

# Package ‘Strategus’

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**Type** Package

**Title** Coordinating and Executing Analytics Using HADES Modules

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**Description** An R package for coordinating and executing analytics using HADES modules.

**License** Apache License 2.0

**URL** <https://ohdsi.github.io/Strategus>, <https://github.com/OHDSI/Strategus>

**BugReports** <https://github.com/OHDSI/Strategus/issues>

**Depends** R (>= 4.2.0),  
CohortGenerator (>= 0.8.0),  
DatabaseConnector (>= 6.2.3)

**Imports** targets,  
renv (>= 1.0.0),  
ParallelLogger (>= 3.1.0),  
dplyr,  
checkmate,  
keyring,  
rlang,  
utils,  
R.utils,  
digest,  
methods,  
tibble,  
ResultModelManager (>= 0.3.0),  
SqlRender (>= 1.11.0),  
semver,  
htr2,  
jsonlite

**Suggests** testthat (>= 3.0.0),  
fs,  
knitr,  
rmarkdown,  
Eunomia,  
withr

**Remotes** ohdsi/CohortGenerator,  
ohdsi/ResultModelManager,  
ohdsi/Eunomia

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---

addModuleSpecifications

*Add module specifications to analysis specifications*

---

### Description

Add module specifications to analysis specifications

### Usage

```
addModuleSpecifications(analysisSpecifications, moduleSpecifications)
```

**Arguments**

analysisSpecifications

An object of type AnalysisSpecifications as created by [createEmptyAnalysisSpecifications](#)

moduleSpecifications

An object of type ModuleSpecifications.

**Value**

Returns the analysisSpecifications object with the module specifications added.

---

 addSharedResources     *Add shared resources to analysis specifications*


---

**Description**

Add shared resources to analysis specifications

**Usage**

addSharedResources(analysisSpecifications, sharedResources)

**Arguments**

analysisSpecifications

An object of type AnalysisSpecifications as created by [createEmptyAnalysisSpecifications](#)

sharedResources

An object of type SharedResources.

**Value**

Returns the analysisSpecifications object with the module specifications added.

---

 compareLockFiles     *Compare two renv.lock files*


---

**Description**

Used to compare renv.lock files and return the results in a data.frame. The return value will include a "full join" representation of the packages across the two lock files.

**Usage**

compareLockFiles(filename1, filename2)

**Arguments**

filename1     The first renv.lock file name

filename2     The second renv.lock file name

**Value**

A data.frame with the comparison of the rev.lock files

---

```
createCdmExecutionSettings
    Create CDM execution settings
```

---

### Description

Create CDM execution settings

### Usage

```
createCdmExecutionSettings(
    connectionDetailsReference,
    workDatabaseSchema,
    cdmDatabaseSchema,
    cohortTableNames = CohortGenerator::getCohortTableNames(cohortTable = "cohort"),
    tempEmulationSchema = getOption("sqlRenderTempEmulationSchema"),
    workFolder,
    resultsFolder,
    logFileName = file.path(resultsFolder, "strategus-log.txt"),
    minCellCount = 5,
    integerAsNumeric = getOption("databaseConnectorIntegerAsNumeric", default = TRUE),
    integer64AsNumeric = getOption("databaseConnectorInteger64AsNumeric", default = TRUE),
    resultsConnectionDetailsReference = NULL,
    resultsDatabaseSchema = NULL
)
```

### Arguments

connectionDetailsReference

A string that can be used to retrieve database connection details from a secure local store.

workDatabaseSchema

A database schema where intermediate data can be stored. The user (as identified in the connection details) will need to have write access to this database schema.

cdmDatabaseSchema

The database schema containing the data in CDM format. The user (as identified in the connection details) will need to have read access to this database schema.

cohortTableNames

An object identifying the various cohort table names that will be created in the workDatabaseSchema. This object can be created using the [CohortGenerator::getCohortTableNames](#) function.

tempEmulationSchema

Some database platforms like Oracle and Impala do not truly support temp tables. To emulate temp tables, provide a schema with write privileges where temp tables can be created.

workFolder

A folder in the local file system where intermediate results can be written.

resultsFolder

A folder in the local file system where the module output will be written.

logFileName

Logging information from Strategus and all modules will be located in this file. Individual modules will continue to have their own module-specific logs. By default this will be written to the root of the resultsFolder

minCellCount	The minimum number of subjects contributing to a count before it can be included in results.
integerAsNumeric	Logical: should 32-bit integers be converted to numeric (double) values? If FALSE 32-bit integers will be represented using R's native Integer class. Default is TRUE
integer64AsNumeric	Logical: should 64-bit integers be converted to numeric (double) values? If FALSE 64-bit integers will be represented using bit64::integer64. Default is TRUE
resultsConnectionDetailsReference	A string that can be used to retrieve the results database connection details from a secure local store.
resultsDatabaseSchema	A schema where the results tables are stored

**Value**

An object of type ExecutionSettings.

---

```
createEmptyAnalysisSpecifications
```

*Create an empty analysis specifications object.*

---

**Description**

Create an empty analysis specifications object.

**Usage**

```
createEmptyAnalysisSpecifications()
```

**Value**

An object of type AnalysisSpecifications.

---

```
createResultDataModels
```

*Create Result Data Models*

---

**Description**

Use this at the study design stage to create data models for modules This functions loads modules and executes any custom code to create schemas in a results database If recreate is set to TRUE all existing data will be removed, otherwise

**Usage**

```

createResultDataModels(
  analysisSpecifications,
  executionSettings,
  executionScriptFolder = NULL,
  keyringName = NULL,
  restart = FALSE,
  enforceModuleDependencies = TRUE
)

```

**Arguments**

analysisSpecifications	An object of type AnalysisSpecifications as created by <a href="#">createEmptyAnalysisSpecifications()</a>
executionSettings	An object of type ExecutionSettings as created by <a href="#">createCdmExecutionSettings()</a> or <a href="#">createResultsExecutionSettings()</a> .
executionScriptFolder	Optional: the path to use for storing the execution script. when NULL, this function will use a temporary file location to create the script to execute.
keyringName	The name of the keyring to operate on. This function assumes you have created the keyring before calling this function. It defaults to NULL to select the default keyring. If the keyring is password protected, the password must be stored in the environment variable STRATEGUS_KEYRING_PASSWORD so it is retrieved using the command Sys.getenv("STRATEGUS_KEYRING_PASSWORD")
restart	Restart run? Requires executionScriptFolder to be specified, and be the same as the executionScriptFolder used in the run to restart.
enforceModuleDependencies	When set to TRUE, Strategus will enforce module dependencies that are declared by each module. For example, the CohortDiagnostics module declares a dependency on the CohortGenerator module and Strategus will require that an analysis specification declare that both modules must exist in order to execute the analysis. When set to FALSE, Strategus will not enforce these module dependencies which assumes you have properly run all module dependencies yourself. Setting this to FALSE is not recommended since it is potentially unsafe.

---

```
createResultsExecutionSettings
```

*Create Results execution settings*

---

**Description**

Create Results execution settings

**Usage**

```
createResultsExecutionSettings(
  resultsConnectionDetailsReference,
  resultsDatabaseSchema,
  workFolder,
  resultsFolder,
  logFileName = file.path(resultsFolder, "strategus-log.txt"),
  minCellCount = 5,
  integerAsNumeric = getOption("databaseConnectorIntegerAsNumeric", default = TRUE),
  integer64AsNumeric = getOption("databaseConnectorInteger64AsNumeric", default = TRUE)
)
```

**Arguments**

resultsConnectionDetailsReference	A string that can be used to retrieve the results database connection details from a secure local store.
resultsDatabaseSchema	A schema where the results tables are stored
workFolder	A folder in the local file system where intermediate results can be written.
resultsFolder	A folder in the local file system where the module output will be written.
logFileName	Logging information from Strategus and all modules will be located in this file. Individual modules will continue to have their own module-specific logs. By default this will be written to the root of the resultsFolder
minCellCount	The minimum number of subjects contributing to a count before it can be included in results.
integerAsNumeric	Logical: should 32-bit integers be converted to numeric (double) values? If FALSE 32-bit integers will be represented using R's native Integer class. Default is TRUE
integer64AsNumeric	Logical: should 64-bit integers be converted to numeric (double) values? If FALSE 64-bit integers will be represented using bit64::integer64. Default is TRUE

**Value**

An object of type ExecutionSettings.

---

ensureAllModulesInstantiated

*Ensure all modules are instantiated*

---

**Description**

Ensure that all modules referenced in the analysis specifications are instantiated locally in the folder specified in the INSTANTIATED\_MODULES\_FOLDER environmental variable.

Missing modules will be fetched from remote repositories.

This function will also check whether there are different versions of the same module specified, which is not allowed, and whether all modules required by the specified modules are also instantiated.

**Usage**

```
ensureAllModulesInstantiated(
  analysisSpecifications,
  forceVerification = FALSE,
  enforceModuleDependencies = TRUE
)
```

**Arguments**

`analysisSpecifications`

An object of type `AnalysisSpecifications` as created by `createEmptyAnalysisSpecifications`.

`forceVerification`

When set to `TRUE`, the verification process is forced to re-evaluate if a module is properly installed. The default is `FALSE` since if a module is successfully validated, the module will contain the hash value of the module's `renv.lock` file in the file system so it can by-pass running this check every time.

`enforceModuleDependencies`

When set to `TRUE`, Strategus will enforce module dependencies that are declared by each module. For example, the `CohortDiagnostics` module declares a dependency on the `CohortGenerator` module and Strategus will require that an analysis specification declare that both modules must exist in order to execute the analysis. When set to `FALSE`, Strategus will not enforce these module dependencies which assumes you have properly run all module dependencies yourself. Setting this to `FALSE` is not recommended since it is potentially unsafe.

**Value**

A list containing the install status of all modules (`TRUE` if all are installed properly) and a tibble listing the instantiated modules.

---

execute

*Execute analysis specifications.*

---

**Description**

Execute analysis specifications.

**Usage**

```
execute(
  analysisSpecifications,
  executionSettings,
  executionScriptFolder = NULL,
  keyringName = NULL,
  restart = FALSE,
  enforceModuleDependencies = TRUE
)
```

**Arguments**

analysisSpecifications	An object of type AnalysisSpecifications as created by <a href="#">createEmptyAnalysisSpecifications()</a>
executionSettings	An object of type ExecutionSettings as created by <a href="#">createCdmExecutionSettings()</a> or <a href="#">createResultsExecutionSettings()</a> .
executionScriptFolder	Optional: the path to use for storing the execution script. when NULL, this function will use a temporary file location to create the script to execute.
keyringName	The name of the keyring to operate on. This function assumes you have created the keyring before calling this function. It defaults to NULL to select the default keyring. If the keyring is password protected, the password must be stored in the environment variable STRATEGUS_KEYRING_PASSWORD so it is retrieved using the command Sys.getenv("STRATEGUS_KEYRING_PASSWORD")
restart	Restart run? Requires executionScriptFolder to be specified, and be the same as the executionScriptFolder used in the run to restart.
enforceModuleDependencies	When set to TRUE, Strategus will enforce module dependencies that are declared by each module. For example, the CohortDiagnostics module declares a dependency on the CohortGenerator module and Strategus will require that an analysis specification declare that both modules must exist in order to execute the analysis. When set to FALSE, Strategus will not enforce these module dependencies which assumes you have properly run all module dependencies yourself. Setting this to FALSE is not recommended since it is potentially unsafe.

**Value**

Does not return anything. Is called for the side-effect of executing the specified analyses.

---

getModuleList	<i>Provides a list of HADES modules to run through Strategus</i>
---------------	--

---

**Description**

This function provides a list of modules and their locations that may be used with Strategus.

**Usage**

```
getModuleList()
```

**Value**

A data.frame() of modules that work with Strategus. This will contain: module = The name of the module version = The version of the module remote\_repo = The remote location of the module (i.e. github.com) remote\_username = The organization of the module (i.e. OHDSI) module\_type = 'cdm' or 'results'. 'cdm' refers to modules that are designed to work against patient level data in the OMOP CDM format. 'results' refers to modules that are designed to work against a results database containing output from a 'cdm' module.

---

`installLatestModule`     *Install the latest release of a module*

---

### Description

This function will call out to the OHDSI GitHub repo to find the latest version of the module and attempt to install it. Only modules that are listed in the `getModuleList()` function are allowed since it will have a known GitHub location.

### Usage

```
installLatestModule(moduleName)
```

### Arguments

<code>moduleName</code>	The name of the module to install (i.e. "CohortGeneratorModule"). This parameter must match a value found in the <code>module</code> column of <code>getModuleList()</code>
-------------------------	---

### Value

None - this function is called for its side effects

---

`retrieveConnectionDetails`  
*Retrieve connection details from the secure location*

---

### Description

Retrieve connection details from the secure location

### Usage

```
retrieveConnectionDetails(connectionDetailsReference, keyringName = NULL)
```

### Arguments

<code>connectionDetailsReference</code>	A string that can be used to retrieve the settings from the secure store.
<code>keyringName</code>	The name of the keyring to operate on. This function assumes you have created the keyring before calling this function. It defaults to <code>NULL</code> to select the default keyring. If the keyring is password protected, the password must be stored in the environment variable <code>STRATEGUS_KEYRING_PASSWORD</code> so it is retrieved using the command <code>Sys.getenv("STRATEGUS_KEYRING_PASSWORD")</code>

### Value

Returns an object of type `connectionDetails`.

### See Also

[storeConnectionDetails\(\)](#)

---

runSchemaCreation	<i>Create module(s) result data model</i>
-------------------	---

---

### Description

This function will create the results data model for the modules in the analysisSpecifications. A module can implement its own results data model creation function by implementing the function createDataModelSchema in its Main.R. The default behavior is to use the ResultsModelManager to create the results data model based on the resultsDataModelSpecification.csv in the module's results folder.

### Usage

```
runSchemaCreation(
  analysisSpecifications,
  keyringSettings,
  moduleIndex,
  executionSettings,
  ...
)
```

### Arguments

analysisSpecifications	An object of type AnalysisSpecifications as created by <a href="#">createEmptyAnalysisSpecifications()</a>
keyringSettings	The keyringSettings from the executionSettings context
moduleIndex	The index of the module in the analysis specification
executionSettings	An object of type ExecutionSettings as created by <a href="#">createCdmExecutionSettings()</a> or <a href="#">createResultsExecutionSettings()</a> .
...	For future expansion

---

storeConnectionDetails	<i>Store connection details in a secure location</i>
------------------------	--

---

### Description

Store connection details in a secure location

### Usage

```
storeConnectionDetails(
  connectionDetails,
  connectionDetailsReference,
  keyringName = NULL
)
```

**Arguments**

connectionDetails

An object of type connectionDetails as created by the `DatabaseConnector::createConnectionDetails()` function.

connectionDetailsReference

A string that can be used to retrieve the settings from the secure store.

keyringName

The name of the keyring to operate on. This function assumes you have created the keyring before calling this function. It defaults to NULL to select the default keyring. If the keyring is password protected, the password must be stored in the environment variable STRATEGUS\_KEYRING\_PASSWORD so it is retrieved using the command `Sys.getenv("STRATEGUS_KEYRING_PASSWORD")`

**Value**

Does not return anything. Is called for the side effect of having the connection details stored.

**See Also**

[retrieveConnectionDetails\(\)](#)

---

syncLockFile	<i>Synchronize renv.lock files and overwrite the target file (read the description)</i>
--------------	---

---

**Description**

Used to synchronize the values from the "source of truth" renv.lock file to the target renv.lock file. Packages are compared (by name) and if the version of the package in the "source of truth" is greater than the one found in the target, the target renv.lock file will be updated. This function will automatically update the target file.

Version comparison is handled by the `semver` package and since most packages use semantic versioning. When a package does not use semantic versioning, a warning is provided so the user can review.

**Usage**

```
syncLockFile(sourceOfTruthLockFileName, targetLockFileName)
```

**Arguments**

sourceOfTruthLockFileName

The renv.lock file to use as the source of truth

targetLockFileName

The target renv.lock file that will be synced with the source of truth

**Value**

A data.frame containing the different packages and their version that were involved in the synchronization process

---

unlockKeyring	<i>Helper function to unlock a keyring</i>
---------------	--

---

**Description**

This helper function is used to unlock a keyring by using the password stored in `Sys.getenv("STRATEGUS_KEYRING_PASSWORD")`. It will alert the user if the environment variable with the password is not set.

**Usage**

```
unlockKeyring(keyringName)
```

**Arguments**

keyringName	The name of the keyring to operate on. This function assumes you have created the keyring before calling this function. It defaults to NULL to select the default keyring. If the keyring is password protected, the password must be stored in the environment variable <code>STRATEGUS_KEYRING_PASSWORD</code> so it is retrieved using the command <code>Sys.getenv("STRATEGUS_KEYRING_PASSWORD")</code>
-------------	---

**Value**

Returns TRUE if the keyring was unlocked using the password otherwise it returns FALSE

---

validateLockFile	<i>Validate an renv.lock file to ensure it is ready for use by Strategus</i>
------------------	--

---

**Description**

Will check an `renv.lock` file for a module to verify that it only references tagged packages and includes the packages required by Strategus. It will also check for suggested packages that are useful for testing, such as RSQLite.

**Usage**

```
validateLockFile(filename)
```

**Arguments**

filename	The <code>renv.lock</code> file to validate
----------	---

---

`verifyModuleInstallation`*Verify a module is properly installed*

---

### Description

In some instances a module may fail to instantiate and install due to problems when calling `renv::restore` for the module's `renv.lock` file. This function will allow you to surface inconsistencies between the module `renv.lock` file and the module's `renv` project library. This function will check to that a module has been properly installed using internal functions of the `renv` package. If a module is verified to work via this function, the hash of the module's `renv.lock` file will be written to a text file in the module directory to indicate that it is ready for use. This will allow subsequent calls to work faster since the initial verification process can take some time. It is possible to re-run the verification of a module by using the `forceVerification` parameter.

To fix issues with a module, you will need to open the module's `.Rproj` in RStudio instance and debug the issues when calling `renv::restore()`.

### Usage

```
verifyModuleInstallation(  
  module,  
  version,  
  silent = FALSE,  
  forceVerification = FALSE  
)
```

### Arguments

<code>module</code>	The name of the module to verify (i.e. "CohortGeneratorModule")
<code>version</code>	The version of the module to verify (i.e. "0.2.1")
<code>silent</code>	When TRUE output of this verification process is suppressed
<code>forceVerification</code>	When set to TRUE, the verification process is forced to re-evaluate if a module is properly installed. The default is FALSE since if a module is successfully validated, the module will contain the hash value of the module's <code>renv.lock</code> file in the file system so it can by-pass running this check every time.

### Value

A list with the output of the consistency check

---

withModuleRenv	<i>Load module execution space inside and renv inspired by targets::tar_script but allowing custom variable execution</i>
----------------	---

---

### Description

Designed to allow more human readable code that is executed inside a module as well as simple variable substitution for injecting constants (e.g. simple parameters or file paths used inside and outside of modules)

### Usage

```
withModuleRenv(
  code,
  moduleFolder,
  injectVars = list(),
  tempScriptFile = tempfile(fileext = ".R"),
  job = FALSE,
  processName = paste(moduleFolder, "_renv_run")
)
```

### Arguments

code	code block to execute
moduleFolder	Instantiated Strategus module folder
injectVars	list of var names list(name=value) to replace (e.g. replace list(foo = "some string") will find the pattern foo and replace it with the string some string - be careful!
tempScriptFile	tempFile to write script to
job	run as rstudio job
processName	String name for process

### Details

This pattern also allows dependency injection which could be used if you don't want to use and renv and (instead) would like to use docker images or just execution in the base environment for testing/debugging

### Value

NULL invisibly

---

zipResults	<i>Create a zip file with all study results for sharing with study coordinator</i>
------------	--

---

**Description**

Create a zip file with all study results for sharing with study coordinator

**Usage**

```
zipResults(resultsFolder, zipFile)
```

**Arguments**

resultsFolder	The folder holding the study results. This is found in <code>executionSettings\$resultsFolder</code> .
zipFile	The path to the zip file to be created.

**Details**

Creates a .zip file of the .csv files found in the resultsFolder. The resulting .zip file will have relative paths to the root of the resultsFolder which is generally found in `executionSettings$resultsFolder`.

**Value**

Does not return anything. Is called for the side-effect of creating the zip file with results.

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