studio, build the model and fix errors if necessary
- Run the model and verify simulation results

Below is step-by-step example how to convert IDMM model from Modgen 12.1 to openM++.



Clone existing openM++ model

As starting point please copy one of openM++ sample models, for time-based model we can start from NewTimeBased.

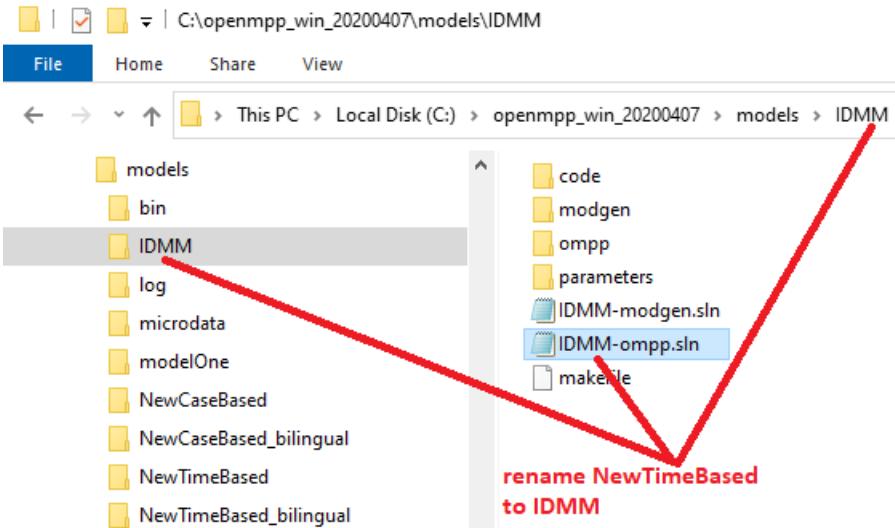


Rename model directory and solution

Rename directory and model solution into `YourModelName.sln`:

- rename `NewTimeBased - Copy` directory into `IDMM`
- rename `NewTimeBased-ompp.sln` into `IDMM-ompp.sln`
- (optional) rename `NewTimeBased-modgen.sln` into `IDMM-modgen.sln`

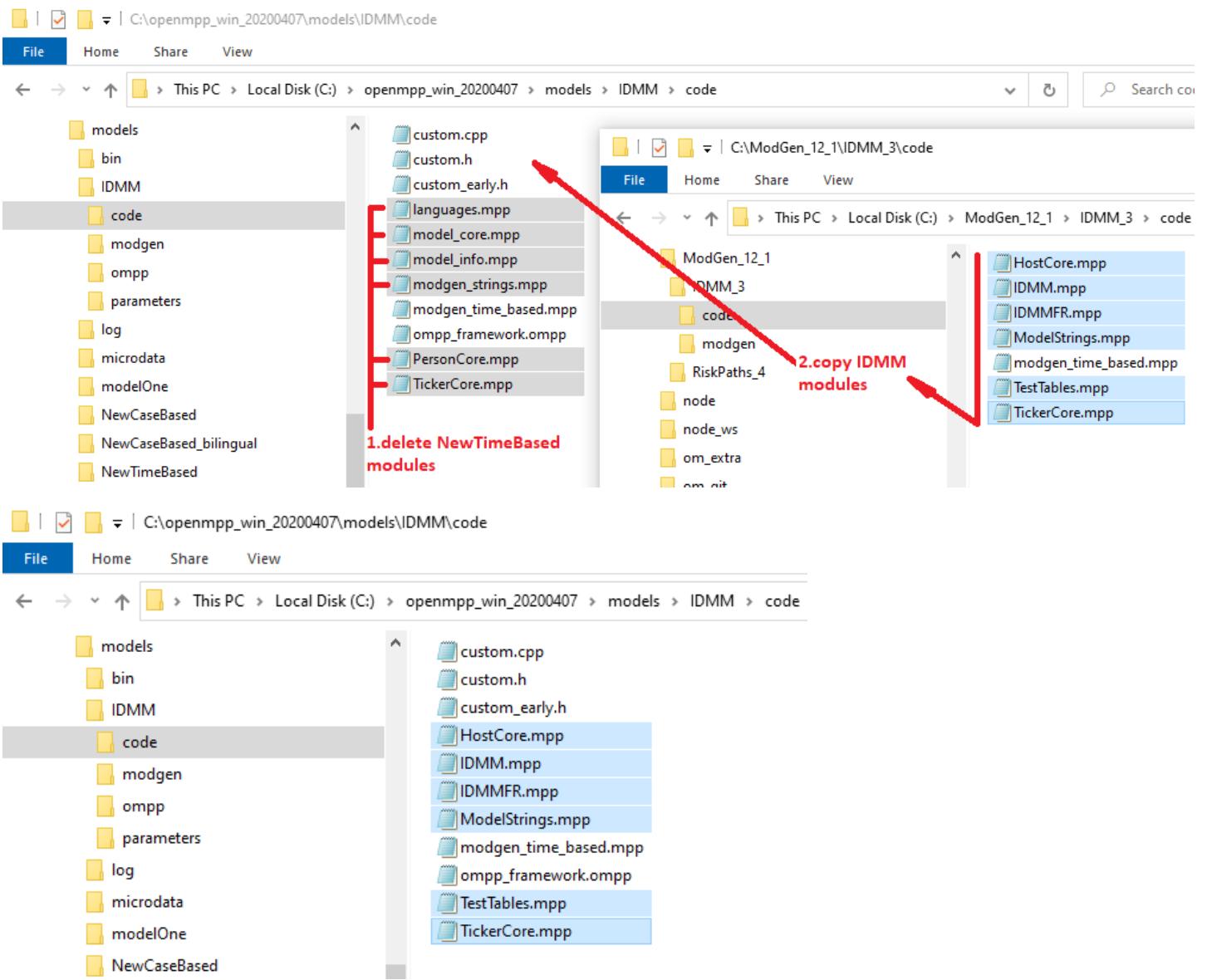
Note: It is not required to use model name as directory name and solution name, but it is openM++ convention and significantly simplifies model maintenance.



Replace sample model .mpp modules with your model .mpp files

Delete `NewTimeBased.mpp` modules and copy your model substantive `.mpp` files instead. For complex models with long maintenance history it may be not always easy to understand what `*.mpp` files are "substantive" and you may need to repeat this step multiple times.

It is also rare, but possible for some `*.mpp` modules to contain special quirky code in order to overcome issues in old version of Modgen or c++. Please inspect your code and adjust it, if necessary, to comply with c++17 standard.

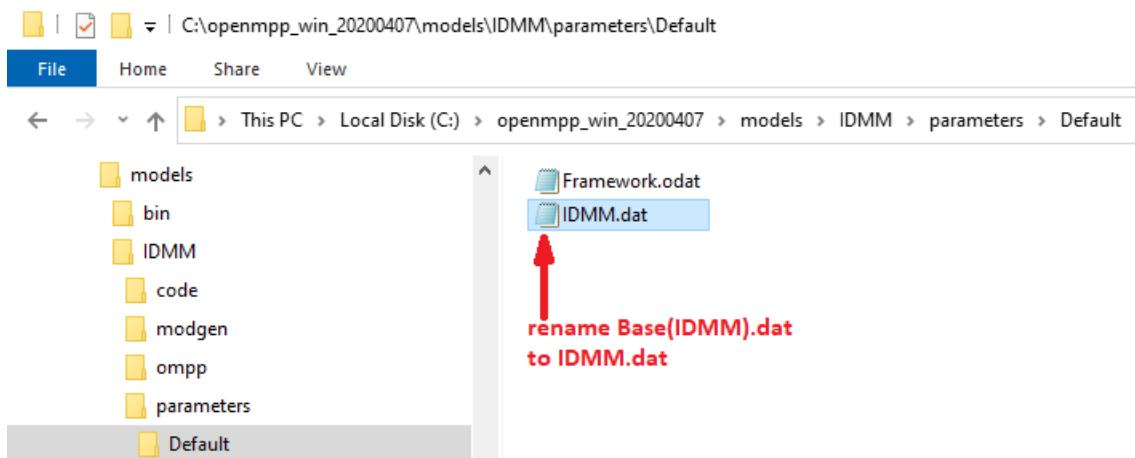
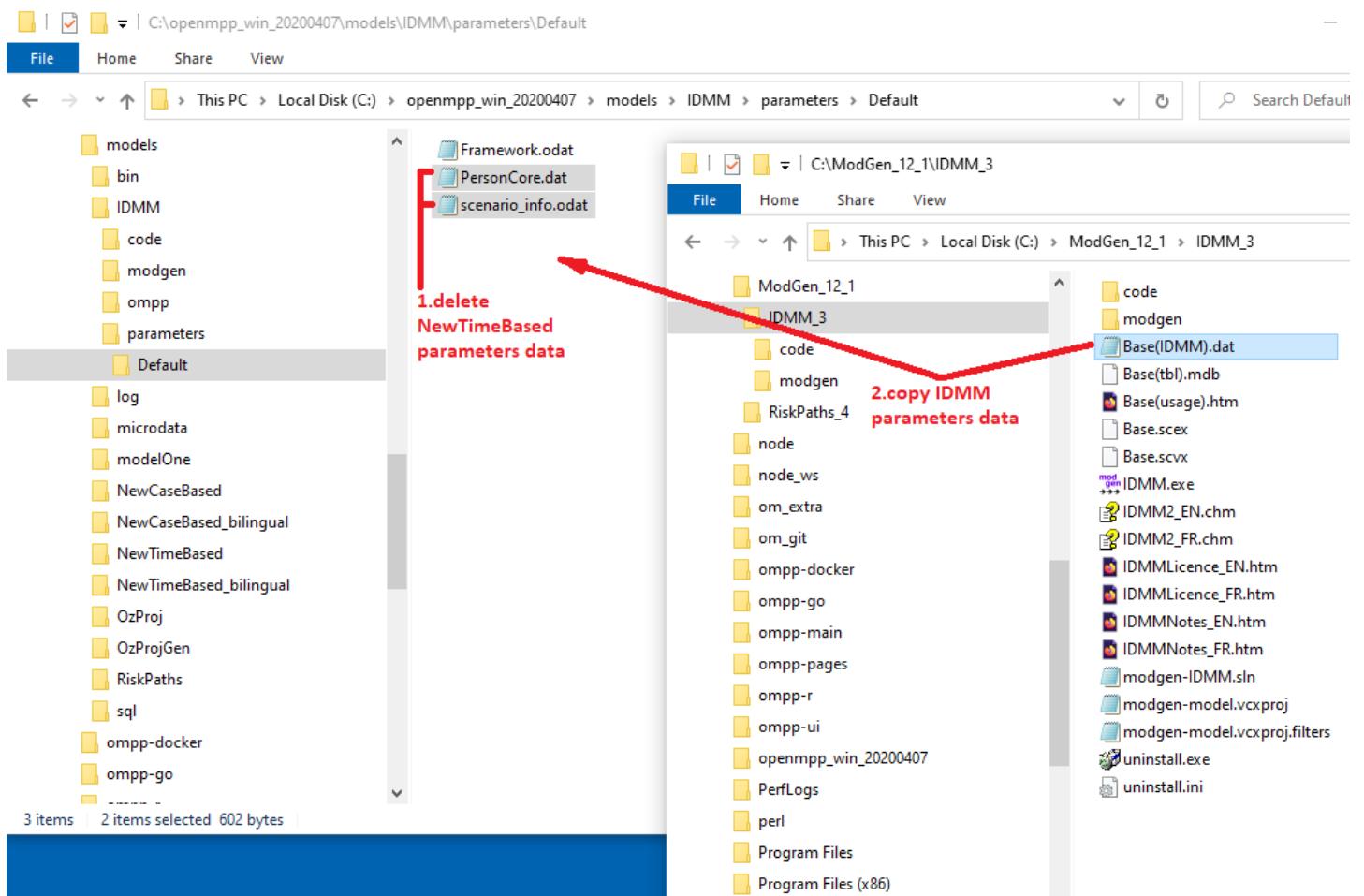


Replace sample model parameter data with your model *.dat files

For our example we need to:

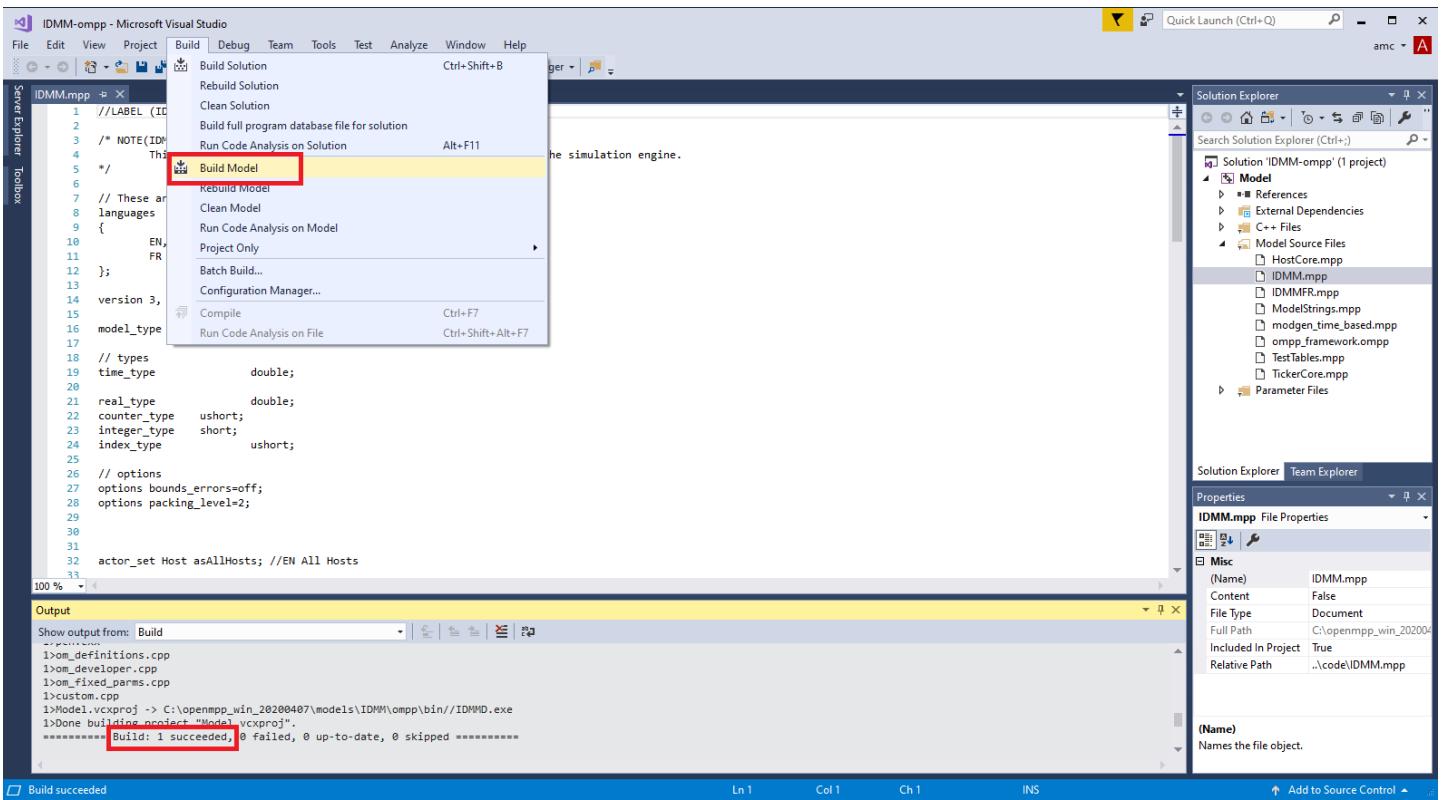
- delete NewTimeBased `parameters/Default/PersonCore.dat` and `parameters/Default/scenario_info.odat`
- copy `Base(IDMM).dat`
- (optional) rename it into `IDMM.dat`

For complex models it is also possible to have `Fixed` parameters data. Please copy it into `parameters/Fixed/` sub-folder.



Open Visual Studio solution and build the model

Open `IDMM-omp.sln` solution in Visual Studio and build the model, fix errors, if necessary.



Run the model and verify simulation results

Last, but obviously very important step, is to run the model and compare Modgen and openM++ simulation results.

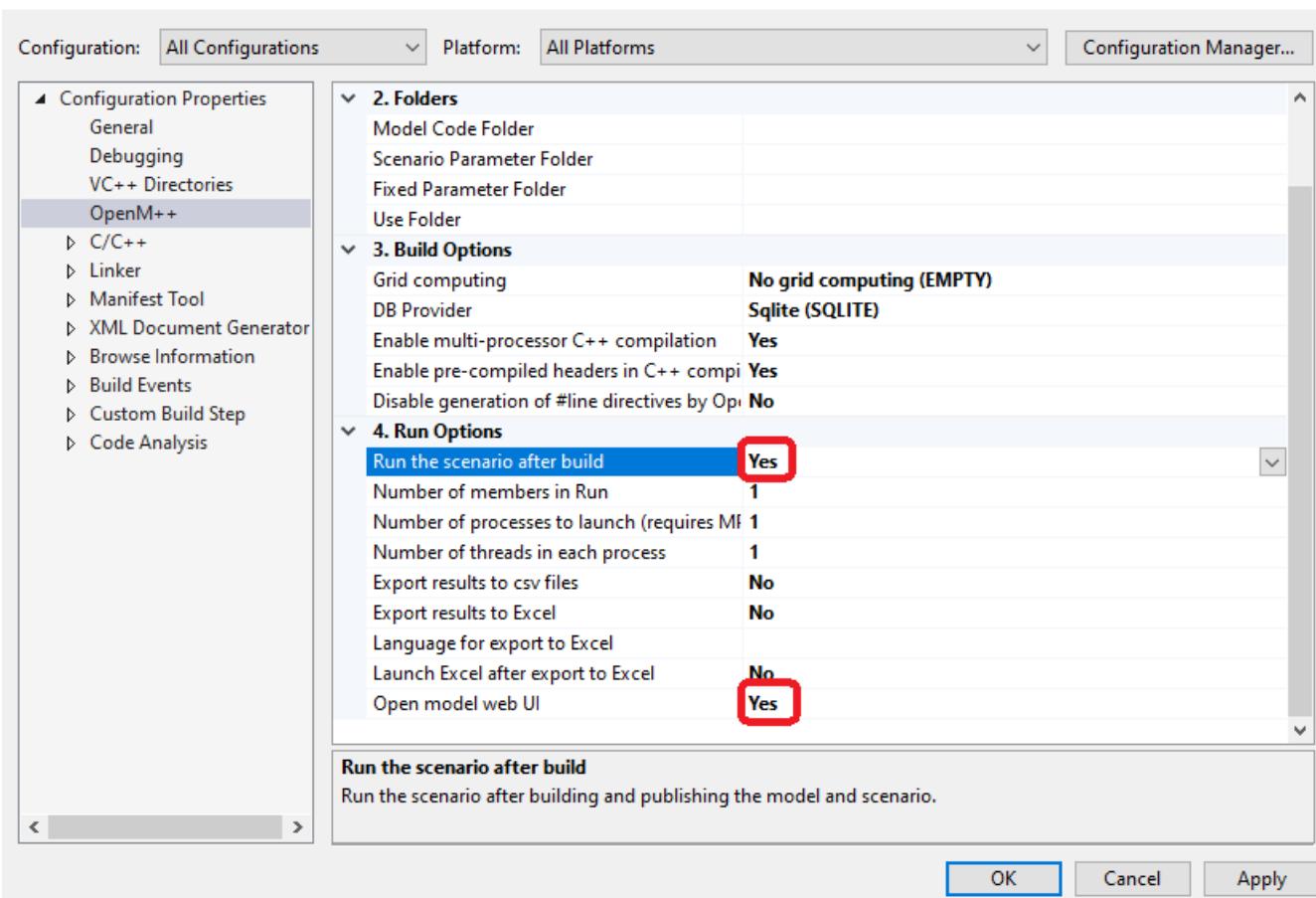
Check `parameters/Default/Framework.odat` values:

```
parameters {
    int SimulationSeed = 16807;
    Time SimulationEnd = 101.0;
};
```

and adjust number of simulation end time if required, re-build the model to update `SimulationEnd` value in `IDMM.sqlite` model database.

You can run openM++ model from command line, or from Visual Studio by changing `Project -> Properties -> OpenM++ -> Run Options`:

Model Property Pages



It is possible to open model run results in openM++ UI (beta version) to examine model parameters and output results:

IDMM.mpp - Microsoft Visual Studio

openM++

IDMM: model

Model Runs: 1 Parameters: 13 Output Tables: 3 Input Sets: 1 Parameters: 13 X01_History

2020-04-07 14:20:39 Default scenario

X01_History: History of the disease

Average of Value vs Report time by Current disease phase

Susceptible Latent Infectious Immune

Output

```
1 //LABEL (IDMM, EN)
2
3 /* NOTE(IDMM, EN)
4 This module
5 */
6
7 // These are the languages
8
9 {
10     EN, // English
11     FR // French
12 };
13
14 version 3, 0, 0, 0;
15
16 model_type time_based;
17
18 // types
19 time_type
20
21 real_type
22 counter_type ush
23 integer_type shor
24 index_type
25
26 // options
27 options bounds_error
28 options packing_level
29
30
31
32 actor_set Host asAll
33
```

Show output from: Build

1>-----

1>2020-04-07 14:20:39,418 m
1>2020-04-07 14:20:39,456 m
1>2020-04-07 14:20:39,487 m
1>2020-04-07 14:20:39,584 m
1>2020-04-07 14:20:39,567 D
1>Starting openM++ UI: <http://localhost:50585/>
===== Build: 1 succeeded

Modgen: Convert Modgen models and usage of C++ in openM++ code

This page is under construction

Microdata files, gpoEventQueue, StartCase(), SignalCase()

It may be your model is using microdata files or it contains references to Modgen global variables: `gpoEventQueue, gbCancelled, gbErrors` or functions: `StartCase(), SignalCase()`. For example if your Modgen code look like:

```
// The Simulation function is called by Modgen to simulate a set of cases.
void Simulation()
{
    // Open the microdata file
    PersonOpenFile();

    // The global variables gbInterrupted, gbCancelled and gbErrors
    // are maintained by the Modgen run-time.
    for (long lCase = 0; lCase < CASES() && !gbInterrupted && !gbCancelled && !gbErrors; lCase++)
    {
        // Simulate a case.
        // Tell the Modgen run-time to prepare to simulate a new case.
        StartCase();

        // Read the record corresponding to the case_id of the case
        long lCaseID = GetCaseID();
        PersonGetRecord(lCaseID);

        // Call the CaseSimulation function defined earlier in this module.
        CaseSimulation();

        // Tell the Modgen run-time that the case has been completed.
        SignalCase();
    }

    // Close the microdata file
    PersonCloseFile();
}

// The CaseSimulation function simulates a single case
void CaseSimulation( )
{
    // .....
    // Process events until there are no more
    ProcessEvents();
    // .....
}

// The ProcessEvents function processes all events until there are none in the event queue.
// It is called by the CaseSimulation function.
void ProcessEvents()

// The Modgen run-time implements the global event queue gpoEventQueue.
while ( !gpoEventQueue->Empty() )
{
    // The global variables gbCancelled and gbErrors
    // are maintained by the Modgen run-time.
    if ( gbCancelled || gbErrors )
    {
        // The user cancelled the simulation, or run-time errors occurred.
        // Terminate the case immediately.
        gpoEventQueue->FinishAllActors();
    }
    else
    {
        // Age all actors to the time of the next event.
        gpoEventQueue->WaitUntil( gpoEventQueue->NextEvent() );

        // Implement the next event.
        gpoEventQueue->Implement();
    }
}
```

Then please use OzProj example model to update your CaseSimulation() function. There are Modgen version of `code_original\OzProj.mpp` and openM++ version: `code\OzProj.mpp` which you can use as starting point to upgrade your model code.

Use of ternary operator may require cast to underlying type

Use of ternary operator may require cast to underlying type (type name followed by `_t`). The Microsoft VC++ error number is a strong hint. The error message text is not helpful.

Assignments from one attribute to another may require cast to underlying type.

Assignments from one attribute to another may require cast to underlying type. Specific Microsoft VC++ error number helps to indicate the occurrence (the error message text is not helpful).

Use of min and max may need to be changed to specify the underlying type.

Use of min and max may need to be changed to specify the underlying type. We would recommend to invoke the template explicitly, eg

```
std::max<double>(a, b)
```

Arguments to print-style functions need to be cast to explicit types.

Non-standard Microsoft functions and types must be replaced with standard.

Non-standard Microsoft functions and types must be replaced with standard. It is easy to detect such error: build your model on MacOS or Linux and to detect all non-standard Microsoft extensions.

Model Localization: Translation of model messages

Quick Start

You can provide translated messages for your model by editing `modelName.message.ini` file located in the same directory where `modelName.exe` is.

For example:

```
dir /B openmpp_win_20180205\models\bin
...
modelOne.exe
modelOne.ini
modelOne.message.ini
modelOne.sqlite
```

`modelOne.message.ini` is translated messages for `modelOne.exe`

Message.ini file **must be UTF-8 encoded** and it contain model translated messages:

```
;;
; modelOne Localized messages
;

[FR]
Run %d = Exécution: %d

[fr-CA]
Run %d = Exécution: %d
;
; Example of multi-line translated message:
;
"Scenario processing" = "\
    Traitement \
    du scénario\
    "

[en]
; Model = Model
```

If translation the same as original message you can exclude it, e.g.: `Model = Model` is not required.

How model finds translated message

At start model determine list user preferred languages. For example if current environment is French Canadian and model default language is EN then language list will be: `(fr-ca, fr, en)`.

User language preference can be changed in Windows Control Panel or by Linux LANG environment variable. You can override environment language by using model command-line or ini-file argument:

```
modelOne.exe -OpenM.MessageLanguage es-EC
```

To find translated message model does lookup in:

- `modelName.message.ini`
- database table `model_word`
- database table `lang_word` Search done in order of user preferred languages.

For example, if `modelOne.message.ini` is same as above and database table `model_word` contains entry:

```
fr-CA Done. Fini.
```

Then model messages in French Canadian environment can be similar to:

```
2014-03-17 17:14:24.0023 Model: modelOne
2014-03-17 17:14:24.0070 Exécution 101
...
2014-03-17 17:14:24.0179 Fini.
```

As you can see for current user language `fr-CA` model found two messages translated in "generic `fr`" French: "Exécution" and "Fini", however "Model" still untranslated. To fix this you can update `modelOne.message.ini` by adding:

```
[fr-CA]
Model = Modèle
```

Then result would look like:

```
2014-03-17 17:14:24.0023 Modèle: modelOne
2014-03-17 17:14:24.0070 Exécution 101
...
2014-03-17 17:14:24.0179 Fini.
```

Model developer: How to mark strings for translation in model code

Omc model compiler automatically include first `"const char *"` argument of

- `theLog->logMsg("some message");`
- `theLog->logFormatted("some format %d %g %s",....);`
- macro `LT("some message")`
- `WriteLogEntry("some message");`
- `WarningMsg("some message");`
- `ModelExit("some message");` into output `model.message.ini` file, which can be used as translation starting point.

If your source code directory already contains translated `code/model.message.ini` then such file is merged with newly added model messages into output `bin/model.message.ini`, which you can forward to translation team.

It is possible to use macro `LT("something")` in order to build concatenated message, however `LT` is "strictly inline" because it returns temporary `const char *` pointer. As result following will crash your model:

```
const char * myBadDay = LT("nice day");
if (myBadDay .... // memory access violation, model crash
```

Also string concatenation considered as bad practice by any translation guide.

How To: Set Model Parameters and Get Results

Overview

There multiple examples how to set input parameters, run the model and get results:

- [run model from Python: simple loop over model parameter](#)
- [run RiskPaths model from Python: advanced parameters scaling](#)
- [run model from R: simple loop over model parameter](#)
- [run RiskPaths model: advanced parameters scaling](#)
- [oms web-service: How to prepare model input parameters](#)

Also openM++ support following APIs:

- [oms: openM++ web-service](#) which you can use from any modern environment: Python, .NET, JavaScript, etc.
- [openMpp R package](#)
- [Go library and tools](#)

Quick examples below do not cover all possible options, please check links above and [Model Run: How model finds input parameters](#) for more details.

Sub-values: sub-samples, members, replicas

Following terms: "simulation member", "replica", "sub-sample" are often used in micro-simulation conversations interchangeably, depending on context. To avoid terminology discussion openM++ uses "sub-value" as equivalent of all above and some older pages of that wiki may contain "sub-sample" in that case.

Model output tables: sub-values, accumulators and expressions

There are two kind of model output tables:

- accumulators table: output sub-values (similar to Modgen sub-samples)
- expressions table: [model output value](#) calculated as accumulators aggregated across sub-values (e.g. [mean](#) or [CV](#) or [SE](#))

All output accumulator tables always contain same number of sub-values, for example model run:

```
model.exe -OpenM.SubValues 16
```

will create 16 sub-values for each accumulator in each output accumulator table.

Model parameters: sub-values (optional)

OpenM++ parameters can also contain sub-values. Parameters sub-values are not required, it is a user choice to run the model and supply sub-values for some parameters.

For example, if user wants to describe statistical uncertainty of parameter [SalaryByYearByProvince](#) then csv file with 16 sub-values can be supplied to run the model:

```
model.exe -OpenM.SubValues 16 -SubFrom.SalaryByYearByProvince csv -OpenM.ParamDir C:\MyCsv\
```

Parameters: Re-use same parameters values as in previous model run

Most of the model parameters are not changing between simulations and only few are varying. It is convenient to select all unchanged parameters from previous model run (from "base" run):

```
model.exe -Parameter.Ratio 0.7 -OpenM.BaseRunId 1234  
model.exe -Parameter.Ratio 0.7 -OpenM.BaseRunDigest 5dc848891ea57db19d8dc08ec7a30804  
model.exe -Parameter.Ratio 0.7 -OpenM.BaseRunName "My base run of the Model"
```

Above command do run the model with parameter `Ratio = 0.7` and the rest of parameters values are the same as it was in previous run with `id = 1234`.

It is also possible to use run diegst or run name to identify "base" model run:

```
model.exe -Parameter.Ratio 0.7 -OpenM.BaseRunDigest 5dc848891ea57db19d8dc08ec7a30804  
model.exe -Parameter.Ratio 0.7 -OpenM.BaseRunName "My base run of the Model"
```

Please keep in mind, model run may not be unique and if database contains multiple model runs with the same name then first run will be selected.

Parameter: Value as command line argument

It is possible to specify value of any scalar parameter as command line argument, for example:

```
model.exe -Parameter.Ratio 0.7
```

There is an example of such technique at [Run model from R: simple loop over model parameter](#) page, where we using NewCaseBased model to study effect of Mortality Hazard input parameter on Duration of Life output:

```
for (mortalityValue from 0.014 to 0.109 by step 0.005)  
{  
    # run the model  
    NewCaseBased.exe -Parameter.MortalityHazard mortalityValue  
}
```

If parameter is enum-based (e.g. classification) then you can specify code or enum id:

```
modelOne.exe -Parameter.baseSalary Full  
modelOne.exe -Parameter.baseSalary 22 -OpenM.IdParameterValue true
```

Parameter: Sub-values [0, N-1] as command line argument

If we want to run the model with multiple sub-values (a.k.a. sub-samples) and want "Grade" parameter sub-values to be created as [0, N-1] then:

```
model.exe -OpenM.SubValues 16 -SubFrom.Grade iota
```

as result sub-values parameter `Grade` would be: [0, ..., 15]

Parameter: Value inside of ini.file

Also any scalar parameter can be defined in model ini-file, i.e.:

```
model.exe -ini my.ini
```

```
; inside of my.ini file:  
;  
[Parameter]  
Z_Parameter = XYZ      ; string parameter  
SomeInt     = 1234       ; integer parameter  
OrLogical   = true       ; boolean parameter  
Anumber     = 9.876e5    ; float parameter
```

Parameters: Csv files

It is also possible to supply some (or even all) model parameters as csv-file(s). For example:

```
model.exe -OpenM.ParamDir C:\my_csv
```

If directory `C:\my_csv\` exist and contains `parameterName.csv` files then model will use it parameter values. For example, `C:\my_csv\Sex.csv` values of "Sex" parameter:

```
sub_id,dim0,param_value
0,      F,    true
0,      M,    false
```

Parameters: Csv files with multiple sub-values

If user want to supply up to 32 sub-values of "Sex" parameter:

```
sub_id,dim0,param_value
0,      F,    true
0,      M,    false
1,      F,    true
1,      M,    true
.....
31,     F,    false
31,     M,    true
```

Important: Presence of multiple sub-values in csv file (or in database) does not mean model will use all parameter sub-values. Only explicitly specified parameter(s) receiving sub-values.

For example, if user run the model 3 times:

```
model.exe -OpenM.SubValues 16
model.exe -OpenM.SubValues 16 -OpenM.ParamDir C:\my_csv
model.exe -OpenM.SubValues 16 -OpenM.ParamDir C:\my_csv -SubFrom.Sex csv
```

- "Sex" parameter expected to be in database and no sub-values used
- "Sex" parameter value is sub-value 0 from C:\my_csv\Sex.csv
- "Sex" parameter using sub-values [0, 15] from C:\my_csv\Sex.csv

Output Tables: Suppress output tables

By default model calculate all output tables and write it into database as model run results. Sometime it may be convenient to save only some output tables to reduce a time of each model run. This can be done by either suppressing model output table(s) or table group(s):

```
model.exe -Tables.Suppress ageSexIncome
model.exe -Tables.Suppress ageSexIncome,fullAgeSalary,A_TablesGroup
```

Or by suppressing output for all tables except of some:

```
model.exe -Tables.Retain ageSexIncome
model.exe -Tables.Retain ageSexIncome,fullAgeSalary,A_TablesGroup
```

Suppress and Retain options are mutually exclusive and cannot be mixed. For example, this model run would fail:

```
model.exe -Tables.Suppress ageSexIncome -Tables.Retain fullAgeSalary
```

Use dbcopy: Export entire model into text files

```
dbcopy -m modelOne
dbcopy -m modelOne -dbcopy.Zip
```

It will create modelOne directory and modelOne.Zip file with:

- all model metadata (e.g. parameters, description, notes,...) in .json files
- csv files with sets of model input parameters
- csv files with model run results and input parameters

Use dbcopy: Export entire model into csv files

```
dbcopy -m modelOne -dbcopy.To csv  
dbcopy -m modelOne -dbcopy.To csv -dbcopy.Zip
```

It will create modelOne directory and modelOne.Zip file with:

- all model metadata (e.g. parameters, description, notes,...) in .csv files
- csv files with sets of model input parameters
- csv files with model run results and input parameters Each model run result and each input parameters set will be in separate sub-directory.

Other variation of csv output is:

```
dbcopy -m modelOne -dbcopy.To csv-1
```

In that case all model runs will be in "all_model_runs" sub-directory and all input sets are in "all_input_sets".

Use dbcopy: Export set of input parameters into text files

```
dbcopy -m modelOne -s modelOne_other -dbcopy.ParamDir pDir
```

It will create `pDir` directory with:

- input parameters set metadata (name, description, notes,...) in .json file
- csv files with sets of model input parameters

Use dbcopy: Export model run results into text files

```
dbcopy -m modelOne -dbcopy.RunId 101  
dbcopy -m modelOne -dbcopy.RunName modelOne_2016_11_22_11_38_49_0945_101
```

It will create a directory with:

- model run metadata (name, description, notes,...) in .json file
- csv files with input parameters used to run the model
- csv files with model output tables values

Use dbcopy: Import parameters from csv files into database

```
dbcopy -m myModel -s MyInput -dbcopy.ParamDir P -dbcopy.ToDateTime "Database=myModel.sqlite;OpenMode=ReadWrite"
```

If any `parameterName.csv` file(s) exist in directory `P` then it will be loaded into `MyInput` set of input parameters.

It is recommended to run `dbcopy -m modelOne -s modelOne_other -dbcopy.ParamDir P` to get familiar how csv files look like.

Use dbcopy: Import parameters, description and notes from text files into database

```
dbcopy -m myModel -s MyInput -dbcopy.ToDateTime "Database=myModel.sqlite;OpenMode=ReadWrite"
```

It will insert or update MyInput set of input parameters in database with:

- if json metadata file exist then input set description, notes and parameter value note updated
- if any `parameterName.csv` files exist then it will be loaded into database

It is recommended to run `dbcopy -m modelOne -s modelOne_other -dbcopy.ParamDir P` to get familiar how json and csv files look like.

Example of json metadata file for "ageSexData" input set of parameters with description, notes and `ageSex` parameter value notes:

```
{
  "ModelName" : "modelOne",
  "Name" : "ageSexData",
  "Txt" : [
    {
      "LangCode" : "EN",
      "Descr" : "Model One set of parameters"
    }
  ],
  "Param" : [
    {
      "Name" : "ageSex",
      "SubCount" : 1,
      "Txt" : [
        {
          "LangCode" : "EN",
          "Note" : "Age by Sex values"
        }
      ]
    }
  ]
}
```

It is also must exist csv file with parameter values: [ageSex.csv](#)

Example of json metadata file for "emptyData" input set of parameters with description and notes in English and French:

```
{
  "ModelName" : "modelOne",
  "Name" : "emptyData",
  "Txt" : [
    {
      "LangCode" : "EN",
      "Descr" : "Model One set of parameters",
      "Note" : "Notes for model One set of parameters"
    },
    {
      "LangCode" : "FR",
      "Descr" : "Je suis désolé je ne parle pas français"
    }
  ]
}
```

Model Run: How model finds input parameters

Model run cycle overview

Model run (execution of the model) consists of the following steps:

- initializing of model process(es) with model run options
- connecting to database and creating "model run" with `run_id` and `run_name`
- find set of input parameters and prepare it for the run
- reading model input parameters
- simulation of sub-values
- writing output sub-values to output tables in database
- aggregating sub-values using [Output Expressions](#)

Results of model run stored in database within unique integer "run_id" and include all model parameters, options and output result tables. **You always can find full set of model input and output by run id.**

OpenM++ models can be run on Windows and Linux platforms, on single desktop computer, on multiple computers over network, in HPC cluster or cloud environment (Google Cloud, Microsoft Azure, Amazon,...). Because openM++ runtime library hides all that complexity from the model we can safely assume model is a single executable on local machine. Please check [Model Run: How to Run the Model](#) for more details.

Sub-values: sub-samples, members, replicas

Following terms: "simulation member", "replica", "sub-sample" are often used in micro-simulation conversations interchangeably, depending on context. To avoid terminology discussion openM++ uses "sub-value" as equivalent of all above and some older pages of our wiki may contain "sub-sample" in that case.

Model output tables: sub-values, accumulators and expressions

There are two kind of model output tables:

- accumulators table: output sub-values (similar to Modgen sub-samples)
- expressions table: [model output value](#) calculated as accumulators aggregated across sub-values (e.g. `mean` or `CV` or `SE`)

All output accumulator tables always contain same number of sub-values, for example model run:

```
model.exe -OpenM.SubValues 16
```

will create 16 sub-values for each accumulator in each output accumulator table.

Model parameters: sub-values (optional)

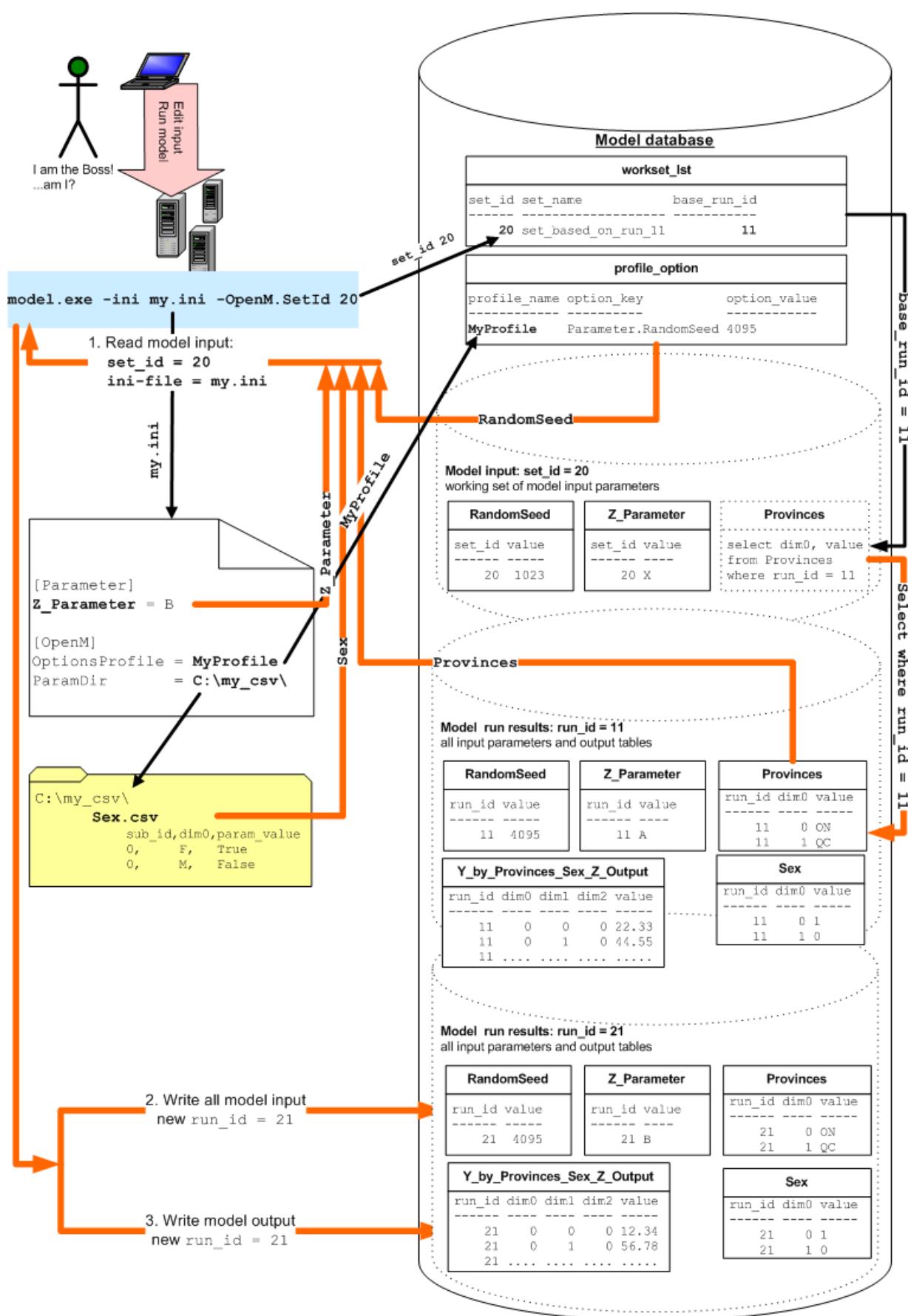
OpenM++ parameters can also contain sub-values. Parameters sub-values are not required, it is a user choice to run the model and supply sub-values for some parameters.

For example, if user wants to describe statistical uncertainty of parameter `SalaryByYearByProvince` then csv file with 16 sub-values can be supplied to run the model:

```
model.exe -OpenM.SubValues16 SubFrom.SalaryByYearByProvince csv -OpenM.ParamDir C:\MyCsv\
```

Note: To simplify diagram below we do omit sub-values from the picture. But in real database there are multiple sub-values for parameters and accumulators; each sub-value identified by `sub_id` column.

How model finds input parameters: Parameters search order



Model search for input parameter values in following order:

- use parameter value specified as command line argument
- use parameter value specified inside of ini-file **[Parameter]** section
- use parameter value from profile_option table
- read parameter.csv file from "OpenM.ParamDir" directory

- import parameter value from other model parameter or other model output table
- use parameter value set of input parameters in database: workset
- use same value as in previous model run: values from "base" run
- use parameter value from default set of input parameters in database: default workset
- some parameters, e.g. number of sub-values may have default value

In any case all input parameters are copied under new run id before simulation starts. That process of copy parameters do guarantee a full copy of input parameters for each model run in database.

Model run options

There are many options which control model run, i.e.: number of sub-values, number of threads, etc. OpenM++ model gets run options in following order:

- as command line arguments
- from model run options ini-file
- from database `profile_option` tables
- use default values

Each option has unique key associated with it, e.g. "Parameter.RandomSeed" is model input parameter "RandomSeed", which is most likely, random generator starting seed. You can use this key to specify model parameter on command line, in ini-file or database. For example:

```
modelOne.exe -Parameter.RandomSeed 123 -ini my.ini
```

would run `modelOne` model with random seed = 123 and other options from `my.ini` file.

Please see [OpenM++ Model Run Options](#) to find out more.

Set of model input parameters in database (workset or scenario) and "base" model run

Database can contain multiple versions of model input parameter value. User can edit (change values of) input parameter(s) and save it as "working set of model input parameters" (a.k.a. "workset" or scenario).

- each set of parameters has unique "set id" and unique "set name"
- each model must have at least one full set of input parameters populated with default values (default set)
- default input set is a first set of model parameters (first means set with minimal set id)

Most of the model parameters are not changing between simulations and only few are varying. It is convenient to select all unchanged parameters from previous model run ("base" run). In order to do that user can:

- specify "base" model run to re-use parameters values
- create input set of parameters as "based on previous model run" and include only updated parameters in that input set Model will use parameters values from command line, csv files, etc. (as described above) and:
- if input set (workset) specified then select all parameters which do exist in that workset
- if "base" model run specified then select the rest parameters values from that previous model run
- if there is no "base" run then select model parameters from model default workset

How model finds input parameters: Default

If user run the model without any arguments:

```
modelOne.exe
```

then input parameters selected from default set, which is the first input data set of that model.

How model finds input parameters: Input set name or Id

To run the model with input data other than default user can specify set id or workset name:

```
modelOne.exe -OpenM.SetId 20
```

```
modelOne.exe -OpenMSetName "My Set of Input Parameters"
```

assuming workset with `set_id = 20` and set with name `My Set of Input Parameters` exists in model database.

How model finds input parameters: re-use parameters from previous model run (base run)

It is often convenient to re-use parameters from previous model run:

```
model.exe -Parameter.Ratio 0.7 -OpenM.BaseRunId 42
```

As result model will be using same parameters values as it was for run with `run_id = 42` except of parameter `Ratio = 0.7`. For more details please see below: [How to specify model base run](#).

How model finds input parameters: Value as command line argument

It is also possible to specify value of any scalar parameter as command line argument, i.e.:

```
model.exe -Parameter.Ratio 0.7
```

There is an example of such technique at [Run model from R: simple loop over model parameter](#) page, where we using NewCaseBased model to study effect of Mortality Hazard input parameter on Duration of Life output:

```
for (mortalityValue from 0.014 to 0.109 by step 0.005)
{
    # run the model
    NewCaseBased.exe -Parameter.MortalityHazard mortalityValue
}
```

How model finds input parameters: iota sub-values command line argument

If we want to run the model with N sub-values (a.k.a. sub-samples) and want `Grade` parameter sub-values to be created as [0,...,N-1] then:

```
model.exe -OpenM.SubValues 10 -SubFrom.Grade iota
```

as result sub-values of parameter `Grade` would be: [0, ..., 9]

How model finds input parameters: Value inside of ini.file

Also any scalar parameter can be defined in model ini-file, i.e.:

```
model.exe -ini my.ini
```

```
; inside of my.ini file:
;
[Parameter]
Z_Parameter = B          ; string parameter
SomeInt     = 1234        ; integer parameter
OrLogical   = true         ; boolean parameter
ANumber     = 9.876e5      ; float parameter
```

How model finds input parameters: Value in model profile

Another way to supply value of scalar parameter(s) is through `profile_option` database table. For example:

```
model.exe -OpenM.SetId 20 -OpenM.Profile MyProfile
```

```

SELECT * FROM profile_lst;

profile_name
-----
MyProfile

SELECT * FROM profile_option;

profile_name    option_key          option_value
-----          -----
MyProfile      Parameter.RandomSeed 4095

```

How model finds input parameters: Csv file

It is also possible to supply some (or even all) model parameters as csv-file(s). For example:

```
model.exe -OpenM.ParamDir C:\my_csv
```

If directory `C:\my_csv\` exist and contains `parameterName.csv` file model will use it parameter values. Parameter directory can be specified as command-line argument or as ini-file entry (it is not recommended to use `profile_option` table for `OpenM.ParamDir` option).

On picture above model run as:

```
model.exe -ini my.ini -OpenM.SetId 20
```

and my.ini file contains:

```
[OpenM]
ParamDir = C:\my_csv\
```

As result `model.exe` will read from `C:\my_csv\Sex.csv` values of "Sex" parameter:

```
sub_id,dim0,param_value
0,      F,    true
0,      M,    false
```

It is also possible to have enum id's in csv files instead of codes, for example `C:\my_csv\Sex.csv` can be:

```
sub_id,dim0,param_value
0,      0,    true
0,      1,    false
```

To use such csv files you need to run the model with `OpenM.IdCsv true` argument:

```
model.exe -OpenM.SetId 20 OpenM.IdCsv true
```

Format of parameter.csv is based on RFC 4180 with some simplification:

- space-only lines silently ignored
- end of line can be CRLF or LF
- values are trimmed unless they are `" double quoted "`
- multi-line string values not supported

If parameter is boolean then following values expected (not case sensitive):

- "true" or "t" or "1"
- "false" or "f" or "0"

Important: Header line must include all dimension names, in ascending order, without spaces, e.g.: `sub_id,dim0,dim1,dim2,dim3,param_value`.

Parameter.csv file must contain all values, e.g. if parameter has 123456 values then csv must have all 123456 lines + header. Sorting order of lines are not important.

Csv file with multiple sub-values

If user want to supply up to 32 sub-values of "Sex" parameter then Sex.csv file look like:

```
sub_id,dim0,param_value
0,      F,    true
0,      M,    false
1,      F,    true
1,      M,    true
.....
31,     F,    false
31,     M,    true
```

Important: Presence of multiple sub-values in csv file (or in database) does not mean model will be using all parameter sub-values. Only explicitly specified parameter(s) receiving sub-values.

For example, if user run the model 8 times:

```
model.exe -OpenM.SubValues 8
model.exe -OpenM.SubValues 8 -OpenM.ParamDir C:\my_csv
model.exe -OpenM.SubValues 8 -OpenM.ParamDir C:\my_csv -SubFrom.Sex csv -SubValues.Sex default
model.exe -OpenM.SubValues 8 -OpenM.ParamDir C:\my_csv -SubFrom.Sex csv -SubValues.Sex 17
model.exe -OpenM.SubValues 8 -OpenM.ParamDir C:\my_csv -SubFrom.Sex csv
model.exe -OpenM.SubValues 8 -OpenM.ParamDir C:\my_csv -SubFrom.Sex csv -SubValues.Sex [24,31]
model.exe -OpenM.SubValues 8 -OpenM.ParamDir C:\my_csv -SubFrom.Sex csv -SubValues.Sex 1,3,5,7,9,11,13,15
model.exe -OpenM.SubValues 8 -OpenM.ParamDir C:\my_csv -SubFrom.Sex csv -SubValues.Sex xAAAA
model.exe -OpenM.SubValues 8 -OpenM.ParamDir C:\my_csv -SubFrom.GeoGroup csv -SubValues.GeoGroup 1,3,5,7,9,11,13,15
```

- "Sex" parameter expected to be in database and no sub-values used
- "Sex" parameter value is selected as "default" (sub_id=0) from `C:\my_csv\Sex.csv`, if .csv file exist
- "Sex" parameter value is selected as "default" (sub_id=0) from `C:\my_csv\Sex.csv`, .csv file must exist
- "Sex" parameter value is selected as sub_id = 17 from `C:\my_csv\Sex.csv`
- "Sex" parameter using sub-values [0,7] from `C:\my_csv\Sex.csv`
- "Sex" parameter using sub-values [24,31] from `C:\my_csv\Sex.csv`
- "Sex" parameter using sub-values 1,3,5,7,9,11,13,15 from `C:\my_csv\Sex.csv`
- "Sex" parameter using sub-values 1,3,5,7,9,11,13,15 from `C:\my_csv\Sex.csv` (bit mask)
- all parameters of GeoGroup using sub-values 1,3,5,7,9,11,13,15 from .csv files form `C:\my_csv\` directory

"Default" sub-value id can be explicitly defined for input parameter by person who published input set of parameters (workset). If "default" sub_id is not defined for that parameter then sub_id=0 assumed. Sub-value id's in the input set of parameters (in workset) can have be any integer (can be negative and not even have to sequential). For example if RatioByProvince parameter have 32 sub-values then typically sub_id's are [0,31], but it can be [-10, -8, -6, -4, -2, 0, 2, 4, ..., 52] and default sub_id can be = -10.

Important: Number of sub-values in csv must be at least as user required. In example above `Sex.csv` contains 32 sub-values and user cannot run model with more than 32 sub-values.

How model finds input parameters: Import value from upstream model

If input parameter specified as "importable" by model developer then value(s) can be imported from run values of upstream model parameter or output table. For example if model developer of `BigModel` specified:

```
import Phi (RedModel.RedPhi) sample_dimension= off;
import Zet (SunModel.SunZet) sample_dimension= off;
```

And model user running `BigModel` as:

```
BigModel.exe -Import.All true
```

Then:

- value of `BigModel` parameter `Phi` must be imported from last run of `RedModel` parameter `RedPhi`
- value of `BigModel` parameter `Zet` must be imported from last run of `SunModel` output table `SunZet`

There are multiple options to control model import. For example if user run `BigModel` 9 times:

```
BigModel.exe -Import.All true
BigModel.exe -Import.SunModel true
BigModel.exe -ImportRunDigest.SunModel abcdefghf12345678
BigModel.exe -ImportRunId.SunModel 123
BigModel.exe -ImportRunName.SunModel GoodRun
BigModel.exe -ImportDigest.SunModel 87654321fedcba
BigModel.exe -ImportId.SunModel 456
BigModel.exe -ImportExpr.SunZet expr4
BigModel.exe -ImportDatabase.SunModel "Database=../NewSunModel.sqlite;OpenMode=ReadOnly;"
```

- Import all importable parameters from last successful run of upstream models
- Import all parameters importable from `SunModel` using values of last successful run of `SunModel`
- Import all parameters importable from `SunModel` using values of run where digest = `abcdefghf12345678`
- Import all parameters importable from `SunModel` using values of run where id = 123
- Import all parameters importable from `SunModel` using values of last successful run where run name = `GoodRun`
- Import all parameters importable from `SunModel` where model digest is `87654321fedcba` using values of last successful run
- Import all parameters importable from `SunModel` where model id = 456 using values of last successful run
- Import parameter `Zet` from `SunModel` output table `SunZet` expression `expr4` using values of last successful run
- Import all parameters importable from `SunModel` from database `../NewSunModel.sqlite`

Import options can be combined with sub-values options if model user want to select specific sub-values from upstream model parameter.

Default database to search for upstream model:

- if upstream model `SunModel` exist in current model database then it is imported from current database
- else it must be default upstream model SQLite database: `SunModel.sqlite`

How model finds input parameters: Value from previous model run (base run)

Most of the model parameters are not changing between simulations and only few parameters are varying. In that case it is convenient to select unchanged parameters from previous model run ("base" run).

Base run can be identified by `run_id` or run digest or run name. **Please note:** model run names are not unique and if there are multiple runs in database with the same name then first run selected:

```
SELECT MIN(run_id) WHERE run_name = 'Default model run';
```

Create set of input parameters based on previous model run

Input set of model parameters (workset) can be created as "based on existing run" and store only small number of model parameters, all the rest will be selected from "base" run by `run_id`.

On picture above command line to run the model is:

```
model.exe -ini my.ini -OpenM.SetId 20
```

and input set with id 20 defined as "based on run" with id = 11:

```
SELECT set_id, set_name, base_run_id FROM workset_lst WHERE set_id = 20;
set_id set_name          base_run_id
----- 
20 set_based_on_run_11    11
```

Because workset with id = 20 does not include "Provinces" input parameter those values selected from existing model run by `run_id = 11`:

```
SELECT dim0, param_value FROM Provinces WHERE run_id = 11;  
dim0 value  
----  
0    ON  
1    QC
```

Note: sql above specially simplified, actual database table names, column names and queries bit more complex.

How to specify model base run

It is possible to explicitly specify model base run to select input parameters. For example:

```
model.exe -Parameter.Ratio 0.7 -OpenM.SetName "Age Input Values" -OpenM.BaseRunId 42
```

Model will use parameter `Ratio = 0.7` and select all parameters which do exist in `Age Input Values` workset:

```
SELECT dim0, param_value FROM Age WHERE set_name = 'Age Input Values';  
dim0 value  
----  
0    [0,21]  
1    22+  
.... select all other parameters where parameter exist in 'Age Input Values' ....
```

And the rest of model parameters selected from base run:

```
SELECT dim0, param_value FROM Provinces WHERE run_id = 42;  
dim0 value  
----  
0    BC  
1    NS
```

It is also possible to use run digest or run name to identify "base" model run:

```
model.exe -Parameter.Ratio 0.7 -OpenM.BaseRunDigest 5dc848891ea57db19d8dc08ec7a30804  
model.exe -Parameter.Ratio 0.7 -OpenM.BaseRunName "My base run of the Model"
```

Please keep in mind, model run may not be unique and if database contains multiple model runs with the same name then first run will be selected.

Parameter sub-values from database

If we want to run the model with multiple sub-values (a.k.a. sub-samples) and want "RatioByProvince" parameter sub-values selected from database:

```
model.exe -OpenM.SubValues 8 -SubFrom.RatioByProvince db
```

Model will select "RatioByProvince" parameter sub-values from default workset or from base run, if there are no RatioByProvince parameter in default workset. Database **must** contain at least 8 sub-values for "RatioByProvince".

```
model.exe -OpenM.SubValues 8 -SubFrom.GeoGroup db
```

For GeoGroup of parameters model will select sub-values from default workset or from base run, if there are no such parameter in default workset. Database **must** contain at least 8 sub-values for all parameters of GeoGroup.

For example:

```
SELECT sub_id, dim0, param_value FROM RatioByProvince WHERE run_id = 11;
```

sub_id	dim0	value
0	0	1.00
0	1	1.01
1	0	1.02
1	1	1.03
2	0	1.04
2	1	1.05
.....		
31	0	1.31
31	1	1.32

In that case first 8 sub-values will be selected with `sub_id` between 0 and 7.

There are multiple options to specify which sub-values to select from database, for example:

```
model.exe -OpenM.SubValues 8
model.exe -OpenM.SubValues 8 -SubFrom.RatioByProvince db
model.exe -OpenM.SubValues 8 -SubFrom.RatioByProvince db -SubValues.Sex [24,31]
model.exe -OpenM.SubValues 8 -SubFrom.RatioByProvince db -SubValues.Sex 1,3,5,7,9,11,13,15
model.exe -OpenM.SubValues 8 -SubFrom.RatioByProvince db -SubValues.Sex xAAAAA
model.exe -OpenM.SubValues 8 -SubFrom.RatioByProvince db -SubValues.Sex default
model.exe -OpenM.SubValues 8 -SubFrom.RatioByProvince db -SubValues.Sex 17
model.exe -OpenM.SubValues 8 -SubFrom.GeoGroup db -SubValues.GeoGroup 17
```

- "RatioByProvince" parameter expected to be in database and no sub-values used
- "RatioByProvince" parameter using sub-values [0,7] from database
- "RatioByProvince" parameter using sub-values [24,31] from database
- "RatioByProvince" parameter using sub-values 1,3,5,7,9,11,13,15 from database
- "RatioByProvince" parameter using sub-values 1,3,5,7,9,11,13,15 from database (bit mask)
- "RatioByProvince" parameter value is selected as "default" (sub_id=0) from database
- "RatioByProvince" parameter value is selected as sub_id = 17 from database
- all parameters of GeoGroup are selected as sub_id = 17 from database

"Default" sub-value id can be explicitly defined for input parameter by person who published input set of parameters (workset). If "default" sub_id is not defined for that parameter then sub_id=0 assumed. Sub-value id's in the input set of parameters (in workset) can have be any integer (can be negative and not even have to sequential). For example if RatioByProvince parameter have 32 sub-values then typically sub_id's are [0,31], but it can be [-10, -8, -6, -4, -2, 0, 2, 4, ..., 52] and default sub_id can be = -10.

On the other hand, in model run results sub_id is always [0,N-1] for run parameters and output tables. For example:

```
model.exe -OpenM.SubValues 8 -SubFrom.RatioByProvince db -SubValues.Sex [24,31]
```

"RatioByProvince" parameter in model run will have sub_id column values: [0,7].

Model Output Expressions

Sub-values: sub-samples, members, replicas

Following terms: "simulation member", "replica", "sub-sample" are often used in micro-simulation conversations interchangeably, depending on context. To avoid terminology discussion openM++ uses "sub-value" as equivalent of all above and some older pages of that wiki may contain "sub-sample" in that case.

Model output tables: sub-values, accumulators and expressions

There are two kind of model output tables:

- accumulators table: output sub-values (similar to Modgen sub-samples)
- expressions table: model output value calculated as accumulators aggregated across sub-values (e.g. `mean` or `CV` or `SE`)

All output accumulator tables always contain same number of sub-values, for example model run:

```
model.exe -OpenM.Subvalues 16
```

will create 16 sub-values for each accumulator in each output accumulator table.

Sub-values (accumulators) output tables

During the simulation OpenM++ model collect the results in "accumulators" and, at the end, write it into output accumulators table(s). Each output accumulator table contains results of model executions for all sub-values.

For example:

Model output table "Salary by Sex" has two accumulators and two dimensions:

- salary: 0 = "Low", 1 = "Medium", 2 = "High"
- sex: 0 = "Female", 1 = "Male"

If we run that model twice, first time with one sub-value and second with eight sub-values then output results may look like:

```
SELECT
    run_id, dim0, dim1, acc_id, sub_id, acc_value
FROM modelone_201208171604590148_a0_salarySex
ORDER BY 1, 2, 3, 4, 5;

run_id  dim0   dim1   acc_id  sub_id  acc_value
-----  -----  -----  -----  -----  -----
11      0       0       0       0       50.0
11      0       0       1       0       1.0
11      0       1       0       0       60.0
11      0       1       1       0       2.0
11      1       0       0       0       51.6
11      1       0       1       0       2.0
11      1       1       0       0       62.0
11      1       1       1       0       3.0
11      2       0       0       0       53.2
11      2       0       1       0       3.0
11      2       1       0       0       64.0
11      2       1       1       0       4.0
12      0       0       0       0       50.0
12      0       0       0       1       100.0
12      0       0       0       2       150.0
12      0       0       0       3       200.0
12      0       0       0       4       250.0
12      0       0       0       5       300.0
12      0       0       0       6       350.0
12      0       0       0       7       400.0
12      0       0       1       0       1.0
....more results....
12      2       1       1       7       11.0
```

Columns are:

- `run_id`: is unique run id for that model execution; all model input parameters and output results can be found by `run_id`;
- `dim0`: salary dimension items;

- dim1: sex dimension items;
- acc_id: zero-based accumulator number;
- sub_id: zero-based sub-value number;
- acc_value: accumulator value;

Accumulators are low level simulation results and useful mostly to analyze simulation model itself.

Aggregated values output tables

On top of accumulator values for each sub-value model can produce more meaningful output results by using OpenM++ output expressions, i.e.: median value across all sub-values. To do that model developer (or model user) can specify output aggregation expression, for example, median value is: `OM_AVG(acc0)`.

Each "value" output table can contain unlimited (reasonably unlimited) amount of aggregation expressions. Each expression must include aggregation function(s) with accumulators as argument(s) and, optionally, other arithmetic operators and basic SQL functions, such as `ABS` or `SQRT`.

Following OpenM++ sub-values aggregation functions are supported:

- `OM_COUNT(...expr...)` - count of values across all sub-values:

```
COUNT(...expr...)
```

- `OM_SUM(...expr...)` - sum of values across all sub-values:

```
SUM(...expr...)
```

- `OM_AVG(...expr...)` - average value over sub-values:

```
AVG(...expr...)
```

- `OM_VAR(...expr...)` - variance over sub-values:

```
SUM( (...expr... - AVG(...expr...)) * (...expr... - AVG(...expr...)) )
/ ( COUNT(...expr...) - 1 )
```

- `OM_SD(...)` - standard deviation:

```
SQRT(OM_VAR(...expr...))
```

- `OM_SE(...expr...)` - standard error:

```
SQRT(OM_VAR(...expr...)) / COUNT(...expr...))
```

- `OM_CV(...expr...)` - coefficient of variation:

```
100 * ( OM_SD(...expr...) / AVG(...expr...) )
```

Aggregation expression can be more complex than a single function, for example: `OM_SUM(acc0) / OM_COUNT(acc0)` is equivalent of `OM_AVG(acc0)`. And `OM_SD(acc1)` can be written as:

```
SQRT(OM_SUM( (acc1 - OM_AVG(acc1)) * (acc1 - OM_AVG(acc1)) ) / ( OM_COUNT(acc1) - 1 ))
```

It is possible, as you can see, combine and nest aggregation functions in the expression.

It is important to understand:

- openM++ does aggregation across the sub-values, or other word, COUNT() is (almost) always number of sub-values.
- aggregation done by underlying SQL database, so, only non-NULL accumulator values are aggregated, so, COUNT() is number of non-NULL accumultor values across sub-values.
- accumulators always must be inside some aggregation function, i.e. this is an error: `acc0 + OM_SUM(acc1)` because `acc0` is not aggregated.

If you want to aggregate simulation results in your own way then it is always possible to combine openM++ and standard SQL functions in some custom expression. For example, if sub-values of your model is parts of large population then your may want to collect count and sum in separate accumulators and instead of `OM_AVG(...)` use custom median expression, like:

```
OM_SUM(acc0) / OM_SUM(acc1)
```

Examples of aggregation expressions

OpenM++ output table expressions translated into SQL aggregation queries. For example, if we have accumulator table:

```
CREATE TABLE out4_sub
(
    run_id      INT          NOT NULL,
    dim0        INT          NOT NULL,
    dim1        VARCHAR(8)   NOT NULL,
    sub_id      INT          NOT NULL,
    acc0        FLOAT        NULL,
    PRIMARY KEY (run_id, dim0, dim1, sub_id)
);

SELECT run_id, dim0, dim1, sub_id, acc0 FROM out4_sub ORDER BY run_id, dim0, dim1 DESC;

run_id  dim0    dim1    sub_id  acc0
-----  ----  -----  -----  -----
2       10      M       0       1
2       10      M       1       2
2       10      M       2       3
2       10      M       3       4
2       10      F       0       1.5
2       10      F       1       2.5
2       10      F       2       3.5
2       10      F       3       4.5
2       20      M       0       10
2       20      M       1       20
2       20      M       2       30
2       20      M       3       40
2       20      F       0       10.5
2       20      F       1       20.5
2       20      F       2       30.5
2       20      F       3       40.5
3       10      M       0       5
3       10      M       1       6
3       10      F       0       7
3       10      F       1       8
3       20      M       0       50
3       20      M       1       60
3       20      F       0       70
3       20      F       1       80
```

Please, keep in mind: this is simplified example and in real openM++ database sub-value tables look like as described at the top of the article.

Then following results would be produced by openM++ aggregation functions:

Count, Average, Sum, Min and Max:

```

SELECT
  S.run_id, S.dim0, S.dim1,
  COUNT(S.acc0) AS "cnt",
  AVG(S.acc0)   AS "avg",
  SUM(S.acc0)   AS "sum",
  MIN(S.acc0)   AS "min",
  MAX(S.acc0)   AS "max"
FROM out4_sub S
GROUP BY S.run_id, S.dim0, S.dim1
ORDER BY S.run_id, S.dim0, S.dim1 DESC;

```

run_id	dim0	dim1	cnt	avg	sum	min	max
2	10	M	4	2.5	10	1	4
2	10	F	4	3	12	1.5	4.5
2	20	M	4	25	100	10	40
2	20	F	4	25.5	102	10.5	40.5
3	10	M	2	5.5	11	5	6
3	10	F	2	7.5	15	7	8
3	20	M	2	55	110	50	60
3	20	F	2	75	150	70	80

Count, Average and Variance:

```

SELECT
  S.run_id, S.dim0, S.dim1,
  COUNT(S.acc0) AS "cnt",
  AVG(S.acc0)   AS "avg",
  SUM(
    (S.acc0 - (SELECT AVG(VM1.acc0) FROM out4_sub VM1 WHERE VM1.run_id = S.run_id AND VM1.dim0 = S.dim0 AND VM1.dim1 = S.dim1)) *
    (S.acc0 - (SELECT AVG(VM2.acc0) FROM out4_sub VM2 WHERE VM2.run_id = S.run_id AND VM2.dim0 = S.dim0 AND VM2.dim1 = S.dim1))
  ) /
  ((SELECT COUNT(VC1.acc0) FROM out4_sub VC1 WHERE VC1.run_id = S.run_id AND VC1.dim0 = S.dim0 AND VC1.dim1 = S.dim1) - 1) AS "var"
FROM out4_sub S
GROUP BY S.run_id, S.dim0, S.dim1
ORDER BY S.run_id, S.dim0, S.dim1 DESC;

```

run_id	dim0	dim1	cnt	avg	var
2	10	M	4	2.5	1.66666666666667
2	10	F	4	3	1.66666666666667
2	20	M	4	25	166.666666666667
2	20	F	4	25.5	166.666666666667
3	10	M	2	5.5	0.5
3	10	F	2	7.5	0.5
3	20	M	2	55	50
3	20	F	2	75	50

Count, Average and Standard Deviation:

```

SELECT
  S.run_id, S.dim0, S.dim1,
  COUNT(S.acc0) AS "cnt",
  AVG(S.acc0)   AS "avg",
  SQRT(
    SUM(
      (S.acc0 - (SELECT AVG(SDM1.acc0) FROM out4_sub SDM1 WHERE SDM1.run_id = S.run_id AND SDM1.dim0 = S.dim0 AND SDM1.dim1 = S.dim1)) *
      (S.acc0 - (SELECT AVG(SDM2.acc0) FROM out4_sub SDM2 WHERE SDM2.run_id = S.run_id AND SDM2.dim0 = S.dim0 AND SDM2.dim1 = S.dim1))
    ) /
    ((SELECT COUNT(SCD1.acc0) FROM out4_sub SCD1 WHERE SCD1.run_id = S.run_id AND SCD1.dim0 = S.dim0 AND SCD1.dim1 = S.dim1) - 1)
  ) AS "sd"
FROM out4_sub S
GROUP BY S.run_id, S.dim0, S.dim1
ORDER BY S.run_id, S.dim0, S.dim1 DESC;

```

run_id	dim0	dim1	cnt	avg	sd
2	10	M	4	2.5	1.29099444873581
2	10	F	4	3	1.29099444873581
2	20	M	4	25	12.9099444873581
2	20	F	4	25.5	12.9099444873581
3	10	M	2	5.5	0.707106781186548
3	10	F	2	7.5	0.707106781186548
3	20	M	2	55	7.07106781186548
3	20	F	2	75	7.07106781186548

Count, Average, and Standard Error:

```

SELECT
    S.run_id, S.dim0, S.dim1,
    COUNT(S.acc0) AS "cnt",
    AVG(S.acc0)   AS "avg",
    SQRT(
        SUM(
            (S.acc0 - (SELECT AVG(SEM1.acc0) FROM out4_sub SEM1 WHERE SEM1.run_id = S.run_id AND SEM1.dim0 = S.dim0 AND SEM1.dim1 = S.dim1)) *
            (S.acc0 - (SELECT AVG(SEM2.acc0) FROM out4_sub SEM2 WHERE SEM2.run_id = S.run_id AND SEM2.dim0 = S.dim0 AND SEM2.dim1 = S.dim1))
        ) /
        ( (SELECT COUNT(SEC1.acc0) FROM out4_sub SEC1 WHERE SEC1.run_id = S.run_id AND SEC1.dim0 = S.dim0 AND SEC1.dim1 = S.dim1) - 1) /
        (SELECT COUNT(SEC2.acc0) FROM out4_sub SEC2 WHERE SEC2.run_id = S.run_id AND SEC2.dim0 = S.dim0 AND SEC2.dim1 = S.dim1)
    ) AS "se"
FROM out4_sub S
GROUP BY S.run_id, S.dim0, S.dim1
ORDER BY S.run_id, S.dim0, S.dim1 DESC;

run_id dim0      dim1      cnt      avg      se
----- ----      ---      ---      ---      --
2       10         M         4       2.5     0.645497224367903
2       10         F         4       3       0.645497224367903
2       20         M         4       25      6.45497224367903
2       20         F         4       25.5    6.45497224367903
3       10         M         2       5.5     0.5
3       10         F         2       7.5     0.5
3       20         M         2       55      5
3       20         F         2       75      5

```

Count, Average, an Coefficient of Variation:

```

SELECT
    S.run_id, S.dim0, S.dim1,
    COUNT(S.acc0) AS "cnt",
    AVG(S.acc0)   AS "avg",
    100.0 * (
        SQRT(
            SUM(
                (S.acc0 - (SELECT AVG(CVM1.acc0) FROM out4_sub CVM1 WHERE CVM1.run_id = S.run_id AND CVM1.dim0 = S.dim0 AND CVM1.dim1 = S.dim1)) *
                (S.acc0 - (SELECT AVG(CVM2.acc0) FROM out4_sub CVM2 WHERE CVM2.run_id = S.run_id AND CVM2.dim0 = S.dim0 AND CVM2.dim1 = S.dim1))
            ) /
            ( (SELECT COUNT(CVC1.acc0) FROM out4_sub CVC1 WHERE CVC1.run_id = S.run_id AND CVC1.dim0 = S.dim0 AND CVC1.dim1 = S.dim1) - 1)
        ) /
        (SELECT AVG(CVM3.acc0) FROM out4_sub CVM3 WHERE CVM3.run_id = S.run_id AND CVM3.dim0 = S.dim0 AND CVM3.dim1 = S.dim1)
    ) AS "cv"
FROM out4_sub S
GROUP BY S.run_id, S.dim0, S.dim1
ORDER BY S.run_id, S.dim0, S.dim1 DESC;

run_id dim0      dim1      cnt      avg      cv
----- ----      ---      ---      ---      --
2       10         M         4       2.5     51.6397779494322
2       10         F         4       3       43.0331482911935
2       20         M         4       25      51.6397779494322
2       20         F         4       25.5    50.6272332837571
3       10         M         2       5.5     12.8564869306645
3       10         F         2       7.5     9.42809041582064
3       20         M         2       55      12.8564869306645
3       20         F         2       75      9.42809041582063

```

SQL implementation details

In the previous section we are using simplified representation of accumulator table and SQL dialect, which is not compatible across all vendors. Real SQL aggregation queries can be found in `expr_sql` column of `table_expr` metadata table. For example if source model expression is:

```
(OM_SUM(acc0) / OM_SUM(acc2))
```

then result look like:

```
SELECT
    M1.run_id, M1.dim0, (SUM(M1.acc_value) / SUM(L1A2.acc2)) AS expr1
FROM RiskPaths_201410071856440009_a2_T03_FertilityByAge M1
INNER JOIN
(
    SELECT run_id, dim0, sub_id, acc_value AS acc2
    FROM RiskPaths_201410071856440009_a2_T03_FertilityByAge
    WHERE acc_id = 2
) L1A2
ON (L1A2.run_id = M1.run_id AND L1A2.dim0 = M1.dim0 AND L1A2.sub_id = M1.sub_id)
WHERE M1.acc_id = 0
GROUP BY M1.run_id, M1.dim0
```

Model Run Options and ini-file

Overview

There are many options which control model run, i.e.: number of cases, random generator starting seed, etc. OpenM++ model gets run options in following order:

- as command line arguments
- from ini-file (similar to Modgen .sce file)
- from database `profile_option` tables
- use default values

Each option has unique key string associated with it, i.e. "Parameter.StartingSeed" is model input parameter "StartingSeed", which is most likely, random generator starting seed. You can use this key to specify model parameter on command line, in ini-file or database. For example:

```
modelOne.exe -Parameter.StartingSeed 123 -ini small.ini
```

would run "modelOne" model with starting seed = 123 and other options from `small.ini` file.

Note: We recommend to use normal Windows command line cmd.exe. If you are using Windows PowerShell then it may be necessary to put "quotes" around command line options, e.g.:

```
modelOne.exe "-Parameter.StartingSeed" 123 "-ini" "small.ini"
```

OpenM++ database connection

If database connection string is not specified then model try to open SQLite database OM_MODEL_NAME.sqlite (i.e.: `modelOne.sqlite`) in current working directory. Default database connection string is:

```
Database=OM_MODEL_NAME.sqlite; Timeout=86400; OpenMode=ReadWrite;
```

Please notice, Linux file names are case sensitive and `modelOne.sqlite` is different from `ModelOne.sqlite`.

You can specify database connection string as command line argument, i.e.:

```
modelOne.exe -OpenM.Database "Database=C:\My Model\m1.sqlite; Timeout=86400; OpenMode=ReadWrite;"
```

Or, more convenient, by using ini-file

```
modelOne.exe -ini C:\MyModel\small.ini
```

Following parameters allowed for SQLite database connection:

- Database - (required) database file name or URI, file name can be empty
- Timeout - (optional) table lock "busy" timeout in seconds, default=0
- OpenMode - (optional) database file open mode: ReadOnly, ReadWrite, Create, default=ReadOnly
- DeleteExisting - (optional) if true then delete existing database file, default: false

Please notice: to run the model you need `OpenMode=ReadWrite`.

Model development options

Model developer can pass an arbitrary run option from ini-file and use it to debug model code. In order to do that model should be started with following command line arguments:

```
model.exe -ini some.ini -OpenM.IniAnyKey
```

Or any of equivalent formats:

```
model.exe -ini some.ini      -OpenM.IniAnyKey true
model.exe -OpenM.IniFile some.ini -OpenM.IniAnyKey true
model.exe -OpenM.IniFile some.ini -OpenM.IniAnyKey 1
model.exe -OpenM.IniFile some.ini -OpenM.IniAnyKey yes
```

Special boolean option `-OpenM.IniAnyKey true` allow to pass any key and values to model development code from ini-file.

For example, you can process following ini-file development options:

```
[MyTest]
ShowReport = yes           ; true if: "yes", "1", "true" or empty value, false if missing
ReportStyle = readable     ; string option
MinimumTime = 1234.56       ; double value, use as default: -inf
LineCount = 4321            ; integer option
EntityId = 1234567890123456789 ; Long Long integer
SelectedNames = e1,e2,e3    ; comma separated list of event names
```

by including code below into `ompp_framework.ompp`:

```
// process development model run options from model ini-file
void ProcessDevelopmentOptions(const IRunOptions * const i_options)
{
using namespace std;

bool isShowReport = i_options->boolOption("MyTest.ShowReport");
string rptStyle = i_options->strOption("MyTest.ReportStyle");
double minTime = i_options->doubleOption("MyTest.MinimumTime", -numeric_limits<double>::infinity());
int lineCount = i_options->intOption("MyTest.LineCount", 0);
long long entityId = i_options->longOption("MyTest.EntityId", 0);

// option is a list of comma separated names
list<string> evtList = openm::splitCsv(i_options->strOption("MyTest.SelectedNames"));

// if option is not specified at all
if (!i_options->isOptionExist("MyTest.ShowReport")) {
    // do something
}

// get a copy of all model run options, including openM++ standard options
vector<pair<string, string>> allOpts = i_options->allOptions();

// each option is a pair of key and value
for (const auto & opt : allOpts) {
    // string key = opt.first;
    // string value = opt.second;
}
}
```

Important:

Model development options should not be used as model parameters and should not affect modeling results. It is strictly for debugging and development purpose. OpenM++ does not provide any guarantee about model development options.

OpenM++ ini-file run options

To specify name of ini-file you can use `-s` or `-ini` or `-OpenM.IniFile` command line option. Please see [OpenM++ ini-file format](#) to find out more about ini-file structure supported by openM++.

Example of model ini-file:

```
;=====
;#
;# model parameters
;# any scalar model parameter can be specified in [Parameter] section
;# or as command line argument or in profile_option table
;
[Parameter]
;# random seed value
;
; StartingSeed = 16807

;# base salary is classification parameter
;# using enum code "Full" to specify parameter value
;
```

```

;# If [OpenM] is parameter value=true (see below) then we must use baseSalary=22 instead
;
; baseSalary = Full

;#####
;#
;# openM++ run options
;#
;# OpenM++ boolean options:
;#   True value is any of: "yes", "1", "true" or empty value
;#   False value is any of: "no"  "0", "false"
;# Boolean values are not case sensitive, e.g.: "yes" == "YES" and it is a true value
;
; [OpenM]

;# number of sub-values, default: 1
;
; SubValues = 16

;# max number of modeling threads, default: 1
;#
;# if number of sub-values per process < number of modeling threads then sub-values run sequentially.
;# if more threads specified then sub-values run in parallel.
;#
;# for example:
;#   model.exe -OpenM.SubValues 8
;#   model.exe -OpenM.SubValues 8 -OpenM.Threads 4
;#   mpiexec -n 2 model.exe -OpenM.SubValues 31 -OpenM.Threads 7
;
; Threads = 4

;# if NotOnRoot is true then do not use "root" process for modeling
;# default value: false
;# empty value:  true
;#
;# this option can be used only if multiple model.exe processes are running in parallel
;# otherwise it has no effect.
;#
;# for example:
;#   (a) mpiexec -n 4 model.exe -OpenM.SubValues 16
;#   (b) mpiexec -n 4 model.exe -OpenM.SubValues 16 -OpenM.NotOnRoot true
;# both commands above do launch four model.exe processes
;# but in second case only three children are doing modeling
;# and root process dedicated to run controlling activity
;
; NotOnRoot = false

;# database connection string
;#   default database name: model_name.sqlite
;
; Database = "Database=modelOne.sqlite; Timeout=86400; OpenMode=ReadWrite;"

;# name of model run results
;# if not specified then automatically generated
;
; RunName = my-default-scenario

;# set id is an id of input set of model parameters
;#
;# default: min(set id)
;
; SetId = 101

;# set name is name of input set to get model parameters
;# if set name specified then it used to find set of model input parameters
;# if SetId option specified then SetName is ignored
;
; SetName = Default

;# if specified then use parameters from base run instead of input set
;# find base run by run id
;
; BaseRunId = 1234

;# if specified then use parameters from base run instead of input set
;# if BaseRunId option NOT specified then find base run by run digest
;
; BaseRunDigest = 6866f742cabab735ced1577c56b23e93

;# if specified then use parameters from base run instead of input set
;# if BaseRunId and BaseRunDigest options are NOT specified then find base run by run name
;# run name is not unique and as result it will be a first model run with that name
;
; BaseRunName = My_Model_Run

;# run id to restart model run (i.e. after power failure)
;
; RestartRunId =

```

```

> RESTRICTED - 

;# task id is an id of modeling task
;# if modeling task id specified then
;# model will run all input sets included into that modeling task
;
; TaskId = 1

;# task name is name of modeling task
;# if task name specified then it used to get task id
;# if task id specified then set name is ignored
;
; TaskName = taskOne

;# task run name is name of modeling task run
;# if not specified then automatically generated
;
; TaskRunName = run-first-task-with-16-sub-values

;# task "wait":
;# default value: false
;# empty value: true
;#
;# allow to dynamically append new input data into modeling task
;# modeling task not completed automatically
;# it is waiting until some external script signal:
;#   UPDATE task_run_lst SET status = 'p' WHERE task_run_id = 1234;
;
; TaskWait = false

;# profile name to select run options from profile_option database table
;
; Profile = modelOne

;# convert to string format for float, double, long double, default: %.15g
;
; DoubleFormat = %.15g

;# path to parameters csv file(s) directory
;# if specified then for each parameter where exist param/dir/parameterName.csv
;# values from csv file are used to run the model
;
; ParamDir = ./csv

;# if true then parameter(s) csv file(s) contain enum id's, default: enum code
;# default value: false
;# empty value: true
;
; IdCsv = false

;# value of scalar parameter(s) can be specified in [Parameter] section (see above)
;# or as command Line argument -Parameter.Name of model.exe
;#
;# if IdParameterValue is true
;# then scalar parameter(s) value is enum id's, default: enum code
;# default value: false
;# empty value: true
;
; IdParameterValue = false

;# if true then use sparse output to database, default: false
;# default value: false
;# empty value: true
;
; SparseOutput = false

;# if use sparse and abs(value) <= SparseNullValue then value not stored
;# default = FLT_MIN
;
; SparseNullValue = 1.0E-37

;# if positive then used to report percent completed of simulation, default: 1
;
; ProgressPercent = 1

;# if positive then used to report simulation progress, default: 0
;# for case based models it is number of cases completed and must integer value
;# for time based models it is time passed from first event and must positive value, e.g.: 0.1
;
; ProgressStep = 1000

;# Language to display output messages
;# default: set in Windows Control Panel or by Linux LANG
;
; MessageLanguage = en-CA

;# if true then Log model version info
;# default value: false

```

```

;# empty value: true
;
; Version = false

;# process run stamp, default: log file time stamp
;# use it to find model run(s) in run_lst table
;# or model task run in task_run_lst table
;
; RunStamp = 2012_08_17_16_04_59_148

;# log settings:
;# Log can be enabled/disabled for 3 independent streams:
;#   console      - standard output
;#   "Last run" file - Log file with specified name, truncated on every model run
;#   "stamped" file - Log file with unique name, created for every model run
;#
;# "stamped" name produced from "Last run" name by adding time-stamp and/or pid-stamp, i.e.:
;#   modelOne.Log => modelOne.2012_08_17_16_04_59_148.987654.Log
;
; LogToConsole    = true      ; log to console, default: true
; LogToFile       = false     ; log to file
; LogToStampedFile = false    ; log to "stamped" file
; LogUseTimeStamp = false    ; use time-stamp in log "stamped" file name
; LogUsePidStamp  = false    ; use pid-stamp in log "stamped" file name
; LogFilePath     = model.log ; log file path, default = current/dir/modelExeName.log
; LogNoMsgTime   = false     ; if true then do not prefix log messages with date-time
; LogSql          = false     ; debug only: log sql statements

;# trace Log settings:
;# trace can be enabled/disabled for 3 independent streams:
;#   console      - cout stream
;#   "Last run" file - trace file with specified name (default: input set name)
;#   "stamped" file - Log file with unique name, created for every model run
;#
;# "stamped" name produced from "Last run" name by adding time-stamp and/or pid-stamp, i.e.:
;#   trace.txt => trace.2012_08_17_16_04_59_148.987654.txt
;#
;# If trace to file is enabled
;# then existing "last run" trace file truncated even model does not write anything into trace output
;
; TraceToConsole  = false     ; log to console
; TraceToFile     = false     ; log to file
; TraceToStampedFile = false    ; log to "stamped" file
; TraceFilePath   = trace.txt ; log file path, default: input_set_name.txt
; TraceUseTimeStamp = false    ; use time-stamp in log "stamped" file name
; TraceUsePidStamp = false    ; use pid-stamp in log "stamped" file name
; TraceNoMsgTime  = true      ; if true then do not prefix trace messages with date-time

;#####
;#
;# Language-specific options
;#



[EN]
;#
;# model run description in English
;
; RunDescription = model run with 50,000 cases

[FR]
;#
;# model run description in French
;
; RunDescription = je suis désolé je ne parle pas français

;#####
;#
;# Ouput tables suppression.
;#
;# It can be in one of the two forms:
;#   Suppress = ATable,BTable,Group1,Group2
;# Or:
;#   Retain   = ATable,BTable,Group1,Group2
;#
;# Suppress and Retain options are mutually exclusive and cannot be mixed.
;# For example, this model run would fail:
;#   model.exe -Suppress.A -Retain.B

[Tables]
;#
;# Suppress output table "ageSexIncome"
;# and suppress group of output tables "AdditionalTables"
;
; Suppress = ageSexIncome,AdditionalTables

;# Or suppress all output tables
;# except of "ageSexIncome" table and tables included into "AdditionalTables" group:

```

```

;

; Retain    = ageSexIncome,AdditionalTables

;#####
;#
;# where to find sub-values for model parameter or group of parameters: db, csv, iota
;
[SubFrom]

;# where to find sub-values for parameter "Member"
;# "iota" means create parameter "Member" sub-values as 0,1,...[OpenM].SubValues-1
;
; Member = iota

;# where to find sub-values for "baseSalary" parameter
;# "db" means read sub-values from input set (read from model database)
;# modelOne default input set has 4 sub-values for "baseSalary" and "salaryFull"
;
; baseSalary = db

;# where to find sub-values for "salaryFull" parameter
;# "csv" means read all sub-values from parameter.csv file
;# by default only one sub-value read from csv file
;
; salaryFull = csv

;# sub-value for all members of "age_sex_parameters" group coming from .csv files:
;#
;# age_sex_parameters = csv
;#
;# it is the same as:
;# -SubFrom.ageSex csv -SubFrom.salaryAge csv
;# because this group consist of: "ageSex" and "salaryAge"

;#####
;#
;# how many sub-values to select for parameter and which sub id to select
;# it is also can be applied to the parameters group
;#
;# SubValues option can be:
;#   range:      SubValues.Age [1,4]
;#   list of id's: SubValues.Age 2,1,4,3
;#   bit mask:   SubValues.Age x0F
;#   single id:  SubValues.Age 7
;#   default id: SubValues.Age default
;#
;# if you running:
;#   model.exe -OpenM.SubValues 4 -SubFrom.Age csv
;# then Age.csv file must have at least 4 sub values with sub id's 0,1,2,3
;#
;# to use only one single sub-value either specify "default" id:
;#   model.exe -OpenM.SubValues 4 -SubFrom.Age db -SubValues.Age default
;# or explicit sub-value id:
;#   model.exe -OpenM.SubValues 4 -SubFrom.Age csv -SubValues.Age 7
;#
;# to select 4 sub-values use [first,last] range or comma-separated List or bit mask:
;#   model.exe -OpenM.SubValues 4 -SubFrom.Age csv -SubValues.Age [4,7]
;#   model.exe -OpenM.SubValues 4 -SubFrom.Age csv -SubValues.Age 4,5,6,7
;#   model.exe -OpenM.SubValues 4 -SubFrom.Age csv -SubValues.Age xF0
;#
[SubValues]

; baseSalary = default
; isOldAge    = 4,2,1,3

;# use sub-values 2 and 3 for all members of "age_sex_parameters" group:
;
; age_sex_parameters = 2,3
;
;# it is the same as:
;# -SubValues.ageSex 2,3 -SubValues.salaryAge 2,3
;# because this group consist of: "ageSex" and "salaryAge"

;#####
;#
;# import model parameters from other model(s)
;
[Import]

;# if "All" is true then import all parameters (all parameters which has import statement).
;# default value: false
;# empty value:   true
;
; All = true
;
;# for each upstream model last succesful run is used to import parameters
;#

```

```

## if "modelName" is true then import all parameters from upstream "modelName".
## default value: false
## empty value:  true
## Example:
##   import parameters from last succesful run of upstream model "RedModel"
;
; RedModel = true

;=====
;#
## import model parameters from run specified by run digest
;#
[ImportRunDigest]

## Example:
## import parameters from upstream model "RedModel" where run digest = abcdefghef12345678
;
; RedModel = abcdefghef12345678

;=====
;#
## import model parameters from run specified by run id
;
[ImportRunId]

## Example:
## import parameters from upstream model "RedModel" where run id = 101
;
; RedModel = 101

;=====
;#
## import model parameters from last sucessful run with specified run name
;
[ImportRunName]

## Example:
## import parameters from last successful run of upstream model "RedModel" where run name = GoodRun
;
; RedModel = GoodRun

;=====
;#
## import model parameters from last sucessful run of model with specified digest
;
[ImportDigest]

## Example:
## import parameters from last successful run of upstream model "RedModel" where model digest = 87654321fedcba
;
; RedModel = 87654321fedcba

;=====
;#
## import model parameters from last sucessful run of model with specified id
;
[ImportId]

## Example:
## import parameters from last successful run of upstream model "RedModel" where model id = 123
;
; RedModel = 123

;=====
;#
## import model parameter from specified expression of output table
;
[ImportExpr]

## If upstream output table has multiple measure values (multiple expressions)
## the by default first expression of output table is used to import parameter value.
## To override default measure name (expression name) can be explicitly specified.
;#
## Example:
## import parameter from AgeTable of upstream model "RedModel" using "expr2" value as parameter values
;
; AgeTable = expr2

;=====
;#
## import model parameter from specified model database
;
[ImportDatabase]

## By default upstream model imported from the same database as current (downstream) model
## or, if not exist there then from defalut SQLite database with name modelName.sqlite
## Use connection string to override default database rule.
;

```

```

;#
;# Example:
;# import parameters from upstream model "RedModel" in database ./RedHot.sqlite
;
; RedModel = "Database=../RedHot.sqlite;OpenMode=RedaOnly;"


;#=====
;#
;# model development options
;# it is available in model code only if model.exe started with command line options:
;#
;# model.exe -ini iniFileName.ini -OpenM.IniAnyKey
;#
;# Or:
;#
;# model.exe -ini iniFileName.ini -OpenM.IniAnyKey 1
;# model.exe -ini iniFileName.ini -OpenM.IniAnyKey yes
;# model.exe -ini iniFileName.ini -OpenM.IniAnyKey true
;#
;# OpenM++ boolean options:
;#   True value is any of: "yes", "1", "true" or empty value
;#   False value is any of: "no"  "0", "false"
;# Boolean values are not case sensitive, e.g.: "yes" == "YES" and it is a true value
;
; [EventTrace]
;
; ReportStyle = readable
; ShowScheduling = yes           ; true if: "yes", "1", "true" or empty value
; MinimumTime = 1234.56          ; double value, default: -inf
; MaximumTime =                  ; double value, default: +inf
; SelectedEntities =             ; comma separated list of integers
; SelectedEvents = e1,e2,e3      ; comma separated list of event names

```

Number of sub-values stored in `run_lst.sub_count` table:

run_id	model_id	run_name	sub_count	sub_started	sub_completed	create_dt
11	1	ModelOne 2013-05-30 22:50:29.0447	4	4	4	2013-05-30 22:50:29.0447

OpenM++ Compiler (omc) Run Options

Overview

There are a number of options which control model compilation and publishing. The most frequently used are:

- model name
- input directory containing model .ompp or .mpp source files
- input directory with model parameters (a.k.a. "scenario" .dat files or parameters .csv files)
- input scenario name

OpenM++ compiler (omc) gets run options in following order:

- as command line arguments
- from options ini-file
- use default values

Following options supported by omc command line:

- `-Omc.ModelName` name/of/model/executable, e.g. RiskPaths
- `-Omc.ScenarioName` name/of/base/scenario, e.g. Base, it can be list of names
- `-Omc.InputDir` input/dir/to/find/source/files
- `-Omc.OutputDir` output/dir/to/place/compiled/cpp_and_h_and_sql/files
- `-Omc.UseDir` use/dir/with/ompp/files
- `-Omc.ParamDir` input/dir/to/find/parameter/files/for/scenario, it can be list of directories
- `-Omc.FixedDir` input/dir/to/find/fixed/parameter/files/
- `-Omc.CodePage` code page for converting source files, e.g. windows-1252
- `-Omc.SqlDir` sql/script/dir to create SQLite database
- `-Omc.SqlPublishTo` create sql scripts to publish in `SQLite,MySQL,PostgreSQL,MSSQL,Oracle,DB2`, default: `SQLite`
- `-OpenM.IniFile` some/optional/omc.ini
- `-Omc.TraceScanning` detailed tracing from scanner
- `-Omc.TraceParsing` detailed tracing from parser
- `-Omc.MessageLanguage` language to display output messages, default: user environment settings
- `-Omc.MessageFnc` localized message functions, default: `LT,logMsg,logFormatted,WriteLogEntry,WarningMsg,ModelExit`
- `-Omc.SqlDir` sql/script/dir to create SQLite database
- `-Omc.SqlPublishTo` create sql scripts to publish in `SQLite,MySQL,PostgreSQL,MSSQL,Oracle,DB2`, default: `SQLite`

Or you can use short form of command line arguments:

- `-m` short form of `-Omc.ModelName`
- `-s` short form of `-Omc.ScenarioName`
- `-i` short form of `-Omc.InputDir`
- `-o` short form of `-Omc.OutputDir`
- `-u` short form of `-Omc.UseDir`

- `-p` short form of `-Omc.ParamDir`
- `-f` short form of `-Omc.FixedDir`
- `-ini` short form of `-OpenM.IniFile`

Each option has unique key string associated with it, i.e.: `Omc.InputDir`. You can use this key to specify command line argument or as ini-file Section.Key entry. For example:

```
omc.exe -m RiskPaths -Omc.InputDir ../code -ini my-omc.ini
```

would compile model `RiskPaths` source files: `../code/*.ompp` and `../../code/*.mpp` with some other options specified through `my-omc.ini` file.

Omc do compile model source `.ompp` and `.mpp` files and create `model.sqlite` database with parameter values from `.odat`, `.dat`, `.csv` and `.tsv` files:

```
omc.exe -m RiskPaths -i ../code -s Default -p ..parameters/Default
```

Command above will read `.odat`, `.dat`, `.csv` and `.tsv` files from `..parameters/Default` directory and create `RiskPaths.sqlite` database with `Default` input set of parameters (`Default` scenario).

It is possible to create multiple input sets of parameters (multiple scenarios) when you are building the model:

```
omc.exe -m RiskPaths -i ../code -s Default,Other -p ..parameters/Default,..parameters/other/dir
```

Above command will create two input sets of parameters:

- scenario `Default` from `.dat`, `.odat`, `.csv` and `.tsv` files in `..parameters/Default` directory
- scenario `Other` from `.csv` and `.tsv` files in `..parameters/other/dir`

Please notice: additional scenario directory can contain only CSV or TSV files and not `.dat` or `.odat` files.

How to use CSV or TSV files for input parameters values

You can use CSV or TSV files to supply input parameters for your model. For example, if `RiskPaths` model has `SeparationDurationBaseline` parameter:

```
partition DISSOLUTION_DURATION    //EN Duration since union dissolution
{
  2, 6, 10, 15
};

.....
// Separation Duration Baseline of 2nd Formation
double SeparationDurationBaseline[DISSOLUTION_DURATION] = {
  0.1995702, 0.1353028, 0.1099149, 0.0261186, 0.0456905
};
```

then you can supply parameter values from `RiskPaths/parameters/RiskPaths.dat` or from `RiskPaths/parameters/SeparationDurationBaseline.csv`:

```
dim0,      param_value
"(-∞,2)", 0.1995702
"[2,6]",   0.1353028
"[6,10)",  0.1099149
"[10,15)", 0.0261186
"[15,∞)",  0.0456905
```

Following rules applied to parameter CSV or TSV files:

- file name must same as parameter name, which is `SeparationDurationBaseline` in example above
- it can be `parameter.csv` with comma-separated values or `parameter.tsv` with tab-separated values
- if dimension item name or parameter value contains comma then it must be "quoted"
- header line of the file must contain dimension names and "param_value", for example: `dim0,otherDim,dim3,param_value`

- (optional) if parameter has multiple sub-values then header line must start with "sub_id" (see example below)
- if scenario directory contains some .dat file with parameter values and also ParameterName.csv then CSV values do override .dat values. That allow you to quickly adjust parameters values by simply dropping CSV files into scenario directory without changing any .dat files.

Following formats of CSV or TSV files supported:

- CSV (or TSV) file with dimension(s) and parameter value(s)
- CSV (or TSV) file with dimension(s) and multiple parameter sub-values
- CSV or TSV files with IDs as dimension(s) items
- CSV or TSV file with parameter values only, without dimensions

CSV (or TSV) file with dimension(s) and parameter value(s)

Dimension items must be supplied as item "names", similar to `partition DISSOLUTION_DURATION` above. Or take a look into another example of two-dimensional parameter:

```
classification SEX //EN Sex
{
    FEMALE,
    MALE
};

range YEAR //EN Year
{
    2019,
    2021
};

.....
double GenderByYearRatio[SEX][YEAR] = {
    0.1, (2)0.2, 0.5, 0.6, 0.7
};
```

GenderByYearRatio.csv file:

```
dim0, dim1, param_value
FEMALE, 2019, 0.1
FEMALE, 2020, 0.2
FEMALE, 2021, 0.2
MALE, 2019, 0.5
MALE, 2020, 0.6
MALE, 2021, 0.7
```

- Line order in the file is not important and openM++ will sort it automatically.
- If there some line(s) are missing then parameter value will be a default for that parameter type, for example: double NaN.

CSV (or TSV) file with dimension(s) and multiple parameter sub-values

It can be used for uncertainty probabilistic analysis, file example:

```
sub_id, dim0, dim1, param_value
0, FEMALE, 2019, 0.1
0, FEMALE, 2020, 0.2
0, FEMALE, 2021, 0.2
0, MALE, 2019, 0.5
0, MALE, 2020, 0.6
0, MALE, 2021, 0.7
1, FEMALE, 2019, 1.1
1, FEMALE, 2020, 1.2
1, FEMALE, 2021, 1.2
1, MALE, 2019, 1.5
1, MALE, 2020, 1.6
1, MALE, 2021, 1.7
.....
```

- Header line must start with "sub_id" in order to indicate presence of sub values in parameter.csv file.
- Sub value id's can be any integer values, for example: -1, 0, 4, 8, 12, 42. It must be integer but does not need to be positive or sequential.

- First sub value id in CSV file considered as "default" sub value for that parameter.

CSV or TSV files with IDs as dimension(s) items

You can use dimension item ID instead of item names, for example SeparationDurationBaseline.id.csv:

```
dim0, param_value
0, 0.1995702
1, 0.1353028
2, 0.1099149
3, 0.0261186
4, 0.0456905
```

GenderByYearRatio.id.csv:

```
dim0, dim1, param_value
0, 0, 0.1
0, 1, 0.2
0, 2, 0.2
1, 0, 0.5
1, 1, 0.6
1, 2, 0.7
```

Please notice file naming convention: `ParameterName.id.csv` or `ParameterName.id.tsv`

CSV or TSV file with parameter values only

File containing only parameter value(s) without dimensions, for example SeparationDurationBaseline.value.csv:

```
0.1995702, 0.1353028, 0.1099149, 0.0261186, 0.0456905
```

GenderByYearRatio.value.csv:

```
0.1, 0.2, 0.2,
0.5,
0.6, 0.7
```

- Please notice file naming convention: `ParameterName.value.csv` or `ParameterName.value.tsv`
- Parameter values order in the file must be exactly the same as it is in .dat file.
- Also, similar to c++ initialization and parameter.dat file, it is not important how many values are on each line.

Omc ini-file options

To specify name of ini-file you can use `-ini` or `-OpenM.IniFile` command line option. Please see [OpenM++ ini-file format](#) to find out more.

Example of omc ini-file:

```
; This is an example of omc.ini options file
;

; Omc-specific options
;
[Omc]

;
; model name, it must be specified either on command line or here
; no default value
;
; ModelName = NewCaseBased

;
; input directory to get source .ompp or .mpp files to compile
; default = current directory
;
; InputDir = ./code

;
; output directory to place generated .cpp and .h files for the model
; default = current directory
```

```

;
; OutputDir = ../build/NewCaseBased

;
; use directory to resolve 'use' statements
; default = directory/of/omc.exe/../use/
;
; UseDir = ../../use

;
; name of default set of input parameters (a.k.a. base scenario data)
; it can be multiple names separated by comma or semicolon
;
; default = Default
;
; ScenarioName = Default
;
; ScenarioName = Default,Other,Test

;
; parameter directory to get source .dat or .csv files to publish a scenario
; it can be multiple directories separated by comma or semicolon
;
; default = Default
;
; ParamDir = parameters/Default
;
; ParamDir = parameters/Default,parameters/Other/dir,parameters/some/Test

;
; fixed directory to get source .dat files with fixed parameter values
; default = Fixed
;
; FixedDir = parameters/Fixed

;
; directory where common sql scripts located (used to create SQLite database)
; default = directory/of/omc.exe/../sql/
;
; SqlDir = ../../sql      sql/script/dir to create SQLite database

;
; database providers comma-separated list
; supported providers: SQLite,MySQL,PostgreSQL,MSSQL,Oracle,DB2
; default: SQLite
;
; SqlPublishTo = SQLite

;
; code page for converting source files into utf-8
; default on Linux: utf-8 (no conversion)
; default on Windows: current user code page, e.g.: windows-1252
;
; CodePage = windows-1252

;
; language to display output messages
; default: Windows Control Panel or Linux LANG
;
; messageLang = en-CA

;
; localized message functions
; first argument of the Function("const char * message",...) translated into other language
; by lookup in omc.message.ini where "message" = "translated message"
; default: LT,LogMsg,LogFormatted,WriteLogEntry,WarningMsg,ModelExit
;
; MessageFnc = LT,LogMsg,LogFormatted,WriteLogEntry,WarningMsg,ModelExit

;
; Common openM++ run options supported by omc
;

[OpenM]

;
; log settings:
; Log can be enabled/disabled for 3 independent streams:
;   console          - cout stream
;   "last run" file - log file with specified name, truncated on every compiler run
;   "stamped" file  - log file with unique name, created for every compiler run
;
; "stamped" name produced from "last run" name by adding time-stamp and pid-stamp, i.e.:
;   omc.log => omc.2012_08_17_16_04_59_148.1234.log
;

LogToConsole    = true      ; Log to console
LogNoMsgTime   = true      ; if true then do not prefix Log messages with date-time
; LogToFile     = true      ; Log to file
; LogToStampedFile = true   ; Log to "stamped" file
; LogUseTimeStamp = true    ; use time-stamp in log "stamped" file name
; LogUseDidStamp = true    ; use mid-stamp in log "stamped" file name

```

```
; LogUserLogOutput = true ; use plu-scumpr or log_scumpr file name  
; LogFilePath      = omc.log ; Log file path, default = current/dir/omc.log  
; LogSql           = true    ; debug only: log sql statements (reserved, but not used by omc)
```

OpenM++ ini-file format

OpenM++ ini-file format

OpenM++ ini-files are similar to other well-known implementations of ini-files. It is a text file consist of [sections] of key = value pairs and optional comments. For example:

```
[General]
Cases = 12345 ; number of cases

; openM++ specific options
[OpenM]
SparseOutput = true
```

Ini-file can contain following lines:

- [section] line where section is [anything in square brackets]
- Key = Value lines
- empty lines and comment lines

Value can take multiple lines with \ at the end of the line for continuation.

Value can be a string, integer, double or boolean type. Boolean values:

- True value is any of: "yes", "1", "true" or empty value
- False value is any of: "no" "0", "false" Boolean values are not case sensitive, e.g.: "yes" is same as "YeS" and it is a true value Double values must be in "C" locale, which means using dot as decimals separator, i.e.: -123456.78e+9

Comments are optional and can start from either semicolon or hash sign at any position of the line. You can escape comment separator by putting value in single 'apostrophes' or double "quotes".

Example of ini-file format recognized by openM++:

```

[Test] ; section is required, global entries are not allowed
# this is also a comment
; next line is empty value without comment

non =
rem = ; comment only and empty value
val = no comments
dsn = "DSN='server'; UID='user'; PWD='secret'"; ; database connection string example
lst = "the # quick" brown 'fox # jumps ; over' # use "quote" and 'apostrophe' to escape characters and keep spaces
unb = "unbalanced quote" ; this is not a comment: it is a value started from " quote

trim = Aname,Bname, \ ; multi-line value joined with spaces trimmed
      Cname,DName ; result is: Aname,Bname,Cname,DName

; multi-line value started with " quote or ' apostrophe
; right spaces before \ is not trimmed, result is:
; Multi line   text with spaces
;
keep = "Multi line  \
        text with spaces"

; multi-line value started with " quote or ' apostrophe
; result is the same as above:
; Multi Line   text with spaces
;
same = "\ \
        Multi line  \
        text with spaces\
        "
;

; General settings
[General]
StartingSeed=16807
Subsamples=8
Cases = 5000 ; only for case-based
SimulationEnd = 100 ; only for time-based
UseSparse = true

#
# override values of above [Test] section with new values
#
[Test]
val=new value of no comments
dsn="new value of UID='user'; PWD='secret'"; ; new database connection string
lst=new value of "the # quick" fox 'jumps # over' # new list of test words

```

Ompp-UI: openM++ user interface

How to use openM++ UI

Open++ user interface (ompp-ui) is a lightweight web UI which is:

- scalable: can be run on single end-user desktop and in cluster environment
- cloud ready: can be deployed in private or public cloud (Amazon AWS, Microsoft Azure, Google Cloud, etc.)
- portable: work on Windows, Linux and MacOS, 32 and 64 bit versions
- open source: it is open source product

By default ompp-ui does not require any installation, to run it do one of the following:

- on Windows double click on `bin\ompp_ui.bat`
- on Linux double click on `bin/ompp_ui.sh`
- on MacOS double click on `bin/ompp_ui.command`

Any of above script is relatively simple, all it does is starting oms web-service:

```
cd ~/openmpp_mac_20200704
bin/oms
.....
2020-06-19 16:07:57.892 Model directory: models/bin
2020-06-19 16:07:57.930 Listen at localhost:4040
2020-06-19 16:07:57.930 To start open in your browser: localhost:4040
2020-06-19 16:07:57.931 To finish press Ctrl+C
```

and open your browser at <http://localhost:4040>

It is also possible to run the model and open UI from IDE:

- Visual Studio, details at [Windows: Create and Debug Models](#)
- Visual Studio Code, details at [Linux: Create and Debug Models](#)
- Xcode, details at [MacOS: Create and Debug Models](#)

Current openM++ UI status: beta version of UI suitable for single user.

OpenM++ UI is an advanced beta which incorporates significant portions of core required UI functionality, but which is missing others. The underlying software architecture is modern and layered, to make it easy to change or evolve the UI. Lower layers of openM++ contain functionality (eg run import and export, result export, distributed cloud execution) which is not yet exposed or accessible in the current UI.

Your feedback on the openM++ UI is welcomed. Please feel free to join and participate in [discussion of the openM++ UI on GitHub](#).

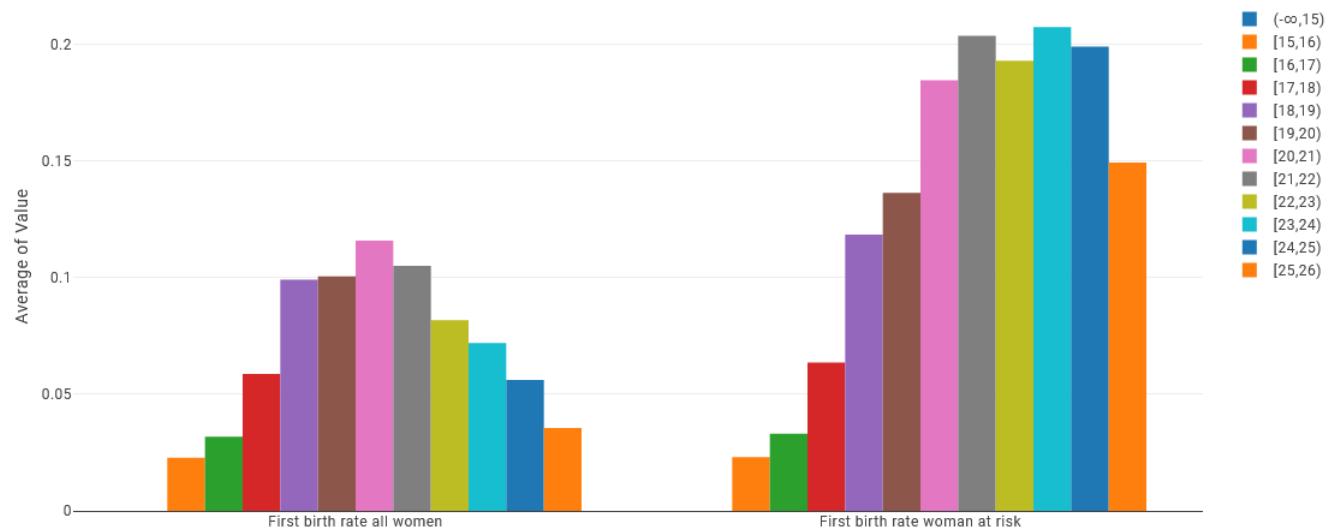
Model Runs: 1 × Parameters: 9 × Output Tables: 7 × Input Sets: 1 × Parameters: 9 × T03_FertilityByAge ×

2020-04-10 18:50:43 RiskPaths_Default scenario

Σ Σ Σ Σ Σ Σ Σ Σ Σ Σ T03_FertilityByAge: Age-specific fertility

Grouped Column Chart

Average of Value vs Measures (EN) by Age



Model Runs: 1 × Parameters: 9 × Output Tables: 7 × Input Sets: 1 × Parameters: 9 × T03_FertilityByAge ×

2020-04-10 18:50:43 RiskPaths_Default scenario

Σ Σ Σ Σ Σ Σ Σ Σ Σ Σ T03_FertilityByAge: Age-specific fertility

Table Heatmap

Average

Measures (EN)

Value

Age

Measures (EN)

First birth rate all women

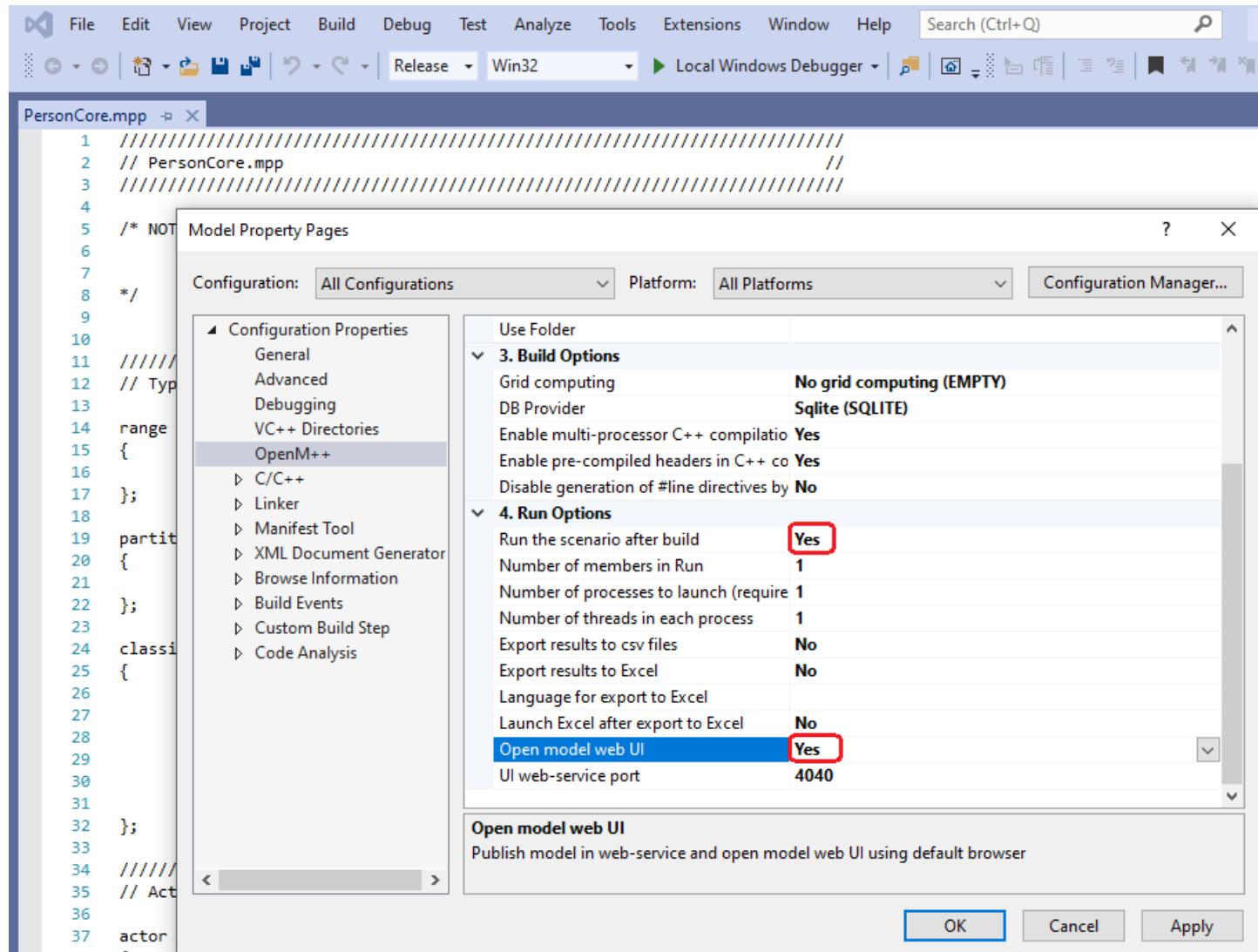
First birth rate woman at risk

Totals

Age	Measures (EN)	First birth rate all women	First birth rate woman at risk	Totals
(-∞, 15)		0.0000	0.0000	0.0000
[15, 16)		0.0228	0.0230	0.0229
[16, 17)		0.0318	0.0331	0.0324
[17, 18)		0.0588	0.0637	0.0612
[18, 19)		0.0992	0.1185	0.1089
[19, 20)		0.1006	0.1364	0.1185
[20, 21)		0.1160	0.1848	0.1504
[21, 22)		0.1052	0.2039	0.1545
[22, 23)		0.0818	0.1931	0.1374
[23, 24)		0.0720	0.2076	0.1398
[24, 25)		0.0562	0.1992	0.1277
[25, 26)		0.0356	0.1494	0.0925
Totals		0.0650	0.1261	0.0955

Start model UI on Windows from Visual Studio

To open UI from Visual Studio solution model build change project settings as on screenshot below. Optionally you may also want to run the model during model build to see results in UI.



Start model UI on Linux from Visual Studio Code

To open UI from Visual Studio Code on Linux please configure "Start UI" task for the model. It can be done by using menu Terminal -> Configure Tasks... and create tasks similar to [RiskPaths](#) model below.

```
{
// See https://go.microsoft.com/fwlink/?LinkId=733558
// for the documentation about the tasks.json format
"version": "2.0.0",
"tasks": [
    {
        "label": "build-RiskPaths",
        "type": "shell",
        "command": "make all publish run",
        "options": {
            "cwd": "models/RiskPaths"
        },
        "problemMatcher": "$gcc",
        "group": {
            "kind": "build",
            "isDefault": true
        },
        "dependsOrder": "sequence",
        "dependsOn": [
            "build-libopenm",
            "stop-ui-RiskPaths"
        ]
    },
    {
        "label": "start-ui-RiskPaths",
        "type": "shell",
        "command": "../start-ompp-ui-linux.sh",
        "options": {
            "cwd": "models/RiskPaths"
        },
        "problemMatcher": []
    },
    {
        "label": "stop-ui-RiskPaths",
        "type": "shell",
        "command": "../stop-ompp-ui-linux.sh",
        "options": {
            "cwd": "models/RiskPaths"
        },
        "problemMatcher": []
    },
    {
        "label": "clean-RiskPaths",
        "type": "shell",
        "command": "make cleanall",
        "options": {
            "cwd": "models/RiskPaths"
        },
        "group": "build",
        "problemMatcher": []
    },
    {
        "label": "build-libopenm",
        "type": "shell",
        "command": "make libopenm",
        "options": {
            "cwd": "openm"
        },
        "problemMatcher": "$gcc",
        "group": "build"
    }
]
}
```

To start UI please go to menu Terminal -> Run Task... -> `start-ui-RiskPaths` After you done with UI it is recommended to shutdown background oms web-service by using Terminal -> Run Task... -> `stop-ui-RiskPaths`

File Edit Selection View Go Run Terminal Help

The screenshot shows the Visual Studio Code interface with the title bar "case_based_common.ompp - openmpp_centos_20200604 - Visual Studio Code". The menu bar includes File, Edit, Selection, View, Go, Run, Terminal, and Help. The Explorer sidebar on the left lists open editors and projects. The main area shows a file named "case_based_common.ompp" with code related to simulation progress and agent cleanup. A context menu is open over the code, with the title "Select the task to run". The menu contains several options: build-RiskPaths, clean-RiskPaths, build-libopenm, start-ui-NewCaseBased, build-NewCaseBased, build-modelOne, clean-NewCaseBased, start-ui-RiskPaths, stop-ui-NewCaseBased, stop-ui-RiskPaths, grunt, gulp, jake, and npm. The "start-ui-RiskPaths" and "stop-ui-RiskPaths" items are highlighted with red boxes. A red arrow points from the text "menu Terminal -> Run Task..." to the "start-ui-RiskPaths" item. The status bar at the bottom shows "PROBLEMS 112", "OUTPUT", "TERMINAL", and "DEBUG CONSOLE". The terminal tab is active, displaying log output from a simulation process.

```
// Debug check for no left-over agents for which Finish was not
// TODO - consider making an optional warning activated by a mod
// which could be turned on/off.
assert(0 == BaseAgent::om_active_agents());

// cleanup entities and event queue after case has completed.
BaseAgent::exit_simulation_all();
BaseEvent::clean_all();
```

TERMINAL

```
2020-06-12 16:22:22.317 member=0 Simulation progress=96% cases=4800
2020-06-12 16:22:22.319 member=0 Simulation progress=97% cases=4850
2020-06-12 16:22:22.320 member=0 Simulation progress=98% cases=4900
2020-06-12 16:22:22.322 member=0 Simulation progress=99% cases=4950
2020-06-12 16:22:22.324 member=0 Simulation progress=100% cases=5000
2020-06-12 16:22:22.324 member=0 Simulation summary: cases=5000, events/case=112.9
2020-06-12 16:22:22.324 member=0 Write output tables - start
2020-06-12 16:22:22.340 member=0 Write output tables - finish
2020-06-12 16:22:22.342 Writing into aggregated output tables, run: 104
2020-06-12 16:22:22.362 Done.
[1] + Done
"/usr/bin/qdb" --interpreter=mi --tty=${DbqTerm}
```

Start model UI on MacOS from Xcode

To start model UI after build completed please change `Model.xcconfig` variable `START_OMPP_UI` to "1" or "true" or "yes" (case-sensitive)

The screenshot shows the Xcode interface with the project 'RiskPaths' open. The left sidebar displays the project structure, including 'libopenm', 'libsqliite', 'Model' (which contains 'code' and 'Xcode-src' subfolders), 'Products', and 'Frameworks'. The main editor area shows the 'Model.xcconfig' file with the following content:

```
1 //  
2 // Model configuration settings  
3 //  
4 // Copyright (c) OpenM++  
5 // This code is licensed under MIT license (see LICENSE.txt for details)  
6 //  
7 #include "../Model-common.xcconfig"  
8 //  
9 // Model name: by default is the same as target name  
10 // Please rename target to match your actual model name  
11 //  
12 MODEL_NAME = $(TARGET_NAME)  
13 //  
14 // omc compiler settings:  
15 //  
16 // OMC_CODE_PAGE: encoding name (code page) of source .mpp/.ompp files  
17 // OMC_NO_LINE: if true then disable generation of #line directives.  
18 // case-insensitive true: "true" or "yes" or "1"  
19 // anything else is false  
20 //  
21 SCENARIO_NAME = Default  
22 OMC_SCENARIO_PARAM_DIR = $(SRCROOT)/parameters/$(SCENARIO_NAME)  
23 OMC_FIXED_PARAM_DIR = $(SRCROOT)/parameters/Fixed  
24 OMC_CODE_PAGE = WINDOWS-1252  
25 OMC_NO_LINE = false  
26 //  
27 // UI settings:  
28 //  
29 // START_OMPUI: if true then start openM++ UI.  
30 // case-sensitive true: "true" or "yes" or "1"  
31 // anything else is false  
32 //  
33 START_OMPUI = 1
```

The line '33 START_OMPUI = 1' is highlighted with a red rectangle.

Ompp-UI Localization: Translation of openM++ UI

Quick Start

To provide translated messages for openM++ UI you should:

- create translated messages file for your language, for example Deutsch: `ompp-ui/src/i18n/de/index.js`
- modify openM++ UI main page `ompp-ui/src/layouts/MainLayout.vue` to support new language
- rebuild openM++ by running `npm run dev` as described at [Quick Start for OpenM++ Developers: Build ompp-ui](#)

Please contact us at [GitHub openM++ UI project](#) or by email: `openmpp dot org at gmail dot com` for assistance. We certainly can do all necessary steps to include your translation into openM++ UI.

Example of translated messages file

Short fragment from translated messages file `ompp-ui/src/i18n/fr/index.js` for Français language:

```
export default {
  'About': 'À propos',
  'Advanced Run Options': "Options d'exécution avancées",
  'Yes': 'Oui',
  'You have {count} unsaved parameter(s)': 'Vous avez {count} paramètre(s) non enregistré(s)'
}
```

We would appreciate any help with French translation, since person who did it is not a locuteur natif français. Thank you in advance.

OpenM++ UI localization based on [internationalization plugin for Vue.js](#) and you can find detailed documentation at that project GitHub page.

How to modify UI main page to include to support new language

Open `ompp-ui/src/layouts/MainLayout.vue` in any text editor and modify following part of the code:

```
import(
  /* webpackInclude: /(fr/en-us)\.js$/ */

```

to include new language, for example Deutsch:

```
import(
  /* webpackInclude: /(de/fr/en-us)\.js$/ */

```

Oms: openM++ web-service

What is openM++ web-service

OpenM++ web-service (oms) is a JSON web-service written in Go and used from openM++ UI JavaScript. Today most of popular development platforms (.NET, Java, Python, Perl, R, JavaScript, etc.) with only few lines of code allow to create HTTP client and send-receive JSON data. That makes integration with openM++ very easy.

How to start openM++ web-service

OpenM++ web-service does not required any installation. It can be run with default settings from command-line prompt.

To start openM++ web-service on Windows:

- download and unzip openM++ <https://github.com/openmpp/main/releases/latest> binaries into `C:\SomeDir\`
- run oms from command-line:

```
C:  
cd \SomeDir\openmpp_win_20190508\  
bin\oms.exe -oms.ApiOnly
```

```
2017-12-19 12:14:22.0363 Model directory: models/bin  
2017-12-19 12:14:22.0400 Starting at localhost:4040  
2017-12-19 12:14:22.0402 To finish press Ctrl+C
```

To start openM++ web-service on Linux:

- download and unpack openM++, i.e.:

```
wget https://github.com/openmpp/main/releases/download/v1.2.0/openmpp_centos_20190508.tar.gz  
tar xzf openmpp_centos_20190508.tar.gz
```

- run oms executable:

```
cd openmpp_centos_20190508/  
bin/oms -oms.ApiOnly
```

```
2017-12-19 12:14:22.0363 Model directory: models/bin  
2017-12-19 12:14:22.0400 Starting at localhost:4040  
2017-12-19 12:14:22.0402 To finish press Ctrl+C
```

OpenM++ web-service configuration

Oms default configuration options can be overwritten by command-line arguments or ini-file. For example:

```
oms -l :7070  
oms -l :7070 -oms.ApiOnly  
oms -oms.ApiOnly -oms.ModelDir ..some/dir  
oms -oms.ApiOnly -OpenM.LogToConsole false -OpenM.LogToFile  
oms -oms.ApiOnly -OpenM.LogToConsole false -OpenM.LogToFile -OpenM.LogUseDailyStamp  
oms -ini oms.ini
```

Following options supported by oms:

```

-oms.Listen:      address to listen, default: localhost:4040
-l:              address to listen (short form of -oms.Listen)
-oms.RootDir:    oms root directory, default: current directory
-oms.ModelDir:   models directory, if relative then must be relative to oms root directory, default: models/bin
-oms.ModelLogDir: models log directory, if relative then must be relative to oms root directory, default: models/log
-oms.LogRequest: if true then log HTTP requests
-oms.ApiOnly:    if true then API only web-service, no UI
-oms.MaxRowCount: max number of rows to select for parameter or output table values, default: 100
-oms.Languages:  comma-separated list of supported UI languages
-oms.CodePage:   code page to convert source file into utf-8, e.g.: windows-1252
-oms.DoubleFormat: format to convert float or double value to string, default: %.15g
-oms.MaxRunHistory: max number of model runs to keep in run list history, default: 100.

-OpenM.OptionsFile: path to ini-file
-ini:             path to ini-file (short of -OpenM.OptionsFile)
-OpenM.LogToConsole: if true then log to standard output, default: true
-v:               if true then log to standard output (short of -OpenM.LogToConsole)
-OpenM.LogToFile:  if true then log to file
-OpenM.LogFilePath: path to log file, default = current/dir/exeName.log
-OpenM.LogUseTs:   if true then use time-stamp in log file name
-OpenM.LogUsePid:  if true then use pid-stamp in log file name
-OpenM.LogUseDailyStamp: if true then use daily-stamp in log file name
-OpenM.LogSql:     if true then log sql statements into log file

```

There are many common options, e.g.: `-OpenM.LogToFile` which can be used with any openM++ executable: models, complier, dbcopy. Please check [openM++ ini-files and command-line arguments](#) page.

Note: We recommend to use normal Windows command line cmd.exe. If you are using Windows PowerShell then it may be necessary to put "quotes" around command line options, e.g.:

```
oms.exe "-oms.ApiOnly"
```

Clients of oms web-service can retrieve configuration by calling [GET web-service configuration](Oms-API-GET-service-config]. Response to that call also contain environment variables which names started from `OM_CFG_` prefix. For example openM++ UI uses following server variables:

```

OM_CFG_LOGIN_URL=/public/login_required.html
OM_CFG_LOGOUT_URL=/login?logout=true
OM_CFG_DEFAULT_RUN_TMPL=run.Win32.Debug.template.txt

```

Note: values above are examples only.

Oms as "pure" web-service vs "full" web-UI

By default `oms.exe` started in "full" web-UI mode. That means it handles web-service requests and web-UI content from `./html` sub-directory. If you want only "pure" web-service mode without UI then use:

```
oms -oms.ApiOnly
```

Oms directory structure and log options

Following directory structure expected by default:

```

./          -> oms "root" directory, by default it is current directory
html/       -> web-UI directory with HTML, js, css, images...
etc/        -> config files directory, contain template(s) to run models on MPI cluster
log/        -> recommended log files directory
models/
  bin/    -> default model.exe and model.sqlite directory
  log/    -> default directory for models run log files

```

If you don't have `html/` directory and don't want web-UI then:

```
oms -oms.ApiOnly
```

Configuration files `etc` directory is required only if you want to run models on MPI cluster, otherwise it's optional.

You can explicitly specify oms log files location, models and models log directory, ex.:

```
oms -oms.ModelDir /my-models -oms.ModelLogDir /my-models-log
```

If you want to use log file and no console messages:

```
oms -OpenM.LogToConsole=false -OpenM.LogToFile  
oms -OpenM.LogToConsole=false -OpenM.LogFilePath log/oms.log
```

If you want to use "daily" log files:

```
oms -OpenM.LogUseDailyStamp -OpenM.LogToFile  
oms -OpenM.LogUseDailyStamp -OpenM.LogFilePath log/oms.log
```

Arguments of web-service methods

Following arguments most often used in web-service methods:

:model - model digest or model name

Example of method:

```
GET /api/model/:model
```

Call example:

```
http://localhost:4040/api/model/f5024ac32c4e8abfc696a0f925141c95  
http://localhost:4040/api/model/modelOne
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

:run - model run or model task run

Example of method:

```
GET /api/model/:model/run/:run/status  
GET /api/model/:model/task/:task/run-status/run/:run
```

Call example:

```
http://localhost:4040/api/model/modelOne/run/modelOne_first_run/status  
http://localhost:4040/api/model/modelOne/run/d06f4a0a45a9514c22593025e489f933/status  
http://localhost:4040/api/model/modelOne/task/taskOne/run-status/run/First Task Run
```

This argument is used to identify model run or modeling task run.

Modeling task run can be identified by task run stamp or task run name.

Model run can be identified by run digest or run stamp or run name. It is recommended to use run digest because it is uniquely identifies model run. Run stamp can be explicitly specified as command line option when you run the model. If run stamp not specified then it is automatically generated as timestamp string, ex: 2016_08_17_07_55_123. It is also possible to use run name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

:lang - language code

Example of method:

```
GET /api/model/:model/text/lang/:lang
```

Call example:

```
http://localhost:4040/api/model/modelOne/text/lang/EN  
http://localhost:4040/api/model/modelOne/text/lang/en_US
```

Language code can be a model language (ex.: EN, FR) or any MIME language (see [BCP47](#) or [RFC3282](#)). If no language explicitly specified

then `Accept-Language` header is used (supplied by browser).

Result returned in best matched language supported by model. For example for en_US result is model language EN, if model supported EN language. If no such language then result is in default model language or can be empty.

:set - set of input data (a.k.a. workset)

Method examples:

```
GET /api/model/:model/workset/:set/status  
POST /api/model/:model/workset/:set/readonly/:val
```

Call examples:

```
http://localhost:4040/api/model/modelOne/workset/modelOne_set/status  
curl -v -X POST http://localhost:4040/api/model/modelOne/workset/modelOne_set/readonly/1
```

Workset is a set of model input parameters (a.k.a. "scenario" input) and it used to run the model. Each model workset uniquely identified by name.

:task - modeling task

Method examples:

```
GET /api/model/:model/task/:task/text/lang=FR
```

Call examples:

```
http://localhost:4040/api/model/modelOne/task/taskOne/text  
curl -v http://localhost:4040/api/model/modelOne/task/taskOne/text/lang=fr_CA
```

Modeling task consists of multiple input data sets (a.k.a. worksets or scenarios in Modgen). Task can be used to run the model in batch mode.

:profile - set of key-value options

Method examples:

```
GET /api/model/:model/profile/:profile  
POST /api/model/:model/profile/:key/value/:value
```

Call examples:

```
http://localhost:4040/api/model/modelOne/profile/modelOne  
curl -v -X POST http://localhost:4040/api/model/modelOne/profile/m1/key/Parameter.StartingSeed/value/4095
```

Profile is a set of key-value options and it used to run the model. Each profile uniquely identified by profile name. Each profile can include multiple key-value options.

Results of web-service methods

Run status

Model run status and task run status may contain one of the following values:

```
i = initial state, not running yet  
p = run in progress  
w = task wait for additional input  
s = completed successfully  
x = completed by exit (reserved fro internal use)  
e = completed with error
```

Important: if model run failed with exception (e.g. database write exception) then status may not be updated and still `p=in progress`.

Oms: openM++ web-service API

Web-service methods arguments

```
:model - model digest or model name  
:lang - language code  
:run - model run digest or run stamp or run name, modeling task run stamp or task run name  
:set - name of workset (input set of model parameters)  
:profile - profile name  
:task - modeling task
```

See more details at: [Arguments of web-service methods](#).

GET Model Metadata

GET model list

```
GET /api/model-list
```

GET model list including text (description and notes)

```
GET /api/model-list/text  
GET /api/model-list/text/lang/:lang  
GET /api/model-list-text?lang=en
```

GET model definition metadata

```
GET /api/model/:model  
GET /api/model?model=modelNameOrDigest
```

GET model metadata including text (description and notes)

```
GET /api/model/:model/text  
GET /api/model/:model/text/lang/:lang  
GET /api/model-text?model=modelNameOrDigest&lang=en
```

GET model metadata including text in all languages

```
GET /api/model/:model/text/all  
GET /api/model-text-all?model=modelNameOrDigest
```

GET Model Extras

GET model languages

```
GET /api/model/:model/lang-list  
GET /api/lang-list?model=modelNameOrDigest
```

GET model language-specific strings

```
GET /api/model/:model/word-list  
GET /api/model/:model/word-list/lang/:lang  
GET /api/word-list?model=modelNameOrDigest&lang=en
```

GET model profile

```
GET /api/model/:model/profile/:profile  
GET /api/model-profile?model=modelNameOrDigest&profile=profileName
```

GET list of profiles

```
GET /api/model/:model/profile-list  
GET /api/model-profile-list?model=modelNameOrDigest
```

GET Model Run results metadata

GET list of model runs

```
GET /api/model/:model/run-list  
GET /api/model-run-list?model=modelNameOrDigest
```

GET list of model runs including text (description and notes)

```
GET /api/model/:model/run-list/text  
GET /api/model/:model/run-list/text/lang/:lang  
GET /api/model-run-list-text?model=modelNameOrDigest&lang=en
```

GET status of model run

```
GET /api/model/:model/run/:run/status  
GET /api/model-run-status?model=modelNameOrDigest&run=runDigestOrStampOrName
```

GET status of model run list

```
GET /api/model/:model/run/:run/status/list  
GET /api/model-run-status-list?model=modelNameOrDigest&run=runDigestOrStampOrName
```

GET status of first model run

```
GET /api/model/:model/run/status/first  
GET /api/model-run-first-status?model=modelNameOrDigest
```

GET status of last model run

```
GET /api/model/:model/run/status/last  
GET /api/model-run-last-status?model=modelNameOrDigest
```

GET status of last completed model run

```
GET /api/model/:model/run/status/last-completed  
GET /api/model-run-last-completed-status?model=modelNameOrDigest
```

GET model run metadata and status

```
GET /api/model/:model/run/:run  
GET /api/model-run-text?model=modelNameOrDigest&run=runDigestOrStampOrName
```

GET model run including text (description and notes)

```
GET /api/model/:model/run/:run/text  
GET /api/model/:model/run/:run/text/lang/:lang  
GET /api/model-run-text?model=modelNameOrDigest&run=runDigestOrStampOrName&lang=en
```

GET model run including text in all languages

```
GET /api/model/:model/run/:run/text/all  
GET /api/model-run-text-all?model=modelNameOrDigest&run=runDigestOrStampOrName
```

GET Model Workset metadata: set of input parameters

GET list of model worksets

```
GET /api/model/:model/workset-list  
GET /api/workset-list?model=modelNameOrDigest
```

GET list of model worksets including text (description and notes)

```
GET /api/model/:model/workset-list/text  
GET /api/model/:model/workset-list/text/:lang  
GET /api/workset-list-text?model=modelNameOrDigest&lang=en
```

GET workset status

```
GET /api/model/:model/workset/:set/status  
GET /api/model/:model/workset/:set  
GET /api/workset-status?model=modelNameOrDigest&set=setName
```

GET model default workset status

```
GET /api/model/:model/workset/status/default  
GET /api/workset-default-status?model=modelNameOrDigest
```

GET workset including text (description and notes)

```
GET /api/model/:model/workset/:set/text  
GET /api/model/:model/workset/:set/text/:lang  
GET /api/workset-text?model=modelNameOrDigest&set=setName  
GET /api/workset-text?model=modelNameOrDigest&set=setName&lang=en
```

GET workset including text in all languages

```
GET /api/model/:model/workset/:set/text/all  
GET /api/workset-text-all?model=modelNameOrDigest&set=setName
```

Read Parameters or Output Tables values

Read parameter values from workset

```
POST /api/model/:model/workset/:set/parameter/value
```

Read parameter values from workset (enum id's)

```
POST /api/model/:model/workset/:set/parameter/value-id
```

Read parameter values from model run

```
POST /api/model/:model/run/:run/parameter/value
```

Read parameter values from model run (enum id's)

```
POST /api/model/:model/run/:run/parameter/value-id
```

Read output table values from model run

```
POST /api/model/:model/run/:run/table/value
```

Read output table values from model run (enum id's)

```
POST /api/model/:model/run/:run/table/value-id
```

GET Parameters or Output Tables values

GET parameter values from workset

```
GET /api/model/:model/workset/:set/parameter/:name/value  
GET /api/model/:model/workset/:set/parameter/:name/value/start/:start  
GET /api/model/:model/workset/:set/parameter/:name/value/start/:start/count/:count  
GET /api/workset-parameter-value?model=modelNameOrDigest&set=setName&name=parameterName&start=0&count=100
```

GET parameter values from model run

```
GET /api/model/:model/run/:run/parameter/:name/value
GET /api/model/:model/run/:run/parameter/:name/value/start/:start
GET /api/model/:model/run/:run/parameter/:name/value/start/:start/count/:count
GET /api/run-parameter-value?model=modelNameOrDigest&run=runDigestOrStampOrName&name=parameterName&start=0&count=100
```

GET output table expression(s) from model run

```
GET /api/model/:model/run/:run/table/:name/expr
GET /api/model/:model/run/:run/table/:name/expr/start/:start
GET /api/model/:model/run/:run/table/:name/expr/start/:start/count/:count
GET /api/run-table-expr?model=modelNameOrDigest&run=runDigestOrStampOrName&name=salarySex&start=0&count=100
```

GET output table accumulator(s) from model run

```
GET /api/model/:model/run/:run/table/:name/acc
GET /api/model/:model/run/:run/table/:name/acc/start/:start
GET /api/model/:model/run/:run/table/:name/acc/start/:start/count/:count
GET /api/run-table-acc?model=modelNameOrDigest&run=runDigestOrStampOrName&name=salarySex&start=0&count=100
```

GET output table all accumulators from model run

```
GET /api/model/:model/run/:run/table/:name/all-acc
GET /api/model/:model/run/:run/table/:name/all-acc/start/:start
GET /api/model/:model/run/:run/table/:name/all-acc/start/:start/count/:count
GET /api/run-table-all-acc?model=modelNameOrDigest&run=runDigestOrStampOrName&name=salarySex&start=0&count=100
```

GET Parameters or Output Tables values as CSV

GET csv parameter values from workset

```
GET /api/model/:model/workset/:set/parameter/:name/csv
GET /api/model/:model/workset/:set/parameter/:name/csv-bom
GET /api/workset-parameter-csv?model=modelNameOrDigest&set=setName&name=parameterName&bom=true
```

GET csv parameter values from workset (enum id's)

```
GET /api/model/:model/workset/:set/parameter/:name/csv-id
GET /api/model/:model/workset/:set/parameter/:name/csv-id-bom
GET /api/workset-parameter-csv-id?model=modelNameOrDigest&set=setName&name=parameterName&bom=true
```

GET csv parameter values from model run

```
GET /api/model/:model/run/:run/parameter/:name/csv
GET /api/model/:model/run/:run/parameter/:name/csv-bom
GET /api/run-parameter-csv?model=modelNameOrDigest&run=runDigestOrStampOrName&name=parameterName&bom=true
```

GET csv parameter values from model run (enum id's)

```
GET /api/model/:model/run/:run/parameter/:name/csv-id
GET /api/model/:model/run/:run/parameter/:name/csv-id-bom
GET /api/run-parameter-csv-id?model=modelNameOrDigest&run=runDigestOrStampOrName&name=parameterName&bom=true
```

GET csv output table expressions from model run

```
GET /api/model/:model/run/:run/table/:name/expr/csv
GET /api/model/:model/run/:run/table/:name/expr/csv-bom
GET /api/run-table-expr-csv?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true
```

GET csv output table expressions from model run (enum id's)

```
GET /api/model/:model/run/:run/table/:name/expr/csv-id
GET /api/model/:model/run/:run/table/:name/expr/csv-id-bom
GET /api/run-table-expr-csv-id?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true
```

GET csv output table accumulators from model run

```
GET /api/run-table-acc-csv?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true  
GET /api/model/:model/run/:run/table/:name/acc/csv  
GET /api/model/:model/run/:run/table/:name/acc/csv-bom
```

GET csv output table accumulators from model run (enum id's)

```
GET /api/run-table-acc-csv-id?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true  
GET /api/model/:model/run/:run/table/:name/acc/csv-id  
GET /api/model/:model/run/:run/table/:name/acc/csv-id-bom
```

GET csv output table all accumulators from model run

```
GET /api/run-table-all-acc-csv?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true  
GET /api/model/:model/run/:run/table/:name/all-acc/csv  
GET /api/model/:model/run/:run/table/:name/all-acc/csv-bom
```

GET csv output table all accumulators from model run (enum id's)

```
GET /api/run-table-all-acc-csv-id?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true  
GET /api/model/:model/run/:run/table/:name/all-acc/csv-id  
GET /api/model/:model/run/:run/table/:name/all-acc/csv-id-bom
```

GET Modeling Task metadata and task run history

GET list of modeling tasks

```
GET /api/model/:model/task-list  
GET /api/task-list?model=modelNameOrDigest
```

GET list of modeling tasks including text (description and notes)

```
GET /api/model/:model/task-list/text  
GET /api/model/:model/task-list/text/lang/:lang  
GET /api/task-list-text?model=modelNameOrDigest&lang=en
```

GET modeling task input worksets

```
GET /api/model/:model/task/:task/sets  
GET /api/task-sets?model=modelNameOrDigest&task=taskName
```

GET modeling task run history

```
GET /api/model/:model/task/:task/runs  
GET /api/task-runs?model=modelNameOrDigest&task=taskName
```

GET status of modeling task run

```
GET /api/model/:model/task/:task/run-status/run/:run  
GET /api/task-run-status?model=modelNameOrDigest&task=taskName&run=taskRunStampOrName
```

GET status of modeling task run list

```
GET /api/model/:model/task/:task/run-status/list/:run  
GET /api/task-run-status-list?model=modelNameOrDigest&task=taskName&run=taskRunStampOrName
```

GET status of modeling task first run

```
GET /api/model/:model/task/:task/run-status/first  
GET /api/task-first-run-status?model=modelNameOrDigest&task=taskName
```

GET status of modeling task last run

```
GET /api/model/:model/task/:task/run-status/last  
GET /api/task-last-run-status?model=modelNameOrDigest&task=taskName
```

GET status of modeling task last completed run

```
GET /api/model/:model/task/:task/run-status/last-completed  
GET /api/task-last-completed-run-status?model=modelNameOrDigest&task=taskName
```

GET modeling task including text (description and notes)

```
GET /api/model/:model/task/:task/text  
GET /api/model/:model/task/text/:lang/:lang  
GET /api/task-text?model=modelNameOrDigest&task=taskName&lang=en
```

GET modeling task text in all languages

```
GET /api/model/:model/task/:task/text/all  
GET /api/task-text-all?model=modelNameOrDigest&task=taskName
```

Update Model Profile: set of key-value options

POST create or replace profile

```
PATCH /api/model/:model/profile  
POST /api/model-profile?model=modelNameOrDigest
```

DELETE profile

```
DELETE /api/model/:model/profile/:profile  
POST /api/model-profile-delete?model=modelNameOrDigest&profile=profileName
```

POST create or replace profile option

```
POST /api/model/:model/profile/:profile/key/:key/value/:value
```

DELETE profile option

```
DELETE /api/model/:model/profile/:profile/key/:key  
POST /api/model-profile-key-delete?model=modelNameOrDigest&profile=profileName&key=someKey
```

Update Model Workset: set of input parameters

POST update workset read-only status

```
POST /api/model/:model/workset/:set/readonly/:readonly  
POST /api/workset-readonly?model=modelNameOrDigest&set=setName&readonly=true
```

PUT create new workset

```
PUT /api/workset-create
```

PUT create or replace workset

```
PUT /api/workset-new
```

PATCH create or merge workset

```
PATCH /api/workset
```

DELETE workset

```
DELETE /api/model/:model/workset/:set  
POST /api/workset-delete?model=modelNameOrDigest&set=setName
```

DELETE parameter from workset

```
DELETE /api/model/:model/workset/:set/parameter/:name  
POST /api/workset-parameter-delete?model=modelNameOrDigest&set=setName&name=name
```

PATCH update workset parameter values

```
PATCH /api/model/:model/workset/:set/parameter/:name/new/value  
POST /api/workset-parameter-new-value?model=modelNameOrDigest&set=setName&name=parameterName
```

PATCH update workset parameter values (enum id's)

```
PATCH /api/model/:model/workset/:set/parameter/:name/new/value-id  
POST /api/workset-parameter-new-value-id?model=modelNameOrDigest&set=setName&name=parameterName
```

PUT copy parameter from model run into workset

```
PUT /api/model/:model/workset/:set/copy/parameter/:name/from-run/:run  
POST /api/copy-parameter-from-run?model=modelNameOrDigest&set=setName&name=parameterName&run=runDigestOrStampOrName"
```

PUT copy parameter from workset to another

```
PUT /api/model/:model/workset/:set/copy/parameter/:name/from-workset/:from-set  
POST /api/copy-parameter-from-workset?model=modelNameOrDigest&set=dstSetName&name=parameterName&from-set=srcSetName"
```

Update Model Runs

PATCH update model run text (description and notes)

```
PATCH /api/run/text
```

DELETE model run

```
DELETE /api/model/:model/run/:run  
POST /api/run-delete?model=modelNameOrDigest&run=runDigestOrStampOrName
```

Update Modeling Tasks

PUT create or replace modeling task

```
PUT /api/task-new
```

PATCH create or update modeling task

```
PATCH /api/task
```

DELETE modeling task

```
DELETE /api/model/:model/task/:task  
POST /api/task-delete?model=modelNameOrDigest&task=taskId
```

Run Models: run models and monitor progress

POST a request to run the model

```
POST /api/run
```

GET state of current model run

```
GET /api/run/log/model/:model/stamp/:stamp  
GET /api/run/log/model/:model/stamp/:stamp/start/:start/count/:count  
GET /api/run-log?model=modelNameOrDigest&stamp=runStamp&start=0&count=0
```

User: manage user settings and data

GET user views for the model

```
GET /api/user/view/model/:model
```

PUT user views for the model

```
PUT /api/user/view/model/:model
```

DELETE user views for the model

```
DELETE /api/user/view/model/:model
```

Administrative: manage web-service state

GET web-service configuration

```
GET /api/service/config
```

GET web-service state

```
GET /api/service/state
```

POST a request to refresh models catalog

```
POST /api/admin/all-models/refresh
```

POST a request to close models catalog

```
POST /api/admin/all-models/close
```

PUT a request to shutdown web-service

```
PUT /api/admin/shutdown
```

Oms: How to prepare model input parameters

Overview

OpenM++ provides multiple different ways to supply input parameters and run the models as described at:

- [Model Run Cycle: How model finds input parameters](#)
- [Model Run: How to Run the Model](#)

You don't have to do any programming or database operations in order to provide model input parameters, you can:

- provide parameter value as command line argument
- run model with default workset (default "scenario")
- use workset name ("scenario" name) to run the model
- use ini-file to provide model parameters
- supply parameter values as csv-file(s)

Also following API available for advanced parameter manipulation and output results processing:

- [JSON web-service](#) to use with any modern framework (.NET, JavaScript, Python, etc.)
- [Go library and tools](#)
- [OpenMpp R package](#) and [R usage examples](#)

Current page describe an usage of openM++ JSON web-service (oms) in order to prepare, examine and modify model input parameters. There are two terms are used in text below: "workset" and "base run". Please see [Model Run Cycle: How model finds input parameters](#) page for details.

Workset: set of model input parameters (a.k.a. "scenario")

Workset is a set of model input parameters in database which we can use to run the model. Each workset has unique name. Each model must have "default workset", which is a first set of model input parameters. Model user can create, modify and delete worksets.

Base run

Each model run started from creating full copy of model input parameters in database, which are used for that particular model run. Because usually only small portion of model parameters are changing between model runs it is convenient to create new workset (new "scenario") based on input parameters of previous model run, which is called "base run". In that case we only need to supply few modified parameter values and the rest is coming from "base run" parameters.

Start Oms: OpenM++ JSON web-service

Below we are using [oms web-service](#) to prepare model input. Most examples are created with browser output and `curl` to avoid any unnecessary programing languages details.

You can start oms web-service on Windows:

```
C:  
cd \SomeDir\openmpp_win_20190508\  
bin\oms.exe -oms.ApiOnly
```

Or Linux:

```
cd openmpp_centos_20190508/  
bin/oms -oms.ApiOnly
```

If your models are not in `models/bin` sub-folder then use:

```
bin/oms -oms.ApiOnly -oms.ModelDir ../my_model_dir
```

Please see [Oms web-service](#) page for more details.

Get list of published models

We need to know model name at least, or better model digest to find or modify model input parameters. Open your favorite browser and type:

```
http://localhost:4040/api/model-list
```

Result can look like:

```
[  
  {  
    "ModelId": 1,  
    "Name": "modelOne",  
    "Digest": "_201208171604590148_",  
    "Type": 0,  
    "Version": "1.0",  
    "CreateDateTime": "2012-08-17 16:04:59.0148",  
    "DefaultLangCode": "EN"  
  },  
  {  
    "ModelId": 101,  
    "Name": "RiskPaths",  
    "Digest": "db6e5168c74a73a4f5b194cb2a793444",  
    "Type": 0,  
    "Version": "3.0.0.0",  
    "CreateDateTime": "2018-12-14 18:36:05.0272",  
    "DefaultLangCode": "EN"  
  }  
]
```

Get list of model worksets (set of input parameters, a.k.a. "scenarios")

Go to:

```
http://localhost:4040/api/model/modelOne/workset-list
```

```
[  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "Default",  
    "BaseRunDigest": "",  
    "IsReadonly": true,  
    "UpdateDateTime": "2013-05-29 23:55:07.1234",  
    "Txt": [],  
    "Param": []  
  },  
  .....  
]
```

Model default set of input parameters

First workset is a default set of model input parameters. You can explore more it at

```
http://localhost:4040/api/model/modelOne/workset/Default/text
```

and look at each parameter values, for example:

```
http://localhost:4040/api/model/modelOne/workset/Default/parameter/StartingSeed/value
```

```
[  
  {  
    "Dims": [],  
    "IsNull": false,  
    "Value": 8191,  
    "SubId": 0  
  }  
]
```

Or

```
http://localhost:4040/api/model/modelOne/workset/Default/parameter/ageSex/value
```

```
[{"Dims": ["10-20", "M"], "IsNull": false, "Value": 0.1, "SubId": 0}, {"Dims": ["10-20", "F"], "IsNull": false, "Value": 0.2, "SubId": 0}, {"Dims": ["20-30", "M"], "IsNull": false, "Value": 0.3, "SubId": 0}, {"Dims": ["20-30", "F"], "IsNull": false, "Value": 0.4, "SubId": 0}, {"Dims": ["30-40", "M"], "IsNull": false, "Value": 0.5, "SubId": 0}, {"Dims": ["30-40", "F"], "IsNull": false, "Value": 0.6, "SubId": 0}, {"Dims": ["40+", "M"], "IsNull": false, "Value": 0.7, "SubId": 0}, {"Dims": ["40+", "F"], "IsNull": false, "Value": 0.8, "SubId": 0}]
```

Model run results and run input parameters

To see the history of model runs:

```
http://localhost:4040/api/model/modelOne/run-list
```

```
[ { "modelName": "modelOne", "modelDigest": "_201208171604590148_", "name": "Default", "subCount": 1, "subStarted": 1, "subCompleted": 1, "createDateTime": "2019-01-10 18:36:13.0655", "status": "s", "updateDateTime": "2019-01-10 18:36:13.0669", "digest": "6fbad822cb9ae42deea1ede626890711", "txt": [], "opts": {}, "param": [], "progress": [] }, ..... { "modelName": "modelOne", "modelDigest": "_201208171604590148_", "name": "Parameter sub-values 2 from csv", "subCount": 2, "subStarted": 2, "subCompleted": 2, "createDateTime": "2019-01-10 18:36:13.0745", "status": "s", "updateDateTime": "2019-01-10 18:36:13.0762", "digest": "ac72e96b549638d31acaf6ee965b23c2", "txt": [], "opts": {}, "param": [], "progress": [] }, ..... ]
```

Model run can be uniquely identified by run digest, for example above:

- digest: `ac72e96b549638d31acaf6ee965b23c2`, run name: "Parameter sub-values 2 from csv"
- digest: `6fbad822cb9ae42deea1ede626890711`, run name: "Default"

Run name may not be unique, but in examples below we going to use name just to improve readability.

To see the parameter value from particular model run:

```
http://localhost:4040/api/model/modelOne/run/Default/parameter/StartingSeed/value
```

```
[
  {
    "Dims": [],
    "IsNull": false,
    "Value": 1023,
    "SubId": 0
  }
]
```

Or

```
http://localhost:4040/api/model/modelOne/run/Default/parameter/baseSalary/value
```

```
[
  {
    "Dims": [],
    "IsNull": false,
    "Value": "Full",
    "SubId": 0
  }
]
```

Use model profile to supply parameter values

Profile is a set of key-value options, similar to ini-file, which can be used to run the model. Each profile can be identified by profile name. It may be more convenient to use profiles instead of ini-files because profiles are stored in database and you don't need to deal with multiple files in order to publish and run the model in cloud.

To create profile named `seed-1-base-full` with values of `StartingSeed` and `baseSalary` parameters :

```
curl -v -X PATCH -H "Content-Type: application/json" \
"http://localhost:4040/api/model/modelOne/profile" \
-d \
'{ "Name": "seed-1-base-full",
  "Opts": {
    "OpenM.StartingSeed": "1023",
    "OpenM.baseSalary": "Full"
  }
}'
```

Above curl command line is Linux specific, on Windows you must use ^ instead of \ for multi-line input and also double "quotes" and \" instead of single 'quotes'.

To view model profile:

```
http://localhost:4040/api/model/modelOne/profile/seed-1-base-full
```

```
{
  "Name": "seed-1-base-full",
  "Opts": {
    "OpenM.StartingSeed": "1023",
    "OpenM.baseSalary": "Full"
  }
}
```

To modify profile value:

```
curl -v -X POST http://localhost:4040/api/model/modelOne/profile/seed-1-base-full/key/Parameter.StartingSeed/value/4095
```

You can create multiple profiles similar to above in order to run the model with different `StartingSeed` and `baseSalary` parameter values:

```
modelOne -OpenM.Profile seed-1-base-full
modelOne -OpenM.Profile seed-1-base-part
modelOne -OpenM.Profile seed-2-base-full
modelOne -OpenM.Profile seed-2-base-part
```

It is the same as supply parameter values on command line:

```
modelOne -Parameter.StartingSeed 1023 -Parameter.baseSalary Full
modelOne -Parameter.StartingSeed 1023 -Parameter.baseSalary Part
modelOne -Parameter.StartingSeed 2047 -Parameter.baseSalary Full
modelOne -Parameter.StartingSeed 2047 -Parameter.baseSalary Part
```

Above model runs are using profile or command line values of `StartingSeed` and `baseSalary` and all other parameters are coming from "default" workset (default set of input parameters, a.k.a. default "scenario").

Simple way to create new workset (input set of parameters)

If you already run the model then database contains run results in output tables and copy of input parameters of that model run. We can use previous run parameters as "base" for our new workset, modify only some of it and run our model again.

1. To create `New-Set` of model parameters based on model run named "Default" with digest "6fbad822cb9ae42deea1ede626890711":

```
curl -v -X PUT \
-F 'workset={
    "modelName": "modelOne",
    "name": "New-Set",
    "baseRunDigest": "6fbad822cb9ae42deea1ede626890711",
    "txt": [
        { "langCode": "EN", "descr": "My new set of input parameters" }
    ],
    "param": [
        {
            "name": "StartingSeed",
            "subCount": 1,
            "txt": [
                { "langCode": "EN", "note": "Starting seed new value" }
            ],
            "value": [
                {"dims": [], "isNull": false, "value": 8191, "subId": 0}
            ]
        },
        {
            "name": "ageSex",
            "subCount": 1,
            "txt": [],
            "value": [
                {"dims": ["10-20","M"], "isNull": false, "value": 0.1, "subId": 0},
                {"dims": ["10-20","F"], "isNull": false, "value": 0.2, "subId": 0},
                {"dims": ["20-30","M"], "isNull": false, "value": 0.3, "subId": 0},
                {"dims": ["20-30","F"], "isNull": false, "value": 0.4, "subId": 0},
                {"dims": ["30-40","M"], "isNull": false, "value": 0.5, "subId": 0},
                {"dims": ["30-40","F"], "isNull": false, "value": 0.6, "subId": 0},
                {"dims": ["40+","M"], "isNull": false, "value": 0.7, "subId": 0},
                {"dims": ["40+","F"], "isNull": false, "value": 0.8, "subId": 0}
            ]
        }
    ]
}' \
http://localhost:4040/api/workset-create
```

That `New-Set` contains new values for `StartingSeed` and `ageSex` parameters. All other input values are identical to previous "Default" model run input.

Each input set of model parameters (each workset) must have unique name. Different models can have worksets with same name, i.e. each model can have workset with name "Default". If workset with the same name `New-Set` already exist then this method return an error.

You don't have to create workset based on previous model run, you can omit `BaseRunDigest` and include all parameter values in the new workset. However it may be difficult for complex model with hundreds input parameters.

Advanced way to create new workset (input set of parameters) based on previous model run

If you already run the model then database contains run results in output tables and copy of input parameters of that model run. We can use previous run parameters as "base" for our new workset, modify only some of it and run our model again.

1. To create new `MyFirstSet` of model parameters based on model run named "Default" with digest "6fbad822cb9ae42deea1ede626890711":

```

curl -v -X PUT \
-F 'workset={
  "modelName": "modelOne",
  "name": "MyFirstSet",
  "baseRunDigest": "6fbad822cb9ae42deea1ede626890711",
  "txt": [
    { "langCode": "EN", "descr": "My first set of input parameters" }
  ]
}' \
http://localhost:4040/api/workset-new

```

That workset does not yet include any new parameter values, all input is identical to previous "Default" model run input. In order to modify parameter values we first need to copy into our new workset from any model run, any other workset or upload as csv-file.

2. Copy parameter `StartingSeed` value into `MyFirstSet` workset from `Default-4` model run:

```
curl -v -X PUT http://localhost:4040/api/model/modelOne/workset/MyFirstSet/copy/parameter/StartingSeed/from-run/Default-4
```

3. Copy parameter `baseSalary` value into `MyFirstSet` workset from `modelOne_other` workset:

```
curl -v -X PUT http://localhost:4040/api/model/modelOne/workset/MyFirstSet/copy/parameter/baseSalary/from-workset/modelOne_other
```

4. Upload parameter `ageSex` values into `MyFirstSet` workset from `my_age_sex.csv` csv file:

```

curl -v -X PATCH \
-F 'workset={
  "modelName": "modelOne",
  "name": "MyFirstSet",
  "param": [
    { "name": "ageSex", "subCount": 1 }
  ]
}' \
-F 'parameter-csv=@my_age_sex.csv;filename=ageSex.csv' \
http://localhost:4040/api/workset

```

where content of `my_age_sex.csv` is:

```

sub_id,dim0,dim1,param_value
0,10-20,M,11
0,10-20,F,12
0,20-30,M,13
0,20-30,F,14
0,30-40,M,15
0,30-40,F,16
0,40+,M,17
0,40+,F,18

```

It is also possible to modify some part of parameter values. For example, `ageSex` parameter above is 4*3 matrix and if want to modify values:

```
[30-40, M] = 0.15
[30-40, F] = 0.16
```

then:

```

curl -v -X PATCH -H "Content-Type: application/json" \
http://localhost:4040/api/model/modelOne/workset/MyFirstSet/parameter/ageSex/new/value \
-d '['
  {"Dims": ["30-40", "M"], "IsNull": false, "SubId": 0, "Value": 0.15},
  {"Dims": ["30-40", "F"], "IsNull": false, "SubId": 0, "Value": 0.16}
]'

```

Finally our "MyFirstSet" input set contains new values for 3 parameters: `StartingSeed`, `baseSalary`, `ageSex`, which different from previous "base run" parameters. And now we can **run our model with that new workset**:

```
modelOne -OpenM.SetName MyFirstSet
```

It is also possible to delete parameter from workset, delete entire workset in order to cleanup database and perform some other operations. Please see [Oms: openM++ web-service API](#) for details.

Create or modify modeling task

Modeling task consists of multiple sets of input data and can be run in batch mode. There is an example of modeling task at [Run RiskPaths model from R](#) page where we creating 800 sets of input data to study Childlessness by varying

- Age baseline for first union formation
- Relative risks of union status on first pregnancy After preparing such modeling task we can submit RiskPath model to high performance cluster (HPC) grid or in cloud where model will read 800 input sets and produce 800 model run outputs.

It is also possible to create or modify or delete modeling task without R, using Oms JSON web-service from programming language of your choice.

In order to do this we need first to prepare our input worksets as described above and after that we can create modeling task. For example, if we have two worksets: `MyFirstSet`, `MySecondSet` then we can create task:

```
curl -v -X PUT -H "Content-Type: application/json" \
http://localhost:4040/api/task-new \
-d '{
  "ModelName": "modelOne",
  "Name": "MyTask",
  "Txt": [
    {
      "LangCode": "EN",
      "Descr": "Task to vary 3 parameters",
      "Note": "Study effect of 3 parameters on output results"
    }
  ],
  "Set": [
    "MyFirstSet",
    "MySecondSet"
  ]
}'
```

You can see the list of modeling tasks:

```
http://localhost:4040/api/model/modelOne/task-list
```

examine task metadata, input sets or task run history:

```
http://localhost:4040/api/model/modelOne/task/MyTask/text
http://localhost:4040/api/model/modelOne/task/MyTask/sets
http://localhost:4040/api/model/modelOne/task/MyTask/runs
```

It is also possible to delete or modify task. For example, if you want to add `MyThirdSet` set of parameters to the task above:

```
curl -v -X PATCH -H "Content-Type: application/json" \
http://localhost:4040/api/task \
-d '{
  "ModelName": "modelOne",
  "Name": "MyTask",
  "Set": [
    "MyThirdSet"
  ]
}'
```

After that task will contain 3 input worksets:

```
http://localhost:4040/api/model/modelOne/task/MyTask/sets
```

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "MyTask",
  "Txt": [],
  "Set": [
    "MyFirstSet",
    "MySecondSet",
    "MyThirdSet"
  ],
  "TaskRun": []
}
```

Now you can run the model with that task:

```
modelOne -OpenM.SubValues 16 -OpenM.TaskName MyTask -OpenM.TaskRunName MyTask-sub16
```

and examine history of modeling task run:

```
http://localhost:4040/api/model/modelOne/task/MyTask/runs
```

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "MyTask",
  "Txt": [],
  "Set": [],
  "TaskRun": [
    {
      "Name": "MyTask-sub16",
      "SubCount": 16,
      "CreateDateTime": "2019-01-16 04:38:53.0298",
      "Status": "s",
      "UpdateDateTime": "2019-01-16 04:38:53.0461",
      "TaskRunSet": [
        {
          "Run": {
            "Name": "MyTask_sub16_MyFirstSet_2019_01_16_04_38_53_0304_111",
            "SubCompleted": 16,
            "CreateDateTime": "2019-01-16 04:38:53.0304",
            "Status": "s",
            "Digest": "1cece5a11d522b6225d7f9cb5afda39a"
          },
          "SetName": "MyFirstSet"
        },
        {
          "Run": {
            "Name": "MyTask_sub16_MySecondSet_2019_01_16_04_38_53_0357_112",
            "SubCompleted": 16,
            "CreateDateTime": "2019-01-16 04:38:53.0357",
            "Status": "s",
            "Digest": "4a55cd6614f8f7be439c0776b2a473ab"
          },
          "SetName": "MySecondSet"
        },
        {
          "Run": {
            "Name": "MyTask_sub16_MyThirdSet_2019_01_16_04_38_53_0410_113",
            "SubCompleted": 16,
            "CreateDateTime": "2019-01-16 04:38:53.0410",
            "Status": "s",
            "Digest": "d112237f501317422943880eca54d07b"
          },
          "SetName": "MyThirdSet"
        }
      ]
    }
  ]
}
```

Run model from Python: simple loop over model parameter

OpenM++ integration with Python

This example shows how Python can be used to automate modeling, using very general openM++ interfaces. These same interfaces can be used by platforms and applications other than Python with equivalent functionality.

Following Python script is running openM++ "NewCaseBased" test model with 16 subsamples using mortality hazard data:

```
mortalityData = [0.014 + i * 0.005 for i in range(20)]
```

As result Mortality Hazard increases about eight times in the range of [0.014, 0.109] and we can see eight time decrease of Duration of Life from initial 72 years down to 9 years.

How to run the script

Python example script is using openM++ web-service in order to run the model, modify parameters and read output values. OpenM++ web-service does not require any installation, just [download latest release of openM++](#), unpack it into any directory, start `oms.exe` and run the script:

Windows:

```
cd C:\my-openmpp-release  
bin\ompp_ui.bat  
py ompp-python\life_vs_mortality.py
```

Linux / MacOS:

```
cd ~/my-openmpp-release  
bin/oms  
python3 ompp-python/life_vs_mortality.py
```

As result `oms` web-service will start to listen incoming requests on `http://localhost:4040` and Python script will do all actions using [oms web-service API](#).

You may also need to install `matplotlib` to display the chart and `requests` to communicate with web-service:

```
pip install -U matplotlib  
pip install requests
```

Important:

This is an example script and error handling intentionally omitted. It is highly recommended to use `try ... except` in production code.

Important:

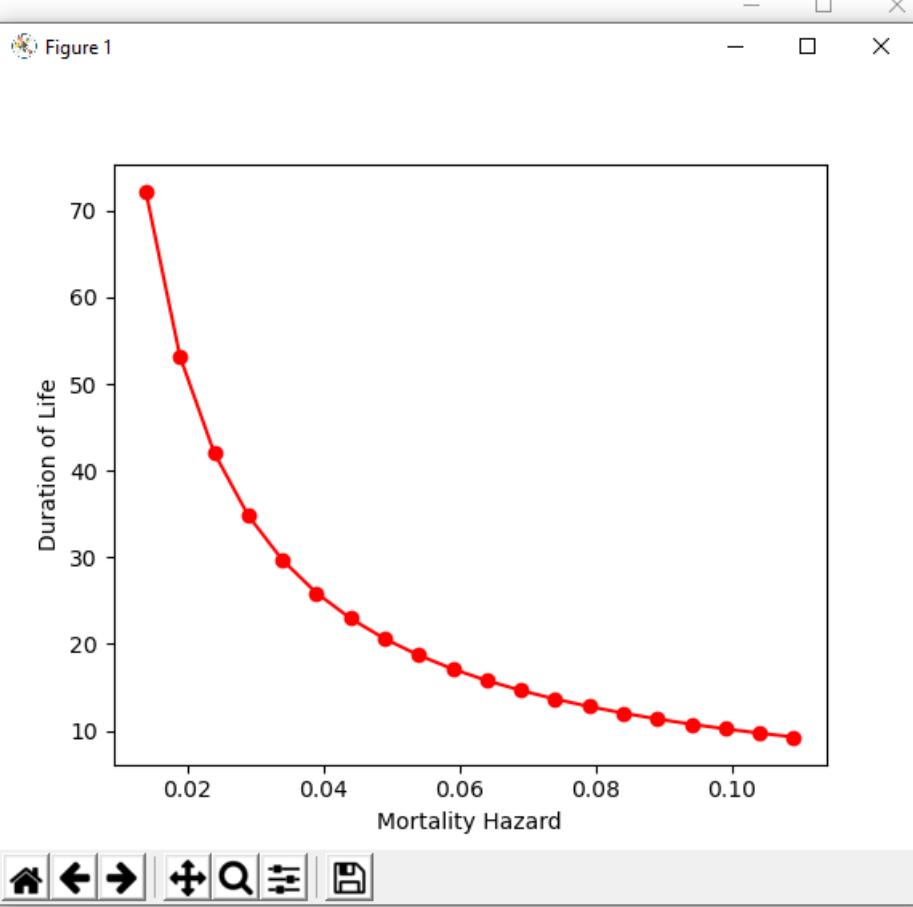
This is an example script and for simplicity it starts 20 instances of the model simultaneously. Obviously this can work only if model relatively simple. DO NOT USE this in production, please use modeling task instead.



Python 3.8.2 Shell

File Edit Shell Debug Option

```
=====
MortalityHazard: 0.014 m
MortalityHazard: 0.019 m
MortalityHazard: 0.024 m
MortalityHazard: 0.02899
MortalityHazard: 0.034 m
MortalityHazard: 0.039 m
MortalityHazard: 0.044 m
MortalityHazard: 0.049 m
MortalityHazard: 0.054 m
MortalityHazard: 0.059 m
MortalityHazard: 0.064 m
MortalityHazard: 0.069 m
MortalityHazard: 0.074 m
MortalityHazard: 0.079 m
MortalityHazard: 0.084 m
MortalityHazard: 0.089 m
MortalityHazard: 0.094 m
MortalityHazard: 0.099 m
MortalityHazard: 0.104 m
MortalityHazard: 0.109 m
Waiting for 20 model run
Waiting for 20 model run
Waiting for 18 model run
Waiting for 15 model run
Waiting for 13 model run
Waiting for 11 model run
Waiting for 8 model runs
Waiting for 5 model runs
Waiting for 3 model runs
All model runs completed
```



Ln: 5 Col: 0

```
# analyze NewCaseBased model varying mortality hazard values
#
mortalityData = [0.014 + i * 0.005 for i in range(20)]

# Use openM++ oms web-service to run NewCaseBased model 20 times
# with different values of MortalityHazard parameter.
# It is the same as command line:
#   NewCaseBased.exe -OpenM.ProgressPercent 100 -Parameter.MortalityHazard 0.014
#   NewCaseBased.exe -OpenM.ProgressPercent 100 -Parameter.MortalityHazard 0.019
#   .... and 18 more mortality hazard values ....
#
# For each request to run the model web-service respond with JSON containing RunStamp
# We can use this RunStamp to find model run status and results.
#
runStampLst = []

for m in mortalityData:
    runModelRq = {
        'modelName': 'NewCaseBased',
        'opts': {
            'Parameter.MortalityHazard': str(m),
            'OpenM.ProgressPercent': '100',
            'OpenM.SubValues': '16',
            'OpenM.Threads': '4'
        }
    }
```

Ln: 1 Col: 0

Python script

```
#
# Python integration example using NewCaseBased model:
#   Loop over MortalityHazard parameter
#   to analyze DurationOfLife output value

# Prerequisite:
#
# download openM++ release from https://github.com/openmpp/main/releases/latest
# unpack it into any directory
# start oms web-service:
#   Windows:
#     cd C:\my-openmpp-release
#     bin\ompp_ui.bat
#   Linux:
#     cd ~/my-openmpp-release
#     bin/oms
```

```

#
# Script below is using openM++ web-service "oms"
# to run the model, modify parameters and read output values.

# Important:
#   Script below starts 20 instances of the model simultaneously.
#   Obviously this can work only if model relatively simple.
#
# DO NOT USE this in production, please use modeling task instead.
#
# Also script below does not handle errors, please use try/except in production.

import time
import requests
import matplotlib.pyplot as plt

# analyze NewCaseBased model varying mortality hazard values
#
mortalityData = [0.014 + i * 0.005 for i in range(20)]

# Use openM++ oms web-service to run NewCaseBased model 20 times
# with different values of MortalityHazard parameter:
#
# NewCaseBased.exe -OpenM.ProgressPercent 100 -OpenM.SubValues 16 OpenM.Threads 4 -Parameter.MortalityHazard 0.014
# NewCaseBased.exe -OpenM.ProgressPercent 100 -OpenM.SubValues 16 OpenM.Threads 4 -Parameter.MortalityHazard 0.019
# .... and 18 more mortality hazard values ....
#
# For each request to run the model web-service respond with JSON containing RunStamp
# We can use this RunStamp to find model run status and results.
#
runStampLst = []

for m in mortalityData:
    runModelRq = {
        'modelName': 'NewCaseBased',
        'Opts': {
            'Parameter.MortalityHazard': str(m),
            'OpenM.ProgressPercent': '100',      # reduce amount of progress messages in the log file
            'OpenM.SubValues': '16',           # use 16 sub-values (sub-samples)
            'OpenM.Threads': '4'              # use 4 modeling threads
        }
    }
    #
    # submit request to web-service to run the model
    #
    rsp = requests.post('http://127.0.0.1:4040/api/run', json=runModelRq)
    rsp.raise_for_status()
    js = rsp.json()
    #
    runStamp = js['RunStamp']
    if runStamp is None or runStamp == '':
        raise Exception('Model fail to start, run stamp is empty')
    #
    runStampLst.append(runStamp)
    #
    print("MortalityHazard:", m, "model run stamp:", runStamp)

# wait until all model runs completed
#
n = len(runStampLst)
runDigestLst = ['' for i in range(n)]
done = [False for i in range(n)]

while n > 0:
    print("Waiting for", n, "model runs to be completed...")
    n = 0
    #
    for i in range(len(runStampLst)):
        if done[i]:
            continue    # run already completed
        #
        rsp = requests.get('http://127.0.0.1:4040/api/model/NewCaseBased/run/' + runStampLst[i] + '/status')
        rsp.raise_for_status()
        js = rsp.json()
        runDigestLst[i], status = js['RunDigest'], js['Status']
        #
        if runDigestLst[i] is None or runDigestLst[i] == '' or \
            status is None or status == '' or \
            status in 'i' 'p': # i = run not started yet, p = run in progress
        #
        n += 1
        continue
    #
    if status == 's':      # success
        done[i] = True
        continue
    #

```

```
raise Exception("Model run failed, run stamp:", runStampLst[i], "status:", status)
#
if n > 0:
    time.sleep(1)

# all model runs completed successfully
print("All model runs completed, retrieve output values...")

# for each run get output value
#   average duration of life: DurationOfLife.Expr3
#
lifeDurationData = []

for runDigest in runDigestLst:
    rsp = requests.get('http://127.0.0.1:4040/api/model/NewCaseBased/run/' + runDigest + '/table/DurationOfLife/expr')
    rsp.raise_for_status()
    js = rsp.json()
    lifeDurationData.append(js[3]['Value'])

# display the results
#
plt.plot(mortalityData, lifeDurationData, 'ro', ls='--')
plt.xlabel('Mortality Hazard')
plt.ylabel('Duration of Life')
plt.show()
```

Run RiskPaths model from Python: advanced parameters scaling

OpenM++ integration with Python: using RiskPaths model

This example shows how Python can be used to automate modeling, using very general openM++ interfaces. These same interfaces can be used by platforms and applications other than Python with equivalent functionality.

Following Python script is running "RiskPaths" model to analyze childlessness by varying two parameters:

- Age baseline for first union formation
- Relative risks of union status on first pregnancy by following scale factor:

```
scaleStep = 0.02
scaleValues = [0.44 + i * scaleStep for i in range(1 + round((1.00 - 0.44) / scaleStep))]
```

Please keep in mind, scaling above result in 841 runs of RiskPaths model and task may take long time to be completed. If you want to get results faster scale values by 0.08 instead of 0.02.

How to run the script

Python example script is using openM++ web-service in order to run the model, modify parameters and read output values. OpenM++ web-service does not require any installation, just [download latest release of openM++](#), unpack it into any directory, start `oms.exe` and run the script:

Windows:

```
cd C:\my-openmpp-release
bin\oms
py ompp-python\riskpaths_childlessness.py
```

Linux / MacOS:

```
cd ~/my-openmpp-release
bin/oms
python3 ompp-python/riskpaths_childlessness.py
```

As result `oms` web-service will start to listen incoming requests on `http://localhost:4040` and Python script will do all actions using [oms web-service API](#).

You may also need to install `matplotlib` to display the chart and `requests` to communicate with web-service:

```
pip install -U matplotlib
pip install requests
```

Important:

This is an example script and error handling intentionally omitted. It is highly recommended to use `try ... except` in production code.

Python 3.8.2 Shell

File Edit Shell Debug Options Window Help

```
Completed 165 model runs out of 225
Completed 166 model runs out of 225
Completed 169 model runs out of 225
Completed 171 model
Completed 173 model
Completed 175 model
Completed 177 model
Completed 179 model
Completed 181 model
Completed 183 model
Completed 184 model
Completed 187 model
Completed 189 model
Completed 191 model
Completed 193 model
Completed 194 model
Completed 197 model
Completed 199 model
Completed 201 model
Completed 203 model
Completed 204 model
Completed 206 model
Completed 209 model
Completed 210 model
Completed 212 model
Completed 213 model
Completed 215 model
Completed 218 model
Completed 219 model
Completed 222 model
Completed 224 model
Modeling task compl.
```

```
# Create new input#
#
# set number of sim
simulationCases[0]['Value'] = 1000

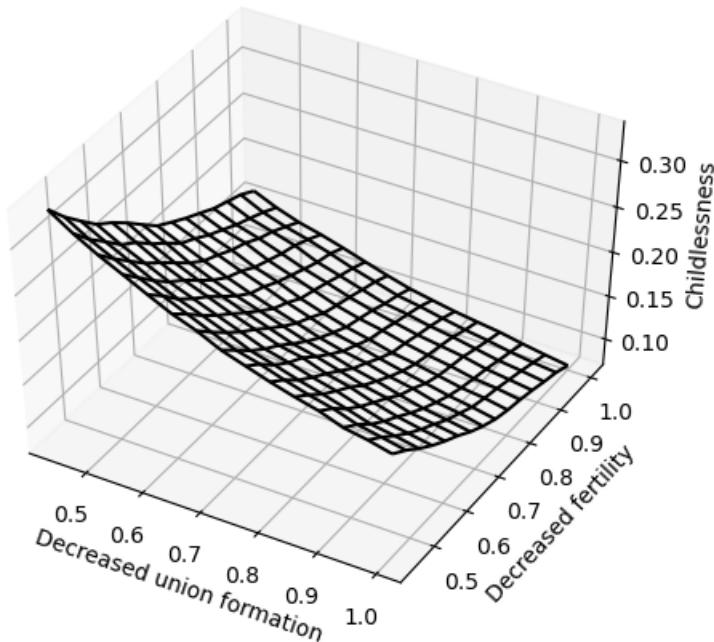
# for AgeBaselineForm1 and UnionStatusPreg1 parameter values
# apply scale in range from 0.44 to 1.0
#
scaleStep = 0.04
scaleValues = [0.44 + i * scaleStep for i in range(1 + round((1.00 - 0.44) / scaleStep))]

ageValues = [x['Value'] for x in ageFirstUnion]
unionValues = [x['Value'] for x in unionStatusPreg]

inpSetLst = []
for scaleAgeBy in scaleValues:
    #
    print("Scale age by:", scaleAgeBy)
    for i in range(len(ageFirstUnion)):
        ageFirstUnion[i]['Value'] = ageValues[i] * scaleAgeBy
```

In 67 Col 6

Figure 1



Python script

```
#
# Python integration example using RiskPaths model
#   to analyze contribution of delayed union formations
#   versus decreased fertility on childlessness
#
# Input parameters:
#   AgeBaselineForm1: age baseline for first union formation
#   UnionStatusPreg1: relative risks of union status on first pregnancy
# Output value:
#   T05_CohortFertility: Cohort fertility, expression 1
#
# Prerequisite:
#
# download openM++ release from https://github.com/openmpp/main/releases/latest
# unpack it into any directory
# start oms web-service:
#   Windows:
#     cd C:\my-openmpp-release
#     bin\ompp_ui.bat
```

```

#   Linux:
#     cd ~/my-openmpp-release
#     bin/oms
#
# Script below is using openM++ web-service "oms"
# to run the model, modify parameters and read output values.

# Important:
#   Script below does not handle errors, please use try/except in production.

import time
import requests
import numpy as np
import matplotlib.pyplot as plt

# get default values for AgeBaselineForm1, UnionStatusPreg1 and SimulationCases parameters
# by reading it from first model run results
# assuming first run of the model done with default set of parameters
#
rsp = requests.get('http://127.0.0.1:4040/api/model/RiskPaths/run/status/first')
rsp.raise_for_status()
firstRunStatus = rsp.json()
firstRunDigest = firstRunStatus['RunDigest']

rsp = requests.get('http://127.0.0.1:4040/api/model/RiskPaths/run/' + firstRunDigest + '/parameter/AgeBaselineForm1/value')
rsp.raise_for_status()
ageFirstUnion = rsp.json()

rsp = requests.get('http://127.0.0.1:4040/api/model/RiskPaths/run/' + firstRunDigest + '/parameter/UnionStatusPreg1/value')
rsp.raise_for_status()
unionStatusPreg = rsp.json()

rsp = requests.get('http://127.0.0.1:4040/api/model/RiskPaths/run/' + firstRunDigest + '/parameter/SimulationCases/value')
rsp.raise_for_status()
simulationCases = rsp.json()

# create new input data for our modelling task
#
# set number of simulation cases
simulationCases[0]['Value'] = 1000

# for AgeBaselineForm1 and UnionStatusPreg1 parameter values
# apply scale in range from 0.44 to 1.0
#
scaleStep = 0.02
scaleValues = [0.44 + i * scaleStep for i in range(1 + round((1.00 - 0.44) / scaleStep))]

ageValues = [x['Value'] for x in ageFirstUnion]
unionValues = [x['Value'] for x in unionStatusPreg]

inpSetLst = []
for scaleAgeBy in scaleValues:
    #
    print("Scale age by:", scaleAgeBy)
    for i in range(len(ageFirstUnion)):
        ageFirstUnion[i]['Value'] = ageValues[i] * scaleAgeBy

    for scaleUnionBy in scaleValues:
        #
        # scale first two values of unionStatusPreg vector
        unionStatusPreg[0]['Value'] = unionValues[0] * scaleUnionBy
        unionStatusPreg[1]['Value'] = unionValues[1] * scaleUnionBy
        #
        # create new set of input parameters
        # automatically generate unique names for each input set
        #
        inpSetRq = {
            'ModelName': 'RiskPaths',
            'Name': '',
            'BaseRunDigest': firstRunDigest,
            'IsReadonly': True,
            'Txt': [
                {
                    'LangCode': 'EN',
                    'Descr': 'Scale age: ' + str(scaleAgeBy) + ' union status: ' + str(scaleUnionBy)
                }
            ],
            'Param': [
                {
                    'Name': 'AgeBaselineForm1',
                    'SubCount': 1,
                    'Value': ageFirstUnion,
                    'Txt': [{"LangCode": "EN", "Note": "Age values scale by: " + str(scaleAgeBy)}]
                },
                {
                    'Name': 'UnionStatusPreg1',
                    'SubCount': 1,
                    'Value': unionStatusPreg,
                    'Txt': [{"LangCode": "EN", "Note": "Union Status values scale by: " + str(scaleUnionBy)}]
                }
            ]
        }
        inpSetLst.append(inpSetRq)

```

```

        }
    ],
#
# create new input set of model parameters
# automatically generate unique name for that input set
#
rsp = requests.put('http://127.0.0.1:4040/api/workset-create', json=inpSetRq)
rsp.raise_for_status()
js = rsp.json()
#
inpSetName = js['Name']
if inpSetName is None or inpSetName == '':
    raise Exception("Fail to create input set, scales:", scaleAgeBy, scaleUnionBy)
#
inpSetLst.append(inpSetName)

# create modeling task from all input sets
# automatically generate unique name for the task
#
inpLen = len(inpSetLst)
print("Create task from", inpLen, "input sets of parameters")

taskRq = {
    'ModelName': 'RiskPaths',
    'Name': '',
    'Set': inpSetLst,
    'Txt': [
        {
            'LangCode': 'EN',
            'Descr': 'Task to run RiskPaths ' + str(inpLen) + ' times',
            'Note': 'Task scales AgeBaselineForm1 and UnionStatusPregl parameters from 0.44 to 1.00 with step ' + str(scaleStep)
        }
    ]
}
rsp = requests.put('http://127.0.0.1:4040/api/task-new', json=taskRq)
rsp.raise_for_status()
js = rsp.json()

taskName = js['Name']
if taskName is None or taskName == '':
    raise Exception("Error at create modeling task")

#
# submit request to web-service to run RiskPaths with modeling task
#
runModelRq = {
    'ModelName': 'RiskPaths',
    'Opts': {
        'OpenM.TaskName': taskName,
        'OpenM.ProgressPercent': '100'
    }
}
rsp = requests.post('http://127.0.0.1:4040/api/run', json=runModelRq)
rsp.raise_for_status()
js = rsp.json()
#
taskRunStamp = js['RunStamp']
if taskRunStamp is None or taskRunStamp == '':
    raise Exception('Model failed to start, task run stamp is empty')

print("Starting modeling task:", taskName)

# wait until modeling task completed
# and report the progress
#
# task status returned by web-service can be one of:
# i=initial p=in progress s=success x=exit e=error(failed)
#
taskStatus = ''

while taskStatus in '' 'i' 'p' 'w':
    #
    time.sleep(1)
    #
    rsp = requests.get('http://127.0.0.1:4040/api/model/RiskPaths/task/' + taskName + '/run-status/run/' + taskRunStamp)
    rsp.raise_for_status()
    js = rsp.json()
    taskStatus = js['Status']
    #
    # if model not started to run the task yet check again after short sleep
    #
    if taskStatus in '' 'i':
        #
        print("Waiting for modeling task to start...")
        continue
    #
    # if task completed successfully then get pairs of {model run, input set name}
    #

```

```

```
if taskStatus == 's':
 rsp = requests.get('http://127.0.0.1:4040/api/model/RiskPaths/task/' + taskName + '/runs')
 rsp.raise_for_status()
 js = rsp.json()
 taskRuns = js['TaskRun'][0]['TaskRunSet'] # use index=0 because this is first run of our task
 break
#
if task still in progress then count completed model runs
#
if taskStatus in 'i' 'p' 'w':
 rsp = requests.get('http://127.0.0.1:4040/api/model/RiskPaths/run/' + taskRunStamp + '/status/list')
 rsp.raise_for_status()
 trs = rsp.json()
 #
 n = 0
 for r in trs:
 if r['Status'] == 's': n += 1
 #
 print("Completed", n, "model runs out of", inplLen)
 continue
#
any other task run status considered as failure
#
raise Exception("Model run failed, task run stamp:", taskRunStamp, "status:", taskStatus)
#
print("Modeling task completed, retrieving results...")

for each age and union status retrieve output:
childlessness value: T05_CohortFertility.Expr1
#
organize results into 2-dimensional array to plot 3d chart
#
childlessnessVals = np.zeros((len(scaleValues), len(scaleValues)))
runIdx = 0

for ageIdx in range(len(scaleValues)):
 for unionIdx in range(len(scaleValues)):
 #
 runDigest = taskRuns[runIdx]['Run']['RunDigest']
 #
 rsp = requests.get('http://127.0.0.1:4040/api/model/RiskPaths/run/' + runDigest + '/table/T05_CohortFertility/expr')
 rsp.raise_for_status()
 js = rsp.json()
 #
 childlessnessVals[ageIdx][unionIdx] = js[1]['Value']
 runIdx += 1

display the results
#
ageVals, unionVals = np.meshgrid(scaleValues, scaleValues)

fig = plt.figure()
ax = plt.axes(projection='3d')
ax.plot_wireframe(ageVals, unionVals, childlessnessVals, color='black')
ax.set_xlabel('Decreased union formation')
ax.set_ylabel('Decreased fertility')
ax.set_zlabel('Childlessness')
ax.view_init(elev=45)
plt.show()
```

```

Run model from R: simple loop over model parameter

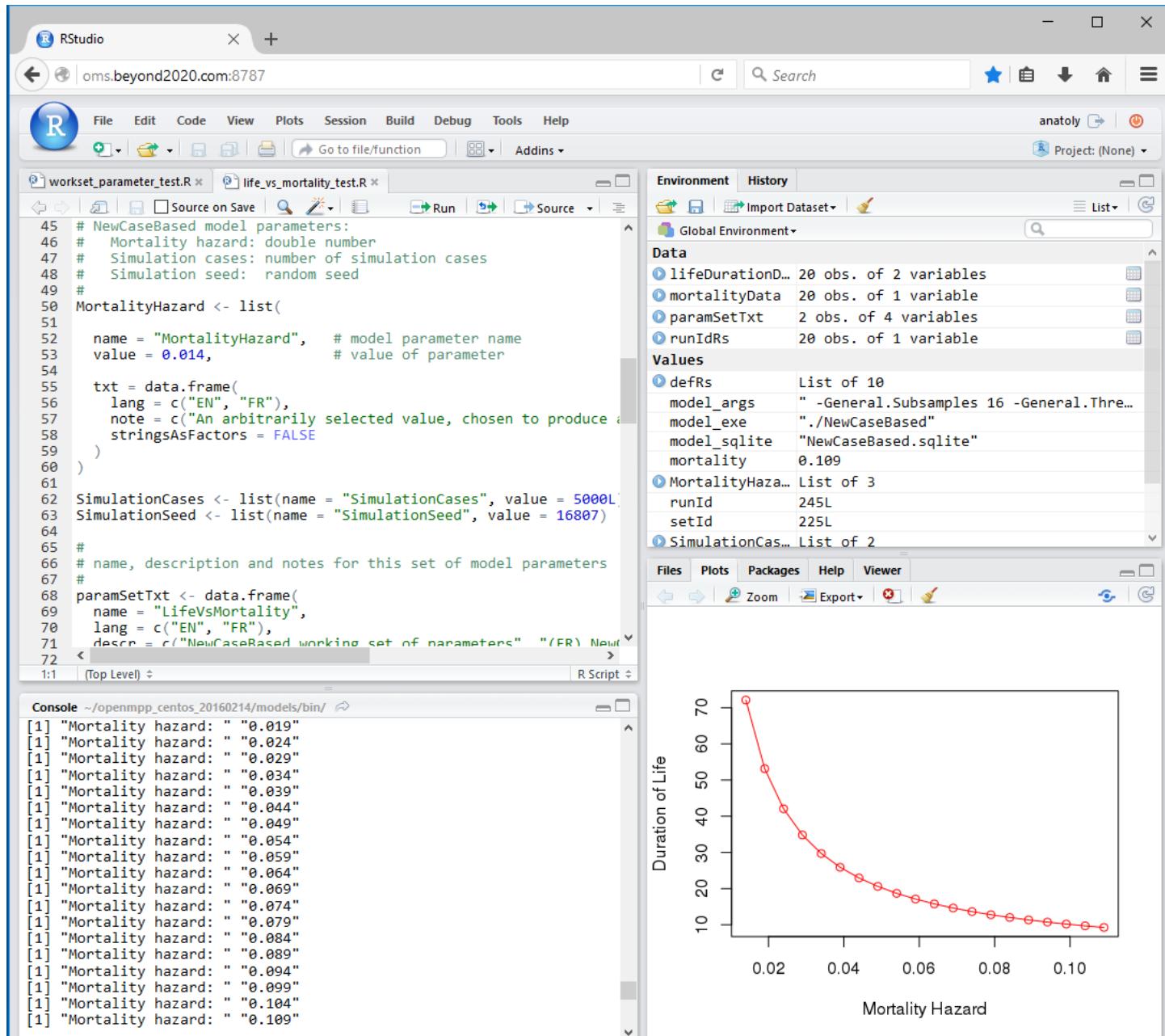
OpenM++ integration with R

It is a convenient to use [GNU R](#) to prepare model parameters and analyze output values. OpenM++ provides R package [openMpp](#) to simplify access to openM++ database for R developers.

Following R example is running openM++ "NewCaseBased" test model with 16 subsamples using mortality hazard data:

```
mortalityData <- data.frame(  
  value = seq(from = 0.014, by = 0.005, length.out = 20)  
)
```

As result Mortality Hazard increases about eight times in the range of [0.014, 0.109] and we can see eight time decrease of Duration of Life from initial 72 years down to 9 years.



R script

```
# use openMpp Library for openM++ database access  
library("openMpp")  
library("RSQLite")  
  
#  
# R integration example using NewCaseBased model  
# Loop over MortalityHazard parameter  
# to analyze DurationOfLife
```

```

" to analyze our outcome(s) "
#



#####
# To run this example please uncomment and/or change values below
# to match your hardware and file system environment:
#
# model_exe    <- path to the model executable, i.e.: "./NewCaseBased" or "NewCaseBased.exe"
# model_sqlite <- path to the model.sqlite database: "NewCaseBased.sqlite"
# model_args   <- optional arguments to control model run, for example:
#           -OpenM.SubValues 16 <- number of simulation members
#           -OpenM.Threads 4    <- number of computational threads
#
### For running on a local machine using the working directory in R
#
# For the following values to work, you must first set the R Working directory
# to the directory containing the NewCaseBased executable and the SQLite database.
# In RStudio Session > Set Working Directory > Choose Directory,
# then navigate to location, e.g.: /ompp_root/models/NewCaseBased/ompp/bin
#
model_exe = "./NewCaseBased"
model_sqlite = "NewCaseBased.sqlite"
model_args = " -OpenM.SubValues 16 -OpenM.Threads 4"
# model_args = " " # default: 1 simulation member and 1 thread
#
### For running on a local machine using explicit paths
#
# model_exe = "/path/to/executable/model/NewCaseBased"
# model_sqlite = "/path/to/SQLite/database/NewCaseBased.sqlite"
#
### For running on cluster (change to match your cluster)
#
# model_exe = "mpiexec"
# model_sqlite = "/mirror/NewCaseBased.sqlite"
# model_args = "-n 8 /mirror/NewCaseBased -OpenM.SubValues 16 -OpenM.Threads 2"
#####

#
# NewCaseBased model parameters:
# Mortality hazard: double number
# Simulation cases: number of simulation cases
# Simulation seed: random seed
#
MortalityHazard <- list(
  name = "MortalityHazard",      # model parameter name
  value = 0.014,                # value of parameter

  txt = data.frame(
    lang = c("EN", "FR"),
    note = c("An arbitrarily selected value, chosen to produce a life expectancy of about 70 years", NA),
    stringsAsFactors = FALSE
  )
)

SimulationCases <- list(name = "SimulationCases", value = 5000L)
SimulationSeed <- list(name = "SimulationSeed", value = 16807)

#
# name, description and notes for this set of model parameters
#
inputSet <- data.frame(
  name = "LifeVsMortality",
  lang = c("EN", "FR"),
  descr = c("NewCaseBased working set of parameters", "(FR) NewCaseBased working set of parameters"),
  note = c(NA, NA),
  stringsAsFactors = FALSE
)

#
# connect to database and find NewCaseBased model
#
theDb <- dbConnect(RSQLite::SQLite(), model_sqlite, synchronous = "full")
invisible(dbGetQuery(theDb, "PRAGMA busy_timeout = 86400")) # recommended

defRs <- getModel(theDb, "NewCaseBased")      # find NewCaseBased model in database

# create new working set of model parameters based on existing model run results
#
firstRunId <- getFirstRunId(theDb, defRs)

setId <- createWorksetBasedOnRun(
  theDb, defRs, firstRunId, inputSet,
  MortalityHazard, SimulationCases, SimulationSeed
)
if (setId <= 0L) stop("workset creation failed")

setReadonlyWorkset(theDb, defRs, TRUE, setId) # workset must be read-only to run the model

```

```

#
# analyze NewCaseBased model varying mortality hazard values
#
mortalityData <- data.frame(
  value = seq(from = 0.014, by = 0.005, length.out = 20)
)

for (mortality in mortalityData$value)
{
  print(c("Mortality hazard: ", mortality))

  system2(
    model_exe,
    paste(
      model_args,
      " -Parameter.MortalityHazard ", mortality,
      " -OpenM.SetId ", setId,
      " -OpenM.LogToConsole false",
      " -OpenM.LogToFile true",
      sep = ""
    )
  )
}

#
# read final results from database
#   average duration of life: DurationOfLife.meas3
#
runIdRs <- getWorksetRunIds(theDb, setId)  # get result id's

lifeDurationData <- NULL
for (runId in runIdRs$run_id)
{
  lifeDurationData <- rbind(
    lifeDurationData,
    selectRunOutputValue(theDb, defRs, runId, "DurationOfLife", "meas3")
  )
}

dbDisconnect(theDb)  # close database connection

#
# display the results
#
plot(
  mortalityData$value,
  lifeDurationData$expr_value,
  type = "o",
  xlab = "Mortality Hazard",
  ylab = "Duration of Life",
  col = "red"
)

```

Run RiskPaths model from R: advanced parameters scaling

OpenM++ integration with R: using RiskPaths model

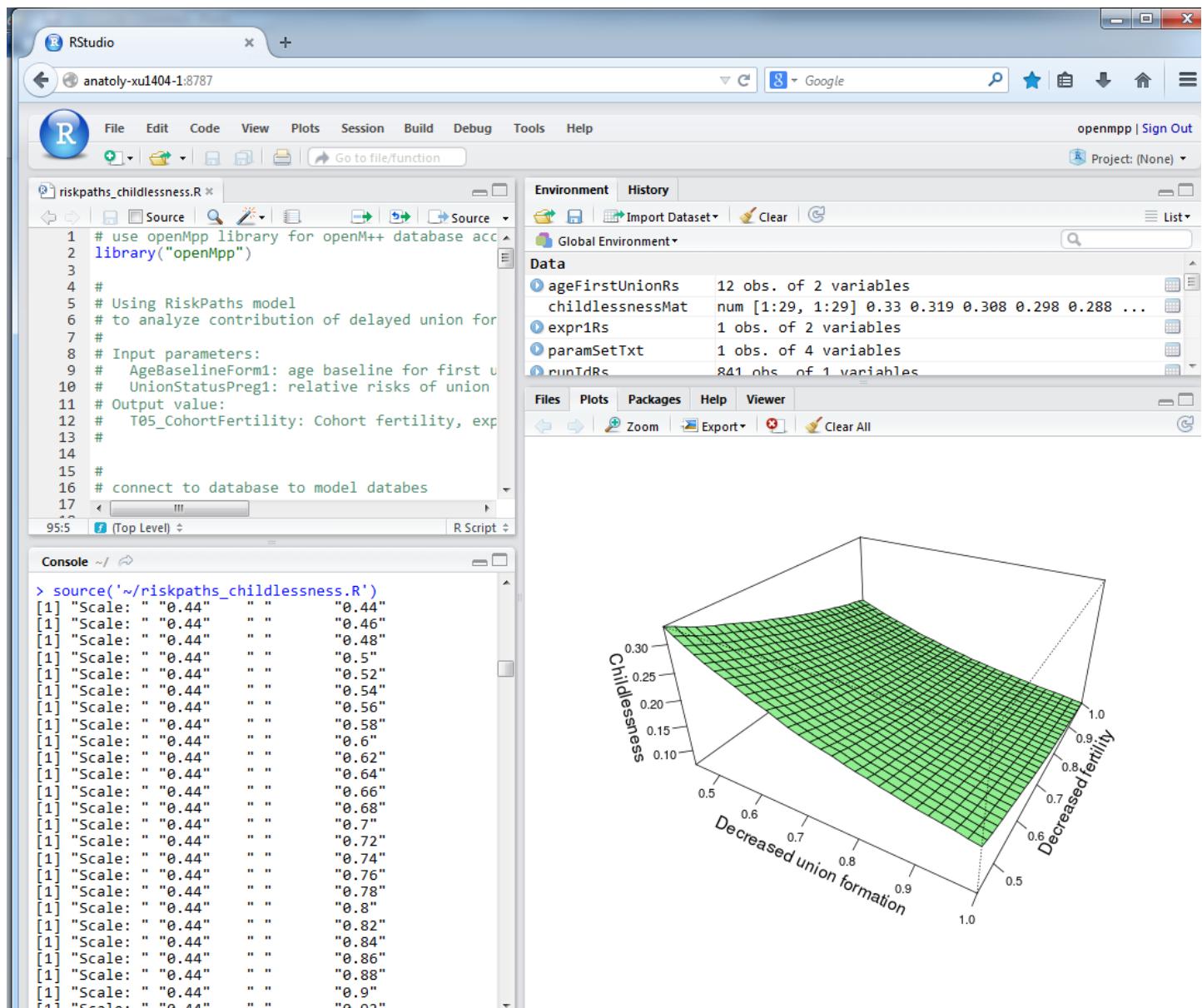
It is a convenient to use [GNU R](#) to prepare model parameters and analyze output values. OpenM++ provides R package [openMpp](#) to simplify access to openM++ database for R developers.

Following R example is running "RiskPaths" model to analyze childlessness by varying two parameters:

- Age baseline for first union formation
- Relative risks of union status on first pregnancy by following scale factor:

```
scaleValues <- seq(from = 0.44, to = 1.00, by = 0.02)
```

Please keep in mind, scaling above result in 841 runs of RiskPaths model and task may take long time to be completed. If you want to get results faster scale values by 0.08 instead of 0.02.



R script

```
# use openMpp Library for openM++ database access
library("openMpp")
library("RSQLite")

#
# Using RiskPaths model
# to analyze contribution of delayed union formations
# versus decreased fertility on childlessness
#
# Input parameters:
```

```

# AgeBaselineForm1: age baseline for first union formation
# UnionStatusPreg1: relative risks of union status on first pregnancy
# Output value:
#   T05_CohortFertility: Cohort fertility, expression 1
#
#####
# To run this example please uncomment and/or change values below
# to match your hardware and file system environment:
#
# model_exe    <- path to the model executable, i.e.: "./RiskPaths" or "RiskPaths.exe"
# model_sqlite <- path to the model.sqlite database: "RiskPaths.sqlite"
# model_args   <- optional arguments to control model run, for example:
#   -OpenM.SubValues 8 <- number of simulation members
#   -OpenM.Threads 4   <- number of computational threads
#
### For running on a Local machine using the working directory in R
#
# For the following values to work, you must first set the R Working directory
# to the directory containing the RiskPaths executable and the SQLite database.
# In RStudio Session > Set Working Directory > Choose Directory,
# then navigate to location, e.g.: /ompp_root/models/RiskPaths/ompp/bin
#
model_exe = "./RiskPaths"
model_sqlite = "RiskPaths.sqlite"
model_args = " " # default: 1 simulation member and 1 thread
# model_args = " -OpenM.SubValues 8 -OpenM.Threads 4"
#
### For running on a Local machine using explicit paths
#
# model_exe = "/path/to/executable/model/RiskPaths"
# model_sqlite = "/path/to/SQLite/database/RiskPaths.sqlite"
#
### For running on cluster (change to match your cluster)
#
# model_exe = "mpiexec"
# model_sqlite = "/mirror/RiskPaths.sqlite"
# model_args = "-n 8 /mirror/RiskPaths -OpenM.SubValues 16 -OpenM.Threads 2"
#####

#
# connect to database to model databases
#
theDb <- dbConnect(RSQLite::SQLite(), model_sqlite, synchronous = "full")
invisible(dbGetQuery(theDb, "PRAGMA busy_timeout = 86400")) # recommended

defRs <- getModel(theDb, "RiskPaths")      # find RiskPaths model in database

#
# create a copy of default model parameters
#
baseRunId <- getFirstRunId(theDb, defRs)
if (baseRunId <= 0)
  stop("no run results found for the model ", i_defRs$modelDic$model_name, " ", defRs$modelDic$model_digest)

#
# get default values for AgeBaselineForm1 and UnionStatusPreg1 parameters
# by reading it from first model run results
# assuming first run of the model done with default set of parameters
#
ageFirstUnionRs <- selectRunParameter(theDb, defRs, baseRunId, "AgeBaselineForm1")
unionStatusPregRs <- selectRunParameter(theDb, defRs, baseRunId, "UnionStatusPreg1")

#
# create modeling task with
# all input parameters same as model default except of
# AgeBaselineForm1, UnionStatusPreg1 and SimulationCases parameters
#
casesParam <- list(name = "SimulationCases", value = 1000L) # number of simulation cases

taskTxt <- data.frame(      # name (auto generated), description and notes for the task
  name = NA,
  lang = "EN",
  descr = "Analyzing childlessness",
  note = NA,
  stringsAsFactors = FALSE
)

taskId <- createTask(theDb, defRs, taskTxt)
if (taskId <= 0L) stop("task creation failed: ", defRs$modelDic$model_name, " ", defRs$modelDic$model_digest)

# parameters scale
scaleValues <- seq(from = 0.44, to = 1.00, by = 0.02)

for (scAgeBy in scaleValues)
{
  print(c("Scale age: ", scAgeBy))
}

```

```

for (scUnionBy in scaleValues)
{
  ageParam <- list(name = "AgeBaselineForm1", value = ageFirstUnionRs$param_value * scAgeBy)

  unionParam <- list(      # scale first two values of parameter vector
    name = "UnionStatusPreg1",
    value =
    sapply(
      1:length(unionStatusPregRs$param_value),
      function(k, sc, vec) ifelse(k <= 2, vec[k] * sc, vec[k]),
      sc = scUnionBy,
      vec = unionStatusPregRs$param_value
    )
  )

  # append new working set of parameters into the task
  setId <- createWorksetBasedOnRun(theDb, defRs, baseRunId, NA, ageParam, unionParam, casesParam)
  setReadonlyWorkset(theDb, defRs, TRUE, setId)

  taskId <- updateTask(theDb, defRs, taskId, setIds = setId)
}

# run the model on cluster or Local desktop
# consult your cluster admin on how to use computational grid
print(paste("Run the model:", model_exe, "...please wait..."))

system2(
  model_exe,
  paste(
    model_args,
    " -OpenM.TaskId ", taskId,
    " -OpenM.LogToConsole false",
    " -OpenM.LogToFile true",
    sep = ""
  )
)

# read results of task run from database
# cohort fertility: T05_CohortFertility.meas1
#
taskRunId <- getTaskLastRunId(theDb, taskId) # most recent task run id
taskRunRs <- selectTaskRun(theDb, taskRunId) # get result id's

scaleLen <- length(scaleValues)
childlessnessMat <- matrix(data = NA, nrow = scaleLen, ncol = scaleLen, byrow = TRUE)

runPos <- 1
for (k in 1:scaleLen)
{
  for (j in 1:scaleLen)
  {
    # cohort fertility: T05_CohortFertility.meas1
    expr1Rs <- selectRunOutputValue(theDb, defRs, taskRunRs$taskRunSet$run_id[runPos], "T05_CohortFertility", "meas1")
    childlessnessMat[k, j] = expr1Rs$expr_value
    runPos <- runPos + 1
  }
}

dbDisconnect(theDb) # close database connection

#
# display the results
#
persp(
  x = scaleValues,
  y = scaleValues,
  z = childlessnessMat,
  xlab = "Decreased union formation",
  ylab = "Decreased fertility",
  zlab = "Childlessness",
  theta = 30, phi = 30, expand = 0.5, ticktype = "detailed",
  col = "lightgreen",
  cex.axis = 0.7
)

```

Windows: Use Docker to get latest version of OpenM++

Why Docker?

There are multiple cases when you want to use Docker containers for openM++ development:

- build your models with latest version of openM++
- build cluster-ready (and cloud-ready) version of your model without installing MPI on your host computer
- do test run of your model in cluster environment without installing and configuring MPI cluster on multiple machines
- build latest version of openM++ from source code without installing and configuring all necessary development tools

All above build and run tasks can be done without Docker and our wiki describes all steps necessary to achieve this. However in that case you will spend a few hours or even days with installing and configuring development and cluster environment. Use of Docker allow to skip unnecessary steps and focus on model development. Also because containers are isolated from host environment there is nothing (except of Docker itself) get installed on your host system and you keep it clean, no software versions conflicts.

In order to use containers Docker for Windows must be installed. It can be done on your host system or on virtual machine. There are short notes about Docker installation at the bottom of that page.

Where to find openM++ Docker images

You can download openM++ images from Docker Hub:

- to run openM++ models pull: `docker pull openmpp/openmpp-run:windows-20H2`
 - Docker Hub description: [openmpp/openmpp-run:windows-20H2](#)
 - GitHub: [source code and Dockerfile](#)
- to build latest version of openM++ and re-build your models: `docker pull openmpp/openmpp-build:windows-20H2`
 - Docker Hub description: [openmpp/openmpp-build:windows-20H2](#)
 - GitHub: [source code and Dockerfile](#)

How to use `openmpp/openmpp-run:windows-20H2` to run your models

To run openM++ model do:

```
docker run .... openmpp/openmpp-run:windows-20H2 MyModel.exe
```

For example, if your models are in `C:\my\models\bin` directory then:

```
docker run -v C:\my\models\bin:C:\ompp openmpp/openmpp-run:windows-20H2 MyModel.exe
docker run -v C:\my\models\bin:C:\ompp openmpp/openmpp-run:windows-20H2 mpixexec -n 2 MyModel_mpi.exe -OpenM.SubValues 16
docker run -v C:\my\models\bin:C:\ompp -e OM_ROOT=C:\ompp openmpp/openmpp-run:windows-20H2 MyModel.exe
```

also you can use `-e OM_ROOT=C:\ompp` to set environment variable for your model, if necessary.

To start command prompt do:

```
docker run -v C:\my\models\bin:C:\ompp -it openmpp/openmpp-run:windows-20H2
```

How to use `openmpp/openmpp-build:windows-20H2` to build openM++ and models

To build latest version of openM++ from source code and rebuild your models do:

```
docker run .... openmpp/openmpp-build:windows-20H2 build-all
```

For example, if your build in `C:\my\build` directory then:

```
docker run -v C:\my\build:C:\build openmpp/openmpp-build:windows-20H2 build-all  
docker run -v C:\my\build:C:\build -e OM_BUILD_PLATFORMS=x64 openmpp/openmpp-build:windows-20H2 build-all  
docker run -v C:\my\build:C:\build -e MODEL_DIRS=RiskPaths openmpp/openmpp-build:windows-20H2 build-all
```

Following environment variables used to control openM++ build:

```
set OM_BUILD_CONFIGS=Release,Debug (default: Release)  
set OM_BUILD_PLATFORMS=Win32,x64 (default: Win32)  
set OM_MSG_USE=MPI (default: EMPTY)  
set MODEL_DIRS=modelOne,NewCaseBased,NewTimeBased,NewCaseBased_bilingual,NewTimeBased_bilingual,IDMM,OzProj,OzProjGen,RiskPaths
```

To build only openM++ libraries and omc compiler do:

```
docker run .... openmpp/openmpp-build:windows-20H2 build-openm
```

Environment variables to control `build-openm: OM_BUILD_CONFIGS, OM_BUILD_PLATFORMS, OM_MSG_USE`

To build models do:

```
docker run .... openmpp/openmpp-build:windows-20H2 build-models
```

Environment variables to control `build-models: OM_BUILD_CONFIGS, OM_BUILD_PLATFORMS, OM_MSG_USE, MODEL_DIRS`

For example, if want to build your own model `MyModel` copy model code into `C:\my\build\models\MyModel` directory and do:

```
docker run -v C:\my\build:C:\build -e MODEL_DIRS=MyModel openmpp/openmpp-build:windows-20H2 build-models  
docker run -v C:\my\build:C:\build -e MODEL_DIRS=MyModel -e OM_BUILD_PLATFORMS=x64 openmpp/openmpp-build:windows-20H2 build-models
```

To build openM++ tools do any of:

```
docker run .... openmpp/openmpp-build:windows-20H2 build-go # Go oms web-service and dbcopy utility  
docker run .... openmpp/openmpp-build:windows-20H2 build-r # openMpp R package  
docker run .... openmpp/openmpp-build:windows-20H2 build-perl # Perl utilities  
docker run .... openmpp/openmpp-build:windows-20H2 build-ui # openM++ UI
```

To create `openmpp_win_YYYYMMDD.zip` deployment archive:

```
docker run .... openmpp/openmpp-build:windows-20H2 build-zip
```

Environment variables to control `build-zip: OM_MSG_USE, MODEL_DIRS`

To customize build you can change any of build scripts inside of \$HOME/build directory:

```
C:\my\build\build-all.bat # rebuild entire openM++ and create openmpp_centos_YYYYMMDD.tar.gz archive  
C:\my\build\build-openm.bat # rebuild entire openM++ runtime libraries and compiler  
C:\my\build\build-models.bat # rebuild openM++ models specified by MODEL_DIRS  
C:\my\build\build-go.bat # rebuild Go oms web-service and dbcopy utility  
C:\my\build\build-r.bat # rebuild openMpp R package  
C:\my\build\build-ui.bat # rebuild openM++ UI  
C:\my\build\build-zip.bat # create openmpp_centos_YYYYMMDD.zip archive
```

To open cmd command prompt or Perl command prompt:

```
docker run -v C:\my\build:C:\build -it openmpp/openmpp-build:windows-20H2 cmd  
docker run -v C:\my\build:C:\build -it openmpp/openmpp-build:windows-20H2 C:\perl\portableshell
```

Docker for Windows installation

Please follow official [Microsoft documentation](#) and [Docker documentation](#) to download and install Docker for Windows. There are few notes below, which you may find useful.

Final result should be "Docker is running":

 Settings

X

- General
- Proxies
- Daemon
- Reset



General

Adjust how Docker Desktop behaves according to your preferences.

Start Docker Desktop when you log in

Automatically check for updates

Send usage statistics

Help us improve Docker Desktop by sending anonymous app lifecycle information (e.g., starts, stops, resets), Windows version and language setting.

Note: When running, Docker Desktop will always send its version.

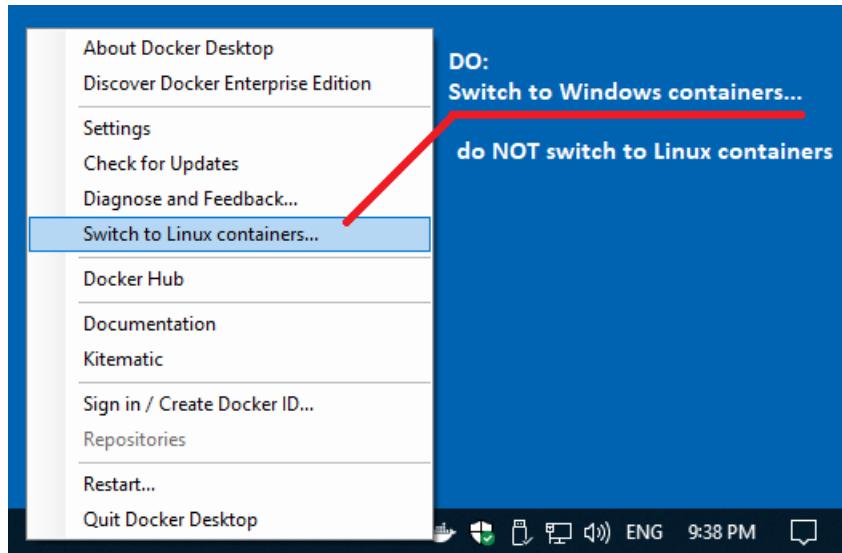
Expose daemon on tcp://localhost:2375 without TLS

Exposing daemon on TCP without TLS helps legacy clients connect to the daemon. It also makes yourself vulnerable to remote code execution attacks. Use with caution.

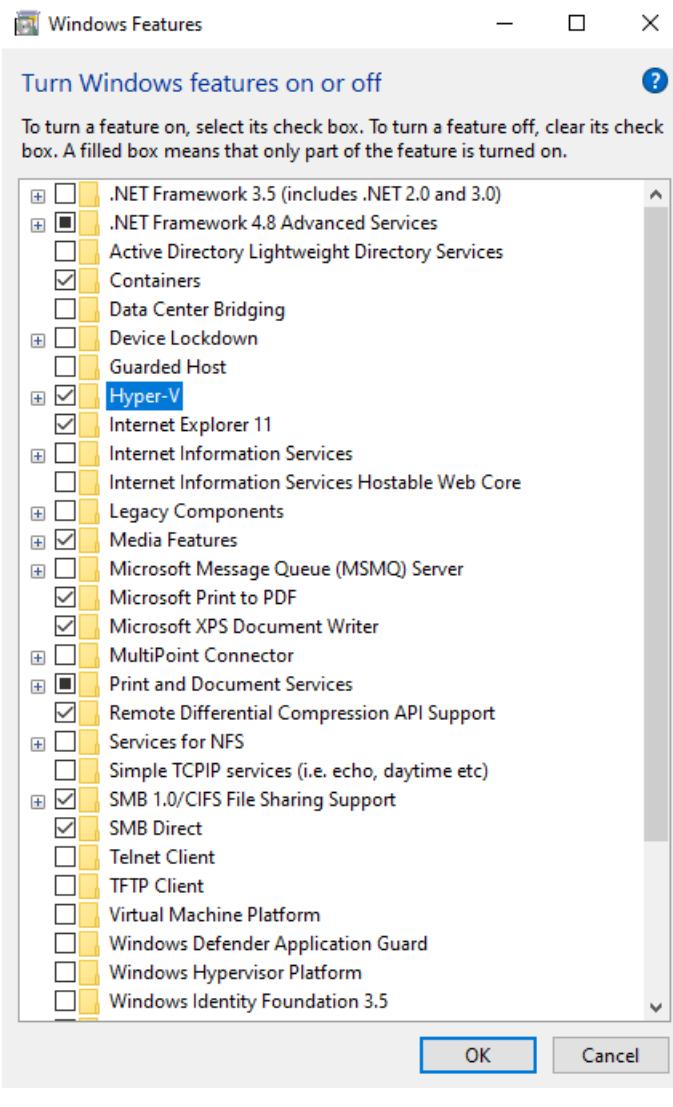
 Docker is running
 Kubernetes is stopped

You are running a stable version. You can switch to [another version](#).

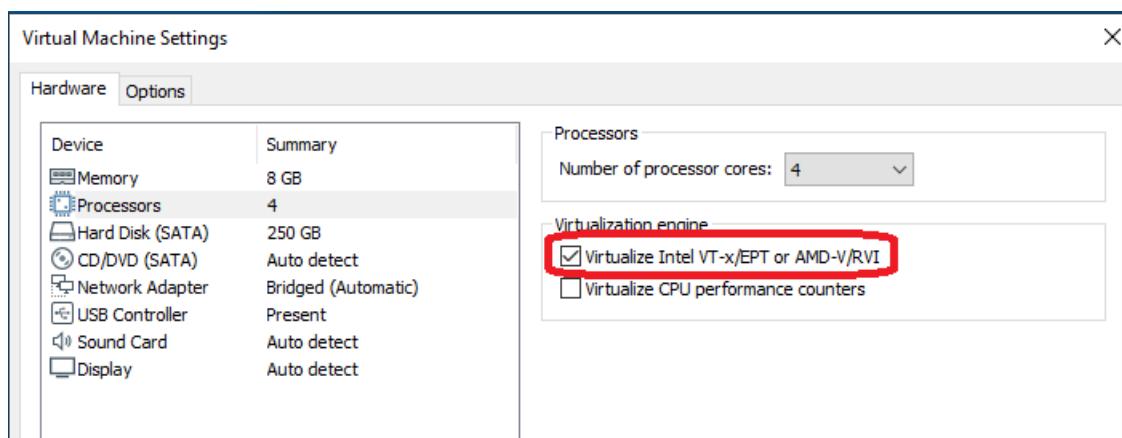
You should do "Switch to Windows containers":



Docker installation require Hyper-V Windows feature "On":



If you installing Docker inside of VMware virtual machine then it may be necessary to turn on "Virtualize Intel VT-x/EPT or AMD-V/RVI" settings. You can turn it off after setup completed:



Linux: Use Docker to get latest version of OpenM++

Why Docker?

There are multiple cases when you want to use Docker containers for openM++ development:

- build your models with latest version of openM++
- build cluster-ready (and cloud-ready) version of your model without installing MPI on your host computer
- do test run of your model in cluster environment without installing and configuring MPI cluster on multiple machines
- build latest version of openM++ from source code without installing and configuring all necessary development tools

All above build and run tasks can be done without Docker and our wiki describes all steps necessary to achieve this. However in that case you will spend a few hours or even days with installing and configuring development and cluster environment. Use of Docker allow to skip unnecessary steps and focus on model development. Also because containers are isolated from host environment there is nothing (except of Docker itself) get installed on your host system and you keep it clean, no software versions conflicts.

To install Docker on Ubuntu do: `sudo apt-get install docker`, for Debian and MX Linux: `su -c "apt-get install docker"`. For most recent RedHat 8 / CentOS 8 please follow [CentOS 8: How to use Docker](#) instructions.

Where to find openM++ Docker images

You can download openM++ images from Docker Hub:

- to run openM++ models pull: `docker pull openmpp/openmpp-run:debian`
 - Docker Hub description: [openmpp/openmpp-run:debian](#)
 - GitHub: [source code and Dockerfile](#)
- to build latest version of openM++ and re-build your models: `docker pull openmpp/openmpp-build:debian`
 - Docker Hub description: [openmpp/openmpp-build:debian](#)
 - GitHub: [source code and Dockerfile](#)

User name, user ID, group ID, home directory

Both containers `openmpp/openmpp-run:debian` and `openmpp/openmpp-build:debian` created with for user and group `ompp, UID=1999, GID=1999, HOME=/home/ompp`. To avoid permissions issues you may need to do one of:

- create user `ompp, UID=1999`, group `ompp, UID=1999` and login as that user
- or use `OMPP_*` environment variables as in examples below to map your current login to container

For example, let assume you logged into your system as `user:group = Me:MyGroup UID:GID = 1234:1234` and want to run model in your home directory: `$HOME/models/bin/MyModel`.

Simple attempt to run the model:

```
docker run openmpp/openmpp-run:debian models/bin/MyModel
```

will fail with error similar to: `"models/bin/MyModel: No such file or directory"` because container don't have an access to the files on your host system.

Let's bind your directory `$HOME/models/bin/MyModel` to the container default `/home/ompp`

```
docker run \
-v $HOME/models/bin:/home/ompp \
openmpp/openmpp-run:debian \
./MyModel
```

That will fail with error `"Permission denied"` because container default login `user:group = ompp:ompp UID:GID = 1999:1999` don't have an access to your files `user:group = Me:MyGroup UID:GID = 1234:1234`.

You can create such login on your host system `user:group = ompp:ompp UID:GID = 1999:1999` and use it to run the models

Or you can tell container to use your current `user:group = Me:MyGroup UID:GID = 1234:1234` instead of default values:

```
docker run \
-v $HOME/models/bin:/home/models \
-e OMPP_USER=models -e OMPP_GROUP=models -e OMPP_UID=$UID -e OMPP_GID=`id -g` \
openmpp/openmpp-run:debian \
./MyModel
```

How to use `openmpp/openmpp-run:debian` to run your models

To run openM++ model do:

```
docker run .... openmpp/openmpp-run:debian ./MyModel
```

For example, if your models are in `$HOME/models/bin` directory then:

```
docker run \
-v $HOME/models/bin:/home/models \
-e OMPP_USER=models -e OMPP_GROUP=models -e OMPP_UID=$UID -e OMPP_GID=`id -g` \
openmpp/openmpp-run:debian \
./MyModel

docker run \
-v $HOME/models/bin:/home/models \
-e OMPP_USER=models -e OMPP_GROUP=models -e OMPP_UID=$UID -e OMPP_GID=`id -g` \
openmpp/openmpp-run:debian \
mpiexec -n 2 MyModel_mpi -OpenM.SubValues 16
```

also you can use `-e OM_ROOT=/home/ompp` to set environment variable for your model, if necessary.

To start shell inside of container do:

```
docker run \
-v $HOME:/home/${USER} \
-e OMPP_USER=${USER} -e OMPP_GROUP=`id -gn` -e OMPP_UID=$UID -e OMPP_GID=`id -g` \
-it openmpp/openmpp-run:debian
bash
```

Following environment variables are used to map container user to your login:

```
OMPP_USER=ompp    # default: ompp, container user name and HOME
OMPP_GROUP=ompp   # default: ompp, container group name
OMPP_UID=1999     # default: 1999, container user ID
OMPP_GID=1999     # default: 1999, container group ID
```

How to use `openmpp/openmpp-build:debian` to build openM++ and models

To build latest version of openM++ from source code and rebuild your models do:

```
docker run ....options.... openmpp/openmpp-build:debian ./build-all
```

For example, if your build in `$HOME/build` directory then:

```

docker run \
-v $HOME/build:/home/build \
-e OMPP_USER=build -e OMPP_GROUP=build -e OMPP_UID=$UID -e OMPP_GID=`id -g` \
openmpp/openmpp-build:debian \
./build-all

docker run \
-v $HOME/build_mpi:/home/build_mpi \
-e OMPP_USER=build_mpi -e OMPP_GROUP=build_mpi -e OMPP_UID=$UID -e OMPP_GID=`id -g` \
-e OM_MSG_USE=MPI \
openmpp/openmpp-build:debian \
./build-all

docker run ....user, group, home.... -e MODEL_DIRS=RiskPaths,IDMM      openmpp/openmpp-build:debian ./build-all
docker run ....user, group, home.... -e OM_BUILD_CONFIGS=RELEASE,DEBUG openmpp/openmpp-build:debian ./build-all
docker run ....user, group, home.... -e OM_MSG_USE=MPI           openmpp/openmpp-build:debian ./build-all

```

Following environment variables used to control openM++ build:

```

OM_BUILD_CONFIGS=RELEASE,DEBUG # default: RELEASE,DEBUG for Libraries and RELEASE for models
OM_MSG_USE=MPI                # default: EMPTY
MODEL_DIRS=modelOne,NewCaseBased,NewTimeBased,NewCaseBased_bilingual,NewTimeBased_bilingual,IDMM,OzProj,OzProjGen,RiskPaths

```

Following environment variables are used to map container user to your login:

```

OMPP_USER=ompp   # default: ompp, container user name and HOME
OMPP_GROUP=ompp # default: ompp, container group name
OMPP_UID=1999    # default: 1999, container user ID
OMPP_GID=1999    # default: 1999, container group ID

```

To build only openM++ libraries and omc compiler do:

```

docker run ....options.... openmpp/openmpp-build:debian ./build-openm

```

Environment variables to control `build-openm: OM_BUILD_CONFIGS, OM_MSG_USE`

To build only models do:

```

docker run ....options.... openmpp/openmpp-build:debian ./build-models

```

Environment variables to control `build-models: OM_BUILD_CONFIGS, OM_MSG_USE, MODEL_DIRS`

For example, if want to build your own model `MyModel` copy model code into `$HOME/build/models/MyModel` directory and do:

```

docker run ....user, group, home.... -e MODEL_DIRS=MyModel openmpp/openmpp-build:debian ./build-models
docker run ....user, group, home.... -e MODEL_DIRS=MyModel -e OM_BUILD_CONFIGS=RELEASE,DEBUG openmpp/openmpp-build:debian ./build-models

```

To build openM++ tools do any of:

```

docker run .... openmpp/openmpp-build:debian ./build-go   # Go oms web-service and dbcopy utility
docker run .... openmpp/openmpp-build:debian ./build-r   # openMpp R package
docker run .... openmpp/openmpp-build:debian ./build-ui  # openM++ UI

```

To create `openmpp_centos_YYYYMMDD.tar.gz` deployment archive:

```

docker run .... openmpp/openmpp-build:debian ./build-tar-gz

```

Environment variables to control `build-tar-gz: OM_MSG_USE, MODEL_DIRS`

To customize build you can change any of build scripts inside of `$HOME/build` directory:

```
$HOME/build/build-all      # rebuild entire openM++ and create openmpp_centos_YYYYMMDD.tar.gz archive  
$HOME/build/build-openm   # rebuild entire openM++ runtime libraries and compiler  
$HOME/build/build-models  # rebuild openM++ models specified by MODEL_DIRS  
$HOME/build/build-go      # rebuild Go oms web-service and dbcopy utility  
$HOME/build/build-r       # rebuild openMpp R package  
$HOME/build/build-ui      # rebuild openM++ UI  
$HOME/build/build-tar-gz  # create openmpp_centos_YYYYMMDD.tar.gz archive
```

To start shell inside of container do:

```
docker run \  
-v $HOME:/home/${USER} \  
-e OMPP_USER=${USER} -e OMPP_GROUP=`id -gn` -e OMPP_UID=$UID -e OMPP_GID=`id -g` \  
-it openmpp/openmpp-build:debian \  
bash
```

CentOS 8: Use Docker to get latest version of OpenM++

Why Docker?

There are multiple cases when you want to use Docker containers for openM++ development:

- build your models with latest version of openM++
- build cluster-ready (and cloud-ready) version of your model without installing MPI on your host computer
- do test run of your model in cluster environment without installing and configuring MPI cluster on multiple machines
- build latest version of openM++ from source code without installing and configuring all necessary development tools

All above build and run tasks can be done without Docker and our wiki describes all steps necessary to achieve this. However in that case you will spend a few hours or even days with installing and configuring development and cluster environment. Use of Docker allow to skip unnecessary steps and focus on model development. Also because containers are isolated from host environment there is nothing (except of Docker itself) get installed on your host system and you keep it clean, no software versions conflicts.

To install Docker on CentOS / RedHat do: `dnf install podman`

Where to find openM++ Docker images

You can download openM++ images from Docker Hub:

- to run openM++ models pull: `podman pull openmpp/openmpp-run:centos-8`
 - Docker Hub description: [openmpp/openmpp-run:centos-8](#)
 - GitHub: [source code and Dockerfile](#)
- to build latest version of openM++ and re-build your models: `podman pull openmpp/openmpp-build:centos-8`
 - Docker Hub description: [openmpp/openmpp-build:centos-8](#)
 - GitHub: [source code and Dockerfile](#)

User name and home directory

Both containers `openmpp/openmpp-run:centos-8` and `openmpp/openmpp-build:centos-8` created with for user `ompp`, `HOME=/home/ompp`. To avoid permissions issues you may need to map that user to your host user namespace and use `:z` option if you want to mount host local directory, for example:

```
podman run - userns=host -v $HOME/build:/home/build:z -e OMPP_USER=build openmpp/openmpp-build:centos-8 ./build-all
```

Above we are mapping container user `build` to our current host user and container user home directory `/home/build` to sub-folder `$HOME/build`.

Or if want to use container user `models` to run our models:

```
podman run - userns=host -v $HOME/models:/home/models:z -e OMPP_USER=models openmpp/openmpp-run:centos-8 ./modelOne
```

How to use `openmpp/openmpp-run:centos-8` to run your models

To run openM++ model do:

```
podman run .... openmpp/openmpp-run:centos-8 ./modelOne
```

For example, if your models are in `$HOME/models/bin` directory then:

```

podman run \
--userns=host \
-v $HOME/models/bin:/home/models:z \
-e OMPP_USER=models \
openmpp/openmpp-run:centos-8 \
./modelOne

podman run \
--userns=host \
-v $HOME/models/bin:/home/models:z \
-e OMPP_USER=models \
openmpp/openmpp-run:centos-8 \
mpiexec --allow-run-as-root -n 2 MyModel_mpi -OpenM.SubValues 16

```

Also you can use `-e OM_ROOT=/home/models/my-openMpp-dir` to set environment variable for your model, if necessary.

To start shell inside of container do:

```
podman run -it openmpp/openmpp-run:centos-8 bash
```

Following environment variable is used to map container user and home directory to your host directory:

```
OMPP_USER=ompp # default: ompp, container user name and HOME
```

How to use `openmpp/openmpp-build:centos-8` to build openM++ and models

To build latest version of openM++ from source code and rebuild your models do:

```
podman run .... openmpp/openmpp-build:centos-8 ./build-all
```

For example, if your build in `$HOME/build` or in `$HOME/build_mpi` directory then:

```

podman run \
--userns=host \
-v $HOME/build:/home/build:z \
-e OMPP_USER=build \
openmpp/openmpp-build:centos-8 \
./build-all

podman run \
--userns=host \
-v $HOME/build_mpi:/home/build_mpi:z \
-e OMPP_USER=build_mpi \
-e OM_MSG_USE=MPI \
openmpp/openmpp-build:centos-8 \
./build-all

podman run .... -e MODEL_DIRS=RiskPaths,IDMM      openmpp/openmpp-build:centos-8 ./build-all
podman run .... -e OM_BUILD_CONFIGS=RELEASE,DEBUG openmpp/openmpp-build:centos-8 ./build-all
podman run .... -e OM_MSG_USE=MPI                 openmpp/openmpp-build:centos-8 ./build-all

```

Following environment variables used to control openM++ build:

```
OM_BUILD_CONFIGS=RELEASE,DEBUG # default: RELEASE,DEBUG for Libraries and RELEASE for models
OM_MSG_USE=MPI                # default: EMPTY
MODEL_DIRS=modelOne,NewCaseBased,NewTimeBased,NewCaseBased_bilingual,NewTimeBased_bilingual,IDMM,OzProj,OzProjGen,RiskPaths
```

Following environment variable is used to map container user and home directory to your host directory:

```
OMPP_USER=ompp # default: ompp, container user name and HOME
```

To build only openM++ libraries and omc compiler do:

```
podman run .... openmpp/openmpp-build:centos-8 ./build-openm
```

Environment variables to control `build-openm: OM_BUILD_CONFIGS, OM_MSG_USE`

To build only models do:

```
podman run .... openmpp/openmpp-build:centos-8 ./build-models
```

Environment variables to control `build-models: OM_BUILD_CONFIGS, OM_MSG_USE, MODEL_DIRS`

For example, if want to build your own model `MyModel` copy model code into `$HOME/build/models/MyModel` directory and do:

```
podman run .... openmpp/openmpp-build:centos-8 ./build-models  
podman run .... -e MODEL_DIRS=MyModel openmpp/openmpp-build:centos-8 ./build-models  
podman run .... -e MODEL_DIRS=MyModel -e OM_BUILD_CONFIGS=RELEASE,DEBUG openmpp/openmpp-build:centos-8 ./build-models
```

To build openM++ tools do any of:

```
podman run .... openmpp/openmpp-build:centos-8 ./build-go    # Go oms web-service and dbcopy utility  
podman run .... openmpp/openmpp-build:centos-8 ./build-r    # openMpp R package  
podman run .... openmpp/openmpp-build:centos-8 ./build-ui   # openM++ UI
```

To create `openmpp_centos_YYYYMMDD.tar.gz` deployment archive:

```
podman run .... openmpp/openmpp-build:centos-8 ./build-tar-gz
```

Environment variables to control `build-tar-gz: OM_MSG_USE, MODEL_DIRS`

To customize build you can change any of build scripts inside of `$HOME/build` directory:

```
$HOME/build/build-all      # rebuild entire openM++ and create openmpp_centos_YYYYMMDD.tar.gz archive  
$HOME/build/build-openm     # rebuild entire openM++ runtime libraries and compiler  
$HOME/build/build-models   # rebuild openM++ models specified by MODEL_DIRS  
$HOME/build/build-go        # rebuild Go oms web-service and dbcopy utility  
$HOME/build/build-r        # rebuild openMpp R package  
$HOME/build/build-ui       # rebuild openM++ UI  
$HOME/build/build-tar-gz   # create openmpp_centos_YYYYMMDD.tar.gz archive
```

To start shell inside of container do:

```
podman run -it openmpp/openmpp-build:centos-8 bash
```

Quick Start for OpenM++ Developers

Where is OpenM++

- Download: [binary files and source code](#)
- Latest source code: [openM++ git](#)
- (optional) Go source code: [openM++ Go git](#)
- (optional) UI source code: [openM++ Go git](#)
- Documentation: this wiki
- Pre-requisites described at: [Setup Development Environment](#).

It is recommended to start from desktop version of openM++, not a cluster (MPI) version.

You need to use cluster version of openM++ to run the model on multiple computers in your network, in cloud or HPC cluster environment. OpenM++ is using MPI to run the models on multiple computers. Please check [Model Run: How to Run the Model](#) page for more details.

Build on Linux

Tested platforms:

- Debian 10, MX Linux 19, Ubuntu 20.04, RedHat (CentOS) 8
- g++ >= 8.3
- (optional) MPI, i.e.: OpenMPI >= 3.1 or MPICH (other MPI implementations expected to work but not tested)
- (optional) OpenMPI >= 4.0 on RedHat (CentOS) >= 8.3 (OpenMPI was broken on CentOS 8.1)

It is not supported, but may also work on older versions, for example Ubuntu 18.04 and RedHat 7 with devtoolset-7 module enabled.

Check your `g++ --version`:

```
g++ (Debian 8.3.0-6) 8.3.0
g++ (Ubuntu 9.3.0-10ubuntu2) 9.3.0
g++ (GCC) 8.3.1 20191121 (Red Hat 8.3.1-5)
```

To build **debug version** of openM++:

```
git clone https://github.com/openmpp/main.git master
cd master/openm/
make
cd ../models/
make
```

To build **release version** of openM++: `make RELEASE=1`

To build **MPI version** of openM++: `make OM_MSG_USE=MPI`

Note: openM++ binary downloads build as: `make RELEASE=1 OM_MSG_USE=MPI`

RedHat / CentOS: to build and run MPI version of openM++:

```
module load mpi/openmpi-x86_64
```

Of course, you can also use 32bit version of OpenMPI or MPICH.

Build on Windows

Tested platforms:

- Windows 10, Windows 7 (64 and 32 bits), 2016 (64 bit)
- expected to work on any Windows 7 and above or 2008R2 and above, 32 and 64 bits, not regularly tested

- Visual Studio 2019 or 2017 (VS 2017 not supported, but may work), including Community Edition
- (optional) Microsoft MPI SDK Redistributable Package

To build **debug version** of openM++:

- checkout from [openM++ git](#) using your favorite Git client into `C:\SomeDir\` or use command line:

```
git clone https://github.com/openmpp/main.git SomeDir
```

- download and unzip [Windows version of bison and flex](#) into `C:\SomeDir\bin\`.
- download and unzip [sqlite3.exe](#) into `C:\SomeDir\bin\`.
- use Visual Studio or MSBuild to build `C:\SomeDir\openm\openm.sln` solution.
- to build test model(s), i.e.: NewCaseBased, use Visual Studio or MSBuild: `C:\SomeDir\models\NewCaseBased\NewCaseBased-ompp.sln`.

To build **MPI version** of openM++:

- download and install [Microsoft MPI SDK](#) and [MPI Redistributable](#).
- use Notepad to open `C:\SomeDir\openm\openm.build.props`, find and edit the line:

```
<OM_MSG_USE>MPI</OM_MSG_USE>
```

- build `C:\SomeDir\openm\openm.sln` solution.
- use Notepad to open `C:\SomeDir\models\models\NewCaseBased\Model.props` and make sure you have:

```
.....
<GRID COMPUTING>MPI</GRID COMPUTING>
.....
```

- build model solution, i.e.: `C:\SomeDir\models\NewCaseBased\NewCaseBased-ompp.sln`

Note: binary downloads build with [Microsoft MPI SDK](#) and [MPI Redistributable](#).

Note: If you getting build error MSB8036:

```
C:\Program Files (x86)\Microsoft Visual Studio\2017\Community\Common7\IDE\VC\VCTargets\Platforms\Win32\PlatformToolsets\v141\Toolset.targets(34,5 ):
error MSB8036: The Windows SDK version 10.0.14393.0 was not found.
Install the required version of Windows SDK or change the SDK version in the project property pages or by right-clicking the solution and selecting "Retarget solution".
```

then do one of the following:

- "Retarget solution"
- use Visual Studio 2019
- start Visual Studio 2017 Installer (VS 2017 not supported but may work)
 - Modify
 - right column
 - check box Windows 8.1 SDK and UCRT SDK

Build on MacOS

- Tested on MacOS 10.15 Catalina and 11.1+ Big Sur

Check your clang, make, bison, SQLite version:

```
clang --version
...
Apple clang version 11.0.0 (clang-1100.0.33.12)

make --version
...
GNU Make 3.81

bison --version
...
bison (GNU Bison) 2.7.12-4996

sqlite3 --version
...
3.28.0 2019-04-15 14:49:49
```

To build **debug version** of openM++:

```
git clone https://github.com/openmpp/main.git ompp-main
cd ompp-main/openm/
make
cd ..../models/
make
```

To build **release version** of openM++: `make RELEASE=1`

You can also use Xcode `~/ompp-main/openm/openm.xcworkspace`.

In order to build omc complier you need to use menu and select Product -> Scheme -> omc

Known issue: Xcode UI does not update check mark on selected scheme To fix it go to Product -> Scheme -> Manage Schemes and use mouse to drag any scheme to move it up or down.

Release version of omc is required in order to build any model other than modelOne.

In order to build and debug modelOne using Xcode please open `~/ompp-main/models/modelOne/modelOne.xcworkspace`

Build R package

- clone from GitHub:

```
git clone https://github.com/openmpp/R.git ompp-r
```

- Windows:

```
cd C:>C:\ompp-r
"C:\Program Files\R\R-3.4.0\bin\R.exe" CMD build openMpp
```

- Linux and MacOS:

```
cd ompp-r
R CMD build openMpp
```

Expected output:

```
* checking for file ‘openMpp/DESCRIPTION’ ... OK
* preparing ‘openMpp’:
* checking DESCRIPTION meta-information ... OK
* checking for LF line-endings in source and make files and shell scripts
* checking for empty or unneeded directories
* building ‘openMpp_0.8.3.tar.gz’
```

Build Go utilities

- setup Go environment as described at: [Setup Development Environment](#).
- initial checkout:

```
mkdir $HOME/ompp
cd $HOME/ompp
export GOPATH=$HOME/ompp
git clone https://github.com/openmpp/go ompp-go
```

- build Go utilities:

```
cd ompp-go
go get github.com/openmpp/go/dbcopy
go get github.com/openmpp/go/oms
```

- rebuild Go utilities if you change source code:

```
cd $HOME/ompp/ompp-go
go install github.com/openmpp/go/dbcopy
go install github.com/openmpp/go/oms
```

After initial checkout first `go get` command can take ~30 seconds because go needs to get all dependencies. To see more details you can use:

```
go get -v github.com/openmpp/go/dbcopy
```

By default only SQLite model databases supported by `dbcopy` and `oms`. If you want to use other databases vendors please compile `dbcopy` with ODBC enabled:

```
go install -tags odbc github.com/openmpp/go/dbcopy
```

Currently supported database vendors are: SQLite (default), Microsoft SQL Server, MySQL, PostgreSQL, IBM DB2, Oracle. You can use dbcopy utility to copy model data between any of vendors above, for example copy from MySQL to MSSQL or from PostgreSQL to SQLite.

Build UI

Instructions below assuming Windows environment and it is very much identical for Linux and MacOS, except of course, back slashes in directory paths.

- setup `node.js` environment as described at: [Setup Development Environment](#).

- checkout and build UI:

```
cd my-openm-plus-plus-dir
git clone https://github.com/openmpp/UI.git ompp-ui
cd ompp-ui
npm install
```

- make sure you have `models\bin` populated with *.sqlite db files and model executables.
- it is recommended to have `my-openm-plus-plus-dir\etc` folder which can be found at openM++ release archive

- start oms web-service by invoking:

- `ompp_ui.bat` on Windows

- `ompp_ui.sh` on Linux

- `ompp_ui.command` on MacOS

- or do it in command line:

```
cd my-openm-plus-plus-dir
bin\oms -oms.HomeDir models -oms.LogRequest
```

- start UI in debug mode:

```
cd my-openm-plus-plus-dir\ompp-ui
npm run dev
```

- open your favorite browser at `http://localhost:8080`

- to build UI for production:

```
cd my-openm-plus-plus-dir\ompp-ui  
npm run build
```

- copy HTML results folder `my-openm-plus-plus-dir\dist\spa*` into `my-openm-plus-plus-dir\html\`
- open your favorite browser at `http://localhost:4040` and refresh (clear browser cache if required)

*Note: UI is beta version and you need to stop `oms` web-service in order to update, add or remove model .sqlite db files.**

Setup Development Environment

OpenM++ Requirements

Your development and runtime environment must meet following:

- OS: 64 or 32 bits version of:
 - Linux (tested): Debian 10, MX Linux 19+, Ubuntu 20.04, RedHat / CentOS 8
 - Windows (tested): 10, 7, 2016
 - MacOS 10.15 Catalina and 11.1+ Big Sur, including new Apple Arm64 CPU (a.k.a. M1)

Note: It does work on most of latest Linux'es, any Windows 7+ or 2008R2+, 32 and 64 bits. We just not testing it regularly on every possible Windows / Linux version.

- Support of c++17:
 - g++ 8.3+
 - Visual Studio 2019 or 2017 (VS 2017 not supported but may work), including Community Edition
 - Xcode 11.2+
- (optional) if want to compile omc (openM++ compiler):
 - bison 2.6+ and flex 2.5+
- (optional) it is recommended to have MPI installed on your local machine or in your HPC cluster:
 - Linux (tested): OpenMPI 1.6+
 - Windows (tested): Microsoft MPI v8+, expected to work starting from HPC Pack 2012 R2 MS-MPI Redistributable Package
 - expected to work: MPICH (MS-MPI is in fact MPICH redistributed by Microsoft)

Optional development tools:

- R 3.5+ (version 4 not tested)
- Go 1.10+, on Windows required MinGw for g++ compiler
- node.js LTS version

Check c++17 capabilities

Linux: To check g++ version type: `g++ --version`, expected output:

```
g++ (Debian 8.3.0-6) 8.3.0
g++ (Ubuntu 9.3.0-10ubuntu2) 9.3.0
g++ (GCC) 8.3.1 20191121 (Red Hat 8.3.1-5)
```

MacOS: To check c++ version type: `clang --version` or `g++ --version`, expected output:

```
Apple clang version 11.0.0 (clang-1100.0.33.12)
```

MacOS: install command line developer tools, if not installed already by Xcode: `xcode-select --install`

Windows: Make sure you have Visual Studio 2019 or 2017 installed with latest update (VS 2017 is not supported but may work).

If you are using different c++ vendor, i.e. Intel c++ then compile and run following test:

```

#include <iostream>
#include <map>
#include <string>
#include <iostream>

using namespace std;

int main(int argc, char** argv)
{
    const map<string, string> capitals {
        { "Poland", "Warsaw"}, 
        { "France", "Paris"}, 
        { "UK", "London"}, 
        { "Germany", "Berlin"} 
    };

    // print Country: Capital
    for (const auto & [k,v] : capitals)
    {
        cout << k << ":" << v << "\n";
    }
    return 0;
}

```

Save above code as `h17.cpp`, compile and run it:

```

g++ -std=c++17 -o h17 h17.cpp
./h17

```

Expected output:

```

France: Paris
Germany: Berlin
Poland: Warsaw
UK: London

```

Bison and Flex

Optional: If you want to recompile omc (OpenM++ compiler) then you need bison version ≥ 2.6 and ≤ 3.5 and flex 2.5.35+ installed.

To check bison and flex version type following commands:

```

bison --version
flex --version

```

Expected output:

```

bison (GNU Bison) 2.7
flex 2.5.37

```

Windows:

- download [Windows version of bison and flex](#)
- if your OpenM++ checkout folder is: `C:\SomeDir\` then unzip `win_flex_bison-latest.zip` into `C:\SomeDir\bin\`

MacOS Bison:

Bison version included in MacOS `bison (GNU Bison) 2.7` released in 2006 and too old for openM++. You can install bison 2.7 from:

- from HomeBrew
- from source code with Macports patch

MacOS Bison from HomeBrew:

- install bison version ≥ 2.6 and ≤ 3.5 , it can be done by HomeBrew:
- install HomeBrew from GUI terminal:

```
/bin/bash -c "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/install.sh)"
```

- install bison 2.7 using HomeBrew:

```
brew install bison@2.7
```

- export bison 2.7, you may also want to add it into your .zprofile: if MacOS on Intel CPU:

```
export PATH="/usr/local/opt/bison@2.7/bin:${PATH}"
export LDFLAGS="-L/usr/local/opt/bison@2.7/lib ${LDFLAGS}"
```

if MacOS on Apple Arm64 CPU (a.k.a. M1):

```
export PATH="/opt/homebrew/opt/bison@2.7/bin:${PATH}"
export LDFLAGS="-L/opt/homebrew/opt/bison@2.7/lib ${LDFLAGS}"
```

- verify bison version

```
bison --version
...
bison (GNU Bison) 2.7.12-4996
```

MacOS Bison from source code:

- download and unpack bison sources:

```
curl -L -o bison-2.7.1.tar.gz https://ftp.gnu.org/gnu/bison/bison-2.7.1.tar.gz
tar xzf bison-2.7.1.tar.gz
cd bison-2.7.1
```

- patch lib/vsnprintf.c for MacOS:

```
curl -L -o secure_snprintf.patch https://raw.githubusercontent.com/macports/macports-ports/b76d1e48dac/editors/nano/files/secure_snprintf.patch
patch -p0 < ./secure_snprintf.patch
```

- make and install bison into \$HOME/bison:

```
mkdir ~/bison
./configure --prefix=${HOME}/bison
make
make install
```

- export bison 2.7, you may also want to add it into your .zprofile:

```
export PATH="${HOME}/bison/bin:${PATH}"
export LDFLAGS="-L${HOME}/bison/lib ${LDFLAGS}"
```

- verify bison version

```
bison --version
...
bison (GNU Bison) 2.7. ...
```

Install MPI

OpenM++ is using MPI to run the models on multiple computers in your network, in cloud or HPC cluster environment.

Linux: To check your MPI version:

```
[user@host ~]$ mpirun --version
mpirun (Open MPI) 1.10.7
```

You may need to load MPI module in your environment on RedHat / CentOS:

```
module load mpi/openmpi-x86_64
mpirun --version
```

Windows: To check your MPI version:

```
C:\> mpiexec /?
Microsoft MPI Startup Program [Version 10.0.12498.5]
.....
```

Windows: download and install [Microsoft MPI SDK and MPI Redistributable](#).

Test MPI

You can test your MPI environment with following code:

```
#include <mpi.h>
#include <iostream>
using namespace std;

int main(int argc, char **argv)
{
    int mpiCommSize;
    int mpiRank;
    int procNameLen;
    char procName[MPI_MAX_PROCESSOR_NAME];

    MPI_Init(&argc, &argv);

    MPI_Comm_size(MPI_COMM_WORLD, &mpiCommSize);
    MPI_Comm_rank(MPI_COMM_WORLD, &mpiRank);
    MPI_Get_processor_name(procName, &procNameLen);

    cout << "Process: " << mpiRank << " of " << mpiCommSize << " name: " << procName << endl;

    MPI_Finalize();
    return 0;
}
```

Save this code as `mhp.cpp`, compile and run it:

```
mpiCC -o mhp mhp.cpp
mpirun -n 4 mhp
```

Expected output is similar to:

```
Process: 0 of 4 name: omm.beyond2020.com
Process: 2 of 4 name: omm.beyond2020.com
Process: 1 of 4 name: omm.beyond2020.com
Process: 3 of 4 name: omm.beyond2020.com
```

Windows: To build MPI tests in Visual Studio:

- create C++ command-line project
- adjust following in project properties:
 - VC Directories -> Include Directories -> C:\Program Files\Microsoft MPI\Inc
 - VC Directories -> Library Directories -> C:\Program Files\Microsoft MPI\Lib\i386
 - Linker -> Input -> Additional Dependencies -> msmpi.lib
- build it and run under Visual Studio debugger

Please use `amd64` version of MS MPI libraries if you want to build 64bit version.

To run MPI test on Windows type following in your command-line prompt:

```
mpiexec -n 4 mhp.exe
```

Expected output is similar to:

```
Process: 3 of 4 name: anatolyw7-om.beyond2020.local
Process: 2 of 4 name: anatolyw7-om.beyond2020.local
Process: 0 of 4 name: anatolyw7-om.beyond2020.local
Process: 1 of 4 name: anatolyw7-om.beyond2020.local
```

Install R

Download and install R version 3.5+ (v4+ not tested):

- Windows: <https://cran.r-project.org/bin/macosx/R-3.6.3.nn.pkg>
- on Linux use your package manager, e.g.: `sudo yum install R`
- MacOS on Intel CPU: <https://cran.r-project.org/bin/macosx/R-3.6.3.nn.pkg>

It is recommended to use [RStudio](#) or [RStudio Server](#) for development.

Install Go

- **Windows:**

- download Go from <https://golang.org/> and install into any directory, e.g.: `C:\Program Files\go`
- download MinGw from your preferable distribution, ex: <https://nuwen.net/mingw.html> and unpack into any directory: `C:\MinGW\`
- create your Go working directory, e.g.: `C:\go_workspace\`
- set your environment variables:

```
set GOPATH=C:\go_workspace
set PATH=%GOPATH%\bin;%PATH%
cd %GOPATH%
C:\MinGW\set_distro_paths.bat
```

It is recommended to use [Visual Studio Code](#) for development.

- **MacOS on Intel CPU:** download and install fresh Go version, for example: <https://golang.org/dl/go1.16.3.darwin-amd64.pkg>
- **MacOS on Arm64 CPU:** download and install fresh Go version, for example: <https://golang.org/dl/go1.16.3.darwin-arm64.pkg>
- **MacOS** Go also can be installed from `go1.16.3.linux-amd64.tar.gz` or `go1.16.3.linux-arm64.tar.gz` archive, similar to Linux
- **MacOS:** include into your .zprofile PATH to Go, for example:

```
export GOROOT=$HOME/go
export PATH=$GOROOT/bin:${PATH}
```

Note: above version number 1.16.3 is only an example, please most recent stable version.

- **Linux:**

- download Go, for example version 1.16.3 from: <https://golang.org/dl/go1.16.3.linux-amd64.tar.gz>
- unpack into any directory, e.g.: `~/go`
- set your environment variables (in .profile or .bash_profile or .bashrc, etc.):

```
export GOROOT=$HOME/go
export PATH=$GOROOT/bin:${PATH}
```

If you want to copy models database content from SQLite to other vendors then you may also need to install unixODBC development package:

```
su -c "yum install unixODBC unixODBC-devel"
```

Currently supported database vendors are: SQLite (default), Microsoft SQL Server, MySQL, PostgreSQL, IBM DB2, Oracle. You can use dbcopy utility to copy model data between any of vendors above, for example copy from MySQL to MSSQL or from PostgreSQL to SQLite.

Install node.js

You need `node.js` in order to build and develop openM++ UI. Please download and install stable version from [Node.js](#).

Windows

- Use any of:

- MSI installer: <https://nodejs.org/dist/v14.16.1/node-v14.16.1-x64.msi>
- Zip archive: <https://nodejs.org/dist/v14.16.1/node-v14.16.1-win-x64.zip>
- if you are using archive then unpack it into `C:\node` directory and to start development open command prompt and type:

```
C:\node\nodevars.bat
cd C:\my-openm-plus-plus-dir\ompp-ui
npm install
```

Linux

- Use your favorite package manager
- Or directly download archive from [Node.js](#) and unpack into `$HOME/node`:

```
curl https://nodejs.org/dist/v14.16.1/node-v14.16.1-linux-x64.tar.xz -o node.tar.xz
mkdir $HOME/node
tar -xJf node.tar.xz -C node --strip-components=1
```

- add PATH to Node into your `.bash_profile` (or `.profile` or `.bashrc`, etc): `export PATH=$HOME/node/bin/:${PATH}`
- checkout and build UI:

```
cd my-openm-plus-plus-dir
git clone https://github.com/openmpp/UI.git ompp-ui
cd ompp-ui
npm install
npm run build
```

MacOS on Intel CPU

- Use any of:
 - Installer: <https://nodejs.org/dist/v14.16.1/node-v14.16.1.pkg>
 - Archive: <https://nodejs.org/dist/v14.16.1/node-v14.16.1-darwin-x64.tar.gz>
- if you are using archive then unpack it into `$HOME/node` and try checkout and build UI:

```
mkdir $HOME/node
tar -xzf node-v14.16.1-darwin-x64.tar.gz -C node --strip-components=1
```

- add PATH to Node into your `.zprofile`: `export PATH=$HOME/node/bin/:${PATH}`
- checkout and build UI as described in Linux section above

MacOS on Arm64 CPU

- install HomeBrew from GUI terminal:


```
/bin/bash -c "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/install.sh)"
```
- install Node.js LTS version using HomeBrew:


```
brew install node@14
```
- add PATH to Node into your `.zprofile`: `export PATH=/opt/homebrew/opt/node@14/bin:${PATH}`
- checkout and build UI as described in Linux section above

Note: In examples above `node-v14.16.1` is an example of current LTS (long term support) version. Please check [Node.js](#) site to download latest LTS version.

OpenM++ HPC cluster: Test Lab

Obsolete

HPC cluster Test Lab not available after October 2018. Instructions below outdated but may be useful as example of development test lab on Linux.

Where is OpenM++ and HPC cluster Test Lab

- Download: [binary files](#)
- Source code: [openM++ git](#)
- Documentation: this wiki
- HPC cluster (test lab): `ssh -p 4022 USER@omm.some-where.com`

OpenM++ HPC cluster test lab consists of:

- master node and 2 quad cores computational nodes.
- all nodes running 64bit Centos 7 and [Open MPI](#).
- computational node names are: om1.some-where.com, om2.some-where.com
- shared directory to put executables: /mirror
- special user to run the tests on cluster: mpi
- script to run on cluster: /mirror/omrun
- cluster hosts description: /mirror/mpihosts

Please read [Quick Start for OpenM++ Developers](#) first. Additional information can be found in Linux section of [Setup Development Environment](#).

Login to OpenM++ HPC cluster

To login on OpenM++ test lab cluster:

```
ssh -p 4022 USER@omm.some-where.com
```

If you are on Windows and using putty, please put following setting here:

```
server name: omm.some-where.com
port: 4022
Window -> Translation -> Remote Charter Set: UTF-8
```

Check your Environment

To verify OpenMPI is working:

```
module load mpi/openmpi-x86_64
mpirun -H omm,om1,om2 uname -n
```

expected output:

```
omm.some-where.com
om1.some-where.com
om2.some-where.com
```

To verify c++ and OpenMPI development environment compile MPI Hello, World:

```

#include <iostream>
#include <mpi.h>

using namespace std;

int main(int argc, char ** argv)
{
    int mpiCommSize;
    int mpiRank;
    int procNameLen;
    char procName[MPI_MAX_PROCESSOR_NAME];

    MPI_Init(&argc, &argv);

    MPI_Comm_size(MPI_COMM_WORLD, &mpiCommSize);
    MPI_Comm_rank(MPI_COMM_WORLD, &mpiRank);
    MPI_Get_processor_name(procName, &procNameLen);

    cout << "Process: " << mpiRank << " of " << mpiCommSize << " name: " << procName << endl;

    MPI_Finalize();
    return 0;
}

```

```

mpiCC -o /mirror/mhw mhw.cpp
cd /mirror
mpirun -H omm,om1,om2 mhw

```

Setup Your Environment

It is convenient to customize .bashrc to setup your environment:

```

# .bashrc
#
# ....something already here....
#
# enable MPI
#
source /usr/share/Modules/init/bash
module load mpi/openmpi-x86_64

```

Tip: If you want to have full Linux GUI on master node then [freeNX](#) client can be a good choice and Eclipse or Netbeans are excellent IDE for C++ development.

Build and Run OpenM++

Check out and compile OpenM++:

```

git clone https://github.com/openmpp/main.git master
cd master/openm/
make OM_MSG_USE=MPI
cd ../models/
make OM_MSG_USE=MPI all publish run

```

Copy build results to /mirror shared directory:

```

cp bin/* /mirror

```

Run the models on cluster with different number of subsamples:

```

cd /mirror
mpirun -H omm,om1,om2 -n 4 modelOne -General.Subsamples 4

```

you will be prompted for mpi user password, expected output is similar to:

```
2013-10-24 12:38:41.0360 Model: modelOne
2013-10-24 12:38:41.0359 Model: modelOne
2013-10-24 12:38:41.0360 Model: modelOne
2013-10-24 12:38:41.0363 Model: modelOne
2013-10-24 12:38:42.0518 Subsample 1
2013-10-24 12:38:42.0518 Subsample 2
2013-10-24 12:38:42.0520 Subsample 3
2013-10-24 12:38:43.0035 Subsample 0
2013-10-24 12:38:43.0062 Reading Parameters
2013-10-24 12:38:43.0062 Reading Parameters
2013-10-24 12:38:43.0062 Reading Parameters
2013-10-24 12:38:43.0063 Reading Parameters
2013-10-24 12:38:43.0066 Running Simulation
2013-10-24 12:38:43.0066 Writing Output Tables
2013-10-24 12:38:43.0066 Running Simulation
2013-10-24 12:38:43.0066 Writing Output Tables
2013-10-24 12:38:43.0066 Running Simulation
2013-10-24 12:38:43.0066 Writing Output Tables
2013-10-24 12:38:43.0198 Done.
2013-10-24 12:38:44.0198 Done.
2013-10-24 12:38:44.0198 Done.
2013-10-24 12:38:44.0200 Done.
```

Development Notes: Defines, UTF-8, Databases, etc.

OpenM++ development notes

This page contains various notes **only for OpenM++ developers**. There is no useful information on that page for anyone else. It is a notes, they are not in any specific order and may not true. OK, you have been warned.

Git layout of main repository

OpenM++ consists of 6 source code repositories published at [GitHub / openmpp](#). Core portion of openM++ located at [GitHub / openmpp / main](#) and has following structure:

- bin - used for OpenM++ compiled binaries and third party tools
- include - includes for public interfaces of compiler and libraries
 - libopenm - model runtime library public interface
 - omc - model compiler public interface
- licenses - third party lincences
- models - test models, for example:
 - NewCaseBased - simple test model
 - NewTimeBased - simple test model
 - modelOne - test model for runtime library, does not use OpenM++ compiler
- openm - OpenM++ core source code
 - libopenm - model runtime library (libopenm) and compiler library (libopenm_omc_db)
 - common - common helper routines, for example: log
 - db - data access classes
 - include - includes for libopenm and libopenm_omc_db
 - model - model base classes
 - msg - message passing library
 - main.cpp - models main() entry point
 - libsqlite - SQLite with extension functions such as SQRT()
 - omc - OpenM++ compiler
- Perl - perl scripts
- props - VC++ project includes to build the models
- R - openMpp R library: integration between OpenM++ and R
- sql - sql scripts to create openM++ database
 - db2 - DB2 version of openM++ database scripts
 - mssql - Microsoft SQL Server version of openM++ database scripts
 - mysql - MySql version of openM++ database scripts
 - postgresql - PostgreSql version of openM++ database scripts
 - sqlite - SQLite version of openM++ database scripts

OpenM++ logs and trace

As it is now model executable output log messages into three streams:

- standard output (console)

- "last" log file: /current/working/dir/modelExeName.log
- "stamped" log file: /current/working/dir/modelExeName.date_time.pid.log

Model trace output is similar to log output but works much faster. Trace output is buffered and may be lost if something goes wrong and model crushed.

You can adjust output log and trace output inside of main() by changing: `theLog->init(...);` parameters. It is also be controlled by .ini options file.

Defines for OpenM++

You may need to change defines to build OpenM++ from source code:

- OM_DB_SQLITE: use SQLite as database provider (only one supported at the moment)
- OM_MSG_MPI: use MPI as for message passing library (see below)
- OM_MSG_EMPTY: use empty version message passing library (default value)
- OM_UCVT_MSSTL: use c++11 STL to convert strings to UTF-8 (default on Windows)
- OM_UCVT_ICONV: use glibc iconv to convert strings and file content to UTF-8 (default on Linux)

Please note:

- OM_MSG_MPI and OM_MSG_EMPTY mutually exclusive
- to set defines properly change `openm.build.props` (on Windows) or use `make OM_MSG_USE=MPI` (on Linux)
- OM_UCVT_MSSTL and OM_UCVT_ICONV mutually exclusive
- OM_UCVT_MSSTL tested on Windows with VC++2012 and account for Microsoft-specific implementation of STL `codecvt` classes.

Defines and other changes for VC++

Defines to compile libsqlite library with extension functions: SQLITE_ENABLE_COLUMN_METADATA; SQLITE_OMIT_LOAD_EXTENSION; HAVE_ACOSH; HAVE_ASINH; HAVE_ATANH;

To avoid innumerous compatibility errors and warnings following must be defined: `_CRT_SECURE_NO_WARNINGS` and `_CRT_NONSTDC_NO_WARNINGS`.

OpenM++ data library notes

IDbExec interface is db-connection wrapper and only the place where real SQL operations executed. All other classes are to wrap OpenM++ database tables and implement "business logic".

Data library is NOT thread-safe by design, do not pass it objects between model threads without proper guards.

Difference between OpenM++ database schema and Modgen schema:

- support multiple models and multiple versions of the same model
- support multiple run results of each model
- tends to be more "relational", i.e.:
 - language-specific rows moved to separate tables
 - sub-samples are in rows not in columns

Database schema "read-only" compatible with Modgen database. For each Modgen table corresponding view created which allow to read from OpenM++ database as from Modgen database. If OpenM++ database contains multiple models (or versions) then it not be exposed to Modgen compatibility views.

OpenM++ database notes

If database connection string is not specified then model try to open SQLite database with name ModelName.sqlite (i.e.: modelOne.sqlite) in current working directory. Other word, default database connection strig is:

```
Database=ModelName.sqlite; Timeout=86400; OpenMode=ReadWrite;
```

Database can be created by following commands:

```
cd  
sqlite3 ModelName.sqlite < ../sql/sqlite/create_db_sqlite.sql  
sqlite3 ModelName.sqlite < ModelName_create_model.sql  
sqlite3 ModelName.sqlite < ModelName_insert_parameters.sql
```

On Linux sqlite3 executable most likely in your PATH. On Windows you must download [sqlite3.exe](#) from SQLite web-site.

OpenM++ data library notes: SQLite

Following parameters allowed for SQLite database connection:

- Database - (required) database file name or URI, file name can be empty
- Timeout - (optional) table lock "busy" timeout in seconds, default=0
- OpenMode - (optional) database file open mode: ReadOnly, ReadWrite, Create, default=ReadOnly
- DeleteExisting - (optional) if true then delete existing database file, default: false

If OpenMode=Create specified then database file created if not exist, which is default SQLite behavior.

Note: minimal connection string syntax for SQLite provider is: "Database=" and in that case SQLite will open temporary database. That kind of connection string does not really make sense for OpenM++ models because temporary database will be deleted after model exit.

OpenM++ message passing library notes

Message passing library (a.k.a. execute library) used for:

- broadcast metadata and input parameters from root process to slave modeling processes
- gather output modeling results from all modeling processes into root process

That library has two versions:

- define OM_MSG_MPI: MPI-based version which does the job as described above (MPI component must be installed)
- define OM_MSG_EMPTY: empty version of library, which does nothing and don't required anything installed

When empty version of library can useful?

To develop and debug your model without having MPI installed and without complexity of multi-process debugging. Obviously, some technique must be used to debug modeling logic inside of single process.

IMsgExec interface is main class for message passing library. All processes involved in the modeling must can be identified by integer process rank. Root process rank is zero.

Messaging library is NOT thread-safe, at least for now, do not pass it objects between model threads without proper guards. It may change in the future versions.

OpenM++ and UTF-8 strings

All strings inside of openM++ source code expected to be are UTF-8 encoded. If you need to pass string to openM++ API, please convert it to UTF-8 first. There is helper function which return file content converted as UTF-8 string:

```
string fileContent = fileToUtf8("someFile.txt");
```

Following rules applied to detect file encoding:

- if byte order mark (BOM) present in the file then it converted according to BOM
- if first 2048000 bytes of file are UTF-8 then file considered as UTF-8 and not converted
- if code page (encoding name) specified, i.e.: "English_US.1252" then it used for conversion

- default user code page (encoding name) used to convert file content to UTF-8

You can use optional parameter to explicitly specify code page (encoding name):

```
string fileContent = fileToUtf8("someFile.txt", "English_Canada.1252"); // Windows: CP-1252
string fileContent = fileToUtf8("someFile.txt", "WINDOWS-1252"); // Linux: CP-1252
```

Encoding name is OS-specific and conversion would fail if name is invalid.

Note: conversion from UTF-32 to UTF-8 not supported on Windows.

Model digest, parameter digest, output table digest, etc.

OpenM++ is using MD5 digest to compare and find models, parameters, output tables and types in database. There are two digests calculated for model run:

- model run values digest which based on
 - values in model run output tables
 - values of model run input parameters
- model run metadata digest which is unique key of model run Model run values digest calculated only after run is completed. It can be empty if run failed.

Model run results do include output table values and all input parameter values. Model runs are stored in database as single copy only. For example, if digest of (parameter A value of model run 101) == digest of (parameter A value of model run 123) then only value from run 101 actually stored in database and run 123 is a link to run 101 value.

Following rules are used to calculate digests:

```
Model digest:
-----
model name, model type, model version
for all model types:
  type digest
for all model parameters:
  parameter digest
for all model output tables:
  table digest

Parameter digest:
-----
parameter name, rank, type digest
for all dimensions:
  id, name, size, type digest

Output table digest:
-----
table name, rank
for all dimensions:
  id, name, size (including "total" item), type digest
for all accumulators:
  acc id, name, source
examples:
  id: 1
    name: acc1
    source: accumulator 1: sum(delta(interval(duration(smoking_status, NON_SMOKER))))
  id: 9
    name: Expr4
    source: 1.0E2 * ( acc4 / acc0 )
for all expressions (a.k.a. measures):
  id, name, source
examples:
  id: 0
    name: Expr0
    source: ( OM_AVG( acc0 ) / ( OM_AVG( acc1 ) - OM_AVG( acc2 ) ) )
  id: 8
    name: E8
    source: OM_AVG(acc8)

Type digest:
-----
type name, dictionary id (e.g.: 3=range), "total" enum id
for all enums:
  id, enum name

Import digest for parameter or output table:
```

```

-----
rank, type digest
for all dimensions:
    id, name, size, type digest

Model run metadata digest:
-----
model digest, run name, sub-values count, create date-time, run stamp

Model run value digest:
-----
sub-values count, completed sub-values count, run status

for all parameters:
    parameter value digest

for all output tables:
    output table value digest

Value digest for parameters:
-----
parameter_name, parameter_digest
sub_id, dimension names, param_value as comma separated header
example (2 dimensions):
    sub_id,dim0,dim1,param_value
for all value rows:
    select sub_id, dimensions id, param_value
    convert sub_id, dimensions id into strings
    convert param_value to string
        if type is float then format as %.15g
        if type is boolean then "true" or "false"
example (2 dimensions boolean):
    2,11,22,true

Value digest for output table:
-----
table_name, table_digest

for all accumulators:
    accumulators value digest

for all expressions:
    expressions value digest

Value digest for output table accumulators:
-----
comma separated header: acc_id, sub_id, dimension names, acc_value
example (2 dimensions):
    acc_id,sub_id,dim0,dim1,acc_value

for all value rows:
    select acc_id, sub_id, dimensions id, acc_value
    convert acc_id, sub_id, dimensions id into strings
    format acc_value as %.15g
example (2 dimensions):
    2,15,11,22,0.1234

Value digest for output table expressions:
-----
comma separated header: expr_id, dimension names, expr_value
example (4 dimensions):
    expr_id,dim0,dim1,dim2,expr_value

for all value rows:
    select expr_id, sub_id, dimensions id, expr_value
    convert expr_id, sub_id, dimensions id into strings
    format expr_value as %.15g
example (4 dimensions):
    1,11,22,33,44,0.789

```

2012, December: OpenM++ Design

About this document

This roadmap and architecture document presented from "model developer" point of view, which imply C++ development process, user aspects of OpenM++ are deliberately excluded. Please refer to OpenM++ user guide pages for additional details.

What is OpenM++

OpenM++ is an open source implementation of the Modgen microsimulation tool created at Statistics Canada. It is not a copy of the Modgen, but a new, functionally equal implementation of publically available Modgen specifications. OpenM++ also has its own important distinct features like portability, scalability and open source, which Modgen does not. Extensive information on Modgen is available on the Statistics Canada web site at <http://www.statcan.gc.ca/microsimulation/modgen/modgen-eng.htm>.

OpenM++ Design Basics

Common OpenM++ design principles:

- portability: it must work on Windows and Linux, 32 and 64 bit versions
- scalability: work on single PC, in cluster or in cloud environment
- open source: it is open source product

OpenM++ is portable and scalable:

OpenM++ designed, developed and tested to work on Windows and Linux, in 32 and 64 bits. As result same model can be created and tested on model developer Windows PC and later run on Linux (or Windows) HPC cluster with thousands CPUs.

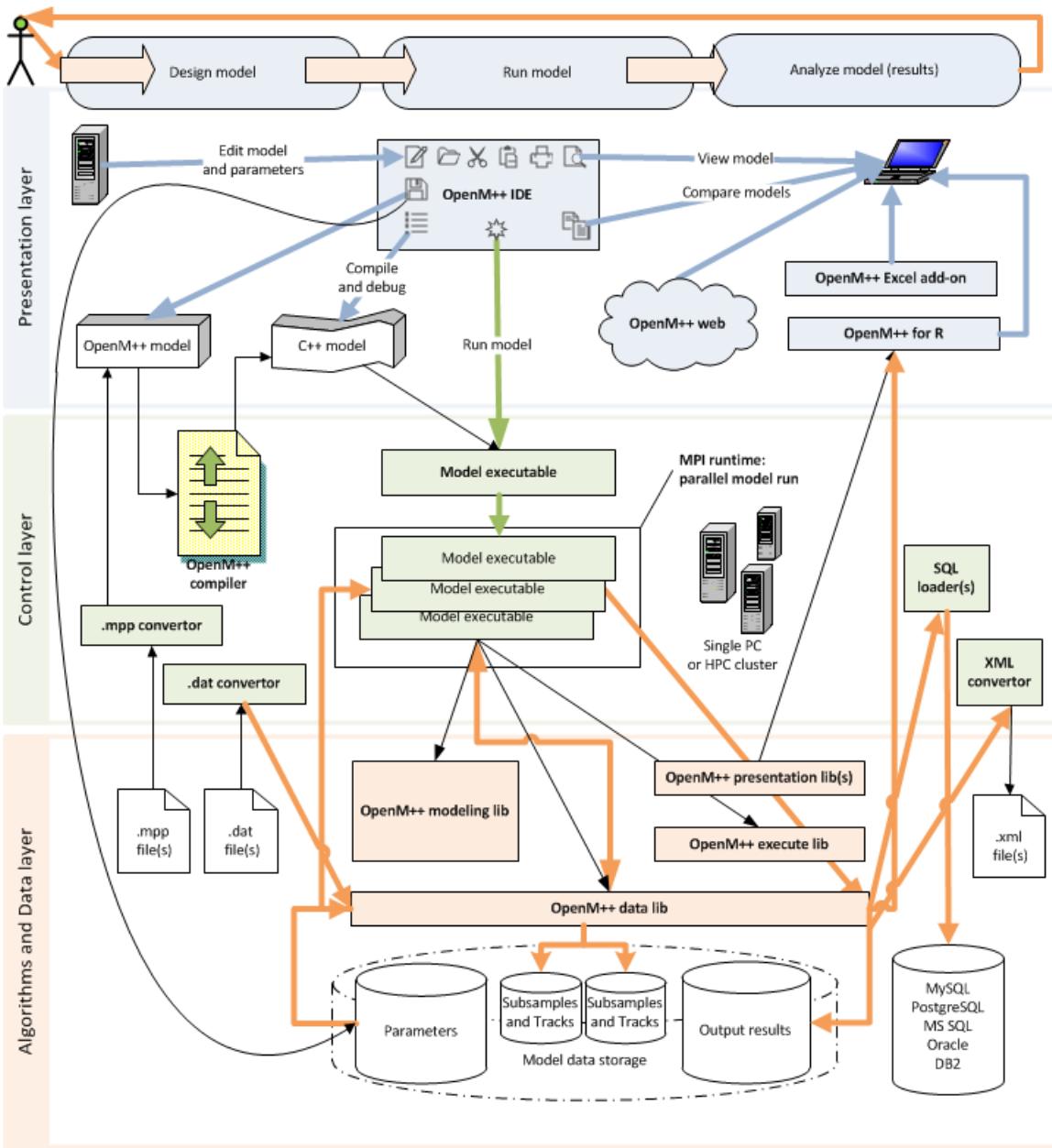
OpenM++ models are essentially highly parallelizable computational applications and fits very well in HPC cluster environment.

Specific version of cluster environment is to be established during first development phase. However, for the purpose of this design document, we can make a safe assumption cluster environment mean MPI cluster since many of existing HPC clusters, including ComputeCanada cluster, are MPI-based.

OpenM++ is web-ready and cloud-ready:

It is important to understand, OpenM++ is targeted to provide "software-as-a-service" cloud models for research community. To simplify this roadmap cloud and web details of OpenM++ omitted here. However, OpenM++ cloud capabilities are essential and all control layer, algorithms and data layer components must be designed, developed and tested as cloud-ready.

OpenM++ Architecture



OpenM++ consists of 3 software layers:

- layer 1: presentation
- layer 2: control
- layer 3: algorithms and data and must accommodate to 3 model life-cycle stages:
 - model design and development stage
 - model run stage
 - modeling results analysis stage

Note: Components described below in the order of OpenM++ layers and not in the order of development. For each component priority of the features specified as (pri1), (pri2) and (pri3); that value does NOT correspond to OpenM++ development phases.

Layer 1: OpenM++ presentation layer

Component 1.1: OpenM++ IDE

OpenM++ IDE is desktop GUI application to:

- (pri1) edit model parameters
- (pri1) view model output results

- (pri1) compare parameters of two models (see note below)
- (pri2) edit model source file(s) with (p3) syntax highlighting for OpenM++ language (.ompp)
- (pri2) compile from .ompp into c++ by invoking OpenM++ compiler, capture error s and warnings
- (pri2) compile and debug c++ model code by using GCC or Microsoft c++
- (pri2) debug c++ model executable
- (pri2) run model on single PC or (p3) submit it to HPC cluster
- (pri3) support source control system(s) integration (svn and/or git)
- (pri2) provide unit testing functionality

Note1: As an alternative OpenM++ GUI can be split into multiple independent applications with desktop or web UI. In any case it must provide and parameter editing capabilities.

Note2: Model comparison initially implemented as simple tool to compare parameters of two models. It can be later extended to support output results comparison with sophisticated analysis, however, most likely it going to be done as part of described below OpenM++ model analysis tools and OpenM++ web solutions.

Component 1.2: OpenM++ output result viewers and model analysis tools

OpenM++ presentation layer should be extendable and must support development of 3rd-party tools to view and analyze model output results. Following viewers to be implemented first:

- (pri1) Excel workbook and /or sample module(s)
- (pri2) import/export into R
- (pri2) basic web UI sample pages for ASP.NET
- (pri3) basic web UI sample pages for PHP
- (pri3) basic web UI sample pages for Java
- (pri3) Excel OpenM++ add-on

Basic web UI sample pages with necessary server-side components provided as reference point for web development and should allow view/edit parameters, view output results and run model executable.

Component 1.3: OpenM++ cloud and web capabilities

OpenM++ must be cloud-ready and support “software-as-a-service” usage of the model(s). These capabilities are out of current document scope. Mentioned above OpenM++ basic web UI sample pages provide starting point for web-developers. As next step web-solutions to use OpenM++ models on the web are going to be developed:

- (pri1) OpenM++ ASP.NET web solution (comparable to ModgenWeb)
- (pri2) OpenM++ PHP web solution
- (pri3) OpenM++ Java web solution

Those web-solutions (as every other portion of OpenM++) must be scalable and portable and ready to be deployed in private or public cloud platform, for example, Microsoft Azure for OpenM++ ASP.NET web solution (specific cloud platforms to be established). Based on that OpenM++ cloud software service capabilities can be created to provide ability for researches to work with their own models, including collaborative modeling, by using thin clients (i.e. web-browsers).

Note: Full C++ model development cycle is not supported by web solutions, however it may be considered as OpneM++ cloud the feature.

Layer 2: OpenM++ controller layer

That layer should provide set of command-line utilities, scripts and components to:

- compile, debug and run OpenM++ models on single PC or in cluster environment

- import, export and convert model data

Component 2.1: OpenM++ compiler

(pri1) The OpenM++ compiler produces C++ code from .ompp source code for a specific model. The .ompp source code is written by a model developer and contains declarative and procedural elements. Declarative elements include types, parameters, agents, variables, inter-agent links, agent collections, events, and cross-tabulations. Procedural elements include code to implement events and (optionally) to prepare secondary inputs and outputs. The OpenM++ compiler also produces a database of meta information on the model which is used by other OpenM++ components.

Component 2.2: OpenM++ controller for MPI cluster

OpenM++ models should run in not only on single PC but also in HPC cluster. OpenM++ cluster controller is a command-line utility, script or set of scripts to support most commonly used HPC cluster environments. For the purpose of this document MPI-compatible environment is assumed, however, other options can be considered as well. Following steps required in order to implement this:

- (pri1) organize test OpenMPI or MPICH2 cluster for CentOS 64bit
- (pri1) establish development environment for Windows 32bit and 64bit
- (pri1) create OpenM++ controller(s) for each cluster environment
- (pri2) establish automated test procedures for OpenM++ models in cluster
- (pri3) organize test OpenMPI or MPICH2 cluster for Debian or Ubuntu 64bit
- (pri3) organize test MS HPC cluster for Windows 64bit

Component 2.3: Modgen compatibility convertors

These are a command-line utilities to convert existing Modgen models into OpenM++ format:

- (pri1) parameters .dat file(s)
- (pri2) source model code .mpp file(s)

Component 2.4: OpenM++ SQL loaders

This is a command-line utility(s) to load data from OpenM++ model data storage into well-known SQL Server databases:

- (pri1) loader for MS SQL Server
- (pri1) loader for MySQL / MariaDB
- (pri2) generic SQL99 loader
- (pri3) loader for Oracle
- (pri3) loader for PostgreSQL
- (pri3) loader for IBM DB2
- (pri3) loader for Apache Derby, H2 or HSQL
- (pri3) loader for LucidDB, InfiniDB or MonetDB

Note: As an alternative solution all or some above functionality can be moved into OpenM++ data library. It also possible to supply few different versions of OpenM++ data library targeted to the different SQL Server database.

Component 2.5: OpenM++ output convertors

This is a command-line utility(s) to convert from OpenM++ model data storage into well-known formats:

- (pri1) .csv convertor for parameters and output results
- (pri2) .xml convertor for model data or user-defined subset of model data
- (pri3) SDMX convertor for model data

- (pri3) converter into Statistics Canada Biobrowser database

Layer 3: OpenM++ algorithms and data layer

This layer consists of OpenM++ common libraries and model data storage (model database).

Component 3.1: OpenM++ modeling library

The modeling library provides core functionality for the model life cycle, including agent creation / destruction, event queue management, on-the-fly cross-tabulation, and pre- and post-simulation processing. It may use OpenM++ data and execute libraries to organize model execution and result aggregation (especially in cluster environment), read model parameters, save model tracks and aggregate cross-tabulation results.

Component 3.2: OpenM++ model data storage (model database)

OpenM++ data storage design should provide an ability to store model parameters and output results inside of SQL database and support model tracking functionality, which may be done through a different database, text or XML file (subject for research during phase 1). OpenM++ data storage can be implemented in following ways:

- (pri1) inside of single embedded (file-based) SQL database
- (pri2) as above plus extra database for model tracking
- (pri3) model parameters and metadata inside of file-based SQL database and output results as .csv files
- (pri3) inside of SQL server database chosen by model developer (i.e. MSSQL, Oracle, etc.)

In any case model data storage should support basic OpenM++ design principles:

- portability between Linux, Windows, 64 and 32bit OS's
- scalability from single PC up to HPC cluster environment

Component 3.3: OpenM++ data library

Data library(s) is a C++ library to support model data read/write operations and hide low-level implementation details to simplify model code and modeling library. As (priority 1) it should support single embedded (file-based) SQL database in portable way. However, in a future (priority 3) it can consist of different implementations of data libraries for different target model storage (for example, to directly write into Oracle).

(priority 2) Second part of OpenM++ data libraries should provide an access to model data from Java and .NET to allow develop model analyzing tools and OpenM++ web solutions.

Component 3.4: OpenM++ execution library

(pri1) Execution is relatively thin C++ layer to simplify modeling library scalable coding, or other words, to avoid low-level details inside of modeling library for handling the difference between single PC and cluster execution. Depending on design decisions and target cluster environment it may not be used directly from modeling library but rather called from OpenM++ cluster controllers (see 2.2). In any case it should:

- (pri1) provide necessary information for model initialization (i.e. number of CPUs)
- (pri1) synchronize parallel model execution (i.e. wait for completion)
- (pri2) support data exchange between models or model and controller (i.e. progress report)
- (pri2) simplify tracking data exchange
- (pri1) organize transparent communication for output result aggregation

For the purpose of this document MPI cluster environment assumed, however other options can be considered as well.

(pri1) It is important to understand the modeling library may be designed in "single-threaded" way and then execution library must organize additional thread(s) for the purpose of model cluster communication, progress reporting, tracking, etc. Multithreading must be done in portable way and following solution should be considered for research during phase 1 of development:

- STL and C++11 standard features for threading and synchronization (i.e.: future)
- glib

- boost::thread and synchronization libraries
- APR (Apache portable runtime)
- OpenMP

Component 3.5: OpenM++ presentation library(s)

(pri1, pri2, pri3) Presentation libraries together with data library allow developing applications to view and analyze OpenM++ model output results. Priority and functionality of presentation libraries development completely defined by priority of OpenM++ viewers, and OpenM++ web solutions, described in 1.2 and 1.3 above. As (pri1) priority .NET presentation library(s) for Excel viewer and ASP.NET basic UI should be implemented.

2012, December: OpenM++ Model Architecture, December 2012

About this document

This roadmap and architecture document presented from "model developer" point of view, which imply C++ development process, user aspects of OpenM++ are deliberately excluded. Please refer to OpenM++ user guide pages for additional details.

OpenM++ model use cases

[OpenM++ by design](#) is portable and scalable environment which allow researchers to run same model on single Windows PC and on Linux (or Windows) HPC cluster by simply re-compiling model C++ code for target platform. For example, model developer can use Visual Studio on his own Windows PC to write, test and debug the model and later send model .cpp code to other researcher who can build and run that model on Linux HPC cluster with hundreds CPUs.

There are four main groups of openM++ model users:

- developer: using C++ IDE with openM++ installed to develop and run models mostly on their local PC
- researcher: uses openM++ models created by developer executable to run simulation on local workstation and/or on HPC cluster
- institutional user: member of research organization with advanced IT infrastructure who mostly running openM++ models in resource-shared environment (i.e. over the web)
- public user: member of the general public using simplified interface over the web.

Those user groups do have distinctive hardware / software environments and different requirements to model architecture:

- developer:
 - mostly local Windows or Linux PC with GUI
 - run the model hundred times to debug it
 - have full admin privileges on his local machine
 - eventually need to pack model executable and data files and send it to researcher
- researcher:
 - HPC cluster (large or small) or local Windows, Linux without GUI
 - run the model multiple times and collect the results
 - run the model 100's or 1000's of times for Probabilistic Sensitivity Analysis or for model estimation.
 - do not have admin privileges, especially on cluster
 - often need to pack model data files to publish it, move from local PC to HPC cluster or share with other researchers
- institutional user:
 - uses web UI to run the model in cloud, on HPC cluster or other powerful server environment
 - have absolutely no access to actual server environment
 - at any time can use IT department to deploy openM++ models in cloud, create modeling web-sites, manage model database on SQL server, etc.
- public user:
 - runs a version of a model via the web written and compiled in openM++ with a limited set of parameters and limited set of output screens, possibly in parallel with hundreds of other general public users.
 - very limited if any capacity at all to save results between sessions.

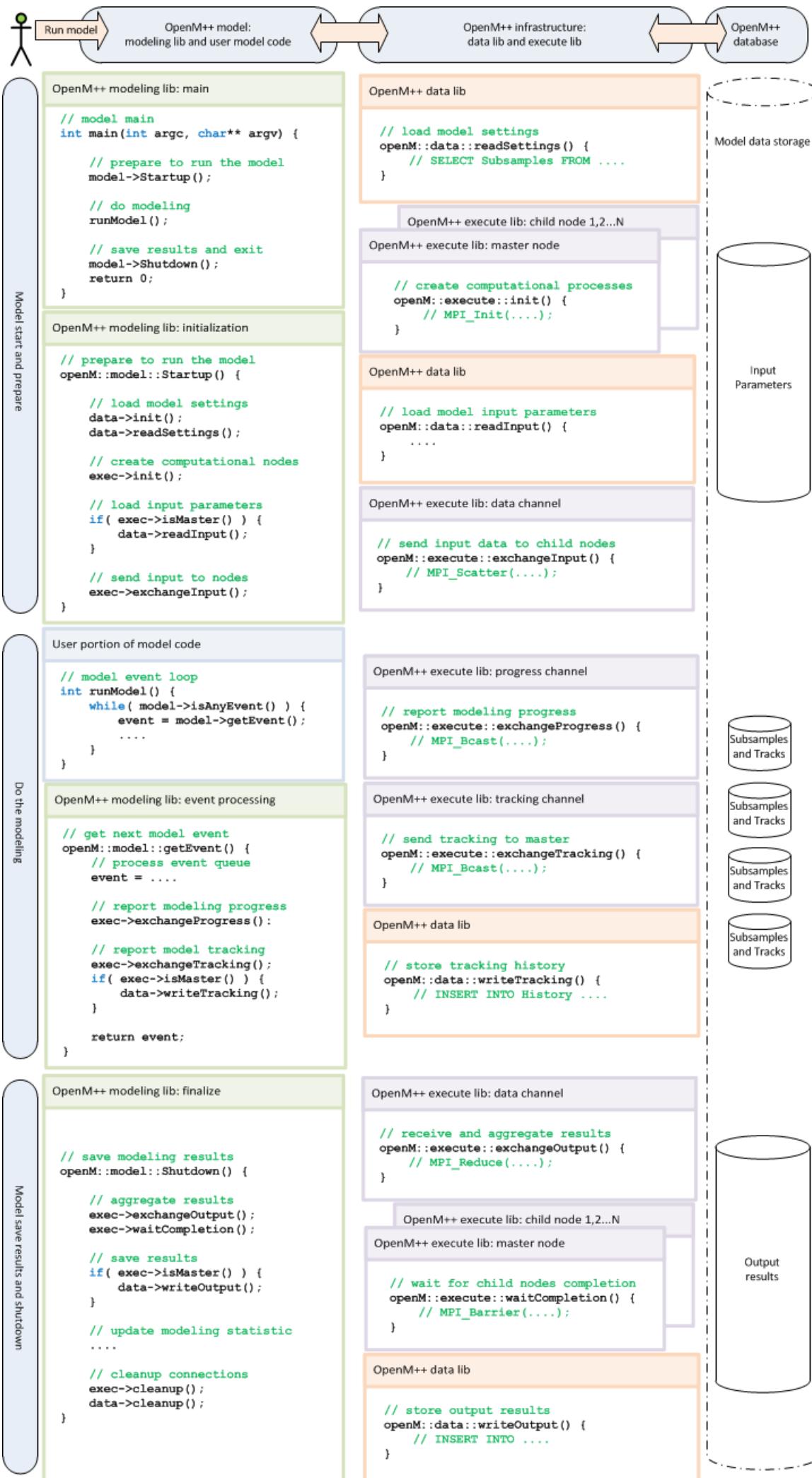
It is typical for openM++ users to not have advanced IT management skill as they are highly regarded professionals in their own area of interest. It may also not always possible for openM++ user to install additional software in their environment (i.e. in public HPC cluster). From that point easiest way of model deployment and model data export-import can be done through simple file operations (file copy). It is obviously not suitable for institutional users, however they can: (a) rely on dedicated IT department resources if necessary and (b) do have installed and supported web-servers, SQL databases servers and other resources where openM++ cloud components can be deployed.

Based on those use cases openM++ model architecture assumes following preferences:

- model, input parameters and output results available as set of files
- user may not want to (or can't install) database client-server software to store model data

Note: To simplify description of model architecture below it is done from developer or researcher user point of view and web cloud aspects are deliberately excluded.

OpenM++ model run cycle



Because openM++ models can scale from single PC to HPC cluster model execution (model run-cycle) depends on environment.

Simple (single PC) case (*italic* indicates optional):

- start of model executable (model.exe)
- read model settings from database (read execution scenario)
- read model input data from database
- run modeling loop:
 - execute user model code
 - *report on model progress if required*
- *do model results aggregation if required*
- write results into database output tables
- finally report execution statistics and exit

If model runs in cluster environment then openM++ can transparently create multiple copies of model executable process and distribute it on cluster nodes.

Model run-cycle on cluster (*italic* indicates optional):

- start of master model executable (model.exe)
- read model settings from database (read execution scenario)
- detect run-time environment
- spawn model.exe processes on computational nodes
- read model input data from database
- distribute input data between all computational nodes
- run modeling loop:
 - execute user model code
 - *report on model progress if required*
 - *collect model tracking information to debug the model*
- wait until all modeling completed on all computational nodes
- collect model results from each node
- *do results aggregation if required*
- write results into database output tables
- finally report execution statistics and exit

Note: It is important to understand the diagram on that page represent schematic picture and real openM++ code may be significantly more complex. For example, report modeling progress call exchangeProgress() may not actually do anything but place a data in the buffer and separate thread would do actual master-slave communication and progress report.

OpenM++ modeling library

The modeling library provides core functionality for the model run-cycle as it is described above. It contains main() entry point, it does agent creation / destruction, event queue management, on-the-fly cross-tabulation, and pre- and post-simulation processing.

It uses OpenM++ data and execute libraries to organize model execution (especially in cluster environment), read model input parameters, save model tracks and aggregate cross-tabulation results:

- for each input parameter model library by known data type, shape and other necessary information (memory address if required) to

instantiate class object and populate it with values by calling data library

- for each output table result model library call data library to save results in model data storage (model database)

OpenM++ model data storage (model database)

OpenM++ data storage should provide an ability to store model parameters and output results. It consist of model data storage (model database), data library and, optionally, can use execute library to organize communication between computational nodes.

It can be implemented in following ways:

- option 0. flat files: directly read-write into flat text (XML, CSV, etc.) files
- option a. flat files + buffering (or MPI-IO): use memory buffering (or MPI-IO) to organize large size chunks and reduce data exchange in cluster environment
- option b. client-server database: use MySQL or other open source SQL server database
- option c. file-based (embedded) SQL database: use file-based database (i.e. SQLite) inside of master process and write custom code to emulate client-server for computational nodes

Evaluating those options from point of view openM++ use cases described above:

Option 0: direct write to flat files may not be realistic approach in cluster environment because:

- computational nodes most likely don't have locale file system
- global shared file system may have very high or prohibitive cost for small write operations. For example, if 100 model executables from 100 computational nodes want write to 100 bytes it may be, in worst case, 100 times slower than if master node writes 100×100 bytes. Of course, MPI-IO can solve that problem.

Option a: flat files + buffering (or MPI-IO)

- pros:
 - most human readable format
 - no additional tools required to create or modify model data, it can be done by any text editor
 - minimal development efforts
- cons:
 - real model data input typically bigger than user can type-in and maintain without additional tools
 - to analyze the data in any other software (i.e. Excel, R, SAS) custom data converter(s) must be developed

Option b: client-server

- pros:
 - relatively easy to implement
 - good performance is almost guaranteed
 - hundreds tools to read, compare and manipulate the data
- cons:
 - require to install and administer SQL server database which many openM++ users, such as model developers and independent researchers may have no right to do or may not want to do

Option c: file-based database (i.e. SQLite)

- pros:
 - hundreds tools to read and manipulate the data (i.e. Firefox SQLite manager add-on)
 - relatively easy to transfer to any database or exchange the data between researchers
- cons:
 - development time to create client-server code for cluster environment much higher than any other options

- it is less convenient as flat text files

OpenM++ data storage roadmap:

OpenM++ data storage can be implemented in following order of priorities:

- (pri1) inside of single embedded (file-based) SQL database
- (pri2) as above plus extra database for model tracking
- (pri3) model parameters and metadata inside of file-based SQL database and output results as .csv files
- (pri3) inside of SQL server database chosen by model developer (i.e. MSSQL, Oracle, etc.)

OpenM++ data library

Data library(s) is a C++ library to support model data read/write operations and hide low-level implementation details to simplify model code and modeling library. It is important to understand there is no "one size fit all solution" and openM++ must provide multiple versions of data library for different target model storage. For example, for model developer SQLite data library may be most convenient, however when openM++ installed as part of web solution then MySQL data library suites more.

Following priority order of data libraries implementation planned:

- (pri1) SQLite as embedded (file-based) database
- (pri2) generic ODBC tested with MySQL (MariaDB), PostgreSQL, MS SQL, Oracle and IBM DB2
- (pri3) flat text files version of data library (using MPI-IO)
- (pri3) MySQL (MariaDB) native client (non-ODBC)
- (pri3) PostgreSQL native client (non-ODBC)

List above is not final and can be changed anytime. Many other options also considered for development of specialized data library version. For example, libmysqld, Firebird, MS Access reviewed as potential candidates for embedded (file-based) database. Also MPI-IO, HDF5, NetCDF considered as foundation for flat text files data library version. And in the future releases it is very much possible to have native client (not ODBC-based) version of data library for MS SQL, Oracle and IBM DB2.

Keep in mind data library is part of the model run-time and not be ideal choice for other purpose. Most easy way to integrate openM++ with existing products is to use SQL loaders or output convertors. It allows to import or export data from openM++ data storage into other well-known SQL servers, i.e. from SQLite into MS SQL or dump it into flat text files (i.e. CSV, XML).

2012, December: Roadmap, Phase 1

OpenM++ Roadmap (phase1)

OpenM++ design details, components and priorities are defined on [OpenM++ design](#) page. Due to research nature of the project OpenM++ components, specific technologies and sequence of development must be periodically reviewed and can be changed.

Following results expected to be delivered at the end of the phase1 project (enumeration corresponds to [OpenM++ design](#)):

- OpenM++ compiler (2.1 priority1)
- OpenM++ controller for MPI cluster (2.2 priority1)
- OpenM++ modelling library (3.1 priority1)
- OpenM++ model data storage design (3.2 priority1)
- OpenM++data library (3.3. priority1)
- OpenM++ execute library (3.4 priority1)

Items above should allow to:

- create simple OpenM++ model
- compile model
- run model on (3.4 priority1) platforms (Windows and Linux, 32 and 64 bit, single PC and cluster)
- read parameters from and write results into OpenM++ model data storage

If time and resources permits following items also going to be delivered as result of the project:

- OpenM++ result viewers for Excel (1.2 priority1)
- OpenM++ basic web UI sample pages for ASP.NET (1.2 priority2)
- OpenM++ presenation libraries for .NET (3.5 priority1)
- compatibility convertor for Modgen parameters .dat files (2.3 priority1)
- compatibility convertor for Modgen source model code .mpp files (2.3 priority2)

Results of OpenM++ phase1 project effectively would cover:

- most existing Modgen desktop functionality, except of GUI
- ModgenWeb functionality on a prototype level (optional result)

Overall phase1 steps

1. Requirements and infrastructure stage (see step 1 below). **Time:** one calendar month
2. Compiler and runtime prototype stage (steps 2 and 3). **Time:** 2-3 months
3. Compiler and runtime alpha version stage (steps 4 and 5). **Time:** 4-6 months
4. Optional OpenM++ phase1 components (steps 8-11). **Time:** 6-16 weeks
5. OpenM++ public beta release stage (step 12). **Time:** 6-8 weeks

Total Time: one year, excluding optional steps

Detailed phase1 roadmap

1. Requirements, risks and technologies evaluation, tools, platforms and infrastructure setup
Time: one calendar month

Result: publically available design documents and development infrastructure

- Establish OpenM++ roadmap, licensing terms, evaluate targeted platforms (i.e. versions of Linux, cluster environments, etc.)
- Create OpenM++ controller for MPI cluster (2.2 priority1)
- Evaluate open source project hosting service and development tools required
- Create OpenM++ project by publishing roadmap and licence(s)

2. OpenM++ data storage design and libraries prototyping

Time: 2-3 months (must be done together with step 3 below)

Result: Prototype of OpenM++ compiler and runtime libraries

- Prototype of OpenM++ modelling library (3.1 priority1) to be used by step 3
- OpenM++ model data storage design (3.2 priority1)
- Initial version of OpenM++data library (3.3. priority1)
- Initial version of OpenM++execute library (3.4. priority1)

3. Initial version of OpenM++ modeling library

Time: 2-3 months (must be done together with step 2 above)

Result: Prototype of OpenM++ compiler and runtime libraries

- Initial version of OpenM++ modelling library (3.1 priority1)
- Initial version of OpenM++ compiler (2.1 priority1)

4. OpenM++ compiler and modeling library

Time: 4-6 months?? (must be done together with step 5 below)

Result: Alpha version of OpenM++ compiler and runtime libraries

- First release of OpenM++ compiler (2.1 priority1), sufficient to compile simplest model
- First release of OpenM++ modelling library (3.1 priority1)

5. OpenM++ execute and data libraries

Time: 4-6 months?? (must be done together with step 4 above)

Result: Alpha version of OpenM++ compiler and runtime libraries

- First release of OpenM++ execute library (3.4. priority1)
- First release of OpenM++data library (3.3. priority1)
- First release of OpenM++ model data storage design (3.2 priority1)
- First release of OpenM++ cluster controllers (2.2 priority1)

6. Results review, roadmap adjustment

Time: one calendar week

Result: Updated roadmap document and adjusted project plan

7. (optional) Initial version of OpenM++ presentation library(s) for .NET (3.5 priority1)

Time: 2-4 weeks

Result: Alpha version of OpenM++ presenation libarary for .NET

8. (optional, depends on step 7) OpenM++ for Excel (1.2 priority1)

Time: 2-4 weeks

Result: Beta version of OpenM++ for Excel

- First release of OpenM++ result viewers for Excel (1.2 priority1)
- First release of OpenM++ presentation library for .NET (3.5 priority1) (it may be Excel-specific library)
- OpenM++ compiler and runtime libraries bug fixes discovered during development

9. (optional, depends on step 7) OpenM++ basic web UI sample pages for ASP.NET (1.2 priority2)

Time: 2-4 weeks

Result: Beta version of OpenM++ web UI primer for ASP.NET

- First release of OpenM++ basic web UI sample pages for ASP.NET (1.2 priority2)
- First release of OpenM++ presentation library(s) for .NET (3.5 priority1) (this is may be ASP.NET specific)
- OpenM++ compiler and runtime libraries bug fixes discovered during development

10. (optional, depends on step 7) First release of compatibility convertor for Modgen parameters .dat files (2.3 priority1)

Time: 2-4 weeks

Result: Beta version of OpenM++ convertor for Modgen parameters .dat files

11. (optional) First release of compatibility convertor for Modgen source model code .mpp files (2.3 priority2)

Time: 2-4 weeks

Result: Beta version of OpenM++ convertor for Modgen source code .mpp files

12. First public release

Time: 6-8 weeks

Result: Public beta version of OpenM++

- Project documentation
- Final testing and bug fixes
- Project review and roadmap adjustment
- First public release

2013, May: Prototype version

OpenM++ Prototype Version: May 2013

Initial openM++ prototype released on May 2013. It includes:

- openM++ compiler (initial prototype)
- runtime library (combined model, data and execute libs)
- two models, compiled, build and running on all target platforms

Important results are:

- openM++ is portable and highly scalable and can run single PC to supercomputing clusters
- openM++ model produce identical results for all platforms and matching existing Modgen results

Below screenshots captured from openM++ WizardCaseBased model running on:

- Windows 64bit, 8 subsamples
- Windows 32bit, 8 subsamples
- Linux 64bit MPI cluster, 8 subsamples
- Linux 32bit non-clustered and without MPI, 1 subsample
- Linux 64bit HPC cluster at ComputeCanada, 512 subsamples

```
C:\om\prototype_lib\openm\Release\x64>mpiexec -np 8 wizardCaseBased.exe
2013-05-10 10:39:15.0963 Model: WizardCaseBased
2013-05-10 10:39:15.0964 Model: WizardCaseBased
2013-05-10 10:39:15.0965 Model: WizardCaseBased
2013-05-10 10:39:15.0971 Model: WizardCaseBased
2013-05-10 10:39:15.0979 Model: WizardCaseBased
2013-05-10 10:39:15.0985 Model: WizardCaseBased
2013-05-10 10:39:15.0989 Model: WizardCaseBased
2013-05-10 10:39:15.0994 Model: WizardCaseBased
2013-05-10 10:39:15.0012 SubSample: 5
2013-05-10 10:39:15.0012 SubSample: 7
2013-05-10 10:39:15.0012 SubSample: 1
2013-05-10 10:39:15.0012 SubSample: 2
2013-05-10 10:39:15.0013 SubSample: 4
2013-05-10 10:39:15.0013 SubSample: 6
2013-05-10 10:39:15.0013 SubSample: 3
2013-05-10 10:39:16.0574 SubSample: 0
2013-05-10 10:39:16.0598 Reading Parameters
2013-05-10 10:39:16.0599 Reading Parameters
2013-05-10 10:39:16.0599 Reading Parameters
2013-05-10 10:39:16.0600 Reading Parameters
2013-05-10 10:39:16.0601 Running Simulation
2013-05-10 10:39:16.0602 Running Simulation
2013-05-10 10:39:16.0602 Running Simulation
2013-05-10 10:39:16.0602 Running Simulation
2013-05-10 10:39:16.0602 Running Simulation
2013-05-10 10:39:16.0603 Writing Output Tables
2013-05-10 10:39:16.0603 Running Simulation
2013-05-10 10:39:16.0605 Writing Output Tables
2013-05-10 10:39:16.0605 Writing Output Tables
2013-05-10 10:39:16.0606 Writing Output Tables
2013-05-10 10:39:16.0606 Writing Output Tables
2013-05-10 10:39:16.0607 Writing Output Tables
2013-05-10 10:39:16.0607 Writing Output Tables
2013-05-10 10:39:16.0607 Writing Output Tables
2013-05-10 10:39:16.0879 Done.
2013-05-10 10:39:16.0879 Done.
2013-05-10 10:39:16.0880 Done.
2013-05-10 10:39:16.0881 Done.
2013-05-10 10:39:16.0884 Done.
2013-05-10 10:39:16.0884 Done.
2013-05-10 10:39:16.0885 Done.
2013-05-10 10:39:16.0885 Done.

C:\om\prototype_lib\openm\Release\x64>sqlite3 -header -column WizardCaseBased.sqlite "SELECT Dim0, Value, Value0, Value1, Value2, Value3, Value4, Value5, Value6, Value7 FROM DurationOfLife ORDER BY 1"
Dim0      Value    Value0    Value1    Value2    Value3    Value4    Value5    Value6    Value7
-----  -----  -----  -----  -----  -----  -----  -----  -----  -----
0       5000.0   5000.0   5000.0   5000.0   5000.0   5000.0   5000.0   5000.0   5000.0
1       0.0081   0.0081   0.0099   0.0013   0.0003   0.0061   0.0068   0.0192   0.0154
2       540.7658  540.7658  760.8044  688.7917  630.3369  750.2663  722.9372  645.1384  567.2142
3       71.9845   71.9845   73.2788   71.5934   71.5169   71.4986   69.9491   73.0923   70.8712
```

CM Command Prompt

C:\om\prototype_lib\openm\Release\Win32> C:\om\prototype_lib\openm\Release\Win32>mpexec -np 8 wizardCaseBased.exe
Windows 32bit
2013-05-10 10:36:26.0404 Model: WizardCaseBased
2013-05-10 10:36:26.0406 Model: WizardCaseBased
2013-05-10 10:36:26.0411 Model: WizardCaseBased
2013-05-10 10:36:26.0413 Model: WizardCaseBased
2013-05-10 10:36:26.0419 Model: WizardCaseBased
2013-05-10 10:36:26.0422 Model: WizardCaseBased
2013-05-10 10:36:26.0423 Model: WizardCaseBased
2013-05-10 10:36:26.0437 Model: WizardCaseBased
2013-05-10 10:36:26.0461 SubSample: 4
2013-05-10 10:36:26.0461 SubSample: 1
2013-05-10 10:36:26.0461 SubSample: 3
2013-05-10 10:36:26.0462 SubSample: 6
2013-05-10 10:36:26.0462 SubSample: 2
2013-05-10 10:36:26.0463 SubSample: 5
2013-05-10 10:36:26.0463 SubSample: 7
2013-05-10 10:36:26.0475 SubSample: 0
2013-05-10 10:36:26.0481 Reading Parameters
2013-05-10 10:36:26.0482 Reading Parameters
2013-05-10 10:36:26.0483 Reading Parameters
2013-05-10 10:36:26.0484 Reading Parameters
2013-05-10 10:36:26.0485 Running Simulation
2013-05-10 10:36:26.0485 Running Simulation
2013-05-10 10:36:26.0485 Running Simulation
2013-05-10 10:36:26.0486 Running Simulation
2013-05-10 10:36:26.0486 Running Simulation
2013-05-10 10:36:26.0486 Running Simulation
2013-05-10 10:36:26.0486 Running Simulation
2013-05-10 10:36:26.0490 Writing Output Tables
2013-05-10 10:36:26.0490 Writing Output Tables
2013-05-10 10:36:26.0492 Writing Output Tables
2013-05-10 10:36:26.0493 Writing Output Tables
2013-05-10 10:36:26.0493 Writing Output Tables
2013-05-10 10:36:26.0494 Writing Output Tables
2013-05-10 10:36:26.0496 Writing Output Tables
2013-05-10 10:36:26.0497 Writing Output Tables
2013-05-10 10:36:27.0764 Done.
2013-05-10 10:36:27.0765 Done.
2013-05-10 10:36:27.0765 Done.
2013-05-10 10:36:27.0765 Done.
2013-05-10 10:36:27.0766 Done.
2013-05-10 10:36:27.0766 Done.
2013-05-10 10:36:27.0766 Done.

C:\om\prototype_lib\openm\Release\Win32>sqlite3 -header -column WizardCaseBased.sqlite "SELECT Dim0, Value, Value0, Value1, Value2, Value3, Value4, Value5, Value6, Value7 FROM DurationOfLife ORDER BY 1"
Dim0 Value Value0 Value1 Value2 Value3 Value4 Value5 Value6 Value7

0 5000.0 5000.0 5000.0 5000.0 5000.0 5000.0 5000.0 5000.0 5000.0
1 0.0081 0.0081 0.0099 0.0013 0.0003 0.0061 0.0068 0.0192 0.0154
2 540.7658 540.7658 760.8044 688.7917 630.3369 750.2663 722.9372 645.1384 567.2142
3 71.9845 71.9845 73.2788 71.5934 71.5169 71.4986 69.9491 73.0923 70.8712

```
mpi@omm:~$ login as: mpi
mpi@omm.beyond2020.com's password:
Last login: Fri May 10 11:13:35 2013 from wall.beyond2020.com
[mpi@omm ~]$ Beyond2020 HPC cluster
[mpi@omm ~]$ uname -a
Linux omm.beyond2020.com 2.6.32-358.6.1.el6.x86_64 #1 SMP Tue Apr 23 19:29:00 UTC 2013 x86_64 x86_64 x86_64 GNU/Linux
[mpi@omm ~]$ omrun -n 8 /mirror/wizardCaseBased
2013-05-10 11:18:39.0074 Model: WizardCaseBased
2013-05-10 11:18:39.0074 Model: WizardCaseBased
2013-05-10 11:18:39.0074 Model: WizardCaseBased
2013-05-10 11:18:39.0072 Model: WizardCaseBased
2013-05-10 11:18:39.0071 Model: WizardCaseBased
2013-05-10 11:18:39.0072 Model: WizardCaseBased
2013-05-10 11:18:39.0071 Model: WizardCaseBased
2013-05-10 11:18:40.0673 SubSample: 6
2013-05-10 11:18:40.0673 SubSample: 7
2013-05-10 11:18:40.0673 SubSample: 4
2013-05-10 11:18:40.0673 SubSample: 5
2013-05-10 11:18:40.0670 SubSample: 2
2013-05-10 11:18:40.0671 SubSample: 3
2013-05-10 11:18:40.0670 SubSample: 1
2013-05-10 11:18:41.0121 SubSample: 0
2013-05-10 11:18:41.0469 Reading Parameters
```

...skip some output here...

```
2013-05-10 11:18:41.0894 Writing Output Tables
2013-05-10 11:18:45.0006 Done.
2013-05-10 11:18:45.0006 Done.
2013-05-10 11:18:45.0006 Done.
2013-05-10 11:18:45.0009 Done.
2013-05-10 11:18:45.0009 Done.
2013-05-10 11:18:45.0008 Done.
2013-05-10 11:18:45.0011 Done.
[mpi@omm ~]$
[mpi@omm ~]$ sqlite3 -header -column /mirror/WizardCaseBased.sqlite "SELECT Dim0, Value, Value0, Value1, Value2, Value3, Value4, Value5, Value6, Value7 FROM DurationOfLife ORDER BY 1"
Dim0      Value    Value0   Value1   Value2   Value3   Value4   Value5   Value6   Value7
-----  -----  -----  -----  -----  -----  -----  -----  -----  -----
0        5000.0   5000.0   5000.0   5000.0   5000.0   5000.0   5000.0   5000.0
1        0.0081   0.0081   0.0099   0.0013   0.0061   0.0068   0.0192   0.0154
2        540.7658 540.7658 760.8044 688.7917 750.2663 722.9372 645.1384 567.2142
3        71.9845  71.9845  73.2788  71.5934  71.4986  69.9491  73.0923  70.8712
[mpi@omm ~]$
```

Terminal - anatoly@anatoly... anatoly - File Manager

Terminal - anatoly@anatoly-xu1204-1:~/prototype_lib/openm/bin/release

Ubuntu Linux, non-clustered

```
File Edit View Terminal Go Help
anatoly@anatoly-xu1204-1:~/prototype_lib/openm/bin/release$ uname -a
Linux anatoly-xu1204-1 3.2.0-41-generic #66-Ubuntu SMP Thu Apr 25 03:28:09 UTC 2013 i686 i686 i386 GNU/Linux
anatoly@anatoly-xu1204-1:~/prototype_lib/openm/bin/release$ ./wizardCaseBased
2013-05-10 16:05:05.0187 Model: WizardCaseBased
2013-05-10 16:05:05.0874 SubSample: 0
2013-05-10 16:05:05.0878 Reading Parameters
anatoly@anatoly-xu1204-1:~/prototype_lib/openm/bin/release$ sqlite3 -column -header WizardCaseBased.sqlite "SELECT Dim0, Value, Value0, Value1, Value2, Value3, Value4, Value5, Value6, Value7 FROM DurationOfLife ORDER BY 1"
Dim0      Value    Value0   Value1   Value2   Value3   Value4   Value5   Value6   Value7
-----  -----  -----  -----  -----  -----  -----  -----  -----  -----
0        5000.0   5000.0   5000.0   5000.0   5000.0   5000.0   5000.0   5000.0
1        0.0081   0.0081   0.0099   0.0013   0.0061   0.0068   0.0192   0.0154
2        540.7658 540.7658 760.8044 688.7917 750.2663 722.9372 645.1384 567.2142
3        71.9845  71.9845  73.2788  71.5934  71.4986  69.9491  73.0923  70.8712
anatoly@anatoly-xu1204-1:~/prototype_lib/openm/bin/release$
```

```

gpc-f104n084-$ showq -w user=anatoly

active jobs-----
JOBID          USERNAME      STATE PROCS  REMAINING           STARTTIME
                                         ComputeCanada SciNet GPC cluster: 32,508 CPU's
0 active jobs          0 of [32508 processors] in use by local jobs (0.00%)
                           3863 of 3963 nodes active   (97.48%)
eligible jobs-----
JOBID          USERNAME      STATE PROCS  WCLIMIT           QUEUETIME
17574880        anatoly       Idle   512    00:15:00   Fri May 10 15:53:35
1 eligible job

...skip some output here...
2013-05-10 20:59:24.0657 Done.
2013-05-10 20:59:24.0938 Done.

-----
Begin PBS Epilogue Fri May 10 20:59:32 EDT 2013 1368233972
Job ID:          17574880.gpc-sched
Username:        anatoly
Group:          mwolfson
Job Name:       wcb_test
Session:        22405
Limits:         neednodes=64:ppn=8 nodes=64:ppn=8,walltime=00:15:00
Resources:      cput=24:53:50,mem=24381588kb,vmem=99168844kb,walltime=00:04:19
Queue:          batch_ib
Account:
Nodes:          gpc-f103n024-ib0 gpc-f107n030-ib0 gpc-f107n036-ib0 gpc-f107n059-ib0
                gpc-f112n082-ib0 gpc-f115n060-ib0 gpc-f118n070-ib0 gpc-f119n029-ib0
...skip some output here...
End PBS Epilogue Fri May 10 20:59:33 EDT 2013 1368233973

-----
gpc-f104n084-$
gpc-f104n084-$ sqlite3 -column -header WizardCaseBased.sqlite 'SELECT Dim0, Value FROM DurationOfLife ORDER BY 1'
Dim0      Value
-----  -----
0        1073741824.0
1        0.0
2        1485.3154
3        71.4271
gpc-f104n084-$
-----  -----
WizardCaseBased model: 1,073,741,824 cases

gpc-f104n084-$ sqlite3 -column -header WizardCaseBased.sqlite 'SELECT DISTINCT M.sub_id AS "SubSample",  (SELECT
DurationOfLife_sub D0 WHERE D0.Dim0 = 0 AND D0.sub_id = M.sub_id) AS "Expr0",  (SELECT D1.sub_value FROM wizardcasebased
D = 1 AND D1.sub_id = M.sub_id) AS "Expr1",  (SELECT D2.sub_value FROM wizardcasebased_1_DurationOfLife_sub D2 WH
D AS "Expr2",  (SELECT D3.sub_value FROM wizardcasebased_1_DurationOfLife_sub D3 WHERE D3.Dim0 = 3 AND D3.sub_id
sed_1_DurationOfLife_sub M ORDER BY 1' |more
SubSample Expr0      Expr1      Expr2      Expr3
-----  -----  -----  -----  -----
0        1073741824.0  0.0       1485.3154  71.4271
1        1073741824.0  0.0       1485.3154  71.4268
2        1073741824.0  0.0       1534.8259  71.4294
3        1073741824.0  0.0       1534.8259  71.4279
4        1073741824.0  0.0       1534.8259  71.4288
-----  -----
WizardCaseBased: 512 sub-samples

...skip some output here...
509        1073741824.0  0.0       1534.8259  71.428
510        1073741824.0  0.0       1485.3154  71.4283
511        1073741824.0  0.0       1485.3154  71.4312
gpc-f104n084-$

```

2013 September: Alpha version

OpenM++ Alpha version: September 2013

OpenM++ alpha version released on September 2013. It includes:

- openM++ compiler (alpha version)
- runtime library (combined model, data and execute libs)
- three models, compiled, build and running on all target platforms

Important results are:

- openM++ models are highly portable, zero efforts required to run same model on different platforms
- openM++ model produce identical results for all platforms and matching existing Modgen results

Below screenshots captured from openM++ Alpha1 model running on:

- Windows 64bit, 8 subsamples
- Windows 32bit, 8 subsamples
- Linux 64bit MPI cluster, 8 subsamples
- Linux 32bit non-clustered and without MPI, 1 subsample
- Linux 64bit HPC cluster at ComputeCanada, 512 subsamples

Windows 64bit

Alpha1 model
8 subsamples
10,000,000 cases

Dim0	Value
0	80000000.0
1	1.56329148
2	1264.52664
3	71.4268421

Windows 32bit

```
C:\om\prototype_lib\openm\Release\Win32>mpiexec -np 8 Alpha1 -General.Cases 10000000
2013-09-26 10:56:55.0915 Model: Alpha1
2013-09-26 10:56:55.0931 Model: Alpha1
2013-09-26 10:56:55.0931 Model: Alpha1
2013-09-26 10:56:55.0931 Model: Alpha1
2013-09-26 10:56:55.0931 Model: Alpha1
2013-09-26 10:56:55.0947 Model: Alpha1
2013-09-26 10:56:55.0978 Reading Parameters
2013-09-26 10:56:55.0978 Running Simulation
2013-09-26 10:56:55.0978 Reading Parameters
2013-09-26 10:56:55.0978 Running Simulation
2013-09-26 10:56:55.0978 Running Simulation
2013-09-26 10:56:55.0978 Running Simulation
2013-09-26 10:56:55.0978 Running Simulation
2013-09-26 10:56:55.0056 Reading Parameters
2013-09-26 10:56:55.0056 Running Simulation
2013-09-26 10:56:55.0103 Reading Parameters
2013-09-26 10:56:55.0103 Running Simulation
2013-09-26 10:56:55.0212 Reading Parameters
2013-09-26 10:56:55.0212 Running Simulation
2013-09-26 11:01:03.0882 Writing Output Tables
2013-09-26 11:01:03.0412 Writing Output Tables
2013-09-26 11:01:04.0786 Writing Output Tables
2013-09-26 11:01:04.0958 Writing Output Tables
2013-09-26 11:01:05.0566 Writing Output Tables
2013-09-26 11:01:06.0565 Writing Output Tables
2013-09-26 11:01:06.0643 Writing Output Tables
2013-09-26 11:01:06.0204 Writing Output Tables
2013-09-26 11:01:06.0329 Done.
2013-09-26 11:01:06.0345 Done.

C:\om\prototype_lib\openm\Release\Win32>sqlite3 -header -column Alpha1.sqlite "SELECT S.unit_id AS "Dim0", S.value AS "Value" FROM alpha1_201309261008330703_v0_DurationOfLife S WHERE S.run_id = ( SELECT MAX(RL.run_id) FROM run_lst RL INNER JOIN model_dic MD ON (MD.model_id = RL.model_id) WHERE MD.model_name = 'Alpha1')"
Dim0      Value
-----
0        80000000.0
1        1.56329148
2        1264.52664
3        71.4268421
```

Beyond2020 Linux HPC cluster

```
[mpi@omm:~]$ login as: mpi
mpi@omm.beyond2020.com's password:
Last login: Thu Sep 26 13:40:37 2013 from wall.beyond2020.com
[mpi@omm ~]$ Linux omm.beyond2020.com 2.6.32-358.6.2.el6.x86_64 #1 SMP Thu May 16 20:59:36 UTC 2013 x86_64 x86_64 x86_64 GNU/Linux
[mpi@omm ~]$ 
[mpi@omm ~]$ omrun -n 8 /mirror/alpha1 -General.Cases 10000000
2013-09-26 14:02:50.0627 Model: Alpha1
2013-09-26 14:02:50.0623 Model: Alpha1
2013-09-26 14:02:50.0624 Model: Alpha1
2013-09-26 14:02:50.0629 Model: Alpha1
2013-09-26 14:02:50.0630 Model: Alpha1
2013-09-26 14:02:50.0632 Model: Alpha1
2013-09-26 14:02:50.0629 Model: Alpha1
2013-09-26 14:02:50.0627 Model: Alpha1
2013-09-26 14:02:52.0332 Reading Parameters
... skip some output here...
2013-09-26 14:04:15.0698 Writing Output Tables
2013-09-26 14:04:18.0856 Done.
2013-09-26 14:04:18.0856 Done.
2013-09-26 14:04:18.0856 Done.
2013-09-26 14:04:18.0852 Done.
2013-09-26 14:04:18.0852 Done.
2013-09-26 14:04:18.0852 Done.
2013-09-26 14:04:18.0859 Done.
[mpi@omm ~]$ 
[mpi@omm ~]$ sqlite3 -header -column /mirror/Alpha1.sqlite "SELECT S.unit_id AS "Dim0", S.value AS "Value" FROM alpha1_201309261328110855_v0_DurationOfLife S WHERE S.run_id = ( SELECT MAX(RL.run_id) FROM run_lst RL INNER JOIN model_dic MD ON (MD.model_id = RL.model_id) WHERE MD.model_name = 'Alpha1')"
Dim0      Value
-----
0        80000000.0
1        1.56329148
2        1264.52664
3        71.4268421
[mpi@omm ~]$ 
```

```

anatoly@anatoly-xu1304-1:~/prototype_lib/openm/bin/release$ uname -a
Linux anatoly-xu1304-1 3.8.0-31-generic #46-Ubuntu SMP Tue Sep 10 19:56:49 UTC 2013 i686 i686 i686 GNU/Linux
anatoly@anatoly-xu1304-1:~/prototype_lib/openm/bin/release$ 
anatoly@anatoly-xu1304-1:~/prototype_lib/openm/bin/release$ 
anatoly@anatoly-xu1304-1:~/prototype_lib/openm/bin/release$ ./alpha1 -General.Cases 10000000
2013-09-27 10:55:40.0071 Model: Alpha1
2013-09-27 10:55:40.0102 Reading Parameters
2013-09-27 10:55:40.0102 Running Simulation
2013-09-27 10:56:26.0308 Writing Output Tables
2013-09-27 10:56:26.0334 Done.
anatoly@anatoly-xu1304-1:~/prototype_lib/openm/bin/release$ sqlite3 -header -column Alpha1.sqlite "SELECT S.unit_id AS "Dim0", S.value AS "Value" FROM alpha1_201309271035060599_v0_DurationOfLife S WHERE S.run_id = (SELECT MAX(RL.run_id) FROM run_1st RL INNER JOIN model_dic MD ON (MD.model_id = RL.model_id) WHERE MD.model_name = 'Alpha1')"
Dim0      Value
-----  -----
0        10000000.0
1        8.48168823
2        1264.52664
3        71.4589877
anatoly@anatoly-xu1304-1:~/prototype_lib/openm/bin/release$ 

```

```

gpc-f102n084-$
gpc-f102n084-$ showq -w user=anatoly

active jobs-----
JOBID      USERNAME      STATE PROCS      REMAINING      STARTTIME
                                         ComputeCanada SciNet GPC cluster: 32,580 CPU's

0 active jobs          0 of 32580 processors in use by local jobs (0.00%)
                           3881 or 3572 nodes active (97.71%)

eligible jobs-----
JOBID      USERNAME      STATE PROCS      WCLIMIT      QUEUETIME
20703912      anatoly      Idle      512      1:00:00  Mon Nov 18 08:42:57

1 eligible job

```

```

2013-11-18 10:11:50.0742 Done.
2013-11-18 10:11:50.0744 Done.

Begin PBS Epilogue Mon Nov 18 10:11:56 EST 2013 1384787516
Job ID:      20703912.gpc-sched
Username:    anatoly
Group:      mwolfson
Job Name:   alpha1_test
Session:    25636
Limits:     neednodes=64:ppn=8 nodes=64:ppn=8,walltime=01:00:00
Resources:  cput=11:12:20,mem=85000000kb,vmem=143316160kb,walltime=00:03:10
Queue:      batch_ib
Account:
Nodes:      gpc-f109n030-ib0 gpc-f109n031-ib0 gpc-f109n032-ib0 gpc-f109n033-ib0
           gpc-f109n034-ib0 gpc-f109n035-ib0 gpc-f109n037-ib0 gpc-f109n038-ib0

512 CPU's used by Alpha1 model

```

```

End PBS Epilogue Mon Nov 18 10:11:57 EST 2013 1384787517
-----
gpc-f102n084-$
gpc-f102n084-$ sqlite3 -header Alpha1.sqlite "SELECT S.unit_id AS "Dim0", S.value AS "Value" FROM alpha1_201311161801100756_v0_DurationOfLife S WHERE S.run_id = (SELECT MAX(RL.run_id) FROM run_1st RL INNER JOIN model_dic MD ON (MD.model_id = RL.model_id) WHERE MD.model_name = 'Alpha1')"
Dim0      Value
-----  -----
0        5120000000.0
1        3.3261520529
2        1534.8258997
3        71.428337802

```

Alpha1 model
512 subsamples
10,000,000 cases

2014 March: Project Status, Phase 1 completed

Current Project Status

OpenM++ phase 1 completed in March 2014 with following results (enumeration corresponds to [OpenM++ design](#) document, which also describes tasks):

- OpenM++ compiler (2.1 priority1): alpha version, working beta version with 60% functionality coverage
 - types (classifications, ranges, partitions)
 - parameters (exogeneous)
 - agents
 - variables (25% complete)
 - inter-agent links
 - events
 - cross tabulation (except margins)
 - meta-information (except labels & groups)
- OpenM++ controller for MPI cluster (2.2 priority1): beta version
- OpenM++ modelling library (3.1 priority1): beta version
 - case-based and time-based models
 - agent & event lifecycle
 - event queue
 - on-the-fly cross-tabulation updating
 - Modgen-equivalent random number generators for exact output comparability
- OpenM++ model data storage design (3.2 priority1): beta version
- OpenM++ data library (3.3. priority1): beta version
- OpenM++ execute library (3.4 priority1): beta version

On top of essential phase 1 Roadmap tasks following items completed:

- compatibility layer for Modgen source model code .mpp files (2.3 priority2): alpha version
- OpenM++ output result viewers and model analysis tools, import/export into R (1.2 priority2): beta version

Deferred items mentioned in [phase 1 Roadmap](#):

- all optional items (except two listed above) due to limited resources
- compatibility converter for Modgen parameters .dat files (2.3 priority1) postponed after extensive design discussions.
- components of OpenM++ compiler (2.1 priority1) due to limited resources
 - agent collections
 - parameters (endogenous)
 - variables (75% remaining)
 - cross-tabulation (margins)
 - meta-information (labels & groups)
 - derived tables
 - other miscellaneous functionality

Overall results of OpenM++ phase 1 cover most of existing Modgen desktop functionality (excluding GUI).

What Next

OpenM++ foundation created as result of phase 1 project and it is opens up following four streams for subsequent development:

- model stream: ongoing work to move existing Modgen models onto OpenM++ platform
- cloud stream: build openM++ cloud PaaS and/or SaaS stack, emphasizing on scalability. **Time:** 11 months
- tools stream: creating openM++ desktop GUI based on Visual Studio, Eclipse or similar for model developers and users. **Time:** 9 months
- core stream: enhance openM++ core functionality, for example, modelling results post-processing and analysis.

Tools and cloud stream partially described in OpenM++ Design and Model Architecture documents.

Core stream task list is very flexible because it is generally include OpenM++ small core enhancements required for other development streams.

For example, as it is today, beta version of OpenM++ supports only SQLite as model database storage and cloud version of OpenM++ most likely require at least one of MySQL, PostgreSQL, Oracle, MSSQL or DB2 support. Due to flexible nature of core stream development it can be done incrementally as long as resources available, however it is very important strictly follow OpenM++ Design documents to make sure we are proceeding to the right direction and avoid common "creeping featurism" mistake.

Current List of small tasks

Following tasks are required to be completed before or during OpenM++ cloud or desktop GUI development (enumeration corresponds to [OpenM++ design](#)):

- OpenM++ output converters:
 - 2.5 priority 1: export into .csv for parameters and output results. **Time:** 10 days
 - 2.5 priority 2: export into .xml for model data or user-defined subset of model data. **Time:** 16 days
- OpenM++ SQL loaders. **Time:** 4 weeks + 10 days for each db-vendor
 - 2.4 priority 1: MS SQL, MySQL / MariaDB
 - 2.4 priority 2: generic SQL99
 - 2.4 priority 3: PostgreSQL, Oracle, DB2, Apache Derby, H2 or HSQL
- extend data library to support MySQL, PostgreSQL, Oracle, MSSQL or DB2 (3.3 priority3). **Time:** 3-4 weeks for each db-vendor
- completion of OpenM++ core support for i18n / L10n in runtime library. **Time:** 3 weeks
- Modgen .dat files compatibility converter (2.3 priority 1): required design decision. **Time:** from 10 days to 6 weeks.
- exploratory subsamples suite for OpenM++ models (see below). **Time:** between 5-9 weeks

Their is no fixed order in the list above, it can be implemented as required by other project or OpenM++ users.

Task: Modgen .dat files compatibility converter

This is high priority component which defined in [OpenM++ design](#) document (2.3 priority 1) as command-line utility to convert existing Modgen models data into OpenM++ format. It was originally planned for phase 1 development, but deferred due to unresolved design dependency with other parts of OpenM++, i.e. cloud model publisher or SQL loaders mentioned above.

There are two important aspects of .dat-converter design:

- language complexity of .dat file syntax, which is in fact c++ initializers syntax with Modgen extensions
- environmental complexity of .dat-converter use cases

Environmental complexity actually means variety of .dat-converter use case scenarios in not yet well defined runtime environment. Please look at explanation on OpenM++ model use cases in [Model Architecture](#) document for more details.

Some examples may include:

- developer:
 - uses local Windows or Linux PC with GUI
 - often recreate SQLite database and load input data hundred times to debug the model
 - eventually need to pack model executable and data files and send it to researcher
- researcher:
 - HPC cluster (large or small) or local Windows, Linux workstation without GUI
 - run the model thousand times loading wide variety of input data from prepared .dat files
 - do not have admin privileges, especially on cluster, as result, can not install or adjust runtime environment
 - often need to pack model .dat files to publish it, move from local PC to HPC cluster or share with other researchers
- institutional user:
 - uses web UI to run the model in cloud, on HPC cluster or other powerful server environment
 - have absolutely no access to actual server environment
 - receives initial set of input .dat files from developer or researcher and want to upload it into cloud database
 - cloud database most likely one of: MySQL, Oracle, MSSQL, PostgreSQL, DB2

From examples above you can see following requirements to model input data tools:

- it must be portable and can not assume specific OS or database
- user may have no access to actual model database (i.e. model developer have no access to cloud instance)

Possible solutions for .dat-files converter in context of above requirements:

- due to language complexity of .dat files it is nice to use OpenM++ compiler (omc) to parse it
- omc read .dat files and saves as:
 - c++ values compiled into model executable, which in turn, saves it into target database during first run
 - pro: everything in one file, ideal for consistency and transfer
 - cons: model executable is huge, which increase compilation and execution time
 - pro/cons: it is not possible to change model input data without re-compilation
 - SQLite database
 - pro: compact storage
 - pro: ideal for model developer (or even researcher) as no any other steps required to run the model
 - pro: there are many standard utilities to browse or edit the data
 - cons: extra tool required to import from SQLite into actual database in cloud environment
 - sql script files
 - pro: portable and human-readable format
 - pro: no any other tools required to transfer data from one environment into another
 - cons: least compact storage, size of input data files are largest of all
 - some other text format, i.e.: .csv or .xml files
 - pro: portable and human-readable format
 - cons: some custom tools required to load the data from such files into model database

We must keep in mind when choosing .dat-converter solution couple of other items from [OpenM++ design](#) document:

- OpenM++ must have SQL-loader utilities to facilitate data export into different model databases
- OpenM++ must have utilities to export input (and output) data into other formats, i.e.: text .csv and .xml files

That means we can rely on presence such OpenM++ utilities in foreseeable future.

Task: Exploratory subsamples suite for OpenM++ models

Current OpenM++ model subsamples design is Modgen-compatible. It was done on purpose to provide Modgen model developers and users familiar concepts and even ability to reuse existing tools within OpenM++. However, there is fundamental limitation in that design, which became obvious when OpenM++ model runs in HPC cluster environment.

For example, if we have 16,000 CPUs cluster then it may be make sense to prepare 1000 different sets of input parameters, submit model job with those 1000 inputs * 16 subsamples each to use all 16,000 CPUs and analyse results to find optimal set of model parameters. It is possible to do in OpenM++ now by specifying working set of input parameters for and run the model 1000 times by submitting 1000 jobs to the cluster. However it would be nice to have such capability incorporated in OpenM++ runtime to allow simply submit single job with 1000 different sets of parameters and 16 subsamples each.

To implement such feature following changes in OpenM++ required:

- execution library: organize model MPI groups to effectively broadcast input parameters to slave modelling processes
- model database schema: allow multiple sets of input parameters for each model run (Modgen allow only single)
- model database schema: store relationship between input set and output results inside of single modelling job
- data library: redesign output results aggregation to do it over related output values (now it is done across all subsamples)

That feature should significantly increase model users productivity and allow more effective HPC cluster resource usage. It is recommended to have it for OpenM++ cloud version.

2016 December: Task List

There is no fixed order in the list below, it can be implemented as required by other project or OpenM++ users.

Soft simulation failure

Currently any model exception is a hard failure and result in model shutdown. It may be right things to do in most situations but can be soften for some simulation errors. If special `SimulationException` thrown by model it should only abort current model run (or even current subsample only) and allow to proceed with next run from modeling task (or next subsample).

Write fixed model parameters in database

Currently fixed (or model generated or derived) model parameters not saved in database and completely hidden from model user. It is a good feature of openM++ in terms of data security, but may not be always necessary. It would be nice to have special openM++ language clause which model developer can use to control when fixed (or model generated or derived) parameter completely hidden or written in database as "output read-only parameter".

Write only selected output tables in database

Currently all output tables written in database as result of model run, which may be unnecessary if user doing parameter estimation and interested only in one or small subset of output tables. It would be nice to have an ability to specify which output tables needs to be written in database.

2017 January: Design Notes. Subsample As Parameter problem. Completed

Status: completed

Task is completed, notes below we do keep just in case.

Problem Scope

This is design notes, it is sketchy and may be incorrect, feel free to change it.

Currently we have one special model parameter: subsample number (a.k.a. member or replica). It is created by runtime as integer [0,N] where N is number of subsamples specified as run option:

```
model.exe -General.Subsamples 16
```

Subsample number plays fundamental role in calculation of [model Output Expressions](#). It is only parameter which used to calculate average (CV, SE, SD and all others) output values. For example if model runs with 16 subsamples then it will produce 16 values for each output accumulator and output expression value is an average of 16 accumulators across subsamples.

It may not be always necessary to have subsample number as special parameter; it can be any other model parameter or set of parameters which varies between model runs. And output expression(s) can be calculated as average (CV, SD, etc.) across any parameter values. However such "demote of subsample number" is quite significant change in model runtime.

Currently model run cycle looks like (extremely simplified):

- start model.exe and connect to database
- read all model parameters
- create modeling threads for each model subsample
- run modeling threads: do simulation
- write output accumulators for each subsample in database
- wait until all subsamples done (wait for exit from all modeling threads)
- calculate output expression values as average (CV,SE,SD,etc.) of accumulators across subsamples
- report on simulation success and exit from model main

If we decide to "demote subsample" or call it as "generalize parameters" then modeling cycle can look like:

- use some external utility to create modeling task and prepare set of input parameter (see [Model Run: How to Run the Model](#))
- (optional) specify runtime expression to vary some model parameters, e.g. subsample number parameter
- run model until modeling task completed (until all input processed) and write all accumulators into database
- use some external utility to calculate output expressions as average (CV,SE,SD,etc.) across any parameter(s)

Questions and problems:

1. How to specify model parameters generators (how to calculate model parameters at runtime). Now we have ompp code translated into c++ by omc compiler to do all derived (model-generated) parameters. It is not dynamic enough - we don't want and should not re-compile model to specify parameter(s) generator. We also have primitive subsample number parameter generator as [0,N]. Such primitive for-loop generators may be good in many situations but not enough.

Is it enough to have an ability in model runtime specify for-loop parameter(s) generator(s) and rely on external utilities (i.e. use our R package) to create more complex modeling tasks?

2. Output expressions calculations. Now we use SQL to calculate averages and, in fact, that SQL allow to have almost arbitrary calculation, but it does aggregation across subsample number.

How to generalize SQL to aggregate across any parameter values, not only subsample number? Do we need to replace SQL with c++ code in

model runtime? Do we need to create other "db_aggregator" utility instead of using model?

3. How to specify parameter generators and output expressions to make it powerful enough and avoid re-inventing of R (Octave, Matlab, SPSS, SAS)?

Example of the problem

Let's assume some hypothetical model with following input parameters:

- population by age and sex
- taxation level
- election outcome
- workforce strike longevity
- random generator seed And model output value is household income.

Model input parameters can be divided in following categories:

- "constant": where parameter values are known and does not change during modeling
 - population current and projected values assumed to be well known and fixed for our model
- "variable": parameter(s) which user want to change to study effect on modeling output results
 - taxation level varies from 1% to 80% with 0.1% step
- "uncertainty": parameters where values are random
 - election outcome parameter: Bernoulli distribution (binary) with mean = 0.6
 - workforce strike: Poisson distribution with rate = 4
 - random number generator seed

In order to study taxation level effect user run the model 800 times with different tax percent input value and calculate 800 average household income output values. Each output income value is an average of 32 "accumulator" values. Each "accumulator" value is a household income value produced by the model for specific combination of "uncertainty" parameters:

```
// create 32 input tuples of uncertainty parameters
//
int setId = database.CreateWorkset(); // input set of uncertainty parameters
bool isBluePartyWin = false;           // election results: win of "blue" or "red" party
double strikeDays = 7.5;              // number of strike days per year
int randomSeed = 12345;               // random number generator seed

for (int k = 0; k < 32; k++) {
    isBluePartyWin = Bernoulli(0.6);
    strikeDays = SumOf_Poisson(4.0);
    seed++;
    // write "uncertainty" parameters into database input set: tuple number = k
    database.WriteParameters(setId, k, isBluePartyWin, strikeDays, randomSeed);
}

// run the model
//
for (double tax = 1; tax < 82; tax += 0.1) {
    model.exe -Parameter.Taxation tax -UncertaintyParameters setId
}
//
// plot output household income depending on taxation level
//
```

Pseudo code above can be implemented in Perl, R or using shell script. Also openM++ already support [Modeling Task](#) which allow to submit multiple inputs to the model and vary parameter(s) values similar to example above.

Solution overview

OpenM++ already have most of components required for our solution, please take a look at:

- [Modeling Task](#)
- [Input parameters sets \(workset\)](#)

- Results aggregation: Model Output Expressions

Following can be done to solve a problem from example above:

1. **Use existing:** R API to create [Modeling Task](#) with 800 values of taxation level parameter.
2. **Add new:** Create tools to generate uncertainty parameters. It can be command-line utilities, GUI tool(s) or part of model runtime. Last option would allow us to reuse existing c++ code.
3. **Add new:** Change database schema in order to store tuples of uncertainty parameters as part of model run input. Currently model is using only single input set of parameters (workset) with single value of each parameter. We need to change database schema and model run initialization ([input parameters search in database](#)) in order to supply all 32 tuples of uncertainty parameters for every model run.
4. **Add new:** Change parameters memory management in order to provide unique value of each uncertainty parameter to each modeling thread. Now all parameters have only one copy of values and it is shared between all subsamples (threads and processes); only subsample number is unique and not shared between threads (see [model run on single computer](#)). And with new runtime we need to make sure only "constant" and "variable" parameters (like population and taxation level above) are shared and "uncertainty" parameters (election outcome, strike, random seed) are unique for each thread.
5. **Add new:** In case if [model run on MPI cluster](#), when there are multiple modeling processes, we need to correctly supply unique values of all uncertainty parameters to each process. Now only subsample number is unique.
6. **Add new:** Change database schema similar to (3) above for model run parameters. Model run contains full copy of input parameters. Today it is only one value for each parameter and we need to change it in order to store all 32 tuples of uncertainty parameters in model run results.
7. **Use existing:** [Model Output Expressions](#) for output results aggregation. No changes required. We not yet have capabilities to compare model run results similar to what ModgenWeb does, but this is out of problem scope.

We can split implementation into two steps:

- First do all necessary run time changes (items 3, 4, 5 and 6 above). That would allow us to run the model with uncertainty parameters created by external tools, for example by R.
- Second is to implement "parameters generators" (item 2 above) to make it convenient to model user.

During that two steps process it is also necessary to implement some compatibility logic to supply parameter "Subsample" in order to keep existing models working.

Note: We should also solve ambiguity of "subsample" term, inherited from Modgen. It can be a model integer parameter with name "Subsample" and in that case it same as any other model parameter, no any kind of special meaning or treatment required. It is also can be used as "uncertainty tuple number" and may not be necessary exposed to modeling code, it can be internal to model runtime and visible in database schema as `sub_id` to order accumulator values and make it comparable between model runs.

GET model list

Get list of the models.

Method:

```
GET /api/model-list
```

Call example:

```
http://localhost:4040/api/model-list
```

Return example: This is a beta version and may change in the future.

```
[  
  {  
    "ModelId": 101,  
    "Name": "IDMM",  
    "Digest": "0f76e04fb52de763f836c7b026c00f80",  
    "Type": 1,  
    "Version": "2.0.0.0",  
    "CreateDateTime": "2017-12-19 15:19:57.0747",  
    "DefaultLangCode": "EN"  
,  
  {  
    "ModelId": 101,  
    "Name": "NewCaseBased",  
    "Digest": "649f17f26d67c37b78dde94f79772445",  
    "Type": 0,  
    "Version": "1.0.0.0",  
    "CreateDateTime": "2017-12-19 15:21:14.0232",  
    "DefaultLangCode": "EN"  
,  
  {  
    "ModelId": 101,  
    "Name": "NewTimeBased",  
    "Digest": "0ceaa8fb0b762c5cb287a4910ede8f7",  
    "Type": 1,  
    "Version": "1.0.1.0",  
    "CreateDateTime": "2017-12-19 15:21:47.0408",  
    "DefaultLangCode": "EN"  
,  
  {  
    "ModelId": 1,  
    "Name": "modelOne",  
    "Digest": "_201208171604590148_",  
    "Type": 0,  
    "Version": "1.0",  
    "CreateDateTime": "2012-08-17 16:04:59.0148",  
    "DefaultLangCode": "EN"  
}  
]
```

GET model list including text (description and notes)

Get model list including text (description and notes).

Methods:

```
GET /api/model-list/text  
GET /api/model-list/text/lang/:lang  
GET /api/model-list-text?lang=en
```

Arguments:

```
:lang - (optional) language code
```

If optional `lang` argument specified then result in that language else in browser language or model default. If no such language exist then result in model default language or can be empty.

Call examples:

```
http://localhost:4040/api/model-list/text  
http://localhost:4040/api/model-list/text/lang/en  
http://localhost:4040/api/model-list-text?lang=en
```

Return example: *This is a beta version and may change in the future.*

```
[
  {
    "Model": {
      "ModelId": 101,
      "Name": "IDMM",
      "Digest": "0f76e04fb52de763f836c7b026c00f80",
      "Type": 1,
      "Version": "2.0.0.0",
      "CreateDateTime": "2017-12-19 15:19:57.0747",
      "DefaultLangCode": "EN"
    },
    "DescrNote": {
      "LangCode": "EN",
      "Descr": "model",
      "Note": ""
    }
  },
  {
    "Model": {
      "ModelId": 101,
      "Name": "NewCaseBased",
      "Digest": "649f17f26d67c37b78dde94f79772445",
      "Type": 0,
      "Version": "1.0.0.0",
      "CreateDateTime": "2017-12-19 15:21:14.0232",
      "DefaultLangCode": "EN"
    },
    "DescrNote": {
      "LangCode": "EN",
      "Descr": "Simple case-based model",
      "Note": "This model can serve as a starting point for more complex case-based models."
    }
  },
  {
    "Model": {
      "ModelId": 101,
      "Name": "NewTimeBased",
      "Digest": "0ceaa8fbc0b762c5cb287a4910ede8f7",
      "Type": 1,
      "Version": "1.0.1.0",
      "CreateDateTime": "2017-12-19 15:21:47.0408",
      "DefaultLangCode": "EN"
    },
    "DescrNote": {
      "LangCode": "EN",
      "Descr": "Simple time-based model",
      "Note": "This model can serve as a starting point for more complex time-based models."
    }
  },
  {
    "Model": {
      "ModelId": 1,
      "Name": "modelOne",
      "Digest": "_201208171604590148_",
      "Type": 0,
      "Version": "1.0",
      "CreateDateTime": "2012-08-17 16:04:59.0148",
      "DefaultLangCode": "EN"
    },
    "DescrNote": {
      "LangCode": "EN",
      "Descr": "First model",
      "Note": "First model: openM++ development test model"
    }
  }
]
```

GET model definition metadata

Get model definition: language-neutral part of model metadata.

Methods:

```
GET /api/model?model=modelNameOrDigest  
GET /api/model/:model
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model?model=modelOne  
http://localhost:4040/api/model?model=649f17f26d67c37b78dde94f79772445  
http://localhost:4040/api/model/modelOne  
http://localhost:4040/api/model/649f17f26d67c37b78dde94f79772445
```

Return example:

```
{  
  "Model": {  
    "ModelId": 1,  
    "Name": "modelOne",  
    "Digest": "_201208171604590148_",  
    "Type": 0,  
    "Version": "1.0",  
    "CreateDateTime": "2012-08-17 16:04:59.148",  
    "DefaultLangCode": "EN"  
  },  
  "Type": [  
    {  
      "ModelId": 1,  
      "TypeId": 4,  
      "TypeHid": 4,  
      "Name": "int",  
      "Digest": "_int_",  
      "DicId": 0,  
      "TotalEnumId": 1,  
      "Enum": null  
    },  
    {  
      "ModelId": 1,  
      "TypeId": 7,  
      "TypeHid": 7,  
      "Name": "bool",  
      "Digest": "_bool_",  
      "DicId": 1,  
      "TotalEnumId": 2,  
      "Enum": [  
        {  
          "ModelId": 1,  
          "TypeId": 7,  
          "EnumId": 0,  
          "Name": "false"  
        },  
        {  
          "ModelId": 1,  
          "TypeId": 7,  
          "EnumId": 1,  
          "Name": "true"  
        }  
      ]  
    },  
    {  
      "ModelId": 1,  
      "TypeId": 14,  
      "TypeHid": 14,  
      "Name": "double",  
      "Digest": "_double_",  
      "DicId": 0,  
      "TotalEnumId": 0,  
      "Enum": null  
    }  
  ]  
}
```

```
"TotalEnumId": 1,
"Enum": null
},
{
  "ModelId": 1,
  "TypeId": 21,
  "TypeHid": 21,
  "Name": "file",
  "Digest": "_file_",
  "DicId": 0,
  "TotalEnumId": 1,
  "Enum": null
},
{
  "ModelId": 1,
  "TypeId": 101,
  "TypeHid": 96,
  "Name": "age",
  "Digest": "_20128171604590121",
  "DicId": 2,
  "TotalEnumId": 500,
  "Enum": [
    {
      "ModelId": 1,
      "TypeId": 101,
      "EnumId": 10,
      "Name": "10-20"
    },
    {
      "ModelId": 1,
      "TypeId": 101,
      "EnumId": 20,
      "Name": "20-30"
    },
    {
      "ModelId": 1,
      "TypeId": 101,
      "EnumId": 30,
      "Name": "30-40"
    },
    {
      "ModelId": 1,
      "TypeId": 101,
      "EnumId": 40,
      "Name": "40+"
    }
  ]
},
{
  "ModelId": 1,
  "TypeId": 102,
  "TypeHid": 97,
  "Name": "sex",
  "Digest": "_20128171604590122",
  "DicId": 2,
  "TotalEnumId": 800,
  "Enum": [
    {
      "ModelId": 1,
      "TypeId": 102,
      "EnumId": 0,
      "Name": "M"
    },
    {
      "ModelId": 1,
      "TypeId": 102,
      "EnumId": 1,
      "Name": "F"
    }
  ]
},
{
  "ModelId": 1,
  "TypeId": 103,
  "TypeHid": 98,
  "Name": "salary",
  "Digest": "_20128171604590123",
  "DicId": 2,
  "TotalEnumId": 400,
  "Enum": [
    {
      "ModelId": 1,
      "TypeId": 103,
      "EnumId": 100,
      "Name": "L"
    },
    {

```

```
"ModelId": 1,
"TypeId": 103,
"EnumId": 200,
"Name": "M"
},
{
"ModelId": 1,
"TypeId": 103,
"EnumId": 300,
"Name": "H"
}
],
{
"ModelId": 1,
"TypeId": 104,
"TypeHid": 99,
"Name": "full",
"Digest": "_20128171604590124",
"DicId": 2,
"TotalEnumId": 44,
"Enum": [
{
"ModelId": 1,
"TypeId": 104,
"EnumId": 22,
"Name": "Full"
},
{
"ModelId": 1,
"TypeId": 104,
"EnumId": 33,
"Name": "Part"
}
]
},
"Param": [
{
"ModelId": 1,
"ParamId": 0,
"ParamHid": 44,
"Name": "ageSex",
"Digest": "_20128171604590131",
"Rank": 2,
"TypeId": 14,
"IsExtendable": true,
"IsHidden": false,
"NumCumulated": 0,
"DbRunTable": "ageSex_p_2012817",
"DbSetTable": "ageSex_w_2012817",
"ImportDigest": "_i0128171604590131",
"Dim": [
{
"ModelId": 1,
"ParamId": 0,
"DimId": 0,
"Name": "dim0",
"TypeId": 101
},
{
"ModelId": 1,
"ParamId": 0,
"DimId": 1,
"Name": "dim1",
"TypeId": 102
}
],
"Import": [
{
"ModelId": 1,
"ParamId": 0,
"FromName": "ageSexIncome",
"FromModel": "modelOne",
"IsSampleDim": false
}
]
},
{
"ModelId": 1,
"ParamId": 1,
"ParamHid": 45,
"Name": "salaryAge",
"Digest": "_20128171604590132",
"Rank": 2,
"TypeId": 4,
"IsExtendable": false,
```

```
"IsHidden": false,
"NumCumulated": 0,
"DbRunTable": "salaryAge_p_2012818",
"DbSetTable": "salaryAge_w_2012818",
"ImportDigest": "_i0128171604590132",
"Dim": [
  {
    "ModelId": 1,
    "ParamId": 1,
    "DimId": 0,
    "Name": "dim0",
    "TypeId": 103
  },
  {
    "ModelId": 1,
    "ParamId": 1,
    "DimId": 1,
    "Name": "dim1",
    "TypeId": 101
  }
],
"Import": [
  {
    "ModelId": 1,
    "ParamId": 1,
    "FromName": "salaryAge",
    "FromModel": "modelOne",
    "IsSampleDim": false
  }
]
},
{
  "ModelId": 1,
  "ParamId": 2,
  "ParamHid": 46,
  "Name": "StartingSeed",
  "Digest": "_20128171604590133",
  "Rank": 0,
  "TypeId": 4,
  "IsExtendable": false,
  "IsHidden": false,
  "NumCumulated": 0,
  "DbRunTable": "StartingSeed_p_2012819",
  "DbSetTable": "StartingSeed_w_2012819",
  "ImportDigest": "_i0128171604590133",
  "Dim": null,
  "Import": [
    {
      "ModelId": 1,
      "ParamId": 2,
      "FromName": "StartingSeed",
      "FromModel": "modelOne",
      "IsSampleDim": false
    }
  ]
},
{
  "ModelId": 1,
  "ParamId": 3,
  "ParamHid": 47,
  "Name": "salaryFull",
  "Digest": "_20128171604590134",
  "Rank": 1,
  "TypeId": 104,
  "IsExtendable": false,
  "IsHidden": false,
  "NumCumulated": 0,
  "DbRunTable": "salaryFull_p_2012812",
  "DbSetTable": "salaryFull_w_2012812",
  "ImportDigest": "_i0128171604590134",
  "Dim": [
    {
      "ModelId": 1,
      "ParamId": 3,
      "DimId": 0,
      "Name": "dim0",
      "TypeId": 103
    }
  ],
  "Import": null
},
{
  "ModelId": 1,
  "ParamId": 4,
  "ParamHid": 48,
  "Name": "baseSalary",
  "Digest": "_20128171604590135",
  "Rank": 0
```

```
    "Rank": 0,
    "TypeId": 104,
    "IsExtendable": false,
    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "baseSalary_p_2012811",
    "DbSetTable": "baseSalary_w_2012811",
    "ImportDigest": "_i0128171604590135",
    "Dim": null,
    "Import": null
},
{
    "ModelId": 1,
    "ParamId": 5,
    "ParamHid": 49,
    "Name": "filePath",
    "Digest": "_20128171604590136",
    "Rank": 0,
    "TypeId": 21,
    "IsExtendable": false,
    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "filePath_p_2012814",
    "DbSetTable": "filePath_w_2012814",
    "ImportDigest": "_i0128171604590136",
    "Dim": null,
    "Import": null
},
{
    "ModelId": 1,
    "ParamId": 6,
    "ParamHid": 50,
    "Name": "isOldAge",
    "Digest": "_20128171604590137",
    "Rank": 1,
    "TypeId": 7,
    "IsExtendable": false,
    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "isOldAge_p_2012815",
    "DbSetTable": "isOldAge_w_2012815",
    "ImportDigest": "_i0128171604590137",
    "Dim": [
        {
            "ModelId": 1,
            "ParamId": 6,
            "DimId": 0,
            "Name": "dim0",
            "TypeId": 101
        }
    ],
    "Import": null
},
],
"Table": [
{
    "ModelId": 1,
    "TableId": 0,
    "TableHid": 82,
    "Name": "salarySex",
    "Digest": "_20128171604590182",
    "IsUser": false,
    "Rank": 2,
    "IsSparse": true,
    "DbExprTable": "salarySex_v_2012882",
    "DbAccTable": "salarySex_a_2012882",
    "DbAccAllView": "salarySex_d_2012882",
    "ExprPos": 1,
    "IsHidden": false,
    "ImportDigest": "_i0128171604590182",
    "Dim": [
        {
            "ModelId": 1,
            "TableId": 0,
            "DimId": 0,
            "Name": "dim0",
            "TypeId": 103,
            "IsTotal": false,
            "DimSize": 3
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "DimId": 1,
            "Name": "dim1",
            "TypeId": 102,
            "IsTotal": true,
            "DimSize": 3
        }
    ]
}
```

```

        },
    ],
    "Acc": [
        {
            "ModelId": 1,
            "TableId": 0,
            "AccId": 0,
            "Name": "acc0",
            "IsDerived": false,
            "SrcAcc": "value_sum()",
            "AccSql": "A.acc_value"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "AccId": 1,
            "Name": "acc1",
            "IsDerived": false,
            "SrcAcc": "value_count()",
            "AccSql": "SELECT A1.acc_value FROM salarySex_a_2012882 A1 WHERE A1.run_id = A.run_id AND A1.sub_id = A.sub_id AND A1.dim0 = A.dim0 AND A1.dim1 = A.dim1 AND A1.acc_id = 1"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "AccId": 2,
            "Name": "acc2",
            "IsDerived": true,
            "SrcAcc": "acc0 + acc1",
            "AccSql": "(A.acc_value) + (SELECT A1.acc_value FROM salarySex_a_2012882 A1 WHERE A1.run_id = A.run_id AND A1.sub_id = A.sub_id AND A1.dim0 = A.dim0 AND A1.dim1 = A.dim1 AND A1.acc_id = 1)"
        }
    ],
    "Expr": [
        {
            "ModelId": 1,
            "TableId": 0,
            "ExprId": 0,
            "Name": "expr0",
            "Decimals": 4,
            "SrcExpr": "OM_AVG(acc0)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, AVG(M1.acc_value) AS expr0 FROM salarySex_a_2012882 M1 WHERE M1.acc_id = 0 GROUP BY M1.run_id, M1.dim0, M1.dim1"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "ExprId": 1,
            "Name": "expr1",
            "Decimals": 4,
            "SrcExpr": "OM_SUM(acc1)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, SUM(M1.acc_value) AS expr1 FROM salarySex_a_2012882 M1 WHERE M1.acc_id = 1 GROUP BY M1.run_id, M1.dim0, M1.dim1"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "ExprId": 2,
            "Name": "expr2",
            "Decimals": 2,
            "SrcExpr": "OM_MIN(acc0)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, MIN(M1.acc_value) AS expr2 FROM salarySex_a_2012882 M1 WHERE M1.acc_id = 0 GROUP BY M1.run_id, M1.dim0, M1.dim1"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "ExprId": 3,
            "Name": "expr3",
            "Decimals": 3,
            "SrcExpr": "OM_AVG(acc0 * acc1)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, AVG(M1.acc_value * A1.acc1) AS expr3 FROM salarySex_a_2012882 M1 INNER JOIN (SELECT run_id, dim0, dim1, sub_id, acc_value AS acc1 FROM salarySex_a_2012882 WHERE acc_id = 1) A1 ON (A1.run_id = M1.run_id AND A1.dim0 = M1.dim0 AND A1.dim1 = M1.dim1 AND A1.sub_id = M1.sub_id) WHERE M1.acc_id = 0 GROUP BY M1.run_id, M1.dim0, M1.dim1"
        }
    ],
    {
        "ModelId": 1,
        "TableId": 1,
        "TableHid": 83,
        "Name": "fullAgeSalary",
        "Digest": "_20128171604590183",
        "IsUser": false,
        "Rank": 3,
        "IsSparse": false,
        "DbExprTable": "fullAgeSalary_v_2012883",

```

```

    "DbAccTable": "fullAgeSalary_a_2012883",
    "DbAccAllView": "fullAgeSalary_d_2012883",
    "ExprPos": 1,
    "IsHidden": false,
    "ImportDigest": "_i0128171604590183",
    "Dim": [
        {
            "ModelId": 1,
            "TableId": 1,
            "DimId": 0,
            "Name": "dim0",
            "TypeId": 104,
            "IsTotal": false,
            "DimSize": 2
        },
        {
            "ModelId": 1,
            "TableId": 1,
            "DimId": 1,
            "Name": "dim1",
            "TypeId": 101,
            "IsTotal": true,
            "DimSize": 5
        },
        {
            "ModelId": 1,
            "TableId": 1,
            "DimId": 2,
            "Name": "dim2",
            "TypeId": 103,
            "IsTotal": false,
            "DimSize": 3
        }
    ],
    "Acc": [
        {
            "ModelId": 1,
            "TableId": 1,
            "AccId": 0,
            "Name": "acc0",
            "IsDerived": false,
            "SrcAcc": "raw_value()",
            "AccSql": "A.acc_value"
        }
    ],
    "Expr": [
        {
            "ModelId": 1,
            "TableId": 1,
            "ExprId": 0,
            "Name": "expr0",
            "Decimals": 2,
            "SrcExpr": "OM_AVG(acc0)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, M1.dim2, AVG(M1.acc_value) AS expr0 FROM fullAgeSalary_a_2012883 M1 WHERE M1.acc_id = 0 GROUP BY M1.run_id, M1.dim0, M1.dim1, M1.dim2"
        }
    ]
},
{
    "ModelId": 1,
    "TableId": 2,
    "TableHid": 84,
    "Name": "ageSexIncome",
    "Digest": "_20128171604590184",
    "IsUser": false,
    "Rank": 2,
    "IsSparse": false,
    "DbExprTable": "ageSexIncome_v_2012884",
    "DbAccTable": "ageSexIncome_a_2012884",
    "DbAccAllView": "ageSexIncome_d_2012884",
    "ExprPos": 0,
    "IsHidden": false,
    "ImportDigest": "_i0128171604590131",
    "Dim": [
        {
            "ModelId": 1,
            "TableId": 2,
            "DimId": 0,
            "Name": "dim0",
            "TypeId": 101,
            "IsTotal": false,
            "DimSize": 4
        },
        {
            "ModelId": 1,
            "TableId": 2,
            "DimId": 1,

```

```

        "Name": "dim1",
        "TypeId": 102,
        "IsTotal": false,
        "DimSize": 2
    }
],
"Acc": [
    {
        "ModelId": 1,
        "TableId": 2,
        "AccId": 0,
        "Name": "acc0",
        "IsDerived": false,
        "SrcAcc": "raw_value()", 
        "AccSql": "A.acc_value"
    },
    {
        "ModelId": 1,
        "TableId": 2,
        "AccId": 1,
        "Name": "acc1",
        "IsDerived": false,
        "SrcAcc": "adjust_value()", 
        "AccSql": "A.acc_value"
    }
],
"Expr": [
    {
        "ModelId": 1,
        "TableId": 2,
        "ExprId": 0,
        "Name": "expr0",
        "Decimals": 2,
        "SrcExpr": "OM_AVG(acc0)",
        "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, AVG(M1.acc_value) AS expr0 FROM ageSexIncome_a_2012884 M1 WHERE M1.acc_id = 0 GROUP BY M1.run_id, M1.dim0, M1.dim1"
    },
    {
        "ModelId": 1,
        "TableId": 2,
        "ExprId": 1,
        "Name": "expr1",
        "Decimals": 3,
        "SrcExpr": "OM_AVG(acc1)",
        "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, AVG(M1.acc_value) AS expr1 FROM ageSexIncome_a_2012884 M1 WHERE M1.acc_id = 1 GROUP BY M1.run_id, M1.dim0, M1.dim1"
    }
]
},
{
    "ModelId": 1,
    "TableId": 3,
    "TableHid": 85,
    "Name": "seedOldAge",
    "Digest": "_20128171604590185",
    "IsUser": false,
    "Rank": 0,
    "IsSparse": false,
    "DbExprTable": "seedOldAge_v_2012885",
    "DbAccTable": "seedOldAge_a_2012885",
    "DbAccAllView": "seedOldAge_d_2012885",
    "ExprPos": 0,
    "IsHidden": false,
    "ImportDigest": "_i0128171604590185",
    "Dim": null,
    "Acc": [
        {
            "ModelId": 1,
            "TableId": 3,
            "AccId": 0,
            "Name": "acc0",
            "IsDerived": false,
            "SrcAcc": "raw_value()", 
            "AccSql": "A.acc_value"
        }
    ],
    "Expr": [
        {
            "ModelId": 1,
            "TableId": 3,
            "ExprId": 0,
            "Name": "expr0",
            "Decimals": 5,
            "SrcExpr": "OM_AVG(acc0)",
            "ExprSql": "SELECT M1.run_id, AVG(M1.acc_value) AS expr0 FROM seedOldAge_a_2012885 M1 WHERE M1.acc_id = 0 GROUP BY M1.run_id"
        }
    ]
}
]
```

```
        },
    ],
    "Group": [
        {
            "ModelId": 1,
            "GroupId": 1,
            "IsParam": true,
            "Name": "AllParameters",
            "IsHidden": false,
            "GroupPc": [
                {
                    "ModelId": 1,
                    "GroupId": 1,
                    "ChildPos": 0,
                    "ChildGroupId": 2,
                    "ChildLeafId": -1
                },
                {
                    "ModelId": 1,
                    "GroupId": 1,
                    "ChildPos": 1,
                    "ChildGroupId": 3,
                    "ChildLeafId": -1
                },
                {
                    "ModelId": 1,
                    "GroupId": 1,
                    "ChildPos": 2,
                    "ChildGroupId": -1,
                    "ChildLeafId": 2
                },
                {
                    "ModelId": 1,
                    "GroupId": 1,
                    "ChildPos": 3,
                    "ChildGroupId": -1,
                    "ChildLeafId": 5
                }
            ]
        },
        {
            "ModelId": 1,
            "GroupId": 2,
            "IsParam": true,
            "Name": "AgeSexParameters",
            "IsHidden": false,
            "GroupPc": [
                {
                    "ModelId": 1,
                    "GroupId": 2,
                    "ChildPos": 0,
                    "ChildGroupId": -1,
                    "ChildLeafId": 0
                },
                {
                    "ModelId": 1,
                    "GroupId": 2,
                    "ChildPos": 1,
                    "ChildGroupId": -1,
                    "ChildLeafId": 1
                },
                {
                    "ModelId": 1,
                    "GroupId": 2,
                    "ChildPos": 2,
                    "ChildGroupId": -1,
                    "ChildLeafId": 6
                }
            ]
        },
        {
            "ModelId": 1,
            "GroupId": 3,
            "IsParam": true,
            "Name": "SalaryParameters",
            "IsHidden": false,
            "GroupPc": [
                {
                    "ModelId": 1,
                    "GroupId": 3,
                    "ChildPos": 0,
                    "ChildGroupId": -1,
                    "ChildLeafId": 1
                },
                {
                    "ModelId": 1,
                    "GroupId": 3,
                    "ChildPos": 1,
                    "ChildGroupId": -1
                }
            ]
        }
    ]
}
```

```
        "ChildPos": 1,
        "ChildGroupId": -1,
        "ChildLeafId": 3
    },
    {
        "ModelId": 1,
        "GroupId": 3,
        "ChildPos": 2,
        "ChildGroupId": -1,
        "ChildLeafId": 4
    }
],
},
{
    "ModelId": 1,
    "GroupId": 10,
    "IsParam": false,
    "Name": "AdditionalTables",
    "IsHidden": false,
    "GroupPc": [
        {
            "ModelId": 1,
            "GroupId": 10,
            "ChildPos": 0,
            "ChildGroupId": -1,
            "ChildLeafId": 1
        },
        {
            "ModelId": 1,
            "GroupId": 10,
            "ChildPos": 1,
            "ChildGroupId": -1,
            "ChildLeafId": 2
        },
        {
            "ModelId": 1,
            "GroupId": 10,
            "ChildPos": 2,
            "ChildGroupId": -1,
            "ChildLeafId": 3
        }
    ]
}
}
```

GET model metadata including text (description and notes)

Get model metadata including text (description and notes) in current user language.

Methods:

```
GET /api/model/:model/text  
GET /api/model/:model/text/lang/:lang  
GET /api/model-text?model=modelNameOrDigest&lang=en
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:lang - (optional) language code
```

If optional `lang` argument specified then result in that language else in browser language or model default. If no such language exist then result in model default language or can be empty.

Call examples:

```
http://localhost:4040/api/model/modelOne/text  
http://localhost:4040/api/model/modelOne/text/lang/en  
http://localhost:4040/api/model/_201208171604590148_/text/lang/en_CA  
http://localhost:4040/api/model-text?model=modelOne&lang=en  
http://localhost:4040/api/model-text?model=_201208171604590148_&lang=FR
```

Return example:

```
{  
  "Model": {  
    "ModelId": 1,  
    "Name": "modelOne",  
    "Digest": "_201208171604590148_",  
    "Type": 0,  
    "Version": "1.0",  
    "CreateDateTime": "2012-08-17 16:04:59.148",  
    "DefaultLangCode": "EN"  
  },  
  "DescrNote": {  
    "LangCode": "EN",  
    "Descr": "First model",  
    "Note": "First model: openM++ development test model"  
  },  
  "TypeTxt": [  
    {  
      "Type": {  
        "ModelId": 1,  
        "TypeId": 4,  
        "TypeHid": 4,  
        "Name": "int",  
        "Digest": "_int_",  
        "DicId": 0,  
        "TotalEnumId": 1  
      },  
      "DescrNote": {  
        "LangCode": "",  
        "Descr": "",  
        "Note": ""  
      },  
      "TypeEnumTxt": []  
    },  
    {  
      "Type": {  
        "ModelId": 1,  
        "TypeId": 7,  
        "TypeHid": 7,  
        "Name": "bool",  
        "Digest": "_bool_",  
        "DicId": 1,  
        "TotalEnumId": 2  
      },  
      "DescrNote": {  
        "LangCode": "",  
        "Descr": "",  
        "Note": ""  
      },  
      "TypeEnumTxt": []  
    }  
  ]  
}
```

```
"TotalEnumId": 2
},
"DescrNote": {
  "LangCode": "EN",
  "Descr": "logical type",
  "Note": ""
},
"TypeEnumTxt": [
  {
    "Enum": {
      "ModelId": 1,
      "TypeId": 7,
      "EnumId": 0,
      "Name": "false"
    },
    "DescrNote": {
      "LangCode": "EN",
      "Descr": "False",
      "Note": ""
    }
  },
  {
    "Enum": {
      "ModelId": 1,
      "TypeId": 7,
      "EnumId": 1,
      "Name": "true"
    },
    "DescrNote": {
      "LangCode": "EN",
      "Descr": "True",
      "Note": ""
    }
  }
],
{
  "Type": {
    "ModelId": 1,
    "TypeId": 14,
    "TypeHid": 14,
    "Name": "double",
    "Digest": "_double_",
    "DicId": 0,
    "TotalEnumId": 1
  },
  "DescrNote": {
    "LangCode": "",
    "Descr": "",
    "Note": ""
  },
  "TypeEnumTxt": []
},
{
  "Type": {
    "ModelId": 1,
    "TypeId": 21,
    "TypeHid": 21,
    "Name": "file",
    "Digest": "_file_",
    "DicId": 0,
    "TotalEnumId": 1
  },
  "DescrNote": {
    "LangCode": "",
    "Descr": "",
    "Note": ""
  },
  "TypeEnumTxt": []
},
{
  "Type": {
    "ModelId": 1,
    "TypeId": 101,
    "TypeHid": 96,
    "Name": "age",
    "Digest": "_20128171604590121",
    "DicId": 2,
    "TotalEnumId": 500
  },
  "DescrNote": {
    "LangCode": "EN",
    "Descr": "Age",
    "Note": ""
  },
  "TypeEnumTxt": [
    {
      "Enum": {
        "ModelId": 1,
        "TypeId": 7,
        "EnumId": 0,
        "Name": "false"
      }
    }
  ]
}
```

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        "Enum": {
            "ModelId": 1,
            "TypeId": 101,
            "EnumId": 10,
            "Name": "10-20"
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "age 10-20",
            "Note": ""
        }
    },
    {
        "Enum": {
            "ModelId": 1,
            "TypeId": 101,
            "EnumId": 20,
            "Name": "20-30"
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "age 20-30",
            "Note": ""
        }
    },
    {
        "Enum": {
            "ModelId": 1,
            "TypeId": 101,
            "EnumId": 30,
            "Name": "30-40"
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "age 30-40",
            "Note": ""
        }
    },
    {
        "Enum": {
            "ModelId": 1,
            "TypeId": 101,
            "EnumId": 40,
            "Name": "40+"
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "age 40+",
            "Note": ""
        }
    }
],
{
    "Type": {
        "ModelId": 1,
        "TypeId": 102,
        "TypeHid": 97,
        "Name": "sex",
        "Digest": "_20128171604590122",
        "DicId": 2,
        "TotalEnumId": 800
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Sex",
        "Note": ""
    },
    "TypeEnumTxt": [
        {
            "Enum": {
                "ModelId": 1,
                "TypeId": 102,
                "EnumId": 0,
                "Name": "M"
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Male",
                "Note": ""
            }
        },
        {
            "Enum": {
                "ModelId": 1,
                "TypeId": 102,
                "EnumId": 1,
                "Name": "F"
            }
        }
    ]
}

```

```
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "Female",
            "Note": ""
        }
    }
},
{
    "Type": {
        "ModelId": 1,
        "TypeId": 103,
        "TypeHid": 98,
        "Name": "salary",
        "Digest": "_20128171604590123",
        "DicId": 2,
        "TotalEnumId": 400
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Salary",
        "Note": ""
    },
    "TypeEnumTxt": [
        {
            "Enum": {
                "ModelId": 1,
                "TypeId": 103,
                "EnumId": 100,
                "Name": "L"
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Low",
                "Note": ""
            }
        },
        {
            "Enum": {
                "ModelId": 1,
                "TypeId": 103,
                "EnumId": 200,
                "Name": "M"
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Medium",
                "Note": ""
            }
        },
        {
            "Enum": {
                "ModelId": 1,
                "TypeId": 103,
                "EnumId": 300,
                "Name": "H"
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "High",
                "Note": ""
            }
        }
    ]
},
{
    "Type": {
        "ModelId": 1,
        "TypeId": 104,
        "TypeHid": 99,
        "Name": "full",
        "Digest": "_20128171604590124",
        "DicId": 2,
        "TotalEnumId": 44
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Full or part time",
        "Note": ""
    },
    "TypeEnumTxt": [
        {
            "Enum": {
                "ModelId": 1,
                "TypeId": 104,
                "EnumId": 22,
                "Name": "F"
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Full time"
            }
        }
    ]
}
```

```

        "Name": "Full"
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Full-time",
        "Note": ""
    }
},
{
    "Enum": {
        "ModelId": 1,
        "TypeId": 104,
        "EnumId": 33,
        "Name": "Part"
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Part-time",
        "Note": ""
    }
}
],
"ParamTxt": [
{
    "Param": {
        "ModelId": 1,
        "ParamId": 0,
        "ParamHid": 44,
        "Name": "ageSex",
        "Digest": "_20128171604590131",
        "Rank": 2,
        "TypeId": 14,
        "IsExtendable": true,
        "IsHidden": false,
        "NumCumulated": 0,
        "DbRunTable": "ageSex_p_2012817",
        "DbSetTable": "ageSex_w_2012817",
        "ImportDigest": "_i0128171604590131"
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Age by Sex",
        "Note": "Age by Sex note"
    }
},
"ParamDimsTxt": [
{
    "Dim": {
        "ModelId": 1,
        "ParamId": 0,
        "DimId": 0,
        "Name": "dim0",
        "TypeId": 101
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Age Dim",
        "Note": "Age Dim notes"
    }
},
{
    "Dim": {
        "ModelId": 1,
        "ParamId": 0,
        "DimId": 1,
        "Name": "dim1",
        "TypeId": 102
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Sex Dim",
        "Note": "Sex Dim notes"
    }
}
],
{
    "Param": {
        "ModelId": 1,
        "ParamId": 1,
        "ParamHid": 45,
        "Name": "salaryAge",
        "Digest": "_20128171604590132",
        "Rank": 2,
        "TypeId": 4,
        "IsExtendable": false,
        "IsHidden": true
    }
}
]
]
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```

    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "salaryAge_p_2012818",
    "DbSetTable": "salaryAge_w_2012818",
    "ImportDigest": "_i0128171604590132"
},
"DescrNote": {
    "LangCode": "EN",
    "Descr": "Salary by Age",
    "Note": "Salary by Age note"
},
"ParamDimsTxt": [
    {
        "Dim": {
            "ModelId": 1,
            "ParamId": 1,
            "DimId": 0,
            "Name": "dim0",
            "TypeId": 103
        },
        "DescrNote": {
            "LangCode": "",
            "Descr": "",
            "Note": ""
        }
    },
    {
        "Dim": {
            "ModelId": 1,
            "ParamId": 1,
            "DimId": 1,
            "Name": "dim1",
            "TypeId": 101
        },
        "DescrNote": {
            "LangCode": "",
            "Descr": "",
            "Note": ""
        }
    }
],
{
    "Param": {
        "ModelId": 1,
        "ParamId": 2,
        "ParamHid": 46,
        "Name": "StartingSeed",
        "Digest": "_20128171604590133",
        "Rank": 0,
        "TypeId": 4,
        "IsExtendable": false,
        "IsHidden": false,
        "NumCumulated": 0,
        "DbRunTable": "StartingSeed_p_2012819",
        "DbSetTable": "StartingSeed_w_2012819",
        "ImportDigest": "_i0128171604590133"
    },
    "DescrNote": {
        "LangCode": "FR",
        "Descr": "Starting Seed",
        "Note": "Random numbers generator starting seed value"
    },
    "ParamDimsTxt": []
},
{
    "Param": {
        "ModelId": 1,
        "ParamId": 3,
        "ParamHid": 47,
        "Name": "salaryFull",
        "Digest": "_20128171604590134",
        "Rank": 1,
        "TypeId": 104,
        "IsExtendable": false,
        "IsHidden": false,
        "NumCumulated": 0,
        "DbRunTable": "salaryFull_p_2012812",
        "DbSetTable": "salaryFull_w_2012812",
        "ImportDigest": "_i0128171604590134"
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Full or part time by Salary level",
        "Note": ""
    },
    "ParamDimsTxt": [

```

```
{
  "Dim": {
    "ModelId": 1,
    "ParamId": 3,
    "DimId": 0,
    "Name": "dim0",
    "TypeId": 103
  },
  "DescrNote": {
    "LangCode": "EN",
    "Descr": "Full Dim",
    "Note": ""
  }
}
],
{
  "Param": {
    "ModelId": 1,
    "ParamId": 4,
    "ParamHid": 48,
    "Name": "baseSalary",
    "Digest": "_20128171604590135",
    "Rank": 0,
    "TypeId": 104,
    "IsExtendable": false,
    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "baseSalary_p_2012811",
    "DbSetTable": "baseSalary_w_2012811",
    "ImportDigest": "_i0128171604590135"
  },
  "DescrNote": {
    "LangCode": "EN",
    "Descr": "Base salary level",
    "Note": ""
  },
  "ParamDimsTxt": []
},
{
  "Param": {
    "ModelId": 1,
    "ParamId": 5,
    "ParamHid": 49,
    "Name": "filePath",
    "Digest": "_20128171604590136",
    "Rank": 0,
    "TypeId": 21,
    "IsExtendable": false,
    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "filePath_p_2012814",
    "DbSetTable": "filePath_w_2012814",
    "ImportDigest": "_i0128171604590136"
  },
  "DescrNote": {
    "LangCode": "EN",
    "Descr": "File path string",
    "Note": ""
  },
  "ParamDimsTxt": []
},
{
  "Param": {
    "ModelId": 1,
    "ParamId": 6,
    "ParamHid": 50,
    "Name": "isOldAge",
    "Digest": "_20128171604590137",
    "Rank": 1,
    "TypeId": 7,
    "IsExtendable": false,
    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "isOldAge_p_2012815",
    "DbSetTable": "isOldAge_w_2012815",
    "ImportDigest": "_i0128171604590137"
  },
  "DescrNote": {
    "LangCode": "EN",
    "Descr": "Is Old Age",
    "Note": "Is Old Age notes"
  },
  "ParamDimsTxt": [
    {
      "Dim": {
        "ModelId": 1,
        "ParamId": 6
      }
    }
  ]
}
```

```

        "Dim": {
            "ModelId": 0,
            "Name": "dim0",
            "TypeId": 101
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "Age Dim",
            "Note": "Age Dim notes"
        }
    }
},
"TableTxt": [
{
    "Table": {
        "ModelId": 1,
        "TableId": 0,
        "TableHid": 82,
        "Name": "salarySex",
        "Digest": "_20128171604590182",
        "IsUser": false,
        "Rank": 2,
        "IsSparse": true,
        "DbExprTable": "salarySex_v_2012882",
        "DbAccTable": "salarySex_a_2012882",
        "DbAccAllview": "salarySex_d_2012882",
        "ExprPos": 1,
        "IsHidden": false,
        "ImportDigest": "_i0128171604590182"
    },
    "LangCode": "EN",
    "TableDescr": "Salary by Sex",
    "TableNote": "Salary by Sex notes",
    "ExprDescr": "Measure",
    "ExprNote": "Measure notes",
    "TableDimsTxt": [
        {
            "Dim": {
                "ModelId": 1,
                "TableId": 0,
                "DimId": 0,
                "Name": "dim0",
                "TypeId": 103,
                "IsTotal": false,
                "DimSize": 3
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Salary Dim",
                "Note": "Salary Dim notes"
            }
        },
        {
            "Dim": {
                "ModelId": 1,
                "TableId": 0,
                "DimId": 1,
                "Name": "dim1",
                "TypeId": 102,
                "IsTotal": true,
                "DimSize": 3
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Sex Dim",
                "Note": "Sex Dim notes"
            }
        }
    ],
    "TableAccTxt": [
        {
            "Acc": {
                "ModelId": 1,
                "TableId": 0,
                "AccId": 0,
                "Name": "acc0",
                "IsDerived": false,
                "SrcAcc": "value_sum()",
                "AccSql": ""
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Sum of salary by sex",
                "Note": ""
            }
        }
    ]
}
]
}

```

```

        },
        {
            "Acc": {
                "ModelId": 1,
                "TableId": 0,
                "AccId": 1,
                "Name": "acc1",
                "IsDerived": false,
                "SrcAcc": "value_count()", 
                "AccSql": ""
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Count of salary by sex",
                "Note": ""
            }
        },
        {
            "Acc": {
                "ModelId": 1,
                "TableId": 0,
                "AccId": 2,
                "Name": "acc2",
                "IsDerived": true,
                "SrcAcc": "acc0 + acc1",
                "AccSql": ""
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Derived accumulator",
                "Note": ""
            }
        }
    ],
    "TableExprTxt": [
        {
            "Expr": {
                "ModelId": 1,
                "TableId": 0,
                "ExprId": 0,
                "Name": "expr0",
                "Decimals": 4,
                "SrcExpr": "OM_AVG(acc0)",
                "ExprSql": ""
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Average acc0",
                "Note": "Average on acc0 notes"
            }
        },
        {
            "Expr": {
                "ModelId": 1,
                "TableId": 0,
                "ExprId": 1,
                "Name": "expr1",
                "Decimals": 4,
                "SrcExpr": "OM_SUM(acc1)",
                "ExprSql": ""
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Sum acc1",
                "Note": ""
            }
        },
        {
            "Expr": {
                "ModelId": 1,
                "TableId": 0,
                "ExprId": 2,
                "Name": "expr2",
                "Decimals": 2,
                "SrcExpr": "OM_MIN(acc0)",
                "ExprSql": ""
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Min acc0",
                "Note": ""
            }
        },
        {
            "Expr": {
                "ModelId": 1,
                "TableId": 0,
                "ExprId": 3,
                "Name": "expr3",
                "Decimals": 2,
                "SrcExpr": "OM_MAX(acc0)",
                "ExprSql": ""
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Max acc0",
                "Note": ""
            }
        }
    ]
}

```

```

        "Name": "expr3",
        "Decimals": 3,
        "SrcExpr": "OM_AVG(acc0 * acc1)",
        "ExprSql": ""
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Average acc0 * acc1",
        "Note": ""
    }
},
],
},
{
    "Table": {
        "ModelId": 1,
        "TableId": 1,
        "TableHid": 83,
        "Name": "fullAgeSalary",
        "Digest": "_20128171604590183",
        "IsUser": false,
        "Rank": 3,
        "IsSparse": false,
        "DbExprTable": "fullAgeSalary_v_2012883",
        "DbAccTable": "fullAgeSalary_a_2012883",
        "DbAccAllView": "fullAgeSalary_d_2012883",
        "ExprPos": 1,
        "IsHidden": false,
        "ImportDigest": "_i0128171604590183"
    },
    "LangCode": "EN",
    "TableDescr": "Full Time by Age by Salary Group",
    "TableNote": "Full Time by Age by Salary Group notes",
    "ExprDescr": "Measure",
    "ExprNote": "Measure notes",
    "TableDimsTxt": [
        {
            "Dim": {
                "ModelId": 1,
                "TableId": 1,
                "DimId": 0,
                "Name": "dim0",
                "TypeId": 104,
                "IsTotal": false,
                "DimSize": 2
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Full Time",
                "Note": "Full or Part Time Dim notes"
            }
        },
        {
            "Dim": {
                "ModelId": 1,
                "TableId": 1,
                "DimId": 1,
                "Name": "dim1",
                "TypeId": 101,
                "IsTotal": true,
                "DimSize": 5
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Age Dim",
                "Note": "Age Dim notes"
            }
        },
        {
            "Dim": {
                "ModelId": 1,
                "TableId": 1,
                "DimId": 2,
                "Name": "dim2",
                "TypeId": 103,
                "IsTotal": false,
                "DimSize": 3
            },
            "DescrNote": {
                "LangCode": "EN",
                "Descr": "Salary Dim",
                "Note": "Salary Dim notes"
            }
        }
    ],
    "TableAccTxt": [
        {

```

```

    "Acc": {
        "ModelId": 1,
        "TableId": 1,
        "AccId": 0,
        "Name": "acc0",
        "IsDerived": false,
        "SrcAcc": "raw_value()",
        "AccSql": ""
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Full time salary by age",
        "Note": "Full time salary by age notes"
    }
},
"TableExprTxt": [
{
    "Expr": {
        "ModelId": 1,
        "TableId": 1,
        "ExprId": 0,
        "Name": "expr0",
        "Decimals": 2,
        "SrcExpr": "OM_AVG(acc0)",
        "ExprSql": ""
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Average acc0",
        "Note": "Average on acc0 notes"
    }
}
],
{
    "Table": {
        "ModelId": 1,
        "TableId": 2,
        "TableHid": 84,
        "Name": "ageSexIncome",
        "Digest": "_20128171604590184",
        "IsUser": false,
        "Rank": 2,
        "IsSparse": false,
        "DbExprTable": "ageSexIncome_v_2012884",
        "DbAccTable": "ageSexIncome_a_2012884",
        "DbAccAllView": "ageSexIncome_d_2012884",
        "ExprPos": 0,
        "IsHidden": false,
        "ImportDigest": "_i0128171604590131"
    },
    "LangCode": "EN",
    "TableDescr": "Age by Sex Income",
    "TableNote": "Age by Sex Income notes",
    "ExprDescr": "Income Measure",
    "ExprNote": "Income Measure notes",
    "TableDimsTxt": [
{
        "Dim": {
            "ModelId": 1,
            "TableId": 2,
            "DimId": 0,
            "Name": "dim0",
            "TypeId": 101,
            "IsTotal": false,
            "DimSize": 4
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "Age Dim",
            "Note": "Age Dim notes"
        }
},
{
        "Dim": {
            "ModelId": 1,
            "TableId": 2,
            "DimId": 1,
            "Name": "dim1",
            "TypeId": 102,
            "IsTotal": false,
            "DimSize": 2
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "Sex Dim",
            "Note": "Sex Dim notes"
        }
}
]
}
]
```

```

        "Note": "Sex Dim notes"
    }
},
"TableAccTxt": [
{
    "Acc": {
        "ModelId": 1,
        "TableId": 2,
        "AccId": 0,
        "Name": "acc0",
        "IsDerived": false,
        "SrcAcc": "raw_value()",
        "AccSql": ""
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Income",
        "Note": "Income notes"
    }
},
{
    "Acc": {
        "ModelId": 1,
        "TableId": 2,
        "AccId": 1,
        "Name": "acc1",
        "IsDerived": false,
        "SrcAcc": "adjust_value()",
        "AccSql": ""
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Income adjusted",
        "Note": "Income adjusted notes"
    }
}
],
"TableExprTxt": [
{
    "Expr": {
        "ModelId": 1,
        "TableId": 2,
        "ExprId": 0,
        "Name": "expr0",
        "Decimals": 2,
        "SrcExpr": "OM_AVG(acc0)",
        "ExprSql": ""
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Average acc0",
        "Note": "Average on acc0 notes"
    }
},
{
    "Expr": {
        "ModelId": 1,
        "TableId": 2,
        "ExprId": 1,
        "Name": "expr1",
        "Decimals": 3,
        "SrcExpr": "OM_AVG(acc1)",
        "ExprSql": ""
    },
    "DescrNote": {
        "LangCode": "EN",
        "Descr": "Average acc1",
        "Note": "Average on acc1 notes"
    }
}
],
{
    "Table": {
        "ModelId": 1,
        "TableId": 3,
        "TableHid": 85,
        "Name": "seedOldAge",
        "Digest": "_20128171604590185",
        "IsUser": false,
        "Rank": 0,
        "IsSparse": false,
        "DbExprTable": "seedOldAge_v_2012885",
        "DbAccTable": "seedoldage_a_2012885",
        "DbAccAllView": "seedOldAge_d_2012885",
        "ExprPos": 0,
        "Truncate": false
    }
}
]
}

```

```
    "IsHidden": false,
    "ImportDigest": "_i0128171604590185"
  },
  "LangCode": "EN",
  "TableDescr": "Seed Old Age",
  "TableNote": "Seed Old Age notes",
  "ExprDescr": "Seed Old Age Measure",
  "ExprNote": "Measure notes",
  "TableDimsTxt": [],
  "TableAccTxt": [
    {
      "Acc": {
        "ModelId": 1,
        "TableId": 3,
        "AccId": 0,
        "Name": "acc0",
        "IsDerived": false,
        "SrcAcc": "raw_value()",
        "AccSql": ""
      },
      "DescrNote": {
        "LangCode": "EN",
        "Descr": "Seed",
        "Note": "Seed notes"
      }
    }
  ],
  "TableExprTxt": [
    {
      "Expr": {
        "ModelId": 1,
        "TableId": 3,
        "ExprId": 0,
        "Name": "expr0",
        "Decimals": 5,
        "SrcExpr": "OM_AVG(acc0)",
        "ExprSql": ""
      },
      "DescrNote": {
        "LangCode": "EN",
        "Descr": "Average acc0",
        "Note": "Average on acc0 notes"
      }
    }
  ]
},
"GroupTxt": [
  {
    "Group": {
      "ModelId": 1,
      "GroupId": 1,
      "IsParam": true,
      "Name": "AllParameters",
      "IsHidden": false,
      "GroupPc": [
        {
          "ModelId": 1,
          "GroupId": 1,
          "ChildPos": 0,
          "ChildGroupId": 2,
          "ChildLeafId": -1
        },
        {
          "ModelId": 1,
          "GroupId": 1,
          "ChildPos": 1,
          "ChildGroupId": 3,
          "ChildLeafId": -1
        },
        {
          "ModelId": 1,
          "GroupId": 1,
          "ChildPos": 2,
          "ChildGroupId": -1,
          "ChildLeafId": 2
        },
        {
          "ModelId": 1,
          "GroupId": 1,
          "ChildPos": 3,
          "ChildGroupId": -1,
          "ChildLeafId": 5
        }
      ]
    },
    "DescrNote": {
      "LangCode": "EN"
    }
  }
]
```

```

        "Group": {
            "ModelId": 1,
            "GroupId": 2,
            "IsParam": true,
            "Name": "AgeSexParameters",
            "IsHidden": false,
            "GroupPc": [
                {
                    "ModelId": 1,
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                    "ChildPos": 0,
                    "ChildGroupId": -1,
                    "ChildLeafId": 0
                },
                {
                    "ModelId": 1,
                    "GroupId": 2,
                    "ChildPos": 1,
                    "ChildGroupId": -1,
                    "ChildLeafId": 1
                },
                {
                    "ModelId": 1,
                    "GroupId": 2,
                    "ChildPos": 2,
                    "ChildGroupId": -1,
                    "ChildLeafId": 6
                }
            ]
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "Age and Sex parameters",
            "Note": "Age and Sex model parameters group"
        }
    },
    {
        "Group": {
            "ModelId": 1,
            "GroupId": 3,
            "IsParam": true,
            "Name": "SalaryParameters",
            "IsHidden": false,
            "GroupPc": [
                {
                    "ModelId": 1,
                    "GroupId": 3,
                    "ChildPos": 0,
                    "ChildGroupId": -1,
                    "ChildLeafId": 1
                },
                {
                    "ModelId": 1,
                    "GroupId": 3,
                    "ChildPos": 1,
                    "ChildGroupId": -1,
                    "ChildLeafId": 3
                },
                {
                    "ModelId": 1,
                    "GroupId": 3,
                    "ChildPos": 2,
                    "ChildGroupId": -1,
                    "ChildLeafId": 4
                }
            ]
        },
        "DescrNote": {
            "LangCode": "EN",
            "Descr": "Salary parameters",
            "Note": "Salary model parameters group"
        }
    },
    {
        "Group": {
            "ModelId": 1,
            "GroupId": 10,
            "IsParam": false,
            "Name": "AdditionalTables",
            "IsHidden": false,
            "GroupPc": [
                {

```

```
"ModelId": 1,  
"GroupId": 10,  
"ChildPos": 0,  
"ChildGroupId": -1,  
"ChildLeafId": 1  
},  
{  
    "ModelId": 1,  
    "GroupId": 10,  
    "ChildPos": 1,  
    "ChildGroupId": -1,  
    "ChildLeafId": 2  
},  
{  
    "ModelId": 1,  
    "GroupId": 10,  
    "ChildPos": 2,  
    "ChildGroupId": -1,  
    "ChildLeafId": 3  
}  
]  
},  
"DescrNote": {  
    "LangCode": "EN",  
    "Descr": "Additional output tables",  
    "Note": "Additional output tables group notes"  
}  
}  
]  
}
```

GET model metadata including text in all languages

Get model metadata including text (description and notes) in all languages.

Methods:

```
GET /api/model/:model/text/all  
GET /api/model-text-all?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/text/all  
http://localhost:4040/api/model/_201208171604590148/text/all  
http://localhost:4040/api/model-text-all?model=modelOne  
http://localhost:4040/api/model-text-all?model=_201208171604590148
```

Return example:

```
{  
  "Model": {  
    "ModelId": 1,  
    "Name": "modelOne",  
    "Digest": "_201208171604590148_",  
    "Type": 0,  
    "Version": "1.0",  
    "CreateDateTime": "2012-08-17 16:04:59.148",  
    "DefaultLangCode": "EN"  
  },  
  "Type": [  
    {  
      "ModelId": 1,  
      "TypeId": 4,  
      "TypeHid": 4,  
      "Name": "int",  
      "Digest": "_int_",  
      "DicId": 0,  
      "TotalEnumId": 1,  
      "Enum": null  
    },  
    {  
      "ModelId": 1,  
      "TypeId": 7,  
      "TypeHid": 7,  
      "Name": "bool",  
      "Digest": "_bool_",  
      "DicId": 1,  
      "TotalEnumId": 2,  
      "Enum": [  
        {  
          "ModelId": 1,  
          "TypeId": 7,  
          "EnumId": 0,  
          "Name": "false"  
        },  
        {  
          "ModelId": 1,  
          "TypeId": 7,  
          "EnumId": 1,  
          "Name": "true"  
        }  
      ]  
    },  
    {  
      "ModelId": 1,  
      "TypeId": 14,  
      "TypeHid": 14,  
      "Name": "double",  
      "Digest": "_double_",  
      "DicId": 0,  
      "TotalEnumId": 0,  
      "Enum": null  
    }  
  ]  
}
```

```
"TotalEnumId": 1,
"Enum": null
},
{
  "ModelId": 1,
  "TypeId": 21,
  "TypeHid": 21,
  "Name": "file",
  "Digest": "_file_",
  "DicId": 0,
  "TotalEnumId": 1,
  "Enum": null
},
{
  "ModelId": 1,
  "TypeId": 101,
  "TypeHid": 96,
  "Name": "age",
  "Digest": "_20128171604590121",
  "DicId": 2,
  "TotalEnumId": 500,
  "Enum": [
    {
      "ModelId": 1,
      "TypeId": 101,
      "EnumId": 10,
      "Name": "10-20"
    },
    {
      "ModelId": 1,
      "TypeId": 101,
      "EnumId": 20,
      "Name": "20-30"
    },
    {
      "ModelId": 1,
      "TypeId": 101,
      "EnumId": 30,
      "Name": "30-40"
    },
    {
      "ModelId": 1,
      "TypeId": 101,
      "EnumId": 40,
      "Name": "40+"
    }
  ]
},
{
  "ModelId": 1,
  "TypeId": 102,
  "TypeHid": 97,
  "Name": "sex",
  "Digest": "_20128171604590122",
  "DicId": 2,
  "TotalEnumId": 800,
  "Enum": [
    {
      "ModelId": 1,
      "TypeId": 102,
      "EnumId": 0,
      "Name": "M"
    },
    {
      "ModelId": 1,
      "TypeId": 102,
      "EnumId": 1,
      "Name": "F"
    }
  ]
},
{
  "ModelId": 1,
  "TypeId": 103,
  "TypeHid": 98,
  "Name": "salary",
  "Digest": "_20128171604590123",
  "DicId": 2,
  "TotalEnumId": 400,
  "Enum": [
    {
      "ModelId": 1,
      "TypeId": 103,
      "EnumId": 100,
      "Name": "L"
    },
    {

```

```
"ModelId": 1,
"TypeId": 103,
"EnumId": 200,
"Name": "M"
},
{
"ModelId": 1,
"TypeId": 103,
"EnumId": 300,
"Name": "H"
}
],
{
"ModelId": 1,
"TypeId": 104,
"TypeHid": 99,
"Name": "full",
"Digest": "_20128171604590124",
"DicId": 2,
"TotalEnumId": 44,
"Enum": [
{
"ModelId": 1,
"TypeId": 104,
"EnumId": 22,
"Name": "Full"
},
{
"ModelId": 1,
"TypeId": 104,
"EnumId": 33,
"Name": "Part"
}
]
},
"Param": [
{
"ModelId": 1,
"ParamId": 0,
"ParamHid": 44,
"Name": "ageSex",
"Digest": "_20128171604590131",
"Rank": 2,
"TypeId": 14,
"IsExtendable": true,
"IsHidden": false,
"NumCumulated": 0,
"DbRunTable": "ageSex_p_2012817",
"DbSetTable": "ageSex_w_2012817",
"ImportDigest": "_i0128171604590131",
"Dim": [
{
"ModelId": 1,
"ParamId": 0,
"DimId": 0,
"Name": "dim0",
"TypeId": 101
},
{
"ModelId": 1,
"ParamId": 0,
"DimId": 1,
"Name": "dim1",
"TypeId": 102
}
],
"Import": [
{
"ModelId": 1,
"ParamId": 0,
"FromName": "ageSexIncome",
"FromModel": "modelOne",
"IsSampleDim": false
}
]
},
{
"ModelId": 1,
"ParamId": 1,
"ParamHid": 45,
"Name": "salaryAge",
"Digest": "_20128171604590132",
"Rank": 2,
"TypeId": 4,
"IsExtendable": false,
```

```
"IsHidden": false,
"NumCumulated": 0,
"DbRunTable": "salaryAge_p_2012818",
"DbSetTable": "salaryAge_w_2012818",
"ImportDigest": "_i0128171604590132",
"Dim": [
  {
    "ModelId": 1,
    "ParamId": 1,
    "DimId": 0,
    "Name": "dim0",
    "TypeId": 103
  },
  {
    "ModelId": 1,
    "ParamId": 1,
    "DimId": 1,
    "Name": "dim1",
    "TypeId": 101
  }
],
"Import": [
  {
    "ModelId": 1,
    "ParamId": 1,
    "FromName": "salaryAge",
    "FromModel": "modelOne",
    "IsSampleDim": false
  }
]
},
{
  "ModelId": 1,
  "ParamId": 2,
  "ParamHid": 46,
  "Name": "StartingSeed",
  "Digest": "_20128171604590133",
  "Rank": 0,
  "TypeId": 4,
  "IsExtendable": false,
  "IsHidden": false,
  "NumCumulated": 0,
  "DbRunTable": "StartingSeed_p_2012819",
  "DbSetTable": "StartingSeed_w_2012819",
  "ImportDigest": "_i0128171604590133",
  "Dim": null,
  "Import": [
    {
      "ModelId": 1,
      "ParamId": 2,
      "FromName": "StartingSeed",
      "FromModel": "modelOne",
      "IsSampleDim": false
    }
  ]
},
{
  "ModelId": 1,
  "ParamId": 3,
  "ParamHid": 47,
  "Name": "salaryFull",
  "Digest": "_20128171604590134",
  "Rank": 1,
  "TypeId": 104,
  "IsExtendable": false,
  "IsHidden": false,
  "NumCumulated": 0,
  "DbRunTable": "salaryFull_p_2012812",
  "DbSetTable": "salaryFull_w_2012812",
  "ImportDigest": "_i0128171604590134",
  "Dim": [
    {
      "ModelId": 1,
      "ParamId": 3,
      "DimId": 0,
      "Name": "dim0",
      "TypeId": 103
    }
  ],
  "Import": null
},
{
  "ModelId": 1,
  "ParamId": 4,
  "ParamHid": 48,
  "Name": "baseSalary",
  "Digest": "_20128171604590135",
  "Rank": 0
```

```
    "Rank": 0,
    "TypeId": 104,
    "IsExtendable": false,
    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "baseSalary_p_2012811",
    "DbSetTable": "baseSalary_w_2012811",
    "ImportDigest": "_i0128171604590135",
    "Dim": null,
    "Import": null
  },
  {
    "ModelId": 1,
    "ParamId": 5,
    "ParamHid": 49,
    "Name": "filePath",
    "Digest": "_20128171604590136",
    "Rank": 0,
    "TypeId": 21,
    "IsExtendable": false,
    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "filePath_p_2012814",
    "DbSetTable": "filePath_w_2012814",
    "ImportDigest": "_i0128171604590136",
    "Dim": null,
    "Import": null
  },
  {
    "ModelId": 1,
    "ParamId": 6,
    "ParamHid": 50,
    "Name": "isOldAge",
    "Digest": "_20128171604590137",
    "Rank": 1,
    "TypeId": 7,
    "IsExtendable": false,
    "IsHidden": false,
    "NumCumulated": 0,
    "DbRunTable": "isOldAge_p_2012815",
    "DbSetTable": "isOldAge_w_2012815",
    "ImportDigest": "_i0128171604590137",
    "Dim": [
      {
        "ModelId": 1,
        "ParamId": 6,
        "DimId": 0,
        "Name": "dim0",
        "TypeId": 101
      }
    ],
    "Import": null
  }
],
"Table": [
  {
    "ModelId": 1,
    "TableId": 0,
    "TableHid": 82,
    "Name": "salarySex",
    "Digest": "_20128171604590182",
    "IsUser": false,
    "Rank": 2,
    "IsSparse": true,
    "DbExprTable": "salarySex_v_2012882",
    "DbAccTable": "salarySex_a_2012882",
    "DbAccAllView": "salarySex_d_2012882",
    "ExprPos": 1,
    "IsHidden": false,
    "ImportDigest": "_i0128171604590182",
    "Dim": [
      {
        "ModelId": 1,
        "TableId": 0,
        "DimId": 0,
        "Name": "dim0",
        "TypeId": 103,
        "IsTotal": false,
        "DimSize": 3
      },
      {
        "ModelId": 1,
        "TableId": 0,
        "DimId": 1,
        "Name": "dim1",
        "TypeId": 102,
        "IsTotal": true,
        "DimSize": 3
      }
    ]
  }
]
```

```

        },
    ],
    "Acc": [
        {
            "ModelId": 1,
            "TableId": 0,
            "AccId": 0,
            "Name": "acc0",
            "IsDerived": false,
            "SrcAcc": "value_sum()",
            "AccSql": "A.acc_value"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "AccId": 1,
            "Name": "acc1",
            "IsDerived": false,
            "SrcAcc": "value_count()",
            "AccSql": "SELECT A1.acc_value FROM salarySex_a_2012882 A1 WHERE A1.run_id = A.run_id AND A1.sub_id = A.sub_id AND A1.dim0 = A.dim0 AND A1.dim1 = A.dim1 AND A1.acc_id = 1"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "AccId": 2,
            "Name": "acc2",
            "IsDerived": true,
            "SrcAcc": "acc0 + acc1",
            "AccSql": "(A.acc_value) + (SELECT A1.acc_value FROM salarySex_a_2012882 A1 WHERE A1.run_id = A.run_id AND A1.sub_id = A.sub_id AND A1.dim0 = A.dim0 AND A1.dim1 = A.dim1 AND A1.acc_id = 1)"
        }
    ],
    "Expr": [
        {
            "ModelId": 1,
            "TableId": 0,
            "ExprId": 0,
            "Name": "expr0",
            "Decimals": 4,
            "SrcExpr": "OM_AVG(acc0)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, AVG(M1.acc_value) AS expr0 FROM salarySex_a_2012882 M1 WHERE M1.acc_id = 0 GROUP BY M1.run_id, M1.dim0, M1.dim1"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "ExprId": 1,
            "Name": "expr1",
            "Decimals": 4,
            "SrcExpr": "OM_SUM(acc1)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, SUM(M1.acc_value) AS expr1 FROM salarySex_a_2012882 M1 WHERE M1.acc_id = 1 GROUP BY M1.run_id, M1.dim0, M1.dim1"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "ExprId": 2,
            "Name": "expr2",
            "Decimals": 2,
            "SrcExpr": "OM_MIN(acc0)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, MIN(M1.acc_value) AS expr2 FROM salarySex_a_2012882 M1 WHERE M1.acc_id = 0 GROUP BY M1.run_id, M1.dim0, M1.dim1"
        },
        {
            "ModelId": 1,
            "TableId": 0,
            "ExprId": 3,
            "Name": "expr3",
            "Decimals": 3,
            "SrcExpr": "OM_AVG(acc0 * acc1)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, AVG(M1.acc_value * A1.acc1) AS expr3 FROM salarySex_a_2012882 M1 INNER JOIN (SELECT run_id, dim0, dim1, sub_id, acc_value AS acc1 FROM salarySex_a_2012882 WHERE acc_id = 1) A1 ON (A1.run_id = M1.run_id AND A1.dim0 = M1.dim0 AND A1.dim1 = M1.dim1 AND A1.sub_id = M1.sub_id) WHERE M1.acc_id = 0 GROUP BY M1.run_id, M1.dim0, M1.dim1"
        }
    ],
    {
        "ModelId": 1,
        "TableId": 1,
        "TableHid": 83,
        "Name": "fullAgeSalary",
        "Digest": "_20128171604590183",
        "IsUser": false,
        "Rank": 3,
        "IsSparse": false,
        "DbExprTable": "fullAgeSalary_v_2012883",

```

```

    "DbAccTable": "fullAgeSalary_a_2012883",
    "DbAccAllView": "fullAgeSalary_d_2012883",
    "ExprPos": 1,
    "IsHidden": false,
    "ImportDigest": "_i0128171604590183",
    "Dim": [
        {
            "ModelId": 1,
            "TableId": 1,
            "DimId": 0,
            "Name": "dim0",
            "TypeId": 104,
            "IsTotal": false,
            "DimSize": 2
        },
        {
            "ModelId": 1,
            "TableId": 1,
            "DimId": 1,
            "Name": "dim1",
            "TypeId": 101,
            "IsTotal": true,
            "DimSize": 5
        },
        {
            "ModelId": 1,
            "TableId": 1,
            "DimId": 2,
            "Name": "dim2",
            "TypeId": 103,
            "IsTotal": false,
            "DimSize": 3
        }
    ],
    "Acc": [
        {
            "ModelId": 1,
            "TableId": 1,
            "AccId": 0,
            "Name": "acc0",
            "IsDerived": false,
            "SrcAcc": "raw_value()",
            "AccSql": "A.acc_value"
        }
    ],
    "Expr": [
        {
            "ModelId": 1,
            "TableId": 1,
            "ExprId": 0,
            "Name": "expr0",
            "Decimals": 2,
            "SrcExpr": "OM_AVG(acc0)",
            "ExprSql": "SELECT M1.run_id, M1.dim0, M1.dim1, M1.dim2, AVG(M1.acc_value) AS expr0 FROM fullAgeSalary_a_2012883 M1 WHERE M1.acc_id = 0 GROUP BY M1.run_id, M1.dim0, M1.dim1, M1.dim2"
        }
    ]
},
{
    "ModelId": 1,
    "TableId": 2,
    "TableHid": 84,
    "Name": "ageSexIncome",
    "Digest": "_20128171604590184",
    "IsUser": false,
    "Rank": 2,
    "IsSparse": false,
    "DbExprTable": "ageSexIncome_v_2012884",
    "DbAccTable": "ageSexIncome_a_2012884",
    "DbAccAllView": "ageSexIncome_d_2012884",
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},
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}
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}
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                    "ChildLeafId": 6
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    "Note": "(FR) Is Old Age notes"
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"Note": "Seed notes"
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"ExprId": 0,
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"TableId": 0,
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"Descr": "Min acc0",
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  "LangCode": "EN",
  "Descr": "Age and Sex parameters",
  "Note": "Age and Sex model parameters group"
},
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  "ModelId": 1,
  "GroupId": 10,
  "LangCode": "EN",
  "Descr": "Additional output tables",
  "Note": "Additional output tables group notes"
},
{
  "ModelId": 1,
  "GroupId": 10,
  "LangCode": "FR",
  "Descr": "(FR) Additional output tables",
  "Note": ""
}
]
}
```

GET model languages

Get model languages.

Methods:

```
GET /api/model/:model/lang-list  
GET /api/lang-list?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/lang-list  
http://localhost:4040/api/model/649f17f26d67c37b78dde94f79772445/lang-list  
http://localhost:4040/api/lang-list?model=modelOne  
http://localhost:4040/api/lang-list?model=649f17f26d67c37b78dde94f79772445
```

Return example:

Known issue: There is no "model languages" table in current database, only master language list table [Lang_Lst](#). As result if there are multiple model in same database it is assumed all models have same list of languages.

```
[  
  {  
    "LangCode": "EN",  
    "Name": "English"  
  },  
  {  
    "LangCode": "FR",  
    "Name": "Français"  
  }  
]
```

GET model language-specific strings

Get model language-specific strings.

Language-specific strings are (code, label) rows from `lang_word` and `model_word` database tables.

Methods:

```
GET /api/model/:model/word-list  
GET /api/model/:model/word-list/lang/:lang  
GET /api/word-list?model=modelNameOrDigest&lang=en
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:lang - (optional) language code
```

If optional lang argument specified then result in that language else in browser language or model default. If no such language exist then result in model default language or can be empty.

Call examples:

```
http://localhost:4040/api/model/modelOne/word-list  
http://localhost:4040/api/model/modelOne/word-list/lang/fr-CA  
http://localhost:4040/api/word-list?model=modelOne  
http://localhost:4040/api/model/_201208171604590148/_word-list
```

Return example:

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "LangCode": "EN",
  "LangWords": [
    {
      "Code": "all",
      "Label": "All"
    },
    {
      "Code": "max",
      "Label": "Max"
    },
    {
      "Code": "min",
      "Label": "Min"
    },
    {
      "Code": "Sub-value %d",
      "Label": "Sub-value %d"
    },
    {
      "Code": "Read",
      "Label": "Read"
    }
  ],
  "ModelLangCode": "EN",
  "ModelWords": [
    {
      "Code": "Event loop completed",
      "Label": "Event loop completed"
    },
    {
      "Code": "Reading Parameters",
      "Label": "Reading Parameters"
    },
    {
      "Code": "Running Simulation",
      "Label": "Running Simulation"
    },
    {
      "Code": "Start model subvalue",
      "Label": "Start model subvalue"
    },
    {
      "Code": "Writing Output Tables",
      "Label": "Writing Output Tables"
    }
  ]
}
```

GET model profile

Get model profile. Profile is a set of key-value options, similar to ini-file, which can be used to run the model. Please keep in mind, there is no actual link between profiles and models and any profile can be applied to run any model (it is by design, similar to ini-file).

Methods:

```
GET /api/model/:model/profile/:profile  
GET /api/model-profile?model=modelNameOrDigest&profile=profileName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:profile - (required) profile name
```

Profile name is unique per database.

Call examples:

```
http://localhost:4040/api/model/modelOne/profile/modelOne  
http://localhost:4040/api/model-profile?model=modelOne&profile=modelOne
```

Return example: *This is a beta version and may change in the future.*

```
{  
  "Name": "modelOne",  
  "Opts": {  
    "OpenM.SparseOutput": "true",  
    "Parameter.StartingSeed": "1023"  
  }  
}
```

GET list of profiles

Get list of profile names by model name or model digest.

Profile is a set of key-value options, similar to ini-file, which can be used to run the model. Please keep in mind, there is no actual link between profiles and models and any profile can be applied to run any model (it is by design, similar to ini-file).

Methods:

```
GET /api/model/:model/profile-list  
GET /api/model-profile-list?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Model digest or name is used by server to find SQLite database. There is no explicit link between model and profile. All profile name from that database will be selected.

Call examples:

```
http://localhost:4040/api/model/modelOne/profile-list  
http://localhost:4040/api/model-profile-list?model=modelOne
```

Return example:

```
[  
  "modelOne"  
]
```

GET list of model runs

Get list of model run results: language-neutral part of run list metadata.

Methods:

```
GET /api/model/:model/run-list  
GET /api/model-run-list?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/run-list  
http://localhost:4040/api/model/_201208171604590148_/run-list  
http://localhost:4040/api/model-run?model=modelOne  
http://localhost:4040/api/model-run?model=_201208171604590148_
```

Return example:

```
[  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "Default",  
    "SubCount": 1,  
    "SubStarted": 1,  
    "SubCompleted": 1,  
    "CreateDateTime": "2021-03-11 00:27:56.583",  
    "Status": "s",  
    "UpdateDateTime": "2021-03-11 00:27:57.030",  
    "RunDigest": "88b8c45b77993133b07a7c85e4447d5c",  
    "ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",  
    "RunStamp": "2021_03_11_00_27_56_535",  
    "Txt": [],  
    "Opts": {},  
    "Param": [],  
    "Table": [],  
    "Progress": []  
  },  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "Default-4",  
    "SubCount": 4,  
    "SubStarted": 4,  
    "SubCompleted": 4,  
    "CreateDateTime": "2021-03-11 00:27:57.119",  
    "Status": "s",  
    "UpdateDateTime": "2021-03-11 00:27:57.955",  
    "RunDigest": "c6ced1efa64dca8a98e5cd323ac7f50d",  
    "ValueDigest": "d900353af61f7f824ddae66b47b456ea",  
    "RunStamp": "2021_03_11_00_27_57_080",  
    "Txt": [],  
    "Opts": {},  
    "Param": [],  
    "Table": [],  
    "Progress": []  
  },  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "First Task Run_Default",  
    "SubCount": 1,  
    "SubStarted": 1,  
    "SubCompleted": 1,  
    "CreateDateTime": "2021-03-11 00:27:58.054",  
    "Status": "s",  
    "UpdateDateTime": "2021-03-11 00:27:58.485",  
    "RunDigest": "419f0d1b7078cff499f87be5d9e8995c",  
    "ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",  
  }]
```

```
"RunStamp": "2021_03_11_00_27_58_005",
"Txt": [],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "First Task Run_modelOne_other",
  "SubCount": 1,
  "SubStarted": 1,
  "SubCompleted": 1,
  "CreateDateTime": "2021-03-11 00:27:58.505",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:27:58.833",
  "RunDigest": "ec2455261ede37787150692c460a2688",
  "ValueDigest": "fb27d108fae2040fa1cae6f49704a1b7",
  "RunStamp": "2021_03_11_00_27_58_005",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Sub-values_2_from_csv",
  "SubCount": 2,
  "SubStarted": 2,
  "SubCompleted": 2,
  "CreateDateTime": "2021-03-11 00:27:58.935",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:27:59.531",
  "RunDigest": "de486efd4c8d002036876a3b9a285f63",
  "ValueDigest": "c91cee4876452c95717b8d2d6aaee7a5",
  "RunStamp": "2021_03_11_00_27_58_895",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Sub-values_4",
  "SubCount": 4,
  "SubStarted": 4,
  "SubCompleted": 4,
  "CreateDateTime": "2021-03-11 00:27:59.631",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:28:00.492",
  "RunDigest": "668da5c876e3c7c8742d24e17071505f",
  "ValueDigest": "2ccb8ebabceb2cfb23bbca6403ac52d0",
  "RunStamp": "2021_03_11_00_27_59_582",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Group_sub-values_2_from_csv",
  "SubCount": 2,
  "SubStarted": 2,
  "SubCompleted": 2,
  "CreateDateTime": "2021-03-11 00:28:00.587",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:28:00.921",
  "RunDigest": "e36f2fbff9439a8f4f7268e50eef2986",
  "ValueDigest": "d73a023253e620a3df7fc45b4b826a60",
  "RunStamp": "2021_03_11_00_28_00_543",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Import_from_Default_run",
  "SubCount": 1,
```

```
"SubCount": 1,
"SubStarted": 1,
"SubCompleted": 1,
"CreateDateTime": "2021-03-11 00:28:01.015",
"Status": "s",
"UpdateDateTime": "2021-03-11 00:28:01.256",
"RunDigest": "dcc2a68b7e86267d7efad9f8b7fd2092",
"ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",
"RunStamp": "2021_03_11_00_28_00_952",
"Txt": [],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Base_run_is_Sub-values_2_from_csv",
  "SubCount": 2,
  "SubStarted": 2,
  "SubCompleted": 2,
  "CreateDateTime": "2021-03-11 00:28:01.326",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:28:01.619",
  "RunDigest": "a57ac3d4c0cefcd09939ad7150661bed",
  "ValueDigest": "c91cee4876452c95717b8d2d6aaee7a5",
  "RunStamp": "2021_03_11_00_28_01_286",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Base_run_and_partial_input_set",
  "SubCount": 1,
  "SubStarted": 1,
  "SubCompleted": 1,
  "CreateDateTime": "2021-03-11 00:28:01.704",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:28:01.913",
  "RunDigest": "f170ec1ad8596d1f82114285c3d93eec",
  "ValueDigest": "f8638fcc86441f3fd22b2c37e0ed5e47",
  "RunStamp": "2021_03_11_00_28_01_661",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Task Run with Suppressed Tables_Default",
  "SubCount": 2,
  "SubStarted": 2,
  "SubCompleted": 2,
  "CreateDateTime": "2021-03-11 00:28:01.994",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:28:02.241",
  "RunDigest": "e40a172f046a248d85f0fc600d9aa133",
  "ValueDigest": "74dc31c98dd0e491bfdbf0f68961576d",
  "RunStamp": "2021_03_11_00_28_01_943",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Task Run with Suppressed Tables_modelOne_other",
  "SubCount": 2,
  "SubStarted": 2,
  "SubCompleted": 2,
  "CreateDateTime": "2021-03-11 00:28:02.253",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:28:02.435",
  "RunDigest": "e97dc09e7ae4965a47688eb90ba434c1",
  "ValueDigest": "7dd0761dcfd04cb8def60c63a2804157",
  "RunStamp": "2021_03_11_00_28_01_943",
  "Txt": [],
  "Opts": {}
}
```

```
"Param": [],
"Table": [],
"Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Task Run with NotSuppressed Tables_Default",
  "SubCount": 2,
  "SubStarted": 2,
  "SubCompleted": 2,
  "CreateDateTime": "2021-03-11 00:28:02.572",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:28:03.016",
  "RunDigest": "ef9920516d16859e1705574d7e6f8891",
  "ValueDigest": "e284bb8c7f1e28aa6dc5b52fa78d975d",
  "RunStamp": "2021_03_11_00_28_02_520",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Task Run with NotSuppressed Tables_modelOne_other",
  "SubCount": 2,
  "SubStarted": 2,
  "SubCompleted": 2,
  "CreateDateTime": "2021-03-11 00:28:03.036",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:28:03.372",
  "RunDigest": "a5b56959d3f3efd82e7702289af43022",
  "ValueDigest": "79c55110928e7d372c0570cf2202867",
  "RunStamp": "2021_03_11_00_28_02_520",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
}
]
```

GET list of model runs including text (description and notes)

Get list of model runs, including text (description and notes).

Methods:

```
GET /api/model/:model/run-list/text  
GET /api/model/:model/run-list/text/lang/:lang  
GET /api/model-run-list-text?model=modelNameOrDigest&lang=en
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:lang - (optional) language code
```

If optional `lang` argument specified then result in that language else in browser language. If no such language exist then text portion of result (description and notes) is empty.

Call examples:

```
http://localhost:4040/api/model/modelOne/run-list/text  
http://localhost:4040/api/model/_201208171604590148/run-list/text  
http://localhost:4040/api/model/modelOne/run-list/text/lang/en_CA  
http://localhost:4040/api/model-run-list-text?model=modelOne&lang=en  
http://localhost:4040/api/model-run-list-text?model=_201208171604590148_&lang=FR
```

Return example:

```
[  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "Default",  
    "SubCount": 1,  
    "SubStarted": 1,  
    "SubCompleted": 1,  
    "CreateDateTime": "2021-03-11 00:27:56.583",  
    "Status": "s",  
    "UpdateDateTime": "2021-03-11 00:27:57.030",  
    "RunDigest": "88b8c45b77993133b07a7c85e4447d5c",  
    "ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",  
    "RunStamp": "2021_03_11_00_27_56_535",  
    "Txt": [  
      {  
        "LangCode": "EN",  
        "Descr": "Model One default set of parameters",  
        "Note": ""  
      }  
    ],  
    "Opts": {},  
    "Param": [],  
    "Table": [],  
    "Progress": []  
  },  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "Default-4",  
    "SubCount": 4,  
    "SubStarted": 4,  
    "SubCompleted": 4,  
    "CreateDateTime": "2021-03-11 00:27:57.119",  
    "Status": "s",  
    "UpdateDateTime": "2021-03-11 00:27:57.955",  
    "RunDigest": "c6ced1efaf64dca8a98e5cd323ac7f50d",  
    "ValueDigest": "d900353af61f7f824ddae66b47b456ea",  
    "RunStamp": "2021_03_11_00_27_57_080",  
    "Txt": [  
      {  
        "LangCode": "EN",  
        "Descr": "Model One default set of parameters",  
        "Note": ""  
      }  
    ]  
  }]
```

```

    "LangCode": "EN",
    "Descr": "Model One default set of parameters",
    "Note": ""
}
],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
"ModelName": "modelOne",
"ModelDigest": "_201208171604590148_",
"Name": "First Task Run_Default",
"SubCount": 1,
"SubStarted": 1,
"SubCompleted": 1,
"CreateDateTime": "2021-03-11 00:27:58.054",
>Status": "s",
"UpdateDateTime": "2021-03-11 00:27:58.485",
"RunDigest": "419f0d1b7078cff499f87be5d9e8995c",
"ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",
"RunStamp": "2021_03_11_00_27_58_005",
"Txt": [
{
    "LangCode": "EN",
    "Descr": "Model One default set of parameters",
    "Note": ""
}
],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
"ModelName": "modelOne",
"ModelDigest": "_201208171604590148_",
"Name": "First Task Run_modelOne_other",
"SubCount": 1,
"SubStarted": 1,
"SubCompleted": 1,
"CreateDateTime": "2021-03-11 00:27:58.505",
>Status": "s",
"UpdateDateTime": "2021-03-11 00:27:58.833",
"RunDigest": "ec2455261ede37787150692c460a2688",
"ValueDigest": "fb27d108fae2040fa1cae6f49704a1b7",
"RunStamp": "2021_03_11_00_27_58_005",
"Txt": [
{
    "LangCode": "EN",
    "Descr": "Model One other set of parameters",
    "Note": ""
}
],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
"ModelName": "modelOne",
"ModelDigest": "_201208171604590148_",
"Name": "Sub-values_2_from_csv",
"SubCount": 2,
"SubStarted": 2,
"SubCompleted": 2,
"CreateDateTime": "2021-03-11 00:27:58.935",
>Status": "s",
"UpdateDateTime": "2021-03-11 00:27:59.531",
"RunDigest": "de486ef4c8d002036876a3b9a285f63",
"ValueDigest": "c91ceee4876452c95717b8d2d6aaeee7a5",
"RunStamp": "2021_03_11_00_27_58_895",
"Txt": [
{
    "LangCode": "EN",
    "Descr": "Parameter sub-values 2 from csv",
    "Note": ""
}
],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
"ModelName": "modelOne",
"ModelDigest": "_201208171604590148_"
}

```

```
ModelDigest : _201208171604590148_ ,
"Name": "Sub-values_4",
"SubCount": 4,
"SubStarted": 4,
"SubCompleted": 4,
"CreateDateTime": "2021-03-11 00:27:59.631",
"Status": "s",
"UpdateDateTime": "2021-03-11 00:28:00.492",
"RunDigest": "668da5c876e3c7c8742d24e17071505f",
"ValueDigest": "2ccb8ebabceb2cfb23bbca6403ac52d0",
"RunStamp": "2021_03_11_00_27_59_582",
"Txt": [
{
    "LangCode": "EN",
    "Descr": "Parameter sub-values 4",
    "Note": ""
}
],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
"ModelName": "modelOne",
"ModelDigest": "_201208171604590148_",
"Name": "Group_sub-values_2_from_csv",
"SubCount": 2,
"SubStarted": 2,
"SubCompleted": 2,
"CreateDateTime": "2021-03-11 00:28:00.587",
"Status": "s",
"UpdateDateTime": "2021-03-11 00:28:00.921",
"RunDigest": "e36f2fbff9439a8f4f7268e50eef2986",
"ValueDigest": "d73a023253e620a3df7fc45b4b826a60",
"RunStamp": "2021_03_11_00_28_00_543",
"Txt": [
{
    "LangCode": "EN",
    "Descr": "Parameter group sub-values 2 from csv",
    "Note": ""
}
],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
"ModelName": "modelOne",
"ModelDigest": "_201208171604590148_",
"Name": "Import_from_Default_run",
"SubCount": 1,
"SubStarted": 1,
"SubCompleted": 1,
"CreateDateTime": "2021-03-11 00:28:01.015",
"Status": "s",
"UpdateDateTime": "2021-03-11 00:28:01.256",
"RunDigest": "dcc2a68b7e86267d7efad9f8b7fd2092",
"ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",
"RunStamp": "2021_03_11_00_28_00_952",
"Txt": [
{
    "LangCode": "EN",
    "Descr": "Import parameters from Default run",
    "Note": ""
}
],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
"ModelName": "modelOne",
"ModelDigest": "_201208171604590148_",
"Name": "Base_run_is_Sub-values_2_from_csv",
"SubCount": 2,
"SubStarted": 2,
"SubCompleted": 2,
"CreateDateTime": "2021-03-11 00:28:01.326",
"Status": "s",
"UpdateDateTime": "2021-03-11 00:28:01.619",
"RunDigest": "a57ac3d4c0cefcd09939ad7150661bed",
"ValueDigest": "c91cee4876452c95717b8d2d6aaee7a5",
"RunStamp": "2021_03_11_00_28_01_286",
"Txt": [
{
```

```

        "LangCode": "EN",
        "Descr": "Parameters from base run Sub-values_2_from_csv",
        "Note": ""
    }
],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
    "ModelName": "modelOne",
    "ModelDigest": "_201208171604590148_",
    "Name": "Base_run_and_partial_input_set",
    "SubCount": 1,
    "SubStarted": 1,
    "SubCompleted": 1,
    "CreateDateTime": "2021-03-11 00:28:01.704",
    "Status": "s",
    "UpdateDateTime": "2021-03-11 00:28:01.913",
    "RunDigest": "f170ec1ad8596d1f82114285c3d93eec",
    "ValueDigest": "f8638fcc86441f3fd22b2c37e0ed5e47",
    "RunStamp": "2021_03_11_00_28_01_661",
    "Txt": [
        {
            "LangCode": "EN",
            "Descr": "Parameters from base run and from partial input set",
            "Note": ""
        }
    ],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
    "ModelName": "modelOne",
    "ModelDigest": "_201208171604590148_",
    "Name": "Task Run with Suppressed Tables_Default",
    "SubCount": 2,
    "SubStarted": 2,
    "SubCompleted": 2,
    "CreateDateTime": "2021-03-11 00:28:01.994",
    "Status": "s",
    "UpdateDateTime": "2021-03-11 00:28:02.241",
    "RunDigest": "e40a172f046a248d85f0fc600d9aa133",
    "ValueDigest": "74dc31c98dd0e491bfdbf0f68961576d",
    "RunStamp": "2021_03_11_00_28_01_943",
    "Txt": [
        {
            "LangCode": "EN",
            "Descr": "Model One default set of parameters",
            "Note": ""
        }
    ],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
    "ModelName": "modelOne",
    "ModelDigest": "_201208171604590148_",
    "Name": "Task Run with Suppressed Tables_modelOne_other",
    "SubCount": 2,
    "SubStarted": 2,
    "SubCompleted": 2,
    "CreateDateTime": "2021-03-11 00:28:02.253",
    "Status": "s",
    "UpdateDateTime": "2021-03-11 00:28:02.435",
    "RunDigest": "e97dc09e7ae4965a47688eb90ba434c1",
    "ValueDigest": "7dd0761dcfd04cb8def60c63a2804157",
    "RunStamp": "2021_03_11_00_28_01_943",
    "Txt": [
        {
            "LangCode": "EN",
            "Descr": "Model One other set of parameters",
            "Note": ""
        }
    ],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
    "ModelName": "modelOne",

```

```
"ModelDigest": "_201208171604590148",
"Name": "Task Run with NotSuppressed Tables_Default",
"SubCount": 2,
"SubStarted": 2,
"SubCompleted": 2,
"CreateDateTime": "2021-03-11 00:28:02.572",
"Status": "s",
"UpdateDateTime": "2021-03-11 00:28:03.016",
"RunDigest": "ef9920516d16859e1705574d7e6f8891",
"ValueDigest": "e284bb8c7f1e28aa6dc5b52fa78d975d",
"RunStamp": "2021_03_11_00_28_02_520",
"Txt": [
  {
    "LangCode": "EN",
    "Descr": "Model One default set of parameters",
    "Note": ""
  }
],
"Opts": {},
"Param": [],
"Table": [],
"Progress": []
},
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148",
  "Name": "Task Run with NotSuppressed Tables_modelOne_other",
  "SubCount": 2,
  "SubStarted": 2,
  "SubCompleted": 2,
  "CreateDateTime": "2021-03-11 00:28:03.036",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:28:03.372",
  "RunDigest": "a5b56959d3f3efd82e7702289af43022",
  "ValueDigest": "79c55110928e7d372c0570cfa2202867",
  "RunStamp": "2021_03_11_00_28_02_520",
  "Txt": [
    {
      "LangCode": "EN",
      "Descr": "Model One other set of parameters",
      "Note": ""
    }
  ],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": []
}
]
]
```

GET status of model run

Get status of model run by run digest, run stamp or run name. If there is only multiple runs with such stamp or name exist then it is better to use [GET status of model run list](#) method to get run status of all runs.

Methods:

```
GET /api/model/:model/run/:run/status  
GET /api/model-run-status?model=modelNameOrDigest&run=runDigestOrStampOrName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex: 2016_08_17_21_07_55_123. It is also possible to use run name, which is more human readable than digest, but if there are multiple runs with same name or same run stamp in database then result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default-4/status  
http://localhost:4040/api/model/modelOne/run/05403de52f30f59b050417561914fbb8/status  
http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/status  
http://localhost:4040/api/model-run-status?model=modelOne&run=Default-4  
http://localhost:4040/api/model-run-status?model=_201208171604590148_&run=Default
```

Return example: *This is a beta version and may change in the future.*

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Default-4",
  "SubCount": 4,
  "SubStarted": 4,
  "SubCompleted": 4,
  "CreateDateTime": "2021-03-11 00:27:57.119",
  "Status": "s",
  "UpdateDateTime": "2021-03-11 00:27:57.955",
  "RunDigest": "c6ced1efa64dca8a98e5cd323ac7f50d",
  "ValueDigest": "d900353af617f824ddae66b47b456ea",
  "RunStamp": "2021_03_11_00_27_57_080",
  "Txt": [],
  "Opts": {},
  "Param": [],
  "Table": [],
  "Progress": [
    {
      "SubId": 0,
      "CreateDateTime": "2021-03-11 00:27:57.151",
      "Status": "s",
      "UpdateDateTime": "2021-03-11 00:27:57.512",
      "Count": 100,
      "Value": 0
    },
    {
      "SubId": 1,
      "CreateDateTime": "2021-03-11 00:27:57.153",
      "Status": "s",
      "UpdateDateTime": "2021-03-11 00:27:57.669",
      "Count": 100,
      "Value": 0
    },
    {
      "SubId": 2,
      "CreateDateTime": "2021-03-11 00:27:57.157",
      "Status": "s",
      "UpdateDateTime": "2021-03-11 00:27:57.649",
      "Count": 100,
      "Value": 0
    },
    {
      "SubId": 3,
      "CreateDateTime": "2021-03-11 00:27:57.159",
      "Status": "s",
      "UpdateDateTime": "2021-03-11 00:27:57.746",
      "Count": 100,
      "Value": 0
    }
  ]
}
```

GET status of model run list

Get status of model runs by run digest, run stamp or run name. If there is only single run with such stamp or name exist then result similar to the result of [GET status of model run](#) method.

Methods:

```
GET /api/model/:model/run/:run/status/list  
GET /api/model-run-status-list?model=modelNameOrDigest&run=runDigestOrStampOrName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex: 2016_08_17_21_07_55_123. It is also possible to use run name, which is more human readable than digest.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default-4/status/list  
http://localhost:4040/api/model/modelOne/run/05403de52f30f59b050417561914fb88/status/list  
http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/status/list  
http://localhost:4040/api/model-run-status-list?model=modelOne&run=Default-4  
http://localhost:4040/api/model-run-status-list?model=_201208171604590148_&run=Default
```

Return example: *This is a beta version and may change in the future.*

```
[  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "Default-4",  
    "SubCount": 4,  
    "SubStarted": 4,  
    "SubCompleted": 4,  
    "CreateDateTime": "2021-03-11 00:27:57.119",  
    "Status": "s",  
    "UpdateDateTime": "2021-03-11 00:27:57.955",  
    "RunDigest": "c6ced1efaf64dca8a98e5cd323ac7f50d",  
    "ValueDigest": "d900353af61f7f824ddae66b47b456ea",  
    "RunStamp": "2021_03_11_00_27_57_080",  
    "Txt": [],  
    "Opts": {},  
    "Param": [],  
    "Table": [],  
    "Progress": [  
      {  
        "SubId": 0,  
        "CreateDateTime": "2021-03-11 00:27:57.151",  
        "Status": "s",  
        "UpdateDateTime": "2021-03-11 00:27:57.512",  
        "Count": 100,  
        "Value": 0  
      },  
      {  
        "SubId": 1,  
        "CreateDateTime": "2021-03-11 00:27:57.153",  
        "Status": "s",  
        "UpdateDateTime": "2021-03-11 00:27:57.669",  
        "Count": 100,  
        "Value": 0  
      },  
      {  
        "SubId": 2,  
        "CreateDateTime": "2021-03-11 00:27:57.157",  
        "Status": "s",  
        "UpdateDateTime": "2021-03-11 00:27:57.649",  
        "Count": 100,  
        "Value": 0  
      },  
      {  
        "SubId": 3,  
        "CreateDateTime": "2021-03-11 00:27:57.159",  
        "Status": "s",  
        "UpdateDateTime": "2021-03-11 00:27:57.746",  
        "Count": 100,  
        "Value": 0  
      }  
    ]  
  ]
```

GET status of first model run

Get status of first model run.

Methods:

```
GET /api/model/:model/run/status/first  
GET /api/model-run-first-status?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/status/first  
http://localhost:4040/api/model/_201208171604590148_/run/status/first  
http://localhost:4040/api/model-run-first-status?model=modelOne
```

Return example: This is a beta version and may change in the future.

```
{  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "Default",  
    "SubCount": 1,  
    "SubStarted": 1,  
    "SubCompleted": 1,  
    "CreateDateTime": "2021-03-11 00:27:56.583",  
    "Status": "s",  
    "UpdateDateTime": "2021-03-11 00:27:57.030",  
    "RunDigest": "88b8c45b77993133b07a7c85e4447d5c",  
    "ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",  
    "RunStamp": "2021_03_11_00_27_56_535",  
    "Txt": [],  
    "Opts": {},  
    "Param": [],  
    "Table": [],  
    "Progress": [  
        {  
            "SubId": 0,  
            "CreateDateTime": "2021-03-11 00:27:56.647",  
            "Status": "s",  
            "UpdateDateTime": "2021-03-11 00:27:56.816",  
            "Count": 100,  
            "Value": 0  
        }  
    ]  
}
```

GET status of last model run

Get status of last model run.

Methods:

```
GET /api/model/:model/run/status/last  
GET /api/model-run-last-status?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/status/last  
http://localhost:4040/api/model/_201208171604590148_/run/status/last  
http://localhost:4040/api/model-run-last-status?model=modelOne
```

Return example: This is a beta version and may change in the future.

```
{  
  "ModelName": "modelOne",  
  "ModelDigest": "_201208171604590148_",  
  "Name": "Task Run with NotSuppressed Tables_modelOne_other",  
  "SubCount": 2,  
  "SubStarted": 2,  
  "SubCompleted": 2,  
  "CreateDateTime": "2021-03-11 00:28:03.036",  
  "Status": "s",  
  "UpdateDateTime": "2021-03-11 00:28:03.372",  
  "RunDigest": "a5b56959d3f3efd82e7702289af43022",  
  "ValueDigest": "79c55110928e7d372c0570cfa2202867",  
  "RunStamp": "2021_03_11_00_28_02_520",  
  "Txt": [],  
  "Opts": {},  
  "Param": [],  
  "Table": [],  
  "Progress": [  
    {  
      "SubId": 0,  
      "CreateDateTime": "2021-03-11 00:28:03.070",  
      "Status": "s",  
      "UpdateDateTime": "2021-03-11 00:28:03.204",  
      "Count": 100,  
      "Value": 0  
    },  
    {  
      "SubId": 1,  
      "CreateDateTime": "2021-03-11 00:28:03.073",  
      "Status": "s",  
      "UpdateDateTime": "2021-03-11 00:28:03.195",  
      "Count": 100,  
      "Value": 0  
    }  
  ]  
}
```

GET status of last completed model run

Get status of last completed model run. Run completed if run status one of: s=success, x=exit, e=error

Methods:

```
GET /api/model/:model/run/status/last-completed  
GET /api/model-run-last-completed-status?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/status/last-completed  
http://localhost:4040/api/model/_201208171604590148_/run/status/last-completed  
http://localhost:4040/api/model-run-last-completed-status?model=modelOne
```

Return example: This is a beta version and may change in the future.

```
{  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "Task Run with NotSuppressed Tables_modelOne_other",  
    "SubCount": 2,  
    "SubStarted": 2,  
    "SubCompleted": 2,  
    "CreateDateTime": "2021-03-11 00:28:03.036",  
    "Status": "s",  
    "UpdateDateTime": "2021-03-11 00:28:03.372",  
    "RunDigest": "a5b56959d3f3efd82e7702289af43022",  
    "ValueDigest": "79c55110928e7d372c0570cfa2202867",  
    "RunStamp": "2021_03_11_00_28_02_520",  
    "Txt": [],  
    "Opts": {},  
    "Param": [],  
    "Table": [],  
    "Progress": [  
        {  
            "SubId": 0,  
            "CreateDateTime": "2021-03-11 00:28:03.070",  
            "Status": "s",  
            "UpdateDateTime": "2021-03-11 00:28:03.204",  
            "Count": 100,  
            "Value": 0  
        },  
        {  
            "SubId": 1,  
            "CreateDateTime": "2021-03-11 00:28:03.073",  
            "Status": "s",  
            "UpdateDateTime": "2021-03-11 00:28:03.195",  
            "Count": 100,  
            "Value": 0  
        }  
    ]  
}
```

GET model run metadata and status

Get model run results metadata and status

Methods:

```
GET /api/model/:model/run/:run  
GET /api/model-run?model=modelNameOrDigest&run=runDigestOrStampOrName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default-4  
http://localhost:4040/api/model/_201208171604590148_/run/Default-4  
http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998  
http://localhost:4040/api/model-run-text?model=modelOne&run=Default-4
```

Return example:

```
{  
  "ModelName": "modelOne",  
  "ModelDigest": "_201208171604590148_",  
  "Name": "Default-4",  
  "SubCount": 4,  
  "SubStarted": 4,  
  "SubCompleted": 4,  
  "CreateDateTime": "2021-03-11 00:27:57.119",  
  "Status": "s",  
  "UpdateDateTime": "2021-03-11 00:27:57.955",  
  "RunDigest": "c6ced1efaf64dca8a98e5cd323ac7f50d",  
  "ValueDigest": "d900353af61f7f824ddae66b47b456ea",  
  "RunStamp": "2021_03_11_00_27_57_080",  
  "Txt": [],  
  "Opts": {  
    "OpenM.RunName": "Default-4",  
    "OpenM.RunStamp": "2021_03_11_00_27_57_080",  
    "OpenM.SetId": "2",  
    "OpenMSetName": "Default",  
    "OpenM.SubValues": "4",  
    "OpenM.Threads": "4"  
  },  
  "Param": [  
    {  
      "Name": "ageSex",  
      "SubCount": 1,  
      "DefaultSubId": 0,  
      "Txt": []  
    },  
    {  
      "Name": "salaryAge",  
      "SubCount": 1,  
      "DefaultSubId": 0,  
      "Txt": []  
    },  
    {  
      "Name": "StartingSeed",  
      "SubCount": 1,  
      "DefaultSubId": 0,  
      "Txt": []  
    }  
  ]  
}
```

```
},
{
  "Name": "salaryFull",
  "SubCount": 1,
  "DefaultSubId": 0,
  "Txt": []
},
{
  "Name": "baseSalary",
  "SubCount": 1,
  "DefaultSubId": 0,
  "Txt": []
},
{
  "Name": "filePath",
  "SubCount": 1,
  "DefaultSubId": 0,
  "Txt": []
},
{
  "Name": "isOldAge",
  "SubCount": 1,
  "DefaultSubId": 0,
  "Txt": []
},
],
"Table": [
  {
    "Name": "salarySex"
  },
  {
    "Name": "fullAgeSalary"
  },
  {
    "Name": "ageSexIncome"
  },
  {
    "Name": "seedOldAge"
  }
],
"Progress": [
  {
    "SubId": 0,
    "CreateDateTime": "2021-03-11 00:27:57.151",
    "Status": "s",
    "UpdateDateTime": "2021-03-11 00:27:57.512",
    "Count": 100,
    "Value": 0
  },
  {
    "SubId": 1,
    "CreateDateTime": "2021-03-11 00:27:57.153",
    "Status": "s",
    "UpdateDateTime": "2021-03-11 00:27:57.669",
    "Count": 100,
    "Value": 0
  },
  {
    "SubId": 2,
    "CreateDateTime": "2021-03-11 00:27:57.157",
    "Status": "s",
    "UpdateDateTime": "2021-03-11 00:27:57.649",
    "Count": 100,
    "Value": 0
  },
  {
    "SubId": 3,
    "CreateDateTime": "2021-03-11 00:27:57.159",
    "Status": "s",
    "UpdateDateTime": "2021-03-11 00:27:57.746",
    "Count": 100,
    "Value": 0
  }
]
```

GET model run including text (description and notes)

Get model run results, including text (description and notes)

Methods:

```
GET /api/model/:model/run/:run/text  
GET /api/model/:model/run/:run/text/lang/:lang  
GET /api/model-run-text?model=modelNameOrDigest&run=runDigestOrStampOrName  
GET /api/model-run-text?model=modelNameOrDigest&run=runDigestOrStampOrName&lang=en
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:lang - (optional) language code
```

If optional `lang` argument specified then result in that language else in browser language. If no such language exist then text portion of result (description and notes) is empty.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default-4/text  
http://localhost:4040/api/model/_201208171604590148/_run/Default-4/text  
http://localhost:4040/api/model/modelOne/run/Default-4/text/lang/en  
http://localhost:4040/api/model/modelOne/run/05403de52f30f59b050417561914fbb8/text/lang/en  
http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/text/lang/en  
http://localhost:4040/api/model-run-text?model=modelOne&run=Default-4&lang=en
```

Return example:

```
{  
  "modelName": "modelOne",  
  "modelDigest": "_201208171604590148_",  
  "name": "Default-4",  
  "subCount": 4,  
  "subStarted": 4,  
  "subCompleted": 4,  
  "createDateTime": "2021-03-11 00:27:57.119",  
  "status": "s",  
  "updateDateTime": "2021-03-11 00:27:57.955",  
  "runDigest": "c6ced1efa64dca8a98e5cd323ac7f50d",  
  "valueDigest": "d900353af61f7f824ddae66b47b456ea",  
  "runStamp": "2021_03_11_00_27_57_080",  
  "txt": [  
    {  
      "langCode": "EN",  
      "descr": "Model One default set of parameters",  
      "note": ""  
    }  
  ],  
  "opts": {  
    "openM.RunName": "Default-4",  
    "openM.RunStamp": "2021_03_11_00_27_57_080",  
    "openM.SetId": "2",  
    "openMSetName": "Default",  
    "openMSubValues": "4",  
    "openMThreads": "4"  
  },  
  "param": [
```

```
{
  "Name": "ageSex",
  "SubCount": 1,
  "DefaultSubId": 0,
  "Txt": [
    {
      "LangCode": "EN",
      "Note": "Age by Sex default values"
    }
  ],
  {
    "Name": "salaryAge",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": [
      {
        "LangCode": "EN",
        "Note": "Salary by Age default values"
      }
    ]
  },
  {
    "Name": "StartingSeed",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": [
      {
        "LangCode": "EN",
        "Note": "Starting seed default value"
      }
    ]
  },
  {
    "Name": "salaryFull",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": [
      {
        "LangCode": "EN",
        "Note": "Full or part time by Salary default values"
      }
    ]
  },
  {
    "Name": "baseSalary",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": []
  },
  {
    "Name": "filePath",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": []
  },
  {
    "Name": "isOldAge",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": [
      {
        "LangCode": "EN",
        "Note": "Is old age default values"
      }
    ]
  }
],
"Table": [
  {
    "Name": "salarySex"
  },
  {
    "Name": "fullAgeSalary"
  },
  {
    "Name": "ageSexIncome"
  },
  {
    "Name": "seedOldAge"
  }
],
"Progress": [
  {
    "SubId": 0,
    "CreateDateTime": "2021-03-11 00:27:57.151",
    "Status": "s",
  }
]
```

```
"UpdateDateTime": "2021-03-11 00:27:57.512",
"Count": 100,
"Value": 0
},
{
"SubId": 1,
"CreateDateTime": "2021-03-11 00:27:57.153",
>Status": "s",
"UpdateDateTime": "2021-03-11 00:27:57.669",
"Count": 100,
"Value": 0
},
{
"SubId": 2,
"CreateDateTime": "2021-03-11 00:27:57.157",
>Status": "s",
"UpdateDateTime": "2021-03-11 00:27:57.649",
"Count": 100,
"Value": 0
},
{
"SubId": 3,
"CreateDateTime": "2021-03-11 00:27:57.159",
>Status": "s",
"UpdateDateTime": "2021-03-11 00:27:57.746",
"Count": 100,
"Value": 0
}
]
}
```

GET model run including text in all languages

Get model run results, including text (description and notes) in all languages

Methods:

```
GET /api/model/:model/run/:run/text/all  
GET /api/model-run-text-all?model=modelNameOrDigest&run=runDigestOrStampOrName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/text/all  
http://localhost:4040/api/model/_201208171604590148_/run/Default/text/all  
http://localhost:4040/api/model/modelOne/run/6fbad822cb9ae42deea1ede626890711/text/all  
http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/text/all  
http://localhost:4040/api/model-run-text-all?model=modelOne&run=Default
```

Return example:

```
{  
  "ModelName": "modelOne",  
  "ModelDigest": "_201208171604590148_",  
  "Name": "Default",  
  "SubCount": 1,  
  "SubStarted": 1,  
  "SubCompleted": 1,  
  "CreateDateTime": "2021-03-11 00:27:56.583",  
  "Status": "s",  
  "UpdateDateTime": "2021-03-11 00:27:57.030",  
  "RunDigest": "88b8c45b77993133b07a7c85e4447d5c",  
  "ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",  
  "RunStamp": "2021_03_11_00_27_56_535",  
  "Txt": [  
    {  
      "LangCode": "EN",  
      "Descr": "Model One default set of parameters",  
      "Note": ""  
    },  
    {  
      "LangCode": "FR",  
      "Descr": "(FR) Model One default set of parameters",  
      "Note": ""  
    }  
  ],  
  "Opts": {  
    "OpenM.RunName": "Default",  
    "OpenM.RunStamp": "2021_03_11_00_27_56_535",  
    "OpenM.SetId": "2",  
    "OpenMSetName": "Default"  
  },  
  "Param": [  
    {  
      "Name": "ageSex",  
      "SubCount": 1,  
      "DefaultSubId": 0,  
      "Txt": [  
        {  
          "LangCode": "EN",  
          "Descr": "Model One default set of parameters",  
          "Note": ""  
        }  
      ]  
    }  
  ]  
}
```

```

    "Note": "Age by Sex default values"
},
{
    "LangCode": "FR",
    "Note": "(FR) Age by Sex default values"
}
],
},
{
    "Name": "salaryAge",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": [
        {
            "LangCode": "EN",
            "Note": "Salary by Age default values"
        },
        {
            "LangCode": "FR",
            "Note": "(FR) Salary by Age default values"
        }
    ]
},
{
    "Name": "StartingSeed",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": [
        {
            "LangCode": "EN",
            "Note": "Starting seed default value"
        }
    ]
},
{
    "Name": "salaryFull",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": [
        {
            "LangCode": "EN",
            "Note": "Full or part time by Salary default values"
        }
    ]
},
{
    "Name": "baseSalary",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": []
},
{
    "Name": "filePath",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": []
},
{
    "Name": "isOldAge",
    "SubCount": 1,
    "DefaultSubId": 0,
    "Txt": [
        {
            "LangCode": "EN",
            "Note": "Is old age default values"
        }
    ]
},
],
"Table": [
{
    "Name": "salarySex"
},
{
    "Name": "fullAgeSalary"
},
{
    "Name": "ageSexIncome"
},
{
    "Name": "seedOldAge"
}
],
"Progress": [
{
    "SubId": 0,
    "CreateDateTime": "2021-03-11 00:27:56.647",
    "Status": "c"
}
]

```

```
    "Status": "S",
    "UpdateDateTime": "2021-03-11 00:27:56.816",
    "Count": 100,
    "Value": 0
  }
]
```

GET list of model worksets

Get list of model worksets: language-neutral part of workset list metadata. Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model.

Methods:

```
GET /api/model/:model/workset-list  
GET /api/workset-list?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/workset-list  
http://localhost:4040/api/model/649f17f26d67c37b78dde94f79772445/workset-list  
http://localhost:4040/api/workset-list?model=modelOne
```

Return example:

```
[  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "modelOne",  
    "BaseRunDigest": "",  
    "IsReadonly": true,  
    "UpdateDateTime": "2013-05-29 23:55:07.1234",  
    "Txt": [],  
    "Param": []  
  },  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "modelOne_set",  
    "BaseRunDigest": "",  
    "IsReadonly": false,  
    "UpdateDateTime": "2013-05-30 23:55:07.1234",  
    "Txt": [],  
    "Param": []  
  },  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "modelOne_other",  
    "BaseRunDigest": "",  
    "IsReadonly": true,  
    "UpdateDateTime": "2013-05-29 23:55:07.1234",  
    "Txt": [],  
    "Param": []  
  }  
]
```

GET list of model worksets including text (description and notes)

Get list of model worksets, including text (description and notes). Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model.

Methods:

```
GET /api/model/:model/workset-list/text  
GET /api/model/:model/workset-list/text/lang/:lang  
GET /api/workset-list-text?model=modelNameOrDigest&lang=en
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:lang - (optional) language code
```

If optional `lang` argument specified then result in that language else in browser language. If no such language exist then text portion of result (description and notes) is empty.

Call examples:

```
http://localhost:4040/api/model/modelOne/workset-list/text  
http://localhost:4040/api/model/649f17f26d67c37b78dde94f79772445/workset-list/text  
http://localhost:4040/api/model/modelOne/workset-list/text/lang/fr-FR  
http://localhost:4040/api/workset-list-text?model=modelOne&lang=en
```

Return example:

```
[  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "modelOne",  
    "BaseRunDigest": "",  
    "IsReadonly": true,  
    "UpdateDateTime": "2013-05-29 23:55:07.1234",  
    "Txt": [  
      {  
        "LangCode": "EN",  
        "Descr": "Model One default set of parameters",  
        "Note": ""  
      }  
    ],  
    "Param": []  
  },  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "modelOne_set",  
    "BaseRunDigest": "",  
    "IsReadonly": false,  
    "UpdateDateTime": "2013-05-30 23:55:07.1234",  
    "Txt": [  
      {  
        "LangCode": "EN",  
        "Descr": "modelOne modified set of parameters",  
        "Note": ""  
      }  
    ],  
    "Param": []  
  },  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "modelOne_other",  
    "BaseRunDigest": "",  
    "IsReadonly": true,  
    "UpdateDateTime": "2013-05-29 23:55:07.1234",  
    "Txt": [  
      {  
        "LangCode": "EN",  
        "Descr": "Model One other set of parameters",  
        "Note": ""  
      }  
    ],  
    "Param": []  
  }  
]
```

GET workset status

Get status of model workset. Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model.

Methods:

```
GET /api/model/:model/workset/:set/status  
GET /api/model/:model/workset/:set  
GET /api/workset-status?model=modelNameOrDigest&set=setName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

Call examples:

```
http://localhost:4040/api/model/modelOne/workset/modelOne_set/status  
http://localhost:4040/api/model/649f17f26d67c37b78dde94f79772445/workset/Default/status  
http://localhost:4040/api/workset-status?model=modelOne&set=modelOne_set
```

Return example: *This is a beta version and may change in the future.*

```
{  
  "SetId": 101,  
  "BaseRunId": 0,  
  "ModelId": 101,  
  "Name": "Default",  
  "Isreadonly": true,  
  "UpdateDateTime": "2017-12-19 15:21:14.0232"  
}
```

GET model default workset status

Get status of default model workset. Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model. Default workset is a first workset of the model with `set_id = min(set_id)` for that model.

Methods:

```
GET /api/model/:model/workset/status/default  
GET /api/workset-default-status?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples:

```
http://localhost:4040/api/model/modelOne/workset/status/default  
http://localhost:4040/api/model/649f17f26d67c37b78dde94f79772445/workset/status/default  
http://localhost:4040/api/workset-default-status?model=modelOne
```

Return example: *This is a beta version and may change in the future.*

```
{  
  "SetId": 101,  
  "BaseRunId": 0,  
  "ModelId": 101,  
  "Name": "Default",  
  "IsReadOnly": true,  
  "UpdateDateTime": "2017-12-19 15:21:14.0232"  
}
```

GET workset including text (description and notes)

Get model workset metadata, including text (description and notes). Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model.

Methods:

```
GET /api/model/:model/workset/:set/text  
GET /api/model/:model/workset/:set/text/lang/:lang  
GET /api/workset-text?model=modelNameOrDigest&set=setName&lang=en
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

```
:lang - (optional) language code
```

If optional `lang` argument specified then result in that language else in browser language. If no such language exist then text portion of result (description and notes) is empty.

Call examples:

```
http://localhost:4040/api/model/modelOne/workset/modelOne_set/text  
http://localhost:4040/api/model/649f17f26d67c37b78dde94f79772445/workset/Default/text  
http://localhost:4040/api/model/modelOne/workset/modelOne_set/text/lang/FR  
http://localhost:4040/api/model/649f17f26d67c37b78dde94f79772445/workset/Default/text/lang/en  
http://localhost:4040/api/workset-text?model=modelOne&set=modelOne_set&lang=en
```

Return example:

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Default",
  "BaseRunDigest": "",
  "IsReadonly": true,
  "UpdateDateTime": "2020-03-17 12:10:48.303",
  "Txt": [
    {
      "LangCode": "EN",
      "Descr": "Model One default set of parameters",
      "Note": ""
    }
  ],
  "Param": [
    {
      "Name": "ageSex",
      "SubCount": 1,
      "DefaultSubId": 0,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Age by Sex default values"
        }
      ]
    },
    {
      "Name": "salaryAge",
      "SubCount": 1,
      "DefaultSubId": 0,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Salary by Age default values"
        }
      ]
    },
    {
      "Name": "StartingSeed",
      "SubCount": 1,
      "DefaultSubId": 0,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Starting seed default value"
        }
      ]
    },
    {
      "Name": "salaryFull",
      "SubCount": 4,
      "DefaultSubId": 3,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Full or part time by Salary default values"
        }
      ]
    },
    {
      "Name": "baseSalary",
      "SubCount": 4,
      "DefaultSubId": 3,
      "Txt": []
    },
    {
      "Name": "filePath",
      "SubCount": 4,
      "DefaultSubId": 3,
      "Txt": []
    },
    {
      "Name": "isOldAge",
      "SubCount": 4,
      "DefaultSubId": 3,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Is old age default values"
        }
      ]
    }
  ]
}
```

GET workset including text in all languages

Get model workset metadata, including text (description and notes), in all languages. Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model.

Methods:

```
GET /api/model/:model/workset/:set/text/all  
GET /api/workset-text-all?model=modelNameOrDigest&set=setName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

Call examples:

```
http://localhost:4040/api/model/modelOne/workset/modelOne_set/text/all  
http://localhost:4040/api/model/649f17f26d67c37b78dde94f79772445/workset/Default/text/all  
http://localhost:4040/api/workset-text-all?model=modelOne&set=modelOne_set
```

Return example:

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "modelOne",
  "BaseRunDigest": "",
  "IsReadonly": true,
  "UpdateDateTime": "2013-05-29 23:55:07.1234",
  "Txt": [
    {
      "LangCode": "EN",
      "Descr": "Model One default set of parameters",
      "Note": ""
    },
    {
      "LangCode": "FR",
      "Descr": "(FR) Model One default set of parameters",
      "Note": ""
    }
  ],
  "Param": [
    {
      "Name": "ageSex",
      "SubCount": 1,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Age by Sex default values"
        },
        {
          "LangCode": "FR",
          "Note": "(FR) Age by Sex default values"
        }
      ]
    },
    {
      "Name": "salaryAge",
      "SubCount": 1,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Salary by Age default values"
        },
        {
          "LangCode": "FR",
          "Note": "(FR) Salary by Age default values"
        }
      ]
    },
    {
      "Name": "StartingSeed",
      "SubCount": 1,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Starting seed default value"
        }
      ]
    },
    {
      "Name": "salaryFull",
      "SubCount": 4,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Full or part time by Salary default values"
        }
      ]
    },
    {
      "Name": "baseSalary",
      "SubCount": 4,
      "Txt": []
    },
    {
      "Name": "filePath",
      "SubCount": 4,
      "Txt": []
    }
  ]
}
```

Read parameter values from workset

Read a "page" of parameter values from workset.

Page is part of parameter values defined by zero-based "start" row number and row count. If row count <= 0 then all rows below start row number returned.

Dimension(s) and enum-based parameters returned as enum codes. If dimension type or parameter type is simple (integer or boolean) then string value used (ex.: "true", "1234").

Method verb must be POST and Content-Type header "application/json". JSON body POSTed to specify parameter name, page size, row count, filters and row order. It is expected to be JSON representation of [db.ReadLayout structure from Go library](#).

Method:

```
POST /api/model/:model/workset/:set/parameter/value
```

Call example:

```
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/workset/modelOne/parameter/value -d @test.json
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

JSON body arguments:

For example:

```
{
  "Name": "ageSex",
  "Offset": 0,
  "Size": 100,
  "IsLastPage": true,
  "Filter": [
    {
      "DimName": "dim0",
      "Op": "IN",
      "Enums": ["20-30", "40+"]
    },
    {
      "DimName": "dim1",
      "Op": "=",
      "Enums": ["F"]
    }
  ],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

```

Name      - (required) parameter name
Offset    - (optional) zero-based start row to select parameter values
Size      - (optional) max row count to select parameter values.
IsLastPage - (optional) if true then always return non-empty last page of data.
Filter     - (optional) conditions to filter dimension enum code(s)
OrderBy    - (optional) list of columns indexes (one based) to order by

```

By default oms service selects 100 rows (it can be configured). If `Size` <= 0 specified then all rows selected.

Filter conditions joined by AND and can have following operations:

```

=      - equal to enum code: dim1 = "F"
IN     - in the list of codes: dim1 IN ("20-30", "40+")
BETWEEN - between min and max: dim0 BETWEEN "20-30" AND "40+"
IN_AUTO - automatically choose most suitable: = or IN or BETWEEN

```

Order by specified by one-based column(s) index(es) in result. In case of parameters columns are:

```
SELECT sub_id, dim0, dim1, ..., value FROM parameterTable ORDER BY 1, 2,...
```

Columns always contain enum id's, not enum codes and therefore result ordered by id's

JSON response:

```
{
  Layout: {
    Offset:    actual first row number of the page data (zero-base),
    Size:     actual data page row count,
    IsLastPage: true if this is last page of data
  },
  Page: [....page of data...]
}
```

Example 1:

JSON body:

```
{
  "Name": "ageSex",
  "Filter": [],
  "OrderBy": []
}
```

Result:

```

< HTTP/1.1 200 OK
< Access-Control-Allow-Origin: *
< Content-Type: application/json
< Date: Tue, 19 Dec 2017 17:13:51 GMT
< Content-Length: 424
<
{"Layout":{"Offset":0,"Size":8,"IsLastPage":true}
,"Page":[{"Dims":["10-20","M"],"IsNull":false,"Value":0.1,"SubId":0}
,{"Dims":["10-20","F"],"IsNull":false,"Value":0.2,"SubId":0}
,{"Dims":["20-30","M"],"IsNull":false,"Value":0.3,"SubId":0}
,{"Dims":["20-30","F"],"IsNull":false,"Value":0.4,"SubId":0}
,{"Dims":["30-40","M"],"IsNull":false,"Value":0.5,"SubId":0}
,{"Dims":["30-40","F"],"IsNull":false,"Value":0.6,"SubId":0}
,{"Dims":["40+","M"],"IsNull":false,"Value":0.7,"SubId":0}
,{"Dims":["40+","F"],"IsNull":false,"Value":0.8,"SubId":0}
]}

```

Example 2:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 6,
  "Size": 4,
  "IsLastPage": true,
  "Filter": [],
  "OrderBy": []
}
```

Result:

```
{"Layout": {"Offset": 6, "Size": 2, "IsLastPage": true},
 "Page": [{"Dims": ["40+", "M"], "IsNull": false, "Value": 0.7, "SubId": 0},
  {"Dims": ["40+", "F"], "IsNull": false, "Value": 0.8, "SubId": 0}
 ]}
```

Example 3:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 2,
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

Result:

```
{"Layout": {"Offset": 2, "Size": 6, "IsLastPage": true},
 "Page": [{"Dims": ["30-40", "F"], "IsNull": false, "Value": 0.6, "SubId": 0},
  {"Dims": ["30-40", "M"], "IsNull": false, "Value": 0.5, "SubId": 0},
  {"Dims": ["20-30", "F"], "IsNull": false, "Value": 0.4, "SubId": 0},
  {"Dims": ["20-30", "M"], "IsNull": false, "Value": 0.3, "SubId": 0},
  {"Dims": ["10-20", "F"], "IsNull": false, "Value": 0.2, "SubId": 0},
  {"Dims": ["10-20", "M"], "IsNull": false, "Value": 0.1, "SubId": 0}
 ]}
```

Example 4:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 0,
  "Size": 100,
  "Filter": [
    {
      "DimName": "dim0",
      "Op": "IN",
      "Enums": ["20-30", "40+"]
    },
    {
      "DimName": "dim1",
      "Op": "=",
      "Enums": ["F"]
    }
  ],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

Result:

```
{"Layout":{"Offset":0,"Size":2,"IsLastPage":true},  
,"Page":[{"Dims":["40+","F"],"IsNull":false,"Value":0.8,"SubId":0},  
,{"Dims":["20-30","F"],"IsNull":false,"Value":0.4,"SubId":0}  
]}
```

Read parameter values from workset (enum id's)

Read a "page" of parameter values from workset.

Page is part of parameter values defined by zero-based "start" row number and row count. If row count <= 0 then all rows below start row number returned. Dimension(s) and enum-based parameters returned as enum id, not enum codes.

Method verb must be POST and Content-Type header "application/json". JSON body POSTed to specify parameter name, page size, row count, filters and row order. It is expected to be JSON representation of [db.ReadLayout](#) structure from Go library.

Method:

```
POST /api/model/:model/workset/:set/parameter/value-id
```

For example:

```
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/workset/modelOne/parameter/value-id -d @test.json
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

JSON body arguments:

For example:

```
{
  "Name": "ageSex",
  "Offset": 0,
  "Size": 100,
  "IsLastPage": true,
  "FilterById": [
    {
      "DimName": "dim0",
      "Op": "IN",
      "EnumIds": [20, 40]
    },
    {
      "DimName": "dim1",
      "Op": "=",
      "EnumIds": [1]
    }
  ],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

Name - (required) parameter name
Offset - (optional) zero-based start row to select parameter values
Size - (optional) max row count to select parameter values.
IsLastPage - (optional) if true then always return non-empty last page of data.
FilterById - (optional) conditions to filter dimension enum id's
OrderBy - (optional) list of columns indexes (one based) to order by

By default oms service selects 100 rows (it can be configured). If `Size` <= 0 specified then all rows selected.

Filter conditions joined by AND and can have following operations:

```
=      - equal to enum id:    dim1 = 1
IN     - in the list of id's: dim0 IN (20, 40)
BETWEEN - between min and max: dim0 BETWEEN 20 AND 40
IN_AUTO - automatically choose most suitable: = or IN or BETWEEN
```

Order by specified by one-based column(s) index(es) in result. In case of parameters columns are:

```
SELECT sub_id, dim0, dim1, ..., value FROM parameterTable
```

JSON response:

```
{
  Layout: {
    Offset: actual first row number of the page data (zero-base),
    Size: actual data page row count,
    IsLastPage: true if this is last page of data
  },
  Page: [....page of data...]
}
```

Example 1:

JSON body:

```
{
  "Name": "ageSex"
}
```

Result:

```
< HTTP/1.1 200 OK
< Content-Type: application/json
< Date: Fri, 14 Dec 2018 01:48:51 GMT
< Content-Length: 508
<
{"Layout":{"Offset":0,"Size":8,"IsLastPage":true},
 "Page":[{"DimIds":[10,0],"IsNull":false,"Value":0.1,"SubId":0},
 {"DimIds":[10,1],"IsNull":false,"Value":0.2,"SubId":0},
 {"DimIds":[20,0],"IsNull":false,"Value":0.3,"SubId":0},
 {"DimIds":[20,1],"IsNull":false,"Value":0.4,"SubId":0},
 {"DimIds":[30,0],"IsNull":false,"Value":0.5,"SubId":0},
 {"DimIds":[30,1],"IsNull":false,"Value":0.6,"SubId":0},
 {"DimIds":[40,0],"IsNull":false,"Value":0.7,"SubId":0},
 {"DimIds":[40,1],"IsNull":false,"Value":0.8,"SubId":0}]]}
```

Example 2:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 6,
  "Size": 4,
  "IsLastPage": true
}
```

Result:

```
{"Layout":{"Offset":6,"Size":2,"IsLastPage":true},
 "Page":[{"DimIds":[40,0],"IsNull":false,"Value":0.7,"SubId":0},
 {"DimIds":[40,1],"IsNull":false,"Value":0.8,"SubId":0}]]}
```

Example 3:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 2,
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

Result:

```
{"Layout": {"Offset": 2, "Size": 6, "IsLastPage": true},
,"Page": [{"DimIds": [30, 1], "IsNull": false, "Value": 0.6, "SubId": 0},
,{ "DimIds": [30, 0], "IsNull": false, "Value": 0.5, "SubId": 0}
,{ "DimIds": [20, 1], "IsNull": false, "Value": 0.4, "SubId": 0}
,{ "DimIds": [20, 0], "IsNull": false, "Value": 0.3, "SubId": 0}
,{ "DimIds": [10, 1], "IsNull": false, "Value": 0.2, "SubId": 0}
,{ "DimIds": [10, 0], "IsNull": false, "Value": 0.1, "SubId": 0}
]}}
```

Example 4:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 0,
  "Size": 100,
  "FilterById": [
    {
      "DimName": "dim0",
      "Op": "IN",
      "EnumIds": [20, 40]
    },
    {
      "DimName": "dim1",
      "Op": "=",
      "EnumIds": [1]
    }
  ],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

Result:

```
{"Layout": {"Offset": 0, "Size": 2, "IsLastPage": true},
,"Page": [{"DimIds": [40, 1], "IsNull": false, "Value": 0.8, "SubId": 0}
,{ "DimIds": [20, 1], "IsNull": false, "Value": 0.4, "SubId": 0}
]}}
```

Read parameter values from model run

Read a "page" of parameter values from model run.

Page is part of parameter values defined by zero-based "start" row number and row count. If row count <= 0 then all rows below start row number returned.

Dimension(s) and enum-based parameters returned as enum codes. Dimension type or parameter type is simple (integer or boolean) then string value used (ex.: "true", "1234").

Method verb must be POST and Content-Type header "application/json". JSON body POSTed to specify parameter name, page size, row count, filters and row order. It is expected to be JSON representation of [db.ReadLayout structure from Go library](#).

Method:

```
POST /api/model/:model/run/:run/parameter/value
```

For example:

```
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/run/Default/parameter/value -d @test.json  
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/run/2016_08_17_21_07_55_123/parameter/value -d @test.json
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

JSON body arguments:

For example:

```
{  
  "Name": "ageSex",  
  "Offset": 0,  
  "Size": 100,  
  "IsLastPage": true,  
  "Filter": [  
    {  
      "DimName": "dim0",  
      "Op": "IN",  
      "Enums": ["20-30", "40+"]  
    }, {  
      "DimName": "dim1",  
      "Op": "=",  
      "Enums": ["F"]  
    }  
  ],  
  "OrderBy": [  
    {"IndexOne": 2,  
     "IsDesc": true},  
    {"IndexOne": 3,  
     "IsDesc": true}  
  ]  
}
```

```

Name      - (required) parameter name
Offset    - (optional) zero-based start row to select parameter values
Size      - (optional) max row count to select parameter values.
IsLastPage - (optional) if true then always return non-empty last page of data.
Filter     - (optional) conditions to filter dimension enum code(s)
OrderBy    - (optional) list of columns indexes (one based) to order by

```

By default oms service selects 100 rows (it can be configured). If `Size` <= 0 specified then all rows selected.

Filter conditions joined by AND and can have following operations:

```

=      - equal to enum code: dim1 = "F"
IN     - in the list of codes: dim1 IN ("20-30", "40+")
BETWEEN - between min and max: dim0 BETWEEN "20-30" AND "40+"
IN_AUTO - automatically choose most suitable: = or IN or BETWEEN

```

Order by specified by one-based column(s) index(es) in result. In case of parameters columns are:

```
SELECT sub_id, dim0, dim1, ..., value FROM parameterTable ORDER BY 1, 2,...
```

Columns always contain enum id's, not enum codes and therefore result ordered by id's

JSON response:

```
{
  Layout: {
    Offset: actual first row number of the page data (zero-base),
    Size: actual data page row count,
    IsLastPage: true if this is last page of data
  },
  Page: [....page of data...]
}
```

Example 1:

JSON body:

```
{
  "Name": "ageSex",
  "Filter": [],
  "OrderBy": []
}
```

Result:

```

< HTTP/1.1 200 OK
< Content-Type: application/json
< Date: Fri, 14 Dec 2018 01:53:21 GMT
< Content-Length: 544
<
{"Layout":{"Offset":0,"Size":8,"IsLastPage":true},
 "Page":[{"Dims":["10-20","M"],"IsNull":false,"Value":0.1,"SubId":0},
 {"Dims":["10-20","F"],"IsNull":false,"Value":0.2,"SubId":0},
 {"Dims":["20-30","M"],"IsNull":false,"Value":0.3,"SubId":0},
 {"Dims":["20-30","F"],"IsNull":false,"Value":0.4,"SubId":0},
 {"Dims":["30-40","M"],"IsNull":false,"Value":0.5,"SubId":0},
 {"Dims":["30-40","F"],"IsNull":false,"Value":0.6,"SubId":0},
 {"Dims":["40+","M"],"IsNull":false,"Value":0.7,"SubId":0},
 {"Dims":["40+","F"],"IsNull":false,"Value":0.8,"SubId":0}]}

```

Example 2:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 6,
  "Size": 4,
  "IsLastPage": true,
  "Filter": [],
  "OrderBy": []
}
```

Result:

```
{"Layout": {"Offset": 6, "Size": 2, "IsLastPage": true},
 "Page": [{"Dims": ["40+", "M"], "IsNull": false, "Value": 0.7, "SubId": 0},
  {"Dims": ["40+", "F"], "IsNull": false, "Value": 0.8, "SubId": 0}
 ]}
```

Example 3:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 2,
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

Result:

```
{"Layout": {"Offset": 2, "Size": 6, "IsLastPage": true},
 "Page": [{"Dims": ["30-40", "F"], "IsNull": false, "Value": 0.6, "SubId": 0},
  {"Dims": ["30-40", "M"], "IsNull": false, "Value": 0.5, "SubId": 0},
  {"Dims": ["20-30", "F"], "IsNull": false, "Value": 0.4, "SubId": 0},
  {"Dims": ["20-30", "M"], "IsNull": false, "Value": 0.3, "SubId": 0},
  {"Dims": ["10-20", "F"], "IsNull": false, "Value": 0.2, "SubId": 0},
  {"Dims": ["10-20", "M"], "IsNull": false, "Value": 0.1, "SubId": 0}
 ]}
```

Example 4:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 0,
  "Size": 100,
  "Filter": [
    {
      "DimName": "dim0",
      "Op": "IN",
      "Enums": ["20-30", "40+"]
    },
    {
      "DimName": "dim1",
      "Op": "=",
      "Enums": ["F"]
    }
  ],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

Result:

```
{"Layout":{"Offset":0,"Size":2,"IsLastPage":true},  
,"Page":[{"Dims":["40+","F"],"IsNull":false,"Value":0.8,"SubId":0},  
,{"Dims":["20-30","F"],"IsNull":false,"Value":0.4,"SubId":0}  
]}
```

Read parameter values from model run (enum id's)

Read a "page" of parameter values from model run.

Page is part of parameter values defined by zero-based "start" row number and row count. If row count <= 0 then all rows below start row number returned. Dimension(s) and enum-based parameters returned as enum id, not enum codes.

Method verb must be POST and Content-Type header "application/json". JSON body POSTed to specify parameter name, page size, row count, filters and row order. It is expected to be JSON representation of [db.ReadLayout structure from Go library](#).

Method:

```
POST /api/model/:model/run/:run/parameter/value-id
```

For example:

```
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/run/Default/parameter/value-id -d @test.json  
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/parameter/value-id -d @test.json
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

JSON body arguments:

For example:

```
{  
    "Name": "ageSex",  
    "Offset": 0,  
    "Size": 100,  
    "IsLastPage": true,  
    "FilterById": [  
        {"DimName": "dim0",  
         "Op": "IN",  
         "EnumIds": [20, 40]  
     }, {  
        {"DimName": "dim1",  
         "Op": "=",  
         "EnumIds": [1]  
     }  
    ],  
    "OrderBy": [  
        {"IndexOne": 2,  
         "IsDesc": true  
     }, {  
        {"IndexOne": 3,  
         "IsDesc": true  
     }  
    ]  
}
```

```

Name      - (required) parameter name
Offset    - (optional) zero-based start row to select parameter values
Size      - (optional) max row count to select parameter values.
IsLastPage - (optional) if true then always return non-empty last page of data.
FilterById - (optional) conditions to filter dimension enum code(s)
OrderBy   - (optional) list of columns indexes (one based) to order by

```

By default oms service selects 100 rows (it can be configured). If `Size` <= 0 specified then all rows selected.

Filter conditions joined by AND and can have following operations:

```

=      - equal to enum id:    dim1 = 1
IN     - in the list of id's: dim0 IN (20, 40)
BETWEEN - between min and max: dim0 BETWEEN 20 AND 40
IN_AUTO - automatically choose most suitable: = or IN or BETWEEN

```

Order by specified by one-based column(s) index(es) in result. In case of parameters columns are:

```
SELECT sub_id, dim0, dim1, ..., value FROM parameterTable ORDER BY 1, 2,...
```

Columns always contain enum id's, not enum codes and therefore result ordered by id's

JSON response:

```
{
  Layout: {
    Offset:    actual first row number of the page data (zero-base),
    Size:      actual data page row count,
    IsLastPage: true if this is last page of data
  },
  Page: [....page of data...]
}
```

Example 1:

JSON body:

```
{
  "Name": "ageSex"
}
```

Result:

```

< HTTP/1.1 200 OK
< Content-Type: application/json
< Date: Fri, 14 Dec 2018 01:56:34 GMT
< Content-Length: 508
<
{"Layout":{"Offset":0,"Size":8,"IsLastPage":true},
 "Page":[{"DimIds":[10,0],"IsNull":false,"Value":0.1,"SubId":0},
 {"DimIds":[10,1],"IsNull":false,"Value":0.2,"SubId":0},
 {"DimIds":[20,0],"IsNull":false,"Value":0.3,"SubId":0},
 {"DimIds":[20,1],"IsNull":false,"Value":0.4,"SubId":0},
 {"DimIds":[30,0],"IsNull":false,"Value":0.5,"SubId":0},
 {"DimIds":[30,1],"IsNull":false,"Value":0.6,"SubId":0},
 {"DimIds":[40,0],"IsNull":false,"Value":0.7,"SubId":0},
 {"DimIds":[40,1],"IsNull":false,"Value":0.8,"SubId":0}]}

```

Example 2:

JSON body:

```
{
  "Name":      "ageSex",
  "Offset":    6,
  "Size":      4,
  "IsLastPage": true
}
```

Result:

```
{"Layout": {"Offset": 6, "Size": 2, "IsLastPage": true},
,"Page": [{"DimIds": [40, 0], "IsNull": false, "Value": 0.7, "SubId": 0}
,{ "DimIds": [40, 1], "IsNull": false, "Value": 0.8, "SubId": 0}
]}
]
```

Example 3:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 2,
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

Result:

```
{"Layout": {"Offset": 2, "Size": 6, "IsLastPage": true},
,"Page": [{"DimIds": [30, 1], "IsNull": false, "Value": 0.6, "SubId": 0}
,{ "DimIds": [30, 0], "IsNull": false, "Value": 0.5, "SubId": 0}
,{ "DimIds": [20, 1], "IsNull": false, "Value": 0.4, "SubId": 0}
,{ "DimIds": [20, 0], "IsNull": false, "Value": 0.3, "SubId": 0}
,{ "DimIds": [10, 1], "IsNull": false, "Value": 0.2, "SubId": 0}
,{ "DimIds": [10, 0], "IsNull": false, "Value": 0.1, "SubId": 0}
]}
]
```

Example 4:

JSON body:

```
{
  "Name": "ageSex",
  "Offset": 0,
  "Size": 100,
  "FilterById": [
    {
      "DimName": "dim0",
      "Op": "IN",
      "EnumIds": [20, 40]
    },
    {
      "DimName": "dim1",
      "Op": "=",
      "EnumIds": [1]
    }
  ],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ]
}
```

Result:

```
{"Layout": {"Offset": 0, "Size": 2, "IsLastPage": true},
,"Page": [{"DimIds": [40, 1], "IsNull": false, "Value": 0.8, "SubId": 0}
,{ "DimIds": [20, 1], "IsNull": false, "Value": 0.4, "SubId": 0}
]}
]
```

Read output table values from model run

Read a "page" of output table values from model run.

- Page is part of output table values defined by zero-based "start" row number and row count. If row count <= 0 then all rows below start row number returned.
- Dimension(s) and enum-based parameters returned as enum codes. If dimension type or parameter type is simple (integer or boolean) then string value used (ex: "true", "1234").
- Values can be from output table **expressions, accumulators or derived accumulators**.
- Method verb must be POST and Content-Type header "application/json".

JSON body POSTed to specify output table name, page size, row count, filters and row order. It is expected to be JSON representation of [db.ReadLayout structure from Go library](#).

Method:

```
POST /api/model/:model/run/:run/table/value
```

For example:

```
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/run/Default/table/value -d @test.json  
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/table/value -d @test.json
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

JSON body arguments:

For example:

```
{
  "Name": "salarySex",
  "Offset": 0,
  "Size": 100,
  "IsLastPage": true,
  "Filter": [
    {
      "DimName": "dim0",
      "Op": "IN",
      "Enums": ["L", "H"]
    },
    {
      "DimName": "dim1",
      "Op": "BETWEEN",
      "Enums": ["F", "all"]
    }
  ],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ],
  "ValueName": "acc2",
  "IsAccum": true,
  "IsAllAccum": true
}
```

Name - (required) output table name
 Offset - (optional) zero-based start row to select output table values
 Size - (optional) max row count to select output table values.
 IsLastPage - (optional) if true then always return non-empty last page of data.
 Filter - (optional) conditions to filter dimension enum id's
 OrderBy - (optional) list of columns indexes (one based) to order by
 ValueName - (optional) if not empty then only that value selected (ex.: "acc2"), default: all values
 IsAccum - (optional) if true then select accumulators
 IsAllAccum - (optional) if true then select from "all accumulators" view else from accumulators table

By default oms service selects 100 rows (it can be configured). If `Size` <= 0 specified then all rows selected.

Filter conditions joined by AND and can have following operations:

```
=      - equal to value:      dim1 = "L"
IN     - in value list:      dim1 IN ("L", "H")
BETWEEN - between min and max: dim0 BETWEEN "F" AND "all"
IN_AUTO - automatically choose most suitable: = or IN or BETWEEN
```

Order by specified by one-based column(s) index(es) in result. Columns always contain enum id's, not enum codes and therefore result ordered by id's

In case of output table expressions columns are:

```
SELECT expr_id, dim0, dim1, ..., expr_value FROM valueTable ORDER BY 1, 2,...
```

In case of output table accumulators columns are:

```
SELECT acc_id, sub_id, dim0, dim1, ..., acc_value FROM accumulatorTable ORDER BY 1, 2,...
```

In case of "all accumulators" columns are:

```
SELECT sub_id, dim0, dim1, ..., acc0, acc1,... FROM allAccumulatorsView ORDER BY 1, 2,...
```

JSON response:

```
{
  Layout: {
    Offset: actual first row number of the page data (zero-base),
    Size: actual data page row count,
    IsLastPage: true if this is last page of data
  },
  Page: [....page of data...]
}
```

Example 1:

JSON body:

```
{  
    "Name": "salarySex",  
    "Filter": [],  
    "OrderBy": []  
}
```

Result:

```
< HTTP/1.1 200 OK  
< Access-Control-Allow-Origin: *  
< Content-Type: application/json  
< Date: Tue, 19 Dec 2017 18:43:54 GMT  
< Transfer-Encoding: chunked  
<  
{"Layout":{"Offset":0,"Size":36,"IsLastPage":true},  
"Page":[{"Dims":["L","M"],"Value":50,"IsNull":false,"ExprId":0},  
,{"Dims":["L","F"],"Value":60,"IsNull":false,"ExprId":0},  
,{"Dims":["L","all"],"Value":1,"IsNull":false,"ExprId":0},  
,{"Dims":["M","M"],"Value":51.59999999999994,"IsNull":false,"ExprId":0},  
, {"Dims":["M","F"],"Value":62,"IsNull":false,"ExprId":0},  
, {"Dims":["M","all"],"Value":2,"IsNull":false,"ExprId":0},  
, {"Dims":["H","M"],"Value":53.2,"IsNull":false,"ExprId":0},  
, {"Dims":["H","F"],"Value":64,"IsNull":false,"ExprId":0},  
, {"Dims":["H","all"],"Value":3,"IsNull":false,"ExprId":0},  
, {"Dims":["L","M"],"Value":1,"IsNull":false,"ExprId":1},  
, {"Dims":["L","F"],"Value":2,"IsNull":false,"ExprId":1},  
, {"Dims":["L","all"],"Value":801,"IsNull":false,"ExprId":1},  
, {"Dims":["M","M"],"Value":3,"IsNull":false,"ExprId":1},  
, {"Dims":["M","F"],"Value":4,"IsNull":false,"ExprId":1},  
, {"Dims":["M","all"],"Value":803,"IsNull":false,"ExprId":1},  
, {"Dims":["H","M"],"Value":4,"IsNull":false,"ExprId":1},  
, {"Dims":["H","F"],"Value":5,"IsNull":false,"ExprId":1},  
, {"Dims":["H","all"],"Value":804,"IsNull":false,"ExprId":1},  
, {"Dims":["L","M"],"Value":50,"IsNull":false,"ExprId":2},  
, {"Dims":["L","F"],"Value":60,"IsNull":false,"ExprId":2},  
, {"Dims":["L","all"],"Value":1,"IsNull":false,"ExprId":2},  
, {"Dims":["M","M"],"Value":51.59999999999994,"IsNull":false,"ExprId":2},  
, {"Dims":["M","F"],"Value":62,"IsNull":false,"ExprId":2},  
, {"Dims":["M","all"],"Value":2,"IsNull":false,"ExprId":2},  
, {"Dims":["H","M"],"Value":53.2,"IsNull":false,"ExprId":2},  
, {"Dims":["H","F"],"Value":64,"IsNull":false,"ExprId":2},  
, {"Dims":["H","all"],"Value":3,"IsNull":false,"ExprId":2},  
, {"Dims":["L","M"],"Value":50,"IsNull":false,"ExprId":3},  
, {"Dims":["L","F"],"Value":120,"IsNull":false,"ExprId":3},  
, {"Dims":["L","all"],"Value":801,"IsNull":false,"ExprId":3},  
, {"Dims":["M","M"],"Value":154.799999999998,"IsNull":false,"ExprId":3},  
, {"Dims":["M","F"],"Value":248,"IsNull":false,"ExprId":3},  
, {"Dims":["M","all"],"Value":1606,"IsNull":false,"ExprId":3},  
, {"Dims":["H","M"],"Value":212.8,"IsNull":false,"ExprId":3},  
, {"Dims":["H","F"],"Value":320,"IsNull":false,"ExprId":3},  
, {"Dims":["H","all"],"Value":2412,"IsNull":false,"ExprId":3}  
]}
```

Example 2:

JSON body:

```
{  
    "Name": "salarySex",  
    "Offset": 32,  
    "Size": 8,  
    "IsLastPage": true,  
    "Filter": [],  
    "OrderBy": []  
}
```

Result:

```
{"Layout":{"Offset":32,"Size":4,"IsLastPage":true},  
"Page":[{"Dims":["M","all"],"Value":1606,"IsNull":false,"ExprId":3},  
, {"Dims":["H","M"],"Value":212.8,"IsNull":false,"ExprId":3},  
, {"Dims":["H","F"],"Value":320,"IsNull":false,"ExprId":3},  
, {"Dims":["H","all"],"Value":2412,"IsNull":false,"ExprId":3}  
]}
```

Example 3:

JSON body:

```
{  
    "Name": "salarySex",  
    "Filter": [],  
    "OrderBy": [{  
        "IndexOne": 2,  
        "IsDesc": true  
    }, {  
        "IndexOne": 3,  
        "IsDesc": true  
    }  
],  
    "IsAccum": true,  
    "IsAllAccum": false  
}
```

Result:

```
{"Layout": {"Offset": 0, "Size": 18, "IsLastPage": true}  
, "Page": [{"Dims": ["H", "M"], "Value": 53.2, "IsNull": false, "AccId": 0, "SubId": 0}  
, {"Dims": ["H", "F"], "Value": 64, "IsNull": false, "AccId": 0, "SubId": 0}  
, {"Dims": ["H", "all"], "Value": 3, "IsNull": false, "AccId": 0, "SubId": 0}  
, {"Dims": ["H", "M"], "Value": 4, "IsNull": false, "AccId": 1, "SubId": 0}  
, {"Dims": ["H", "F"], "Value": 5, "IsNull": false, "AccId": 1, "SubId": 0}  
, {"Dims": ["H", "all"], "Value": 804, "IsNull": false, "AccId": 1, "SubId": 0}  
, {"Dims": ["M", "M"], "Value": 51.59999999999994, "IsNull": false, "AccId": 0, "SubId": 0}  
, {"Dims": ["M", "F"], "Value": 62, "IsNull": false, "AccId": 0, "SubId": 0}  
, {"Dims": ["M", "all"], "Value": 2, "IsNull": false, "AccId": 0, "SubId": 0}  
, {"Dims": ["M", "M"], "Value": 3, "IsNull": false, "AccId": 1, "SubId": 0}  
, {"Dims": ["M", "F"], "Value": 4, "IsNull": false, "AccId": 1, "SubId": 0}  
, {"Dims": ["M", "all"], "Value": 803, "IsNull": false, "AccId": 1, "SubId": 0}  
, {"Dims": ["L", "M"], "Value": 50, "IsNull": false, "AccId": 0, "SubId": 0}  
, {"Dims": ["L", "F"], "Value": 60, "IsNull": false, "AccId": 0, "SubId": 0}  
, {"Dims": ["L", "all"], "Value": 1, "IsNull": false, "AccId": 0, "SubId": 0}  
, {"Dims": ["L", "M"], "Value": 1, "IsNull": false, "AccId": 1, "SubId": 0}  
, {"Dims": ["L", "F"], "Value": 2, "IsNull": false, "AccId": 1, "SubId": 0}  
, {"Dims": ["L", "all"], "Value": 801, "IsNull": false, "AccId": 1, "SubId": 0}]}
```

Example 4:

JSON body:

```
{  
    "Name": "salarySex",  
    "Offset": 0,  
    "Size": 100,  
    "Filter": [  
        {"DimName": "dim0",  
         "Op": "IN",  
         "Enums": ["L", "H"]}  
    ],  
    {"DimName": "dim1",  
     "Op": "BETWEEN",  
     "Enums": ["F", "all"]}  
],  
    "OrderBy": [{  
        "IndexOne": 2,  
        "IsDesc": true  
    }, {  
        "IndexOne": 3,  
        "IsDesc": true  
    }  
],  
    "ValueName": "acc2",  
    "IsAccum": true,  
    "IsAllAccum": true  
}
```

Result:

```
{"Layout":{"Offset":0,"Size":4,"IsLastPage":true}  
, "Page": [{"Dims": ["H", "all"], "SubId": 0, "IsNull": [false], "Value": [807]}  
, {"Dims": ["H", "F"], "SubId": 0, "IsNull": [false], "Value": [69]}  
, {"Dims": ["L", "all"], "SubId": 0, "IsNull": [false], "Value": [802]}  
, {"Dims": ["L", "F"], "SubId": 0, "IsNull": [false], "Value": [62]}  
]}]
```

Read output table values from model run (enum id's)

Read a "page" of output table values from model run.

- Page is part of output table values defined by zero-based "start" row number and row count. If row count <= 0 then all rows below start row number returned.
- Dimension(s) returned as enum id, not enum codes.
- Values can be from output table **expressions, accumulators or derived accumulators**.
- Method verb must be POST and Content-Type header "application/json".

JSON body POSTed to specify output table name, page size, row count, filters and row order. It is expected to be JSON representation of [db.ReadLayout structure from Go library](#).

Method:

```
POST /api/model/:model/run/:run/table/value-id
```

For example:

```
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/run/Default/table/value-id -d @test.json  
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/table/value-id -d @test.json
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

JSON body arguments:

For example:

```
{
  "Name": "salarySex",
  "Offset": 0,
  "Size": 100,
  "IsLastPage": true,
  "FilterById": [
    {
      "DimName": "dim0",
      "Op": "IN",
      "EnumIds": [100, 300]
    },
    {
      "DimName": "dim1",
      "Op": "BETWEEN",
      "EnumIds": [1, 800]
    }
  ],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ],
  "ValueName": "acc2",
  "IsAccum": true,
  "IsAllAccum": true
}
```

Name - (required) output table name
 Offset - (optional) zero-based start row to select output table values
 Size - (optional) max row count to select output table values.
 IsLastPage - (optional) if true then always return non-empty last page of data.
 FilterById - (optional) conditions to filter dimension enum id's
 OrderBy - (optional) list of columns indexes (one based) to order by
 ValueName - (optional) if not empty then only that value selected (ex.: "acc2"), default: all values
 IsAccum - (optional) if true then select accumulators
 IsAllAccum - (optional) if true then select from "all accumulators" view else from accumulators table

By default oms service selects 100 rows (it can be configured). If `Size` ≤ 0 specified then all rows selected.

Filter conditions joined by AND and can have following operations:

```
=      - equal to value:      dim0 = 100
IN     - in value list:      dim0 IN (100, 200, 300)
BETWEEN - between min and max: dim1 BETWEEN 1 AND 800
IN_AUTO - automatically choose most suitable: = or IN or BETWEEN
```

Order by specified by one-based column(s) index(es) in result. Columns always contain enum id's, not enum codes and therefore result ordered by id's

In case of output table expressions columns are:

```
SELECT expr_id, dim0, dim1, ..., expr_value FROM valueTable ORDER BY 1, 2,...
```

In case of output table accumulators columns are:

```
SELECT acc_id, sub_id, dim0, dim1, ..., acc_value FROM accumulatorTable ORDER BY 1, 2,...
```

In case of "all accumulators" columns are:

```
SELECT sub_id, dim0, dim1, ..., acc0, acc1,... FROM allAccumulatorsView ORDER BY 1, 2,...
```

Example 1:

JSON body:

```
{
  "Name": "salarySex"
}
```

Result:

```

< Access-Control-Allow-Origin: *
< Content-Type: application/json
< Date: Tue, 19 Dec 2017 19:04:15 GMT
< Transfer-Encoding: chunked
<
{"Layout":{"Offset":0,"Size":36,"IsLastPage":true},
,"Page":[{"DimIds":[100,0],"Value":50,"IsNull":false,"ExprId":0}
,{["DimIds":[100,1],"Value":60,"IsNull":false,"ExprId":0}
,{["DimIds":[100,800],"Value":1,"IsNull":false,"ExprId":0}
,{["DimIds":[200,0],"Value":51.59999999999994,"IsNull":false,"ExprId":0}
,{["DimIds":[200,1],"Value":62,"IsNull":false,"ExprId":0}
,{["DimIds":[200,800],"Value":2,"IsNull":false,"ExprId":0}
,{["DimIds":[300,0],"Value":53.2,"IsNull":false,"ExprId":0}
,{["DimIds":[300,1],"Value":64,"IsNull":false,"ExprId":0}
,{["DimIds":[300,800],"Value":3,"IsNull":false,"ExprId":0}
,{["DimIds":[100,0],"Value":1,"IsNull":false,"ExprId":1}
,{["DimIds":[100,1],"Value":2,"IsNull":false,"ExprId":1}
,{["DimIds":[100,800],"Value":801,"IsNull":false,"ExprId":1}
,{["DimIds":[200,0],"Value":3,"IsNull":false,"ExprId":1}
,{["DimIds":[200,1],"Value":4,"IsNull":false,"ExprId":1}
,{["DimIds":[200,800],"Value":803,"IsNull":false,"ExprId":1}
,{["DimIds":[300,0],"Value":4,"IsNull":false,"ExprId":1}
,{["DimIds":[300,1],"Value":5,"IsNull":false,"ExprId":1}
,{["DimIds":[300,800],"Value":804,"IsNull":false,"ExprId":1}
,{["DimIds":[100,0],"Value":50,"IsNull":false,"ExprId":2}
,{["DimIds":[100,1],"Value":60,"IsNull":false,"ExprId":2}
,{["DimIds":[100,800],"Value":1,"IsNull":false,"ExprId":2}
,{["DimIds":[200,0],"Value":53.2,"IsNull":false,"ExprId":2}
,{["DimIds":[200,1],"Value":64,"IsNull":false,"ExprId":2}
,{["DimIds":[200,800],"Value":3,"IsNull":false,"ExprId":2}
,{["DimIds":[300,0],"Value":50,"IsNull":false,"ExprId":3}
,{["DimIds":[300,1],"Value":120,"IsNull":false,"ExprId":3}
,{["DimIds":[300,800],"Value":801,"IsNull":false,"ExprId":3}
,{["DimIds":[200,0],"Value":154.7999999999998,"IsNull":false,"ExprId":3}
,{["DimIds":[200,1],"Value":248,"IsNull":false,"ExprId":3}
,{["DimIds":[200,800],"Value":1606,"IsNull":false,"ExprId":3}
,{["DimIds":[300,0],"Value":212.8,"IsNull":false,"ExprId":3}
,{["DimIds":[300,1],"Value":320,"IsNull":false,"ExprId":3}
,{["DimIds":[300,800],"Value":2412,"IsNull":false,"ExprId":3}
]
}

```

Example 2:

JSON body:

```
{
  "Name":      "salarySex",
  "Offset":    32,
  "Size":      8,
  "IsLastPage": true
}
```

Result:

```
{"Layout":{"Offset":32,"Size":4,"IsLastPage":true},
,"Page":[{"DimIds":[200,800],"Value":1606,"IsNull":false,"ExprId":3}
,{["DimIds":[300,0],"Value":212.8,"IsNull":false,"ExprId":3}
,{["DimIds":[300,1],"Value":320,"IsNull":false,"ExprId":3}
,{["DimIds":[300,800],"Value":2412,"IsNull":false,"ExprId":3}
]
}
```

Example 3:

JSON body:

```
{
  "Name": "salarySex",
  "FilterById": [],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ],
  "IsAccum": true,
  "IsAllAccum": false
}
```

Result:

```
{"Layout":{"Offset":0,"Size":18,"IsLastPage":true},
,"Page":[{"DimIds":[300,0],"Value":53.2,"IsNull":false,"AccId":0,"SubId":0}
,{DimIds:[300,1],"Value":64,"IsNull":false,"AccId":0,"SubId":0}
,{DimIds:[300,800],"Value":3,"IsNull":false,"AccId":0,"SubId":0}
,{DimIds:[300,0],"Value":4,"IsNull":false,"AccId":1,"SubId":0}
,{DimIds:[300,1],"Value":5,"IsNull":false,"AccId":1,"SubId":0}
,{DimIds:[300,800],"Value":804,"IsNull":false,"AccId":1,"SubId":0}
,{DimIds:[200,0],"Value":51.599999999999994,"IsNull":false,"AccId":0,"SubId":0}
,{DimIds:[200,1],"Value":62,"IsNull":false,"AccId":0,"SubId":0}
,{DimIds:[200,800],"Value":2,"IsNull":false,"AccId":0,"SubId":0}
,{DimIds:[200,0],"Value":3,"IsNull":false,"AccId":1,"SubId":0}
,{DimIds:[200,1],"Value":4,"IsNull":false,"AccId":1,"SubId":0}
,{DimIds:[200,800],"Value":803,"IsNull":false,"AccId":1,"SubId":0}
,{DimIds:[100,0],"Value":50,"IsNull":false,"AccId":0,"SubId":0}
,{DimIds:[100,1],"Value":60,"IsNull":false,"AccId":0,"SubId":0}
,{DimIds:[100,800],"Value":1,"IsNull":false,"AccId":0,"SubId":0}
,{DimIds:[100,0],"Value":1,"IsNull":false,"AccId":1,"SubId":0}
,{DimIds:[100,1],"Value":2,"IsNull":false,"AccId":1,"SubId":0}
,{DimIds:[100,800],"Value":801,"IsNull":false,"AccId":1,"SubId":0}
]}}
```

Example 3:

JSON body:

```
{
  "Name": "salarySex",
  "Offset": 0,
  "Size": 100,
  "FilterById": [
    {
      "DimName": "dim0",
      "Op": "IN",
      "EnumIds": [100, 300]
    },
    {
      "DimName": "dim1",
      "Op": "BETWEEN",
      "EnumIds": [1, 800]
    }
  ],
  "OrderBy": [
    {
      "IndexOne": 2,
      "IsDesc": true
    },
    {
      "IndexOne": 3,
      "IsDesc": true
    }
  ],
  "ValueName": "acc2",
  "IsAccum": true,
  "IsAllAccum": true
}
```

Result:

```
{"Layout":{"Offset":0,"Size":4,"IsLastPage":true},
,"Page":[{"DimIds":[300,800],"SubId":0,"IsNull":false,"Value":807}
,{DimIds:[300,1],"SubId":0,"IsNull":false,"Value":69}
,{DimIds:[100,800],"SubId":0,"IsNull":false,"Value":802}
,{DimIds:[100,1],"SubId":0,"IsNull":false,"Value":62}
]}]
```

GET parameter values from workset

Read a "page" of parameter values from workset.

Page is part of parameter values defined by zero-based "start" row number and row count. If row count <= 0 then all rows returned.

Dimension(s) and enum-based parameters returned as enum codes.

Methods:

```
GET /api/model/:model/workset/:set/parameter/:name/value  
GET /api/model/:model/workset/:set/parameter/:name/value/start/:start  
GET /api/model/:model/workset/:set/parameter/:name/value/start/:start/count/:count  
GET /api/workset-parameter-value?model=modelNameOrDigest&set=setName&name=parameterName&start=0&count=100
```

Arguments:

:model - (required) model digest or model name

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

:set - (required) workset name

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

:name - (required) parameter name

:start - (optional) start "page" row number, zero-based.
:count - (optional) "page" size, number of rows to select.

By default oms service selects 100 rows (it can be configured). If count <= 0 specified then all rows selected.

Call examples:

```
http://localhost:4040/api/model/modelOne/workset/modelOne_other/parameter/ageSex/value  
http://localhost:4040/api/model/modelOne/workset/modelOne_other/parameter/ageSex/value/start/2  
http://localhost:4040/api/model/modelOne/workset/modelOne_other/parameter/ageSex/value/start/2/count/4  
http://localhost:4040/api/model/_201208171604590148/_workset/modelOne_set/parameter/ageSex/value  
http://localhost:4040/api/workset-parameter-value?model=modelOne&set=modelOne_other&name=ageSex  
http://localhost:4040/api/workset-parameter-value?model=modelOne&set=modelOne_other&name=ageSex&start=0  
http://localhost:4040/api/workset-parameter-value?model=modelOne&set=modelOne_other&name=ageSex&start=0&count=100
```

Return example:

```
[{"Dims": ["10-20", "M"], "IsNull": false, "Value": 1.1, "SubId": 0},  
 {"Dims": ["10-20", "F"], "IsNull": false, "Value": 1.2, "SubId": 0},  
 {"Dims": ["20-30", "M"], "IsNull": false, "Value": 1.3, "SubId": 0},  
 {"Dims": ["20-30", "F"], "IsNull": false, "Value": 1.4, "SubId": 0},  
 {"Dims": ["30-40", "M"], "IsNull": false, "Value": 1.5, "SubId": 0},  
 {"Dims": ["30-40", "F"], "IsNull": false, "Value": 1.6, "SubId": 0},  
 {"Dims": ["40+", "M"], "IsNull": false, "Value": 1.7, "SubId": 0},  
 {"Dims": ["40+", "F"], "IsNull": false, "Value": 1.8, "SubId": 0}]
```

GET parameter values from model run

Read a "page" of parameter values from model run.

Page is part of parameter values defined by zero-based "start" row number and row count. If row count <= 0 then all rows returned.

Dimension(s) and enum-based parameters returned as enum codes.

Methods:

```
GET /api/model/:model/run/:run/parameter/:name/value  
GET /api/model/:model/run/:run/parameter/:name/value/start/:start  
GET /api/model/:model/run/:run/parameter/:name/value/start/:start/count/:count  
GET /api/run-parameter-value?model=modelNameOrDigest&run=runDigestOrStampOrName&name=parameterName&start=0&count=100
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) parameter name
```

```
:start - (optional) start "page" row number, zero-based.  
:count - (optional) "page" size, number of rows to select.
```

By default oms service selects 100 rows (it can be configured). If count <= 0 specified then all rows selected.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/parameter/ageSex/value  
http://localhost:4040/api/model/modelOne/run/Default/parameter/ageSex/value/start/2  
http://localhost:4040/api/model/modelOne/run/Default/parameter/ageSex/value/start/2/count/4  
http://localhost:4040/api/model/_201208171604590148/_run/f172e98da17beb058f30f11768053456/parameter/ageSex/value  
http://localhost:4040/api/model/_201208171604590148/_run/2019_01_17_19_59_52_998/parameter/ageSex/value  
http://localhost:4040/api/run-parameter-value?model=modelOne&run=Default&name=ageSex  
http://localhost:4040/api/run-parameter-value?model=modelOne&run=Default&name=ageSex&start=0  
http://localhost:4040/api/run-parameter-value?model=modelOne&run=Default&name=ageSex&start=0&count=100
```

Return example:

```
[{"Dims": ["10-20", "M"], "IsNull": false, "Value": 0.1, "SubId": 0},  
 {"Dims": ["10-20", "F"], "IsNull": false, "Value": 0.2, "SubId": 0},  
 {"Dims": ["20-30", "M"], "IsNull": false, "Value": 0.3, "SubId": 0},  
 {"Dims": ["20-30", "F"], "IsNull": false, "Value": 0.4, "SubId": 0},  
 {"Dims": ["30-40", "M"], "IsNull": false, "Value": 0.5, "SubId": 0},  
 {"Dims": ["30-40", "F"], "IsNull": false, "Value": 0.6, "SubId": 0},  
 {"Dims": ["40+", "M"], "IsNull": false, "Value": 0.7, "SubId": 0},  
 {"Dims": ["40+", "F"], "IsNull": false, "Value": 0.8, "SubId": 0}]
```

GET output table expression(s) from model run

Read a "page" of output table expression(s) values from model run.

Page is part of output table values defined by zero-based "start" row number and row count. If row count <= 0 then all rows returned.

Dimension(s) returned as enum codes or as string values if dimension type is simple (integer or boolean).

Methods:

```
GET /api/model/:model/run/:run/table/:name/expr  
GET /api/model/:model/run/:run/table/:name/expr/start/:start  
GET /api/model/:model/run/:run/table/:name/expr/start/:start/count/:count  
GET /api/run-table-expr?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&start=0&count=100
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) output table name
```

```
:start - (optional) start "page" row number, zero-based.  
:count - (optional) "page" size, number of rows to select.
```

By default oms service selects 100 rows (it can be configured). If count <= 0 specified then all rows selected.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/expr  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/expr/start/2  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/expr/start/2/count/4  
http://localhost:4040/api/model/_201208171604590148/_run/f172e98da17beb058f30f11768053456/table/salarySex/expr  
http://localhost:4040/api/model/_201208171604590148/_run/2019_01_17_19_59_52_998/table/salarySex/expr  
http://localhost:4040/api/run-table-expr?model=modelOne&run=Default&name=salarySex&start=0&count=100
```

Return example:

```
[{"Dims": ["L", "M"], "Value": 50, "IsNull": false, "ExprId": 0}, {"Dims": ["L", "F"], "Value": 60, "IsNull": false, "ExprId": 0}, {"Dims": ["L", "all"], "Value": 1, "IsNull": false, "ExprId": 0}, {"Dims": ["M", "M"], "Value": 51.59999999999994, "IsNull": false, "ExprId": 0}, {"Dims": ["M", "F"], "Value": 62, "IsNull": false, "ExprId": 0}, {"Dims": ["M", "all"], "Value": 2, "IsNull": false, "ExprId": 0}, {"Dims": ["H", "M"], "Value": 53.2, "IsNull": false, "ExprId": 0}, {"Dims": ["H", "F"], "Value": 64, "IsNull": false, "ExprId": 0}, {"Dims": ["H", "all"], "Value": 3, "IsNull": false, "ExprId": 0}, {"Dims": ["L", "M"], "Value": 1, "IsNull": false, "ExprId": 1}, {"Dims": ["L", "F"], "Value": 2, "IsNull": false, "ExprId": 1}, {"Dims": ["L", "all"], "Value": 801, "IsNull": false, "ExprId": 1}, {"Dims": ["M", "M"], "Value": 3, "IsNull": false, "ExprId": 1}, {"Dims": ["M", "F"], "Value": 4, "IsNull": false, "ExprId": 1}, {"Dims": ["M", "all"], "Value": 803, "IsNull": false, "ExprId": 1}, {"Dims": ["H", "M"], "Value": 4, "IsNull": false, "ExprId": 1}, {"Dims": ["H", "F"], "Value": 5, "IsNull": false, "ExprId": 1}, {"Dims": ["H", "all"], "Value": 804, "IsNull": false, "ExprId": 1}, {"Dims": ["L", "M"], "Value": 50, "IsNull": false, "ExprId": 2}, {"Dims": ["L", "F"], "Value": 60, "IsNull": false, "ExprId": 2}, {"Dims": ["L", "all"], "Value": 1, "IsNull": false, "ExprId": 2}, {"Dims": ["M", "M"], "Value": 51.59999999999994, "IsNull": false, "ExprId": 2}, {"Dims": ["M", "F"], "Value": 62, "IsNull": false, "ExprId": 2}, {"Dims": ["M", "all"], "Value": 2, "IsNull": false, "ExprId": 2}, {"Dims": ["H", "M"], "Value": 53.2, "IsNull": false, "ExprId": 2}, {"Dims": ["H", "F"], "Value": 64, "IsNull": false, "ExprId": 2}, {"Dims": ["H", "all"], "Value": 3, "IsNull": false, "ExprId": 2}, {"Dims": ["L", "M"], "Value": 50, "IsNull": false, "ExprId": 3}, {"Dims": ["L", "F"], "Value": 120, "IsNull": false, "ExprId": 3}, {"Dims": ["L", "all"], "Value": 801, "IsNull": false, "ExprId": 3}, {"Dims": ["M", "M"], "Value": 154.799999999998, "IsNull": false, "ExprId": 3}, {"Dims": ["M", "F"], "Value": 248, "IsNull": false, "ExprId": 3}, {"Dims": ["M", "all"], "Value": 1606, "IsNull": false, "ExprId": 3}, {"Dims": ["H", "M"], "Value": 212.8, "IsNull": false, "ExprId": 3}, {"Dims": ["H", "F"], "Value": 320, "IsNull": false, "ExprId": 3}, {"Dims": ["H", "all"], "Value": 2412, "IsNull": false, "ExprId": 3}]]
```

GET output table accumulator(s) from model run

Read a "page" of output table accumulator(s) values from model run.

Page is part of output table values defined by zero-based "start" row number and row count. If row count <= 0 then all rows returned.

Dimension(s) returned as enum codes or as string values if dimension type is simple (integer or boolean).

Methods:

```
GET /api/model/:model/run/:run/table/:name/acc  
GET /api/model/:model/run/:run/table/:name/acc/start/:start  
GET /api/model/:model/run/:run/table/:name/acc/start/:start/count/:count  
GET /api/run-table-acc?model=modelNameOrDigest&run=runDigestOrStampOrName&name=salarySex&start=0&count=100
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) output table name
```

```
:start - (optional) start "page" row number, zero-based.  
:count - (optional) "page" size, number of rows to select.
```

By default oms service selects 100 rows (it can be configured). If count <= 0 specified then all rows selected.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/acc  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/acc/start/2  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/acc/start/2/count/4  
http://localhost:4040/api/model/_201208171604590148/_run/f172e98da17beb058f30f11768053456/table/salarySex/acc  
http://localhost:4040/api/model/_201208171604590148/_run/2019_01_17_19_59_52_998/table/salarySex/acc  
http://localhost:4040/api/run-table-acc?model=modelOne&run=Default&name=salarySex&start=0&count=100
```

Return example:

```
[{"Dims": ["L", "M"], "Value": 50, "IsNull": false, "AccId": 0, "SubId": 0},  
 {"Dims": ["L", "F"], "Value": 60, "IsNull": false, "AccId": 0, "SubId": 0},  
 {"Dims": ["L", "all"], "Value": 1, "IsNull": false, "AccId": 0, "SubId": 0},  
 {"Dims": ["M", "M"], "Value": 51.59999999999994, "IsNull": false, "AccId": 0, "SubId": 0},  
 {"Dims": ["M", "F"], "Value": 62, "IsNull": false, "AccId": 0, "SubId": 0},  
 {"Dims": ["M", "all"], "Value": 2, "IsNull": false, "AccId": 0, "SubId": 0},  
 {"Dims": ["H", "M"], "Value": 53.2, "IsNull": false, "AccId": 0, "SubId": 0},  
 {"Dims": ["H", "F"], "Value": 64, "IsNull": false, "AccId": 0, "SubId": 0},  
 {"Dims": ["H", "all"], "Value": 3, "IsNull": false, "AccId": 0, "SubId": 0},  
 {"Dims": ["L", "M"], "Value": 1, "IsNull": false, "AccId": 1, "SubId": 0},  
 {"Dims": ["L", "F"], "Value": 2, "IsNull": false, "AccId": 1, "SubId": 0},  
 {"Dims": ["L", "all"], "Value": 801, "IsNull": false, "AccId": 1, "SubId": 0},  
 {"Dims": ["M", "M"], "Value": 3, "IsNull": false, "AccId": 1, "SubId": 0},  
 {"Dims": ["M", "F"], "Value": 4, "IsNull": false, "AccId": 1, "SubId": 0},  
 {"Dims": ["M", "all"], "Value": 803, "IsNull": false, "AccId": 1, "SubId": 0},  
 {"Dims": ["H", "M"], "Value": 4, "IsNull": false, "AccId": 1, "SubId": 0},  
 {"Dims": ["H", "F"], "Value": 5, "IsNull": false, "AccId": 1, "SubId": 0},  
 {"Dims": ["H", "all"], "Value": 804, "IsNull": false, "AccId": 1, "SubId": 0}]
```

GET output table all accumulators from model run

Read a "page" of output table values from "all accumulators" view of model run.

"All accumulators" view include derived accumulators. Page is part of output table values defined by zero-based "start" row number and row count. If row count <= 0 then all rows returned.

Dimension(s) returned as enum codes or as string values if dimension type is simple (integer or boolean).

Methods:

```
GET /api/model/:model/run/:run/table/:name/all-acc  
GET /api/model/:model/run/:run/table/:name/all-acc/start/:start  
GET /api/model/:model/run/:run/table/:name/all-acc/start/:start/count/:count  
GET /api/run-table-all-acc?model=modelNameOrDigest&run=runDigestOrStampOrName&name=salarySex&start=0&count=100
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) output table name
```

```
:start - (optional) start "page" row number, zero-based.  
:count - (optional) "page" size, number of rows to select.
```

By default oms service selects 100 rows (it can be configured). If count <= 0 specified then all rows selected.

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/all-acc  
http://localhost:4040/api/model/modelOne/_run/Default/table/salarySex/all-acc/start/2  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/all-acc/start/2/count/4  
http://localhost:4040/api/model/_201208171604590148/_run/f172e98da17beb058f30f11768053456/table/salarySex/all-acc  
http://localhost:4040/api/model/_201208171604590148/_run/2019_01_17_19_59_52_998/table/salarySex/all-acc  
http://localhost:4040/api/run-table-all-acc?model=modelOne&run=Default&name=salarySex"  
http://localhost:4040/api/run-table-all-acc?model=modelOne&run=Default&name=salarySex&start=0"  
http://localhost:4040/api/run-table-all-acc?model=modelOne&run=Default&name=salarySex&start=0&count=100"
```

Return example:

```
[{"Dims": ["L", "M"], "SubId": 0, "IsNull": [false, false, false], "Value": [50, 1, 51]},  
 {"Dims": ["L", "F"], "SubId": 0, "IsNull": [false, false, false], "Value": [60, 2, 62]},  
 {"Dims": ["L", "all"], "SubId": 0, "IsNull": [false, false, false], "Value": [1, 801, 802]},  
 {"Dims": ["M", "M"], "SubId": 0, "IsNull": [false, false, false], "Value": [51.59999999999994, 3, 54.59999999999994]},  
 {"Dims": ["M", "F"], "SubId": 0, "IsNull": [false, false, false], "Value": [62, 4, 66]},  
 {"Dims": ["M", "all"], "SubId": 0, "IsNull": [false, false, false], "Value": [2, 803, 805]},  
 {"Dims": ["H", "M"], "SubId": 0, "IsNull": [false, false, false], "Value": [53.2, 4, 57.2]},  
 {"Dims": ["H", "F"], "SubId": 0, "IsNull": [false, false, false], "Value": [64, 5, 69]},  
 {"Dims": ["H", "all"], "SubId": 0, "IsNull": [false, false, false], "Value": [3, 804, 807]}]
```

GET csv parameter values from workset

Read entire parameter values from workset as csv file.

Response stream is UTF-8 parameter.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) and enum-based parameters returned as enum codes.

Methods:

```
GET /api/model/:model/workset/:set/parameter/:name/csv  
GET /api/model/:model/workset/:set/parameter/:name/csv-bom  
GET /api/workset-parameter-csv?model=modelNameOrDigest&set=setName&name=parameterName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

```
:name - (required) parameter name
```

Call examples:

```
http://localhost:4040/api/model/modelOne/workset/modelOne_other/parameter/ageSex/csv  
http://localhost:4040/api/model/modelOne/workset/modelOne_other/parameter/ageSex/csv-bom  
http://localhost:4040/api/workset-parameter-csv?model=modelOne&set=modelOne_other&name=ageSex  
http://localhost:4040/api/workset-parameter-csv?model=modelOne&set=modelOne_other&name=ageSex&bom=true
```

Return example:

```
sub_id,dim0,dim1,param_value  
0,10-20,M,1.1  
0,10-20,F,1.2  
0,20-30,M,1.3  
0,20-30,F,1.4  
0,30-40,M,1.5  
0,30-40,F,1.6  
0,40+,M,1.7  
0,40+,F,1.8
```

GET csv parameter values from workset (enum id's)

Read entire parameter values from workset as csv file.

Response stream is UTF-8 parameter.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) and enum-based parameters returned as enum id, not enum codes.

Methods:

```
GET /api/model/:model/workset/:set/parameter/:name/csv-id  
GET /api/model/:model/workset/:set/parameter/:name/csv-id-bom  
GET /api/workset-parameter-csv-id?model=modelNameOrDigest&set=setName&name=parameterName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

```
:name - (required) parameter name
```

Call examples:

```
http://localhost:4040/api/model/modelOne/workset/modelOne_other/parameter/ageSex/csv-id  
http://localhost:4040/api/model/modelOne/workset/modelOne_other/parameter/ageSex/csv-id-bom  
http://localhost:4040/api/workset-parameter-csv-id?model=modelOne&set=modelOne_other&name=ageSex&bom=true
```

Return example:

```
sub_id,dim0,dim1,param_value  
0,10,0,1.1  
0,10,1,1.2  
0,20,0,1.3  
0,20,1,1.4  
0,30,0,1.5  
0,30,1,1.6  
0,40,0,1.7  
0,40,1,1.8
```

GET csv parameter values from model run

Read entire parameter values from model run as csv file.

Response stream is UTF-8 parameter.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) and enum-based parameters returned as enum codes.

Methods:

```
GET /api/model/:model/run/:run/parameter/:name/csv  
GET /api/model/:model/run/:run/parameter/:name/csv-bom  
GET /api/run-parameter-csv?model=modelNameOrDigest&run=runDigestOrStampOrName&name=parameterName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) parameter name
```

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/parameter/ageSex/csv  
http://localhost:4040/api/model/modelOne/run/Default/parameter/ageSex/csv-bom  
http://localhost:4040/api/model/modelOne/run/f172e98da17beb058f30f11768053456/parameter/ageSex/csv  
http://localhost:4040/api/model/modelOne/run/f172e98da17beb058f30f11768053456/parameter/ageSex/csv-bom  
http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/parameter/ageSex/csv  
http://localhost:4040/api/run-parameter-csv?model=modelOne&run=Default&name=ageSex&bom=true
```

Return example:

```
sub_id,dim0,dim1,param_value  
0,10-20,M,0.1  
0,10-20,F,0.2  
0,20-30,M,0.3  
0,20-30,F,0.4  
0,30-40,M,0.5  
0,30-40,F,0.6  
0,40+,M,0.7  
0,40+,F,0.8
```

GET csv parameter values from model run (enum id's)

Read entire parameter values from model run as csv file.

Response stream is UTF-8 parameter.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) and enum-based parameters returned as enum id, not enum codes.

Methods:

```
GET /api/model/:model/run/:run/parameter/:name/csv-id  
GET /api/model/:model/run/:run/parameter/:name/csv-id-bom  
GET /api/run-parameter-csv-id?model=modelNameOrDigest&run=runDigestOrStampOrName&name=parameterName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined. :name - (required) parameter name

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/parameter/ageSex/csv-id  
http://localhost:4040/api/model/modelOne/run/Default/parameter/ageSex/csv-id-bom  
http://localhost:4040/api/model/modelOne/run/f172e98da17beb058f30f11768053456/parameter/ageSex/csv-id  
http://localhost:4040/api/model/modelOne/run/f172e98da17beb058f30f11768053456/parameter/ageSex/csv-id-bom  
http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/parameter/ageSex/csv-id  
http://localhost:4040/api/run-parameter-csv-id?model=modelOne&run=Default&name=ageSex&bom=true
```

Return example:

```
sub_id,dim0,dim1,param_value  
0,10,0,0.1  
0,10,1,0.2  
0,20,0,0.3  
0,20,1,0.4  
0,30,0,0.5  
0,30,1,0.6  
0,40,0,0.7  
0,40,1,0.8
```

GET csv output table expressions from model run

Read entire output table expression(s) values from model run as csv file.

Response stream is UTF-8 outputTable.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) returned as enum codes.

Methods:

```
GET /api/model/:model/run/:run/table/:name/expr/csv  
GET /api/model/:model/run/:run/table/:name/expr/csv-bom  
GET /api/run-table-expr-csv?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) output table name
```

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/expr/csv  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/expr/csv-bom  
http://localhost:4040/api/model/_201208171604590148_/run/f172e98da17beb058f30f11768053456/table/salarySex/expr/csv  
http://localhost:4040/api/model/_201208171604590148_/run/2019_01_17_19_59_52_998/table/salarySex/expr/csv  
http://localhost:4040/api/run-table-expr-csv?model=modelOne&run=Default&name=salarySex&bom=true
```

Return example:

```
expr_name,dim0,dim1,expr_value
expr0,L,M,50
expr0,L,F,60
expr0,L,all,1
expr0,M,M,51.6
expr0,M,F,62
expr0,M,all,2
expr0,H,M,53.2
expr0,H,F,64
expr0,H,all,3
expr1,L,M,1
expr1,L,F,2
expr1,L,all,801
expr1,M,M,3
expr1,M,F,4
expr1,M,all,803
expr1,H,M,4
expr1,H,F,5
expr1,H,all,804
expr2,L,M,50
expr2,L,F,60
expr2,L,all,1
expr2,M,M,51.6
expr2,M,F,62
expr2,M,all,2
expr2,H,M,53.2
expr2,H,F,64
expr2,H,all,3
expr3,L,M,50
expr3,L,F,120
expr3,L,all,801
expr3,M,M,154.8
expr3,M,F,248
expr3,M,all,1606
expr3,H,M,212.8
expr3,H,F,320
expr3,H,all,2412
```

GET csv output table expressions from model run (enum id's)

Read entire output table expression(s) values from model run as csv file.

Response stream is UTF-8 outputTable.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) returned as enum id's.

Methods:

```
GET /api/model/:model/run/:run/table/:name/expr/csv-id  
GET /api/model/:model/run/:run/table/:name/expr/csv-id-bom  
GET /api/run-table-expr-csv-id?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) output table name
```

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/expr/csv-id  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/expr/csv-id-bom  
http://localhost:4040/api/model/_201208171604590148_/run/f172e98da17beb058f30f11768053456/table/salarySex/expr/csv-id  
http://localhost:4040/api/model/_201208171604590148_/run/2019_01_17_19_59_52_998/table/salarySex/expr/csv-id  
http://localhost:4040/api/run-table-expr-csv-id?model=modelOne&run=Default&name=salarySex&bom=true
```

Return example:

```
expr_id,dim0,dim1,expr_value
0,100,0,50
0,100,1,60
0,100,800,1
0,200,0,51.6
0,200,1,62
0,200,800,2
0,300,0,53.2
0,300,1,64
0,300,800,3
1,100,0,1
1,100,1,2
1,100,800,801
1,200,0,3
1,200,1,4
1,200,800,803
1,300,0,4
1,300,1,5
1,300,800,804
2,100,0,50
2,100,1,60
2,100,800,1
2,200,0,51.6
2,200,1,62
2,200,800,2
2,300,0,53.2
2,300,1,64
2,300,800,3
3,100,0,50
3,100,1,120
3,100,800,801
3,200,0,154.8
3,200,1,248
3,200,800,1606
3,300,0,212.8
3,300,1,320
3,300,800,2412
```

GET csv output table accumulators from model run

Read entire output table accumulator(s) values from model run as csv file.

Response stream is UTF-8 outputTable.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) returned as enum codes.

Methods:

```
GET /api/model/:model/run/:run/table/:name/acc/csv  
GET /api/model/:model/run/:run/table/:name/acc/csv-bom  
GET /api/run-table-acc-csv?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) output table name
```

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/acc/csv  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/acc/csv-bom  
http://localhost:4040/api/model/_201208171604590148_/run/f172e98da17beb058f30f11768053456/table/salarySex/acc/csv  
http://localhost:4040/api/model/_201208171604590148_/run/2019_01_17_19_59_52_998/table/salarySex/acc/csv  
http://localhost:4040/api/run-table-acc-csv?model=modelOne&run=Default&name=salarySex&bom=true
```

Return example:

```
acc_name,sub_id,dim0,dim1,acc_value  
acc0,0,L,M,50  
acc0,0,L,F,60  
acc0,0,L,all,1  
acc0,0,M,M,51.6  
acc0,0,M,F,62  
acc0,0,M,all,2  
acc0,0,H,M,53.2  
acc0,0,H,F,64  
acc0,0,H,all,3  
acc1,0,L,M,1  
acc1,0,L,F,2  
acc1,0,L,all,801  
acc1,0,M,M,3  
acc1,0,M,F,4  
acc1,0,M,all,803  
acc1,0,H,M,4  
acc1,0,H,F,5  
acc1,0,H,all,804
```

GET csv output table accumulators from model run (enum id's)

Read entire output table accumulator(s) values from model run as csv file.

Response stream is UTF-8 outputTable.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) returned as enum id's.

Methods:

```
GET /api/model/:model/run/:run/table/:name/acc/csv-id  
GET /api/model/:model/run/:run/table/:name/acc/csv-id-bom  
GET /api/run-table-acc-csv-id?model=modelNameOrDigest&run=runNameOrDigest&name=tableName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) output table name
```

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/acc/csv-id  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/acc/csv-id-bom  
http://localhost:4040/api/model/_201208171604590148_/run/f172e98da17beb058f30f11768053456/table/table/salarySex/acc/csv-id  
http://localhost:4040/api/model/_201208171604590148_/run/2019_01_17_19_59_52_998/table/table/salarySex/acc/csv-id  
http://localhost:4040/api/run-table-acc-csv-id?model=modelOne&run=Default&name=salarySex&bom=true
```

Return example:

```
acc_id,sub_id,dim0,dim1,acc_value  
0,0,100,0,50  
0,0,100,1,60  
0,0,100,800,1  
0,0,200,0,51.6  
0,0,200,1,62  
0,0,200,800,2  
0,0,300,0,53.2  
0,0,300,1,64  
0,0,300,800,3  
1,0,100,0,1  
1,0,100,1,2  
1,0,100,800,801  
1,0,200,0,3  
1,0,200,1,4  
1,0,200,800,803  
1,0,300,0,4  
1,0,300,1,5  
1,0,300,800,804
```

GET csv output table all accumulators from model run

Read entire output table "all-accumulators" view values from model run as csv file.

Response stream is UTF-8 outputTable.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) returned as enum codes.

Methods:

```
GET /api/model/:model/run/:run/table/:name/all-acc/csv  
GET /api/model/:model/run/:run/table/:name/all-acc/csv-bom  
GET /api/run-table-all-acc-csv?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) output table name
```

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/all-acc/csv  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/all-acc/csv-bom  
http://localhost:4040/api/model/_201208171604590148_/run/f172e98da17beb058f30f11768053456/table/salarySex/all-acc/csv  
http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/table/salarySex/all-acc/csv  
http://localhost:4040/api/run-table-all-acc-csv?model=modelOne&run=Default&name=salarySex&bom=true
```

Return example:

```
sub_id,dim0,dim1,acc0,acc1,acc2  
0,L,M,50,1,51  
0,L,F,60,2,62  
0,L,all,1,801,802  
0,M,M,51.6,3,54.6  
0,M,F,62,4,66  
0,M,all,2,803,805  
0,H,M,53.2,4,57.2  
0,H,F,64,5,69  
0,H,all,3,804,807
```

GET csv output table all accumulators from model run (enum id's)

Read entire output table "all-accumulators" view values from model run as csv file.

Response stream is UTF-8 outputTable.csv file attachment, optionally starts with byte order mark (BOM).

Dimension(s) returned as enum id's.

Methods:

```
GET /api/model/:model/run/:run/table/:name/all-acc/csv-id  
GET /api/model/:model/run/:run/table/:name/all-acc/csv-id-bom  
GET /api/run-table-all-acc-csv-id?model=modelNameOrDigest&run=runDigestOrStampOrName&name=tableName&bom=true
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

```
:name - (required) output table name
```

Call examples:

```
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/all-acc/csv-id  
http://localhost:4040/api/model/modelOne/run/Default/table/salarySex/all-acc/csv-id-bom  
http://localhost:4040/api/model/_201208171604590148_/run/f172e98da17beb058f30f11768053456/table/salarySex/all-acc/csv-id  
http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998/table/salarySex/all-acc/csv-id  
http://localhost:4040/api/run-table-all-acc-csv-id?model=modelOne&run=Default&name=salarySex&bom=true
```

Return example:

```
sub_id,dim0,dim1,acc0,acc1,acc2  
0,100,0,50,1,51  
0,100,1,60,2,62  
0,100,800,1,801,802  
0,200,0,51.6,3,54.6  
0,200,1,62,4,66  
0,200,800,2,803,805  
0,300,0,53.2,4,57.2  
0,300,1,64,5,69  
0,300,800,3,804,807
```

GET list of modeling tasks

Get list of modeling tasks: language-neutral part of task list metadata.

Methods:

```
GET /api/model/:model/task-list  
GET /api/task-list?model=modelNameOrDigest
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task-list  
http://localhost:4040/api/model/_201208171604590148_/task-list  
http://localhost:4040/api/task-list?model=modelOne
```

Return example:

```
[  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "taskOne",  
    "Txt": [],  
    "Set": [],  
    "TaskRun": []  
  }  
]
```

GET list of modeling tasks including text (description and notes)

Get list of modeling tasks, including text (description and notes).

Methods:

```
GET /api/model/:model/task-list/text  
GET /api/model/:model/task-list/text/:lang  
GET /api/task-list-text?model=modelNameOrDigest&lang=en
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:lang - (optional) language code
```

If optional `lang` argument specified then result in that language else in browser language. If no such language exist then text portion of result (description and notes) is empty.

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task-list/text  
http://localhost:4040/api/model/modelOne/task-list/text/lang/EN  
http://localhost:4040/api/task-list-text?model=modelOne&lang=fr-CA
```

Return example:

```
[  
  {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "taskOne",  
    "Txt": [  
      {  
        "LangCode": "EN",  
        "Descr": "Task One for Model One",  
        "Note": "Task One: two set of input parameters"  
      }  
    ],  
    "Set": [],  
    "TaskRun": []  
  }  
]
```

GET modeling task input worksets

Get modeling task input sets: language-neutral part of task metadata.

Methods:

```
GET /api/model/:model/task/:task/sets  
GET /api/task-sets?model=modelNameOrDigest&task=taskName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task/taskOne/sets  
http://localhost:4040/api/model/_201208171604590148_/task/taskOne/sets  
http://localhost:4040/api/task-sets?model=modelOne&task=taskOne
```

Return example:

```
{  
  "ModelName": "modelOne",  
  "ModelDigest": "_201208171604590148_",  
  "Name": "taskOne",  
  "Txt": [],  
  "Set": [  
    "Default",  
    "modelOne_other"  
,  
  "TaskRun": []  
}
```

GET modeling task run history

Get modeling task run history: language-neutral part of task metadata.

Methods:

```
GET /api/model/:model/task/:task/runs  
GET /api/task-runs?model=modelNameOrDigest&task=taskName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task/taskOne/runs  
http://localhost:4040/api/model/modelOne/task/taskOne/runs  
http://localhost:4040/api/task-runs?model=modelOne&task=taskOne
```

Return example:

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "taskOne",
  "Txt": [],
  "Set": [],
  "TaskRun": [
    {
      "Name": "First Task Run",
      "SubCount": 1,
      "CreateDateTime": "2020-03-24 16:29:20.427",
      "Status": "s",
      "UpdateDateTime": "2020-03-24 16:29:20.857",
      "RunStamp": "2020_03_24_16_29_20_427",
      "TaskRunSet": [
        {
          "Run": {
            "Name": "First_Task_Run_Default",
            "SubCompleted": 1,
            "CreateDateTime": "2020-03-24 16:29:20.459",
            "Status": "s",
            "RunDigest": "aa3bed04d833966853bdf04f841c5feb",
            "ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",
            "RunStamp": "2020_03_24_16_29_20_427"
          },
          "SetName": "Default"
        },
        {
          "Run": {
            "Name": "First_Task_Run_modelOne_other",
            "SubCompleted": 1,
            "CreateDateTime": "2020-03-24 16:29:20.667",
            "Status": "s",
            "RunDigest": "f8e078c414f15c79d19a2666b126dea5",
            "ValueDigest": "fb27d108fae2040fa1cae6f49704a1b7",
            "RunStamp": "2020_03_24_16_29_20_427"
          },
          "SetName": "modelOne_other"
        }
      ]
    }
  ]
}
```

GET status of modeling task run

Get status of modeling task run.

Methods:

```
GET /api/model/:model/task/:task/run-status/run/:run  
GET /api/task-run-status?model=modelNameOrDigest&task=taskName&run=taskRunStampOrName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

```
:run - (required) modeling task run stamp or task run name
```

Task run stamp and task run name can be explicitly specified as model run options. If task run stamp not specified then it automatically generated as timestamp string, ex.: 2016_08_17_07_55_123. It is recommended to specify unique run stamp or run name when you are running the modeling task. If task run stamp or task run name is not unique then result of this call is undefined. You can use [GET status of modeling task run list](#) method to get status of multiple runs with same name or stamp.

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task/taskOne/run-status/run/First%20Task%20Run  
http://localhost:4040/api/model/_201208171604590148_/task/taskOne/run-status/run/2019_01_17_19_59_53_260  
http://localhost:4040/api/task-run-status?model=modelOne&task=taskOne&run=First+Task+Run
```

Return example: This is a beta version and may change in the future.

```
{  
    "TaskRunId": 101,  
    "TaskId": 1,  
    "Name": "First Task Run",  
    "SubCount": 1,  
    "CreateDateTime": "2019-01-17 19:59:53.260",  
    "Status": "s",  
    "UpdateDateTime": "2019-01-17 19:59:53.539",  
    "RunStamp": "2019_01_17_19_59_53_260"  
}
```

GET status of modeling task run list

Get status of modeling task runs.

Methods:

```
GET /api/model/:model/task/:task/run-status/list/:run  
GET /api/task-run-status-list?model=modelNameOrDigest&task=taskName&run=taskRunStampOrName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

```
:run - (required) modeling task run stamp or task run name
```

Task run stamp and task run name can be explicitly specified as model run options. If task run stamp not specified then it automatically generated as timestamp string, ex.: 2016_08_17_07_55_123. It is recommended to specify unique run stamp or run name when you are running the modeling task.

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task/taskOne/run-status/list/First%20Task%20Run  
http://localhost:4040/api/model/_201208171604590148_/task/taskOne/run-status/list/2019_01_17_19_59_53_260  
http://localhost:4040/api/task-run-status-list?model=modelOne&task=taskOne&run=First+Task+Run
```

Return example: This is a beta version and may change in the future.

```
[  
  {  
    "TaskRunId": 101,  
    "TaskId": 1,  
    "Name": "First Task Run",  
    "SubCount": 1,  
    "CreateDateTime": "2020-02-01 12:10:45.090",  
    "Status": "s",  
    "UpdateDateTime": "2020-02-01 12:10:45.523",  
    "RunStamp": "2020_02_01_12_10_45_090"  
  }  
]
```

GET status of modeling task first run

Get status of modeling task first run.

Methods:

```
GET /api/model/:model/task/:task/run-status/first  
GET /api/task-first-run-status?model=modelNameOrDigest&task=taskName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task/taskOne/run-status/first  
http://localhost:4040/api/model/_201208171604590148_/task/taskOne/run-status/first  
http://localhost:4040/api/task-first-run-status?model=modelOne&task=taskOne
```

Return example: This is a beta version and may change in the future.

```
{  
    "TaskRunId": 101,  
    "TaskId": 1,  
    "Name": "First Task Run",  
    "SubCount": 1,  
    "CreateDateTime": "2019-01-17 19:59:53.260",  
    "Status": "s",  
    "UpdateDateTime": "2019-01-17 19:59:53.539",  
    "RunStamp": "2019_01_17_19_59_53_260"  
}
```

GET status of modeling task last run

Get status of modeling task last (most recent) run.

Methods:

```
GET /api/model/:model/task/:task/run-status/last  
GET /api/task-last-run-status?model=modelNameOrDigest&task=taskName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task/taskOne/run-status/last  
http://localhost:4040/api/model/_201208171604590148_/task/taskOne/run-status/last  
http://localhost:4040/api/task-last-run-status?model=modelOne&task=taskOne
```

Return example: *This is a beta version and may change in the future.*

```
{  
    "TaskRunId": 101,  
    "TaskId": 1,  
    "Name": "First Task Run",  
    "SubCount": 1,  
    "CreateDateTime": "2019-01-17 19:59:53.260",  
    "Status": "s",  
    "UpdateDateTime": "2019-01-17 19:59:53.539",  
    "RunStamp": "2019_01_17_19_59_53_260"  
}
```

GET status of modeling task last completed run

Get status of modeling task last completed run. Run completed if run status one of: s=success, x=exit, e=error.

Methods:

```
GET /api/model/:model/task/:task/run-status/last-completed  
GET /api/task-last-completed-run-status?model=modelNameOrDigest&task=taskName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task/taskOne/run-status/last-completed  
http://localhost:4040/api/model/_201208171604590148_/task/taskOne/run-status/last-completed  
http://localhost:4040/api/task-last-completed-run-status?model=modelOne&task=taskOne
```

Return example: This is a beta version and may change in the future.

```
{  
    "TaskRunId": 101,  
    "TaskId": 1,  
    "Name": "First Task Run",  
    "SubCount": 1,  
    "CreateDateTime": "2019-01-17 19:59:53.260",  
    "Status": "s",  
    "UpdateDateTime": "2019-01-17 19:59:53.539",  
    "RunStamp": "2019_01_17_19_59_53_260"  
}
```

GET modeling task including text (description and notes)

Get modeling task and task run history, including text (description and notes)

Methods:

```
GET /api/model/:model/task/:task/text  
GET /api/model/:model/task/:task/text/lang/:lang  
GET /api/task-text?model=modelNameOrDigest&task=taskName&lang=en
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

```
:lang - (optional) language code
```

If optional `lang` argument specified then result in that language else in browser language. If no such language exist then text portion of result (description and notes) is empty.

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task/taskOne/text  
http://localhost:4040/api/model/modelOne/task/taskOne/text/lang/EN  
http://localhost:4040/api/model/_201208171604590148_/task/taskOne/text/lang/EN  
http://localhost:4040/api/task-text?model=modelOne&task=taskOne&lang=fr-CA
```

Return example:

```
{  
  "Task": {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "taskOne",  
    "Txt": [  
      {  
        "LangCode": "EN",  
        "Descr": "Task One for Model One",  
        "Note": "Task One: two set of input parameters"  
      }  
    ],  
    "Set": [  
      "Default",  
      "modelOne_other"  
    ],  
    "TaskRun": [  
      {  
        "Name": "First Task Run",  
        "SubCount": 1,  
        "CreateDateTime": "2020-03-24 16:29:20.427",  
        "Status": "s",  
        "UpdateDateTime": "2020-03-24 16:29:20.857",  
        "RunStamp": "2020_03_24_16_29_20_427",  
        "TaskRunSet": [  
          {  
            "Run": {  
              "Name": "First_Task_Run_Default",  
              "SubCompleted": 1,  
              "CreateDateTime": "2020-03-24 16:29:20.459",  
              "Status": "s",  
              "RunDigest": "aa3bed04d833966853bd04f841c5feb",  
              "ValueDigest": "6c5c0f48e19f67899c86868bb8a23fd",  
              "RunStamp": "2020_03_24_16_29_20_427"  
            }  
          }  
        ]  
      }  
    ]  
  }  
}
```

```
        "SetName": "Default"
    },
    {
        "Run": [
            {
                "Name": "First_Task_Run_modelOne_other",
                "SubCompleted": 1,
                "CreateDateTime": "2020-03-24 16:29:20.667",
                "Status": "s",
                "RunDigest": "f8e078c414f15c79d19a2666b126dea5",
                "ValueDigest": "fb27d108fae2040fa1cae6f49704a1b7",
                "RunStamp": "2020_03_24_16_29_20_427"
            },
            {
                "SetName": "modelOne_other"
            }
        ]
    }
],
"Txt": {
    "SetTxt": [
        {
            "Default": [
                {
                    "LangCode": "EN",
                    "Descr": "Model One default set of parameters",
                    "Note": ""
                }
            ],
            "modelOne_other": [
                {
                    "LangCode": "EN",
                    "Descr": "Model One other set of parameters",
                    "Note": ""
                }
            ]
        }
    ],
    "RunTxt": [
        {
            "aa3bed04d833966853bd04f841c5feb": [
                {
                    "LangCode": "EN",
                    "Descr": "Model One default set of parameters",
                    "Note": ""
                }
            ],
            "f8e078c414f15c79d19a2666b126dea5": [
                {
                    "LangCode": "EN",
                    "Descr": "Model One other set of parameters",
                    "Note": ""
                }
            ]
        }
    ]
}
```

GET modeling task text in all languages

Get modeling task and task run history, including text (description and notes) in all languages.

Methods:

```
GET /api/model/:model/task/:task/text/all  
GET /api/task-text-all?model=modelNameOrDigest&task=taskName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

Call examples from browser:

```
http://localhost:4040/api/model/modelOne/task/taskOne/text/all  
http://localhost:4040/api/model/_201208171604590148_/task/taskOne/text/all  
http://localhost:4040/api/task-text-all?model=modelOne&task=taskOne
```

Return example:

```
{  
  "Task": {  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "taskOne",  
    "Txt": [  
      {  
        "LangCode": "EN",  
        "Descr": "Task One for Model One",  
        "Note": "Task One: two set of input parameters"  
      },  
      {  
        "LangCode": "FR",  
        "Descr": "(FR) Task One for Model One",  
        "Note": ""  
      }  
    ],  
    "Set": [  
      "Default",  
      "modelOne_other"  
    ],  
    "TaskRun": [  
      {  
        "Name": "First Task Run",  
        "SubCount": 1,  
        "CreateDateTime": "2020-03-24 16:29:20.427",  
        "Status": "s",  
        "UpdateDateTime": "2020-03-24 16:29:20.857",  
        "RunStamp": "2020_03_24_16_29_20_427",  
        "TaskRunSet": [  
          {  
            "Run": {  
              "Name": "First_Task_Run_Default",  
              "SubCompleted": 1,  
              "CreateDateTime": "2020-03-24 16:29:20.459",  
              "Status": "s",  
              "RunDigest": "aa3bed04d833966853bdf04f841c5feb",  
              "ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",  
              "RunStamp": "2020_03_24_16_29_20_427"  
            },  
            "SetName": "Default"  
          },  
          {  
            "Run": {  
              "Name": "Second_Task_Run_Default",  
              "SubCompleted": 1,  
              "CreateDateTime": "2020-03-24 16:29:20.459",  
              "Status": "s",  
              "RunDigest": "aa3bed04d833966853bdf04f841c5feb",  
              "ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",  
              "RunStamp": "2020_03_24_16_29_20_427"  
            },  
            "SetName": "Default"  
          },  
          {  
            "Run": {  
              "Name": "Third_Task_Run_Default",  
              "SubCompleted": 1,  
              "CreateDateTime": "2020-03-24 16:29:20.459",  
              "Status": "s",  
              "RunDigest": "aa3bed04d833966853bdf04f841c5feb",  
              "ValueDigest": "6c5c0f48e19f67899c868688bb8a23fd",  
              "RunStamp": "2020_03_24_16_29_20_427"  
            },  
            "SetName": "Default"  
          }  
        ]  
      }  
    ]  
  }  
}
```

```
        "Name": "First_Task_Run_modelOne_other",
        "SubCompleted": 1,
        "CreateDateTime": "2020-03-24 16:29:20.667",
        "Status": "s",
        "RunDigest": "f8e078c414f15c79d19a2666b126dea5",
        "ValueDigest": "fb27d108fae2040fa1cae6f49704a1b7",
        "RunStamp": "2020_03_24_16_29_20_427"
    },
    "SetName": "modelOne_other"
}
]
]
},
"Txt": {
    "SetTxt": [
        "Default": [
            {
                "LangCode": "EN",
                "Descr": "Model One default set of parameters",
                "Note": ""
            },
            {
                "LangCode": "FR",
                "Descr": "(FR) Model One default set of parameters",
                "Note": ""
            }
        ],
        "modelOne_other": [
            {
                "LangCode": "EN",
                "Descr": "Model One other set of parameters",
                "Note": ""
            },
            {
                "LangCode": "FR",
                "Descr": "(FR) Model One other set of parameters",
                "Note": ""
            }
        ]
    ],
    "RunTxt": [
        "aa3bed04d833966853bdf04f841c5feb": [
            {
                "LangCode": "EN",
                "Descr": "Model One default set of parameters",
                "Note": ""
            },
            {
                "LangCode": "FR",
                "Descr": "(FR) Model One default set of parameters",
                "Note": ""
            }
        ],
        "f8e078c414f15c79d19a2666b126dea5": [
            {
                "LangCode": "EN",
                "Descr": "Model One other set of parameters",
                "Note": ""
            },
            {
                "LangCode": "FR",
                "Descr": "(FR) Model One other set of parameters",
                "Note": ""
            }
        ]
    ]
}
}
```

POST create or replace profile

Create new or replace existing profile.

Profile is a set of key-value options which can be used to run the model.

This method insert new or replace all existing profile options. If no such profile exist in database then new profile created.

If profile already exist then it is delete-insert operation:

- all existing profile key-value options deleted from database;
- new key-value options inserted.

Profile is uniquely identified by name (inside of the database). Profile are not a property of the model and you can use same profile for different models. *Beta version: beta version API uses model name or digest to find profile.*

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

This is a beta version and may change in the future.

Method:

```
PATCH /api/model/:model/profile  
POST /api/model-profile?model=modelNameOrDigest
```

For example:

```
curl -v -X PATCH -H "Content-Type: application/json" "http://localhost:4040/api/model/modelOne/profile" -d @m1.profile.json  
curl -v -X POST -H "Content-Type: application/json" "http://localhost:4040/api/model-profile?model=modelOne" -d @m1.profile.json
```

JSON arguments:

It is expected to be same JSON as return of [GET model profile](#) method.

For example (m1.profile.json file):

```
{  
  "Name": "m1",  
  "Opts": {  
    "OpenM.SparseOutput": "false",  
    "Parameter.StartingSeed": "192"  
  }  
}
```

DELETE profile

Delete existing profile.

Profile is a set of key-value options which can be used to run the model.

This method does delete of existing profile and all profile options. If no such profile exist in database then nothing is changed (it is no-op).

Profile is uniquely identified by name (inside of the database). Profile are not a property of the model and you can use same profile for different models. *Beta version: beta version API uses model name or digest to find profile.*

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

This is a beta version and may change in the future.

Method:

```
DELETE /api/model/:model/profile/:profile  
POST /api/model-profile-delete?model=modelNameOrDigest&profile=profileName
```

For example:

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/profile/m1  
curl -v -X DELETE http://localhost:4040/api/model/_201208171604590148_/profile/m1  
curl -v -X POST "http://localhost:4040/api/model-profile-delete?model=modelOne&profile=m1"
```

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/profile/m1  
  
*   Trying ::1...  
* TCP_NODELAY set  
*   Trying 127.0.0.1...  
* TCP_NODELAY set  
* Connected to localhost (127.0.0.1) port 4040 (#0)  
> DELETE /api/model/modelOne/profile/m1 HTTP/1.1  
> Host: localhost:4040  
> User-Agent: curl/7.54.1  
> Accept: */*  
>  
< HTTP/1.1 200 OK  
< Content-Location: /api/model/modelOne/profile/m1  
< Date: Fri, 28 Dec 2018 03:06:21 GMT  
< Content-Length: 0  
<  
* Connection #0 to host localhost left intact
```

POST create or replace profile option

Create new or replace existing profile option.

Profile is a set of key-value options which can be used to run the model.

This method insert new or replace all existing profile key-value options. If no such profile exist in database then new profile created. If no such key exist in that profile then new key-value inserted. If key already exist the value replaced.

Profile is uniquely identified by name (inside of the database). Profile are not a property of the model and you can use same profile for different models. *Beta version: beta version API uses model name or digest to find profile.*

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

This is a beta version and may change in the future.

Method:

```
POST /api/model/:model/profile/:profile/key/:key/value/:value
```

For example:

```
curl -v -X POST http://localhost:4040/api/model/modelOne/profile/m1/key/Parameter.StartingSeed/value/4095
*   Trying ::1...
* TCP_NODELAY set
*   Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 4040 (#0)
> PATCH /api/model/modelOne/profile/m1/key/Parameter.StartingSeed/value/4095 HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.54.1
> Accept: */*
>
< HTTP/1.1 200 OK
< Content-Location: /api/model/modelOne/profile/m1/key/Parameter.StartingSeed
< Date: Fri, 28 Dec 2018 03:10:49 GMT
< Content-Length: 0
<
* Connection #0 to host localhost left intact
```

DELETE profile option

Delete existing profile option.

Profile is a set of key-value options which can be used to run the model.

This method does delete of existing profile key and associated value. If no such option key exist in that profile then nothing is changed (it is no-op).

Profile is uniquely identified by name (inside of the database). Profile are not a property of the model and you can use same profile for different models. *Beta version: beta version API uses model name or digest to find profile.*

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

This is a beta version and may change in the future.

Method:

```
DELETE /api/model/:model/profile/:profile/key/:key  
POST /api/model-profile-key-delete?model=modelNameOrDigest&profile=profileName&key=someKey
```

For example:

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/profile/m1/key/Parameter.StartingSeed  
* Trying ::1...  
* TCP_NODELAY set  
* Trying 127.0.0.1...  
* TCP_NODELAY set  
* Connected to localhost (127.0.0.1) port 4040 (#0)  
> DELETE /api/model/modelOne/profile/m1/key/Parameter.StartingSeed HTTP/1.1  
> Host: localhost:4040  
> User-Agent: curl/7.54.1  
> Accept: */*  
>  
< HTTP/1.1 200 OK  
< Content-Location: /api/model/modelOne/profile/m1/key/Parameter.StartingSeed  
< Date: Fri, 28 Dec 2018 03:15:15 GMT  
< Content-Length: 0  
<  
* Connection #0 to host localhost left intact
```

POST update workset read-only status

Update read-only status of model workset.

- Workset is a set of model input parameters (a.k.a. "scenario" input).
- Workset can be used to run the model.
- Workset is uniquely identified by name (in model context).
- Workset must be read-only in order to run the model with this set of input parameters.
- If user want to edit this set input parameters it must be read-write (not read-only status).

Methods:

```
POST /api/model/:model/workset/:set/readonly/:readonly  
POST /api/workset-readonly?model=modelNameOrDigest&set=setName&readonly=true
```

Arguments as URL parameters:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

```
:readonly - (required) read-only status
```

Read-only status is a boolean value. It accepts 1, t, T, TRUE, true, True, 0, f, F, FALSE, false, False. Any other value returns an error.

Examples:

```
curl -v -X POST http://localhost:4040/api/model/modelOne/workset/modelOne_set/readonly/1  
* Trying ::1...  
* TCP_NODELAY set  
* Trying 127.0.0.1...  
* TCP_NODELAY set  
* Connected to localhost (127.0.0.1) port 4040 (#0)  
> POST /api/model/modelOne/workset/modelOne_set/readonly/1 HTTP/1.1  
> Host: localhost:4040  
> User-Agent: curl/7.55.1  
> Accept: */*  
>  
< HTTP/1.1 200 OK  
< Content-Location: /api/model/_201208171604590148_/workset/modelOne_set  
< Content-Type: application/json  
< Date: Thu, 20 Dec 2018 03:54:59 GMT  
< Content-Length: 122  
<  
{"SetId":3,"BaseRunId":0,"ModelId":1,"Name":"modelOne_set","Is Readonly":true,"UpdateDateTime":"2018-12-19 22:54:59.0583"}  
* Connection #0 to host localhost left intact
```

```
curl -v -X POST http://localhost:4040/api/model/modelOne/workset/INVALID_NAME/readonly/1
*   Trying ::1...
* TCP_NODELAY set
*   Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 4040 (#0)
> POST /api/model/modelOne/workset/INVALID_NAME/readonly/1 HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.55.1
> Accept: /*
>
< HTTP/1.1 200 OK
< Content-Type: application/json
< Date: Thu, 20 Dec 2018 03:56:50 GMT
< Content-Length: 87
<
>{"SetId":0,"BaseRunId":0,"ModelId":0,"Name":"","Is Readonly":false,"UpdateDateTime":""}
* Connection #0 to host localhost left intact
```

PUT create new workset

Create new model workset and append new parameter(s) values.

- Workset is a set of model input parameters (a.k.a. "scenario" input).
- Workset can be used to run the model.
- Workset is uniquely identified by name (in model context).
- Workset must be read-only in order to run the model with this set of input parameters.
- If user want to edit this set input parameters it must be read-write (not read-only status).

This method creates new workset by inserting workset metadata, parameter(s) metadata and parameter(s) values from json request body. Workset metadata must contain model digest (or model name) and workset name, any other parts of metadata is optional.

Workset parameters are optional, you can create empty workset and add parameters later. Each parameter must have metadata and parameter value(s). Metadata must contain parameter name and number of sub-values (use 1 as default), all other metadata are optional. For each parameter values **must** be supplied. Workset cannot contain parameter metadata only, it must have all parameter values.

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default". If workset with the same name already exist then method return an error.

If workset name not specified or empty then new workset created with unique name.

This is a beta version and may change in the future.

Method:

```
PUT /api/workset-create
```

For example:

```
curl -v -X PUT -H "Content-Type: application/json" "http://localhost:4040/api/workset-create" -d @test.json
```

JSON body:

It is expected to be same JSON metadata as return of [Get Workset Metadata in All Languages](#) method. And for each parameter values expected to be the same as [Page](#) part of JSON return from [Read parameter values from workset](#) method.

JSON response:

```
{
  "SetId": 142,
  "BaseRunId": 101,
  "ModelId": 1,
  "Name": "auto_name_set_of_parameters_2020_05_01_15_22_54_807",
  "IsReadOnly": false,
  "UpdateDateTime": "2020-05-01 15:22:54.809"
}
```

Example 1:

```
{
  "modelName": "modelOne",
  "name": "NewSet",
  "txt": [
    {
      "langCode": "EN",
      "descr": "New Set of model One parameters"
    }
  ]
}
```

Example 2:

```
{  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "NewSet",  
    "BaseRunDigest": "",  
    "IsReadonly": false,  
    "Txt": [  
        {  
            "LangCode": "EN",  
            "Descr": "New Set of model One parameters"  
        },  
        {  
            "LangCode": "FR",  
            "Descr": "(FR) New Set of model One parameters",  
            "Note": "(FR) Note for New Set of model One parameters"  
        }  
    ],  
    "Param": [  
        {  
            "Name": "ageSex",  
            "SubCount": 1,  
            "DefaultSubId": 0,  
            "Txt": [  
                {  
                    "LangCode": "EN",  
                    "Note": "Age by Sex new set of values"  
                },  
                {  
                    "LangCode": "FR",  
                    "Note": "(FR) Age by Sex new set of values"  
                }  
            ],  
            "Value": [  
                {"Dims": ["10-20","M"], "IsNull": false, "Value": 0.1, "SubId": 0},  
                {"Dims": ["10-20","F"], "IsNull": false, "Value": 0.2, "SubId": 0},  
                {"Dims": ["20-30","M"], "IsNull": false, "Value": 0.3, "SubId": 0},  
                {"Dims": ["20-30","F"], "IsNull": false, "Value": 0.4, "SubId": 0},  
                {"Dims": ["30-40","M"], "IsNull": false, "Value": 0.5, "SubId": 0},  
                {"Dims": ["30-40","F"], "IsNull": false, "Value": 0.6, "SubId": 0},  
                {"Dims": ["40+","M"], "IsNull": false, "Value": 0.7, "SubId": 0},  
                {"Dims": ["40+","F"], "IsNull": false, "Value": 0.8, "SubId": 0}  
            ]  
        }  
    ]  
}
```

Example 3:

```
{  
    "ModelName": "modelOne",  
    "ModelDigest": "_201208171604590148_",  
    "Name": "NewSet",  
    "IsReadonly": true,  
    "Txt": [  
        {  
            "LangCode": "EN",  
            "Descr": "New Set of model One parameters"  
        },  
        {  
            "LangCode": "FR",  
            "Descr": "(FR) New Set of model One parameters",  
            "Note": "(FR) Note for New Set of model One parameters"  
        }  
    ],  
    "Param": [  
        {  
            "Name": "ageSex",  
            "SubCount": 1,  
            "DefaultSubId": 0,  
            "Txt": [  
                {  
                    "LangCode": "EN",  
                    "Note": "Age by Sex new set of values"  
                },  
                {  
                    "LangCode": "FR",  
                    "Note": "(FR) Age by Sex new set of values"  
                }  
            ],  
            "Value": [  
                {"Dims": ["10-20","M"], "IsNull": false, "Value": 0.1, "SubId": 0},  
                {"Dims": ["10-20","F"], "IsNull": false, "Value": 0.2, "SubId": 0},  
            ]  
        }  
    ]  
}
```

```

    {"Dims": ["20-30","M"], "IsNull": false, "Value": 0.3, "SubId": 0},
    {"Dims": ["20-30","F"], "IsNull": false, "Value": 0.4, "SubId": 0},
    {"Dims": ["30-40","M"], "IsNull": false, "Value": 0.5, "SubId": 0},
    {"Dims": ["30-40","F"], "IsNull": false, "Value": 0.6, "SubId": 0},
    {"Dims": ["40+","M"], "IsNull": false, "Value": 0.7, "SubId": 0},
    {"Dims": ["40+","F"], "IsNull": false, "Value": 0.8, "SubId": 0}
  ]
},
{
  "Name": "salaryAge",
  "SubCount": 1,
  "DefaultSubId": 0,
  "Txt": [
    {
      "LangCode": "EN",
      "Note": "Salary by Age new set of values"
    },
    {
      "LangCode": "FR",
      "Note": "(FR) Salary by Age new set of values"
    }
  ],
  "Value": [
    {"Dims": ["L","10-20"], "IsNull": false, "Value": 10, "SubId": 0},
    {"Dims": ["L","20-30"], "IsNull": false, "Value": 20, "SubId": 0},
    {"Dims": ["L","30-40"], "IsNull": false, "Value": 30, "SubId": 0},
    {"Dims": ["L","40+"], "IsNull": false, "Value": 40, "SubId": 0},
    {"Dims": ["M","10-20"], "IsNull": false, "Value": 11, "SubId": 0},
    {"Dims": ["M","20-30"], "IsNull": false, "Value": 21, "SubId": 0},
    {"Dims": ["M","30-40"], "IsNull": false, "Value": 31, "SubId": 0},
    {"Dims": ["M","40+"], "IsNull": false, "Value": 41, "SubId": 0},
    {"Dims": ["H","10-20"], "IsNull": false, "Value": 12, "SubId": 0},
    {"Dims": ["H","20-30"], "IsNull": false, "Value": 22, "SubId": 0},
    {"Dims": ["H","30-40"], "IsNull": false, "Value": 32, "SubId": 0},
    {"Dims": ["H","40+"], "IsNull": false, "Value": 42, "SubId": 0}
  ]
},
{
  "Name": "StartingSeed",
  "SubCount": 1,
  "DefaultSubId": 0,
  "Txt": [
    {
      "LangCode": "EN",
      "Note": "Starting seed new set of value"
    }
  ],
  "Value": [
    {"Dims": [], "IsNull": false, "Value": 8191, "SubId": 0}
  ]
},
{
  "Name": "salaryFull",
  "SubCount": 4,
  "DefaultSubId": 3,
  "Txt": [
    {
      "LangCode": "EN",
      "Note": "Full or part time by Salary new set of values"
    }
  ],
  "Value": [
    {"Dims": ["L"], "IsNull": false, "Value": "Part", "SubId": 0},
    {"Dims": ["M"], "IsNull": false, "Value": "Full", "SubId": 0},
    {"Dims": ["H"], "IsNull": false, "Value": "Full", "SubId": 0},
    {"Dims": ["L"], "IsNull": false, "Value": "Part", "SubId": 1},
    {"Dims": ["M"], "IsNull": false, "Value": "Part", "SubId": 1},
    {"Dims": ["H"], "IsNull": false, "Value": "Part", "SubId": 1},
    {"Dims": ["L"], "IsNull": false, "Value": "Full", "SubId": 2},
    {"Dims": ["M"], "IsNull": false, "Value": "Full", "SubId": 2},
    {"Dims": ["H"], "IsNull": false, "Value": "Full", "SubId": 2},
    {"Dims": ["L"], "IsNull": false, "Value": "Full", "SubId": 3},
    {"Dims": ["M"], "IsNull": false, "Value": "Full", "SubId": 3},
    {"Dims": ["H"], "IsNull": false, "Value": "Part", "SubId": 3}
  ]
},
{
  "Name": "baseSalary",
  "SubCount": 4,
  "DefaultSubId": 3,
  "Txt": [],
  "Value": [
    {"Dims": [], "IsNull": false, "Value": "Full", "SubId": 0},
    {"Dims": [], "IsNull": false, "Value": "Part", "SubId": 1},
    {"Dims": [], "IsNull": false, "Value": "Full", "SubId": 2},
    {"Dims": [], "IsNull": false, "Value": "Part", "SubId": 3}
  ]
}

```

```

},
{
  "Name": "filePath",
  "SubCount": 4,
  "DefaultSubId": 3,
  "Txt": [],
  "Value": [
    {"Dims": [], "IsNull": false, "Value": "file 0 path", "SubId": 0},
    {"Dims": [], "IsNull": false, "Value": "file 1 path", "SubId": 1},
    {"Dims": [], "IsNull": false, "Value": "file 2 path", "SubId": 2},
    {"Dims": [], "IsNull": false, "Value": "file 3 path", "SubId": 3}
  ]
},
{
  "Name": "isOldAge",
  "SubCount": 4,
  "DefaultSubId": 3,
  "Txt": [
    {
      "LangCode": "EN",
      "Note": "Is old age new set of values"
    }
  ],
  "Value": [
    {"Dims": ["10-20"], "IsNull": false, "Value": false, "SubId": 0},
    {"Dims": ["20-30"], "IsNull": false, "Value": false, "SubId": 0},
    {"Dims": ["30-40"], "IsNull": false, "Value": false, "SubId": 0},
    {"Dims": ["40+"], "IsNull": false, "Value": true, "SubId": 0},
    {"Dims": ["10-20"], "IsNull": false, "Value": false, "SubId": 1},
    {"Dims": ["20-30"], "IsNull": false, "Value": false, "SubId": 1},
    {"Dims": ["30-40"], "IsNull": false, "Value": false, "SubId": 1},
    {"Dims": ["40+"], "IsNull": false, "Value": true, "SubId": 1},
    {"Dims": ["10-20"], "IsNull": false, "Value": false, "SubId": 2},
    {"Dims": ["20-30"], "IsNull": false, "Value": false, "SubId": 2},
    {"Dims": ["30-40"], "IsNull": false, "Value": false, "SubId": 2},
    {"Dims": ["40+"], "IsNull": false, "Value": true, "SubId": 2},
    {"Dims": ["10-20"], "IsNull": false, "Value": false, "SubId": 3},
    {"Dims": ["20-30"], "IsNull": false, "Value": false, "SubId": 3},
    {"Dims": ["30-40"], "IsNull": false, "Value": false, "SubId": 3},
    {"Dims": ["40+"], "IsNull": false, "Value": true, "SubId": 3}
  ]
}
]
}
}

```

```

curl -v -X PUT -H "Content-Type: application/json" "http://localhost:4040/api/workset-create" -d @m1_ws_new_on_run.json

* Trying ::1...
* TCP_NODELAY set
* Connected to localhost (::1) port 4040 (#0)
> PUT /api/workset-create HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.55.1
> Accept: /*
> Content-Type: application/json
> Content-Length: 399
>
* upload completely sent off: 399 out of 399 bytes
< HTTP/1.1 200 OK
< Content-Location: /api/model/_201208171604590148/_workset/auto_name_set_of_parameters_2020_05_01_15_22_54_807
< Content-Type: application/json
< Date: Fri, 01 May 2020 19:22:54 GMT
< Content-Length: 165
<
{"SetId":142,"BaseRunId":101,"ModelId":1,"Name":"auto_name_set_of_parameters_2020_05_01_15_22_54_807","Is_READONLY":false,"UpdateDateTime":"2020-05-01 15:22:54.809"}
* Connection #0 to host localhost left intact

```

PUT create or replace workset

Create new or replace existing model workset metadata, parameter(s) metadata and parameter(s) values.

- Workset is a set of model input parameters (a.k.a. "scenario" input).
- Workset can be used to run the model.
- Workset is uniquely identified by name (in model context).
- Workset must be read-only in order to run the model with this set of input parameters.
- If user want to edit this set input parameters it must be read-write (not read-only status).

This method replace workset metadata, parameter(s) metadata and parameter(s) values from multipart-form, expected multipart form parts:

- first workset part with workset metadata and parameters metadata in json
- optional multiple parts file-csv=parameterName.csv.

If no such workset exist in database then new workset created.

If workset name not specified or empty then new workset created with unique name.

If workset already exist then it is delete-insert operation:

- existing metadata, parameter list, parameter metadata and parameter values deleted from database;
- new metadata, parameters metadata and parameters values inserted.

For each parameter in the parameter list csv parameter values **must** be supplied. Workset cannot contain parameter metadata only, it must have parameter values as parameter.csv part.

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

This is a beta version and may change in the future.

Method:

```
PUT /api/workset-new
```

For example:

```
curl -v -X PUT -F "workset=@test.json" http://localhost:4040/api/workset-new
curl -v -X PUT -F "workset=@test.json" -F "parameter-csv=@new_ageSex.csv;filename=ageSex.csv" http://localhost:4040/api/workset-new
```

JSON arguments:

It is expected to be same JSON as return of [Get Workset Metadata in All Languages](#) method.

For example (test.json file):

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "modelOne_set2",
  "BaseRunDigest": "",
  "Is Readonly": false,
  "Txt": [
    {
      "LangCode": "EN",
      "Descr": "modelOne modified set of parameters",
      "Note": ""
    },
    {
      "LangCode": "FR",
      "Descr": "(FR) modelOne modified set of parameters",
      "Note": "(FR) modelOne workset notes"
    }
  ],
  "Param": [
    {
      "Name": "ageSex",
      "SubCount": 1,
      "DefaultSubId": 0,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Age by Sex modified values"
        },
        {
          "LangCode": "FR",
          "Note": "(FR) Age by Sex modified values"
        }
      ]
    }
  ]
}
```

Each parameter.csv part expected to be same as return of methods:

- [GET parameter values from model run](#)
- [GET parameter values from workset](#)

For example (`new_ageSex.csv` file):

```
sub_id,dim0,dim1,param_value
0,10-20,M,1.1
0,10-20,F,1.2
0,20-30,M,1.3
0,20-30,F,1.4
0,30-40,M,1.5
0,30-40,F,1.6
0,40+,M,1.7
0,40+,F,1.8
```

JSON response:

```
{
  "SetId": 142,
  "BaseRunId": 101,
  "ModelId": 1,
  "Name": "auto_name_set_of_parameters_2020_05_01_15_22_54_807",
  "Is Readonly": false,
  "UpdateDateTime": "2020-05-01 15:22:54.809"
}
```

PATCH create or merge workset

Create new or merge existing model workset metadata, parameter(s) metadata and replace parameter(s) values.

- Workset is a set of model input parameters (a.k.a. "scenario" input).
- Workset can be used to run the model.
- Workset is uniquely identified by name (in model context).
- Workset must be read-only in order to run the model with this set of input parameters.
- If user want to edit this set input parameters it must be read-write (not read-only status).

This method merge workset metadata, parameter(s) metadata and parameter(s) values from multipart-form, expected multipart form parts:

- first workset part with workset metadata and parameters metadata in json
- optional multiple parts file-csv=parameterName.csv.

First part must have model digest or name and workset name:

- if no such workset exist in database then new workset created.
- if workset already exist then merge existing workset metadata with new.
- if workset name not specified or empty then new workset created with unique name.

Parameter list merged with existing workset parameter list:

- if parameter exist in workset then parameter metadata merged.
- if new parameter values supplied then replace parameter values.
- if parameter not already exist in workset then parameter values **must** be supplied.

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

This is a beta version and may change in the future.

Method:

```
PATCH /api/workset
```

For example:

```
curl -v -X PATCH -F "workset=@test.json" http://localhost:4040/api/workset
curl -v -X PATCH -F "workset=@test.json" -F "parameter-csv=@new_ageSex.csv;filename=ageSex.csv" http://localhost:4040/api/workset
```

JSON arguments:

It is expected to be same JSON as return of [Get Workset Metadata in All Languages](#) method.

For example (test.json file):

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "modelOne_set2",
  "BaseRunDigest": "",
  "Is Readonly": false,
  "Txt": [
    {
      "LangCode": "EN",
      "Descr": "modelOne modified set of parameters",
      "Note": ""
    },
    {
      "LangCode": "FR",
      "Descr": "(FR) modelOne modified set of parameters",
      "Note": "(FR) modelOne workset notes"
    }
  ],
  "Param": [
    {
      "Name": "ageSex",
      "SubCount": 1,
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "Age by Sex modified values"
        },
        {
          "LangCode": "FR",
          "Note": "(FR) Age by Sex modified values"
        }
      ]
    }
  ]
}
```

Each parameter.csv part expected to be same as return of methods:

- GET parameter values from model run
- GET parameter values from workset

For example (new_ageSex.csv file):

```
sub_id,dim0,dim1,param_value
0,10-20,M,1.1
0,10-20,F,1.2
0,20-30,M,1.3
0,20-30,F,1.4
0,30-40,M,1.5
0,30-40,F,1.6
0,40+,M,1.7
0,40+,F,1.8
```

JSON response:

```
{
  "SetId": 142,
  "BaseRunId": 101,
  "ModelId": 1,
  "Name": "auto_name_set_of_parameters_2020_05_01_15_22_54_807",
  "Is Readonly": false,
  "UpdateDateTime": "2020-05-01 15:22:54.809"
}
```

DELETE workset

Delete model workset and workset parameter(s) values from database.

Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model.

Method:

```
DELETE /api/model/:model/workset/:set  
POST /api/workset-delete?model=modelNameOrDigest&set=setName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

Call examples:

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/workset/modelOne_set2  
curl -v -X DELETE http://localhost:4040/api/model/_201208171604590148_/workset/modelOne_set2  
curl -v -X POST "http://localhost:4040/api/workset-delete?model=modelOne&set=modelOne_set2"
```

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/workset/modelOne_set2  
*   Trying ::1...  
* TCP_NODELAY set  
*   Trying 127.0.0.1...  
* TCP_NODELAY set  
* Connected to localhost (127.0.0.1) port 4040 (#0)  
> DELETE /api/model/modelOne/workset/modelOne_set2 HTTP/1.1  
> Host: localhost:4040  
> User-Agent: curl/7.54.1  
> Accept: */*  
>  
< HTTP/1.1 200 OK  
< Location: /api/model/modelOne/workset/modelOne_set2  
< Date: Tue, 19 Dec 2017 03:10:16 GMT  
< Content-Length: 0  
< Content-Type: text/plain; charset=utf-8  
<  
* Connection #0 to host localhost left intact
```

DELETE parameter from workset

Delete parameter from workset: delete workset parameter metadata and parameter values from database.

Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model.

Method:

```
DELETE /api/model/:model/workset/:set/parameter/:name  
POST /api/workset-parameter-delete?model=modelNameOrDigest&set=setName¶meter=name
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

```
:name - (required) parameter name
```

Call examples:

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/workset/modelOne_set2/parameter/ageSex  
curl -v -X DELETE http://localhost:4040/api/model/_201208171604590148_/workset/modelOne_set2/parameter/ageSex  
curl -v -X POST "http://localhost:4040/api/workset-parameter-delete?model=modelOne&set=modelOne_set2¶meter=ageSex"
```

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/workset/modelOne_set2/parameter/ageSex  
*   Trying ::1...  
* TCP_NODELAY set  
*   Trying 127.0.0.1...  
* TCP_NODELAY set  
* Connected to localhost (127.0.0.1) port 4040 (#0)  
> DELETE /api/model/modelOne/workset/modelOne_set2/parameter/ageSex HTTP/1.1  
> Host: localhost:4040  
> User-Agent: curl/7.54.1  
> Accept: */*  
>  
< HTTP/1.1 200 OK  
< Location: /api/model/modelOne/workset/modelOne_set2/parameter/ageSex  
< Date: Fri, 22 Dec 2017 03:16:54 GMT  
< Content-Length: 0  
< Content-Type: text/plain; charset=utf-8  
<  
* Connection #0 to host localhost left intact
```

PATCH update workset parameter values

Update existing parameter values in workset.

Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model.

This method replace existing parameter values by new values. Typical use of this method is a parameter editing through UI when only small part of parameter rows replaced. Input data are json-encoded and expected to be same as [Page](#) part of JSON return from [Read parameter values from workset](#) method.

Dimension(s) and enum-based parameter values expected as enum codes.

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

This is a beta version and may change in the future.

Method:

```
PATCH /api/model/:model/workset/:set/parameter/:name/new/value  
POST /api/workset-parameter-new-value?model=modelNameOrDigest&set=setName&name=parameterName
```

Arguments:

:model - (required) model digest or model name

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

:set - (required) workset name

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

:name - (required) parameter name

Call examples:

```
curl -v -X PATCH -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/workset/modelOne_set/parameter/ageSex/new/value -d @test.json  
curl -v -X PATCH -H "Content-Type: application/json" http://localhost:4040/api/model/_201208171604590148_/workset/modelOne_set/parameter/ageSex/new/value -d @test.json  
curl -v -X POST -H "Content-Type: application/json" "http://localhost:4040/api/workset-parameter-new-value?model=modelOne&set=modelOne_set&name=ageSex" -d @test.json
```

JSON body:

It is expected to be same as [Page](#) part of JSON return from [Read parameter values from workset](#) method.

For example (test.json file):

```
[  
{"Dims": ["10-20", "M"], "IsNull": false, "Value": 1234.1, "SubId": 0}  
, {"Dims": ["10-20", "F"], "IsNull": false, "Value": 5678.2, "SubId": 0}  
]
```

PATCH update workset parameter values (enum id's)

Update existing parameter values in workset.

Workset is a set of model input parameters (a.k.a. "scenario" input). Workset can be used to run the model.

This method replace existing parameter values by new values. Typical use of this method is a parameter editing through UI when only small part of parameter rows replaced. Input data are json-encoded and expected to be the same as [Page](#) part of JSON return from [Read parameter values from workset \(enum id's\)](#) method.

Dimension(s) and enum-based parameter values expected as enum id, not enum codes.

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

This is a beta version and may change in the future.

Method:

```
PATCH /api/model/:model/workset/:set/parameter/:name/new/value-id  
POST /api/workset-parameter-new-value-id?model=modelNameOrDigest&set=setName&name=parameterName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default".

```
:name - (required) parameter name
```

Call examples:

```
curl -v -X PATCH -H "Content-Type: application/json" http://localhost:4040/api/model/modelOne/workset/modelOne_set/parameter/ageSex/new/value-id -d @test.json  
curl -v -X PATCH -H "Content-Type: application/json" http://localhost:4040/api/model/_201208171604590148_/workset/modelOne_set/parameter/ageSex/new/value-id -d @test.json  
curl -v -X POST -H "Content-Type: application/json" "http://localhost:4040/api/workset-parameter-new-value-id?model=modelOne&set=modelOne_set&name=ageSex" -d @test.json
```

JSON body:

It is expected to be same as [Page](#) part of JSON return from [Read parameter values from workset \(enum id's\)](#) method.

For example (test.json file):

```
[  
{"DimIds": [10, 0], "IsNull": false, "Value": 9876.1, "SubId": 0}  
, {"DimIds": [10, 1], "IsNull": false, "Value": 5432.2, "SubId": 0}  
]
```

PUT copy parameter from model run into workset

Copy parameter values and parameter value notes from model run into workset.

- Workset is a set of model input parameters (a.k.a. "scenario" input).
- Workset can be used to run the model.
- Workset must be read-only in order to run the model with this set of input parameters.
- If user want to edit this set input parameters it must be read-write (not read-only status).

Method:

```
PUT /api/model/:model/workset/:set/copy/parameter/:name/from-run/:run  
POST /api/copy-parameter-from-run?model=modelNameOrDigest&set=setName&name=parameterName&run=runDigestOrStampOrName"
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default". Destination workset must be in read-write state (editable), use [POST update workset read-only status](#) method to make workset editable.

```
:name - (required) parameter name
```

If parameter with that name already exist in workset then error returned. You can delete parameter from workset by [DELETE parameter from workset](#) method.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

Call examples:

```
curl -v -X PUT http://localhost:4040/api/model/modelOne/workset/set2/copy/parameter/ageSex/from-run/Default-4  
curl -v -X PUT http://localhost:4040/api/model/_201208171604590148_/workset/set2/copy/parameter/ageSex/from-run/6fbad822cb9ae42deea1ede626890711  
curl -v -X PUT http://localhost:4040/api/model/modelOne/workset/set2/copy/parameter/ageSex/from-run/2019_01_17_19_59_52_998  
curl -v -X POST "http://localhost:4040/api/copy-parameter-from-run?model=modelOne&set=set2&name=ageSex&run=Default-4"
```

```
curl -v -X PUT http://localhost:4040/api/model/modelOne/workset/set2/copy/parameter/ageSex/from-run/Default-4
*   Trying ::1...
* TCP_NODELAY set
*   Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 4040 (#0)
> PUT /api/model/modelOne/workset/set2/copy/parameter/ageSex/from-run/Default-4 HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.54.1
> Accept: */*
>
< HTTP/1.1 200 OK
< Content-Location: /api/model/modelOne/workset/set2/parameter/ageSex
< Date: Mon, 31 Dec 2018 19:34:21 GMT
< Content-Length: 0
<
* Connection #0 to host localhost left intact
```

PUT copy parameter from workset to another

Copy parameter values and parameter value notes from one workset to another.

- Workset is a set of model input parameters (a.k.a. "scenario" input).
- Workset can be used to run the model.
- Workset must be read-only in order to run the model with this set of input parameters.
- If user want to edit this set input parameters it must be read-write (not read-only status).

Method:

```
PUT /api/model/:model/workset/:set/copy/parameter/:name/from-workset/:from-set  
POST /api/copy-parameter-from-workset?model=modelNameOrDigest&set=dstSetName&name=parameterName&from-set=srcSetName"
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:set - (required) destination workset name
```

Workset is uniquely identified by name (inside the model). Different models can have worksets with same name, i.e. each model can have workset with name "Default". Destination workset must be in read-write state (editable), use [POST update workset read-only status](#) method to make workset editable.

```
:name - (required) parameter name
```

If parameter with that name already exist in workset then error returned. You can delete parameter from workset by [DELETE parameter from workset](#) method.

```
:from-set - (required) source workset name
```

Source workset must be in read-only state.

Call examples:

```
curl -v -X PUT http://localhost:4040/api/model/modelOne/workset/set2/copy/parameter/ageSex/from-workset/modelOne_other  
curl -v -X PUT http://localhost:4040/api/model/_201208171604590148_/workset/set2/copy/parameter/ageSex/from-workset/modelOne_other  
curl -v -X POST "http://localhost:4040/api/copy-parameter-from-workset?model=modelOne&set=set2&name=ageSex&from-set=modelOne_other"
```

```
curl -v -X PUT http://localhost:4040/api/model/modelOne/workset/set2/copy/parameter/ageSex/from-workset/modelOne_other  
* Trying ::1...  
* TCP_NODELAY set  
* Trying 127.0.0.1...  
* TCP_NODELAY set  
* Connected to localhost (127.0.0.1) port 4040 (#0)  
> PUT /api/model/modelOne/workset/set2/copy/parameter/ageSex/from-workset/modelOne_other HTTP/1.1  
> Host: localhost:4040  
> User-Agent: curl/7.54.1  
> Accept: */*  
>  
< HTTP/1.1 200 OK  
< Content-Location: /api/model/modelOne/workset/set2/parameter/ageSex  
< Date: Mon, 31 Dec 2018 19:50:05 GMT  
< Content-Length: 0  
<  
* Connection #0 to host localhost left intact
```

PATCH update model run text (description and notes)

Merge (add new or update existing) model run text (description and notes and run parameters value notes).

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Model run must be completed (successfully or with error) before you can modify run text description or notes. If model run still in progress then error returned.

This is a beta version and may change in the future.

Method:

```
PATCH /api/run/text
```

For example:

```
curl -v -X PATCH -H "Content-Type: application/json" http://localhost:4040/api/run/text -d @test.json
```

JSON arguments:

It is expected to be same JSON as return of [GET run including text in all languages](#) method.

Only following parts are used from input json:

- model digest or model name
- run digest, run stamp or run name
- run text language code, description and notes
- parameter value text language code and notes Any other parts on json body are silently ignored because it is not possible to modify model run data, only run text (description and notes) can be updated.

For example (test.json file):

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "Default-4",
  "Digest": "05403de52f30f59b050417561914fbb8",
  "Txt": [
    {
      "LangCode": "EN",
      "Descr": "UPDATED Model One default set of parameters",
      "Note": "UPDATED Note"
    }
  ],
  "Param": [
    {
      "Name": "ageSex",
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "UPDATED Age by Sex default values"
        }
      ]
    },
    {
      "Name": "salaryAge",
      "Txt": [
        {
          "LangCode": "EN",
          "Note": "UPDATED Salary by Age default values"
        }
      ]
    }
  ]
}
```

DELETE model run

Delete model run results from database, including output table values and values of run input parameters.

Method:

```
DELETE /api/model/:model/run/:run  
POST /api/run-delete?model=modelNameOrDigest&run=runDigestOrStampOrName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:run - (required) model run digest or run stamp or run name
```

Model run can be identified by run digest, run stamp or run name. It is recommended to use digest because it is uniquely identifies model run. Run stamp, if not explicitly specified as model run option, automatically generated as timestamp string, ex.: 2016_08_17_21_07_55_123. It is also possible to use name, which is more human readable than digest, but if there are multiple runs with same name in database than result is undefined.

Call examples:

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/run/Default-4  
curl -v -X DELETE http://localhost:4040/api/model/_201208171604590148_/run/05403de52f30f59b050417561914fb88  
curl -v -X DELETE http://localhost:4040/api/model/modelOne/run/2019_01_17_19_59_52_998  
curl -v -X POST "http://localhost:4040/api/run-delete?model=modelOne&run=Default-4"
```

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/run/Default-4  
*   Trying ::1...  
* TCP_NODELAY set  
* Connected to localhost (::1) port 4040 (#0)  
> DELETE /api/model/modelOne/run/Default-4 HTTP/1.1  
> Host: localhost:4040  
> User-Agent: curl/7.54.1  
> Accept: */*  
>  
< HTTP/1.1 200 OK  
< Content-Location: /api/model/modelOne/run/Default-4  
< Date: Fri, 11 Jan 2019 02:25:48 GMT  
< Content-Length: 0  
<  
* Connection #0 to host localhost left intact
```

PUT create or replace modeling task

Create new or replace existing modeling task definition: including task text (description and notes) and list of task input sets (worksets).

It does delete existing and insert new rows into task_txt and task_set db tables. If task does not exist then new task created by inserting into task_lst table.

Following parts can be submitted as JSON body (see example below):

- model name
- model digest
- task name
- task text as array of: language code, description, notes
- task input worksets as array of workset names

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

If task name not specified or empty then new task created with unique name.

Task input worksets must already exist in database: all workset names must exist in workset_lst table.

This is a beta version and may change in the future.

Method:

```
PUT /api/task-new
```

For example:

```
curl -v -X PUT -H "Content-Type: application/json" http://localhost:4040/api/task-new -d @test.json
```

JSON argument:

It is expected to be similar JSON return of [GET task including text in all languages](#) method. It can include only following parts of GET results:

- Task.ModelName
- Task.ModelDigest
- Task.Name
- Task.Txt
- Task.Set

For example (test.json file):

```
{  
  "ModelName": "modelOne",  
  "ModelDigest": "_201208171604590148_",  
  "Name": "task-2",  
  "Txt": [  
    {"LangCode": "EN",  
     "Descr": "Task Two for Model One",  
     "Note": "Task Two: two set of input parameters"},  
    {"LangCode": "FR",  
     "Descr": "(FR) Task Two for Model One",  
     "Note": ""},  
  ],  
  "Set": [  
    "modelOne_other"  
  ]  
}
```

JSON response:

```
{  
  "Name": "auto_name_task_2020_05_01_15_25_38_208"  
}
```

PATCH create or update modeling task

Create new or merge existing modeling task definition: including task text (description and notes) and list of task input sets (worksets).

It does update existing or insert new rows into task_txt and task_set db tables. If task does not exist then new task created by inserting into task_lst table.

Following parts can be submitted as JSON body (see example below):

- model name
- model digest
- task name
- task text as array of: language code, description, notes
- task input worksets as array of workset names

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

If task name not specified or empty then new task created with unique name.

Task input worksets must already exist in database: all workset names must exist in workset_lst table.

This is a beta version and may change in the future.

Method:

```
PATCH /api/task
```

For example:

```
curl -v -X PATCH -H "Content-Type: application/json" http://localhost:4040/api/task -d @test.json
```

JSON argument:

It is expected to be similar JSON return of [GET task including text in all languages](#) method. It can include only following parts of GET results:

- Task.ModelName
- Task.ModelDigest
- Task.Name
- Task.Txt
- Task.Set

For example (test.json file):

```
{
  "ModelName": "modelOne",
  "ModelDigest": "_201208171604590148_",
  "Name": "task-2",
  "Txt": [
    {
      "LangCode": "EN",
      "Descr": "UPDATED Task Two for Model One",
      "Note": "UPDATED Task Two: two set of input parameters"
    },
    {
      "LangCode": "FR",
      "Descr": "(FR) Task Two for Model One",
      "Note": "UPDATED notes"
    }
  ],
  "Set": [
    "Default"
  ]
}
```

JSON response:

```
{
  "Name": "auto_name_task_2020_05_01_15_25_38_208"
}
```

Example:

```
curl -v -X PATCH -H "Content-Type: application/json" http://localhost:4040/api/task -d @task_t2_def_merge.json

*   Trying ::1...
* TCP_NODELAY set
* Connected to localhost (::1) port 4040 (#0)
> PATCH /api/task HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.55.1
> Accept: /*
> Content-Type: application/json
> Content-Length: 364
>
* upload completely sent off: 364 out of 364 bytes
< HTTP/1.1 200 OK
< Content-Location: /api/model/_201208171604590148_/task/auto_name_task_2020_05_01_15_25_38_208
< Content-Type: application/json
< Date: Fri, 01 May 2020 19:25:38 GMT
< Content-Length: 50
<
>{"Name": "auto_name_task_2020_05_01_15_25_38_208"}
* Connection #0 to host localhost left intact
```

DELETE modeling task

Delete modeling task and task run history from database.

Model run results are not deleted and model input parameter values are not deleted. Only task and task run history deleted. Delete done only from task_lst, task_txt, task_set, task_run_lst and task_run_set db tables.

Method:

```
DELETE /api/model/:model/task/:task  
POST  /api/task-delete?model=modelNameOrDigest&task=taskName
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:task - (required) modeling task name
```

Task is uniquely identified by name (inside the model). Different models can have tasks with same name, i.e. each model can have task with name "My First Task".

Call examples:

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/task/task-2  
curl -v -X DELETE http://localhost:4040/api/model/_201208171604590148_/task/task-2  
curl -v -X POST "http://localhost:4040/api/task-delete?model=modelOne&task=task-2"
```

```
curl -v -X DELETE http://localhost:4040/api/model/modelOne/task/task-2  
*   Trying ::1...  
* TCP_NODELAY set  
* Connected to localhost (::1) port 4040 (#0)  
> DELETE /api/model/modelOne/task/task-2 HTTP/1.1  
> Host: localhost:4040  
> User-Agent: curl/7.54.1  
> Accept: */*  
>  
< HTTP/1.1 200 OK  
< Content-Location: /api/model/modelOne/task/task-2  
< Date: Sat, 12 Jan 2019 00:50:07 GMT  
< Content-Length: 0  
<  
* Connection #0 to host anatolyv17om left intact
```

POST a request to run the model

Start new model run.

This is a beta version and may change in the future.

Method:

```
POST /api/run
```

For example:

```
curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/run -d @run_modelOne.json
```

JSON request body:

```
{
  "ModelName": string // model name to run
  "ModelDigest": string // model digest to run
  "RunStamp": string // run stamp, if empty then auto-generated as timestamp
  "Dir": string // working directory to run the model, if relative then must be relative to oms root directory
  "Opts": key-value map // model run options
  "Env": key-value map // environment variables to set
  "Mpi": {
    "Np": int // if non-zero then number of MPI processes
  }
  "Template": string // template file name to make run model command line
}
```

Template is a name of template file inside of `etc` sub-directory to make model run command line. Template file is required only if you want to run the model on MPI cluster, when `Mpi.Np > 0`. If template file name not specified then by default it is: `etc/mpiModelRun.template.txt`.

JSON response example:

```
{
  "modelName": "modelOne",
  "modelDigest": "_201208171604590148_",
  "runStamp": "2019_01_29_21_02_14_452",
  "isFinal": false,
  "updateDateTime": "2019-01-29 21:02:14.452",
  "runName": "",
  "taskRunName": ""
}
```

IsFinal: if true then model run failed to start.

RunStamp: model run stamp, use it to [GET model run status and log](#).

Model console output redirected to log file: `models/log modelName.RunStamp.console.log`, for example: `modelOne.2019_01_29_21_02_14_452.console.log`.

Example 1:

Run modelOne.exe with 2 sub-values (sub-value is similar to Modgen "sub-sample"):

```
{
  "modelName": "modelOne",
  "opts": {
    "OpenM.SubValues": "2"
  }
}
```

```

curl -v -X POST -H "Content-Type: application/json" http://localhost:4040/api/run -d @run_modelOne.json

* Trying ::1...
* TCP_NODELAY set
* Connected to localhost (::1) port 4040 (#0)
> POST /api/run HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.54.1
> Accept: /*
> Content-Type: application/json
> Content-Length: 68
>
* upload completely sent off: 68 out of 68 bytes
< HTTP/1.1 200 OK
< Content-Location: /api/model/_201208171604590148/run/2019_01_29_21_02_14_452
< Content-Type: application/json
< Date: Wed, 30 Jan 2019 02:02:14 GMT
< Content-Length: 188
<
{
  "ModelName": "modelOne",
  "ModelIDigest": "_201208171604590148",
  "RunStamp": "2019_01_29_21_02_14_452",
  "IsFinal": false,
  "UpdateDateTime": "2019-01-29 21:02:14.452",
  "RunName": "",
  "TaskRunName": ""
}
* Connection #0 to host localhost left intact

```

Oms web-service execute following command:

```
./modelOne -OpenM.RunStamp 2019_01_29_21_02_14_452 -OpenM.LogToConsole true -OpenM.SubValues 2
```

As result `modelOne` executable started on server with 2 sub-values. Model console output redirected to log file

`modelOne.2019_01_29_21_02_14_452.console.log`:

```

2019-01-29 21:02:14.469 modelOne
2019-01-29 21:02:14.486 Run: 138
2019-01-29 21:02:14.486 Reading Parameters
2019-01-29 21:02:14.487 Running Simulation
2019-01-29 21:02:14.487 Writing Output Tables
2019-01-29 21:02:14.567 Running Simulation
2019-01-29 21:02:14.567 Writing Output Tables
2019-01-29 21:02:14.622 Done.

```

Example 2:

Run RiskPaths model in `models/work` directory:

```
{
  "ModelName": "RiskPaths",
  "Dir": "models/work",
  "Opts": {
    "OpenM.Database": "Database=../bin/RiskPaths.sqlite;OpenMode=ReadWrite;Timeout=86400;"
  }
}
```

Oms web-service execute following commands:

```

cd models/work
./bin/RiskPaths -OpenM.RunStamp 2019_01_29_21_32_41_179 -OpenM.LogToConsole true -OpenM.Database Database=../bin/RiskPaths.sqlite;OpenMode=ReadWrite;Timeout=86400;

```

Example 3:

Run RiskPaths_mpi model executable on two nodes of small MPI cluster, 4 threads on each node, to calculate 16 sub-values:

```
{
  "ModelName": "RiskPaths",
  "Opts": {
    "OpenM.Threads": "4",
    "OpenM.SubValues": "16"
  },
  "MpI": {
    "Np": 2
  },
  "Template": "mpiSmallCluster.template.txt"
}
```

Oms web-service execute following commands:

```
mpirun -n 2 -wdir models/bin ./RiskPaths_mpi -OpenM.RunStamp 2019_01_29_21_32_10_577 -OpenM.LogToConsole true -OpenM.Threads 4 -OpenM.SubValues 1
6
```

Because `Mpi.Np = 2` model is executed on MPI cluster. If we do not specify template file name `mpiSmallCluster.template.txt` then by default `etc/mpiModelRun.template.txt` will be used.

Example 4:

Run OzProj model, which is required `OM_ROOT` environment variable:

```
{
  "ModelName": "OzProj",
  "RunStamp": "My-uniqueStamp-of-OzProj-run",
  "Env": {
    "OM_ROOT": "../../"
  },
  "Opts": {
    "OpenM.ProgressPercent": "25"
  }
}
```

Oms web-service execute following commands:

```
export OM_ROOT=../../
./OzProj -OpenM.RunStamp My-uniqueStamp-of-OzProj-run -OpenM.LogToConsole true -OpenM.ProgressPercent 25
```

Because `RunStamp` explicitly specified model console output log file name is: `OzProj.My-uniqueStamp-of-OzProj-run.console.log`. It is strongly recommended to use unique run stamps for each model run (modeling task run, if you running modeling task).

GET state of current model run

Get status of model run and view model console output.

This method allow get current model run and model stdout and stderr. It can be used to monitor modeling progress or it can be invoke later to see final model run status and console output.

This is a beta version and may change in the future.

Method:

```
GET /api/run/log/model/:model/stamp/:stamp  
GET /api/run/log/model/:model/stamp/:stamp/start/:start/count/:count  
GET /api/run-log?model=modelNameOrDigest&stamp=runStamp&start=0&count=0
```

Call examples:

```
http://localhost:4040/api/run/log/model/modelOne/stamp/2016_08_17_21_07_55_123  
http://localhost:4040/api/run/log/model/modelOne/stamp/My-own-run-uniqueStamp  
http://localhost:4040/api/run/log/model/modelOne/stamp/My-own-run-uniqueStamp/start/0  
http://localhost:4040/api/run/log/model/modelOne/stamp/My-own-run-uniqueStamp/start/0/count/100  
http://localhost:4040/api/run-log?model=modelOne&stamp=My-own-run-uniqueStamp&start=0&count=100
```

Arguments as URL parameters:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database than result is undefined.

```
:stamp - (required) model run stamp or modeling task run stamp
```

Model run identified by run stamp, which either explicitly specified as part of [request to run the model](#) call or automatically generated as timestamp string, ex: 2016_08_17_21_07_55_123. By default oms service store in memory history of 100 most recent model runs (it can be configured).

```
:start - (optional) start "page" line number from log output, zero-based.  
:count - (optional) "page" size, number of log text lines to view.
```

By default oms service selects 100 lines (it can be configured). If count <= 0 specified then all lines selected.

Example:

```
{  
  "modelName": "modelOne",  
  "modelDigest": "_201208171604590148_",  
  "runStamp": "2019_01_29_20_03_58_681",  
  "isFinal": true,  
  "updateDateTime": "2019-01-29 20:03:58.818",  
  "runName": "",  
  "taskRunName": "",  
  "offset": 0,  
  "size": 6,  
  "totalSize": 6,  
  "lines": [  
    "2019-01-29 20:03:58.694 modelOne",  
    "2019-01-29 20:03:58.712 Run: 135",  
    "2019-01-29 20:03:58.712 Reading Parameters",  
    "2019-01-29 20:03:58.713 Running Simulation",  
    "2019-01-29 20:03:58.713 Writing Output Tables",  
    "2019-01-29 20:03:58.809 Done."  
  ]  
}
```

IsFinal: if true then model run completed.

GET user views for the model

Get persistent views for the model from user home directory on the server.

This method only available:

- if server started in a single user mode
- if server configured to save a user data in home directory

This is a beta version and may change in the future.

Method:

```
GET /api/user/view/model/:model
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database then result is undefined.

Call examples from browser:

```
http://localhost:4040/api/user/view/model/modelOne  
http://localhost:4040/api/user/view/model/a5149e422b9df4a14be0a801ec195f19
```

Return example:

```
{
  "model": {
    "name": "modelOne",
    "parameterViews": [
      {
        "name": "ageSex",
        "view": {
          "rows": [],
          "cols": [
            {
              "name": "dim1",
              "values": ["M", "F"]
            },
            {
              "name": "dim0",
              "values": ["10-20", "20-30", "30-40", "40+"]
            }
          ],
          "others": [],
          "isRowColControls": true,
          "rowColMode": 2
        }
      },
      {
        "name": "salaryAge",
        "view": {
          "rows": [
            {
              "name": "dim0",
              "values": ["L", "M", "H"]
            },
            {
              "name": "dim1",
              "values": ["10-20", "20-30", "30-40", "40+"]
            }
          ],
          "cols": [],
          "others": [],
          "isRowColControls": true,
          "rowColMode": 1
        }
      }
    ]
  }
}
```

PUT user views for the model

Create new or replace existing persistent views for the model as JSON file at user home directory on the server.

This method only available:

- if server started in a single user mode
- if server configured to save a user data in home directory

It does update existing or save new JSON file with persistent model views in user home directory on the server.

This is a beta version and may change in the future.

Method:

```
PUT /api/user/view/model/:model
```

For example:

```
curl -v -X PUT -H "Content-Type: application/json" "http://localhost:4040/api/user/view/model/modelOne" -d @modelOne.view.json
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database then result is undefined.

JSON argument:

It is expected to be similar JSON return of [GET user views for the model](#) method.

For example (modelOne.view.json file):

```
{
  "model": {
    "name": "modelOne",
    "parameterViews": [
      {
        "name": "ageSex",
        "view": {
          "rows": [],
          "cols": [
            {
              "name": "dim1",
              "values": ["M", "F"]
            },
            {
              "name": "dim0",
              "values": ["10-20", "20-30", "30-40", "40+"]
            }
          ],
          "others": [],
          "isRowColControls": true,
          "rowColMode": 2
        }
      },
      {
        "name": "salaryAge",
        "view": {
          "rows": [
            {
              "name": "dim0",
              "values": ["L", "M", "H"]
            },
            {
              "name": "dim1",
              "values": ["10-20", "20-30", "30-40", "40+"]
            }
          ],
          "cols": [],
          "others": [],
          "isRowColControls": true,
          "rowColMode": 1
        }
      }
    ]
  }
}
```

Example:

```
curl -v -X PUT -H "Content-Type: application/json" "http://localhost:4040/api/user/view/model/modelOne" -d @modelOne.view.json

*   Trying ::1...
* TCP_NODELAY set
*   Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 4040 (#0)
> PUT /api/user/view/model/modelOne HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.55.1
> Accept: */*
> Content-Type: application/json
> Content-Length: 826
>
* upload completely sent off: 826 out of 826 bytes
< HTTP/1.1 200 OK
< Date: Tue, 20 Apr 2021 01:38:36 GMT
< Content-Length: 0
<
* Connection #0 to host localhost left intact
```

DELETE user views for the model

Delete persistent views for the model from user home directory on the server.

This method only available:

- if server started in a single user mode
- if server configured to save a user data in home directory

It does delete persistent user views JSON file from user home directory on the server. If such file does not exist then method does nothing and return success.

This is a beta version and may change in the future.

Method:

```
DELETE /api/user/view/model/:model
```

For example:

```
curl -v -X DELETE http://localhost:4040/api/user/view/model/modelOne
```

Arguments:

```
:model - (required) model digest or model name
```

Model can be identified by digest or by model name. It is recommended to use digest because it is uniquely identifies model. It is possible to use model name, which is more human readable than digest, but if there are multiple models with same name in database then result is undefined.

Example:

```
curl -v -X DELETE http://localhost:4040/api/user/view/model/modelOne
*   Trying ::1...
* TCP_NODELAY set
*   Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 4040 (#0)
> DELETE /api/user/view/model/modelOne HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.55.1
> Accept: */*
>
< HTTP/1.1 200 OK
< Content-Location: /api/user/view/model/modelOne
< Content-Type: text/plain
< Date: Tue, 20 Apr 2021 01:41:22 GMT
< Content-Length: 0
<
* Connection #0 to host localhost left intact
```

GET web-service configuration

GET web-service configuration.

This method return web-service configuration and environment variables which names started from `OM_CFG_` prefix.

This is a beta version and may change in the future.

Method:

```
GET /api/service/config
```

Call examples:

```
http://localhost:4040/api/service/config
```

Example:

```
{
  "RootDir": "",
  "RowPageMaxSize": 100,
  "RunHistoryMaxSize": 100,
  "DoubleFmt": "%.15g",
  "LoginUrl": "",
  "LogoutUrl": "",
  "Env": {
    "OM_CFG_LOGIN_URL": "/login_required.html",
    "OM_CFG_LOGOUT_URL": "/login?logout=true"
  },
  "ModelCatalog": {
    "ModelDir": "models/bin",
    "ModelLogDir": "models/log",
    "IsLogDirEnabled": true,
    "LastTimeStamp": ""
  },
  "RunCatalog": {
    "RunTemplates": [
      "run.Win32.Debug.template.txt",
      "run.x64.Debug.template.txt",
      "run.x64.Release.template.txt"
    ],
    "DefaultMpiTemplate": "mpi.ModelRun.template.txt",
    "MpiTemplates": [
      "mpi.ModelRun.template.txt"
    ]
  }
}
```

GET web-service state

GET web-service state.

This method return web-service state, including model run state.

This method is under construction and temporary unavailable

This is a beta version and may change in the future.

Method:

```
GET /api/service/state
```

Call examples:

```
http://localhost:4040/api/service/state
```

Example:

```
work in progress, temporary unavailable
```

POST a request to refresh models catalog

On start oms web-service scan models directory tree (by default it `models/bin` directory and sub-directories) to collect all models metadata from *.sqlite database files. If we want to add, remove or overwrite model.sqlite database file(s) then it is necessary:

- close model.sqlite file(s) by [POST a request to close models catalog](#)
- refresh list of models by [POST a request to refresh models catalog](#)

This is a beta version and may change in the future.

Method:

```
POST /api/admin/all-models/refresh
```

For example:

```
curl -v -X POST http://localhost:4040/api/admin/all-models/refresh

*   Trying ::1...
* TCP_NODELAY set
*   Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 4040 (#0)
> POST /api/admin/all-models/refresh HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.54.1
> Accept: */*
>
< HTTP/1.1 200 OK
< Content-Location: /api/admin/all-models/refresh/models/bin
< Date: Tue, 18 March 2019 01:02:27 GMT
< Content-Length: 0
<
* Connection #0 to host localhost left intact
```

POST a request to close models catalog

On start oms web-service scan models directory tree (by default it `models/bin` directory and sub-directories) to collect all models metadata from *.sqlite database files. If we want to add, remove or overwrite model.sqlite database file(s) then it is necessary:

- close model.sqlite file(s) by [POST a request to close models catalog](#)
- refresh list of models by [POST a request to refresh models catalog](#)

This is a beta version and may change in the future.

Method:

```
POST /api/admin/all-models/close
```

For example:

```
curl -v -X POST http://localhost:4040/api/admin/all-models/close

*   Trying ::1...
* TCP_NODELAY set
*   Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 4040 (#0)
> POST /api/admin/all-models/close HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.54.1
> Accept: */*
>
< HTTP/1.1 200 OK
< Content-Location: /api/admin/all-models/close/models/bin
< Date: Tue, 18 March 2019 01:00:56 GMT
< Content-Length: 0
<
* Connection #0 to host localhost left intact
```

PUT a request to shutdown web-service

PUT a request to shutdown web-service.

This method shutdown web-service. It is expected to close connection and does not return any response, as result client (ex.: browser AJAX) would return an error.

This is a beta version and may change in the future.

Method:

```
PUT /api/admin/shutdown
```

Example:

```
curl -v -X PUT http://localhost:4040/api/admin/shutdown
*   Trying ::1...
* TCP_NODELAY set
*   Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 4040 (#0)
> PUT /api/admin/shutdown HTTP/1.1
> Host: localhost:4040
> User-Agent: curl/7.55.1
> Accept: */*
>
< HTTP/1.1 200 OK
< Date: Tue, 14 Apr 2020 01:33:18 GMT
< Content-Length: 18
< Content-Type: text/plain; charset=utf-8
< Connection: close
<
Shutdown completed* Closing connection 0
```