

CHRISTIAN-ALBRECHTS-UNIVERSITÄT ZU KIEL

Bachelor Project

# **Configurations and Automated Execution in the KIELER Execution Manager**

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# Abbreviations

**API** Application Programming Interface

**GUI** Graphical User Interface

**IDE** Integrated Development Environment

**KIEL** Kiel Integrated Environment for Layout

**KIELER** Kiel Integrated Environment for Layout Eclipse Rich Client

**KIEM** Kiel Integrated Environment for Layout Eclipse Rich Client (KIELER)  
Execution Manager

**KIEMAuto** Automated Executions for the KIELER Execution Manager (KIEM)

**KIEMConfig** Configurations for the KIEM

**UI** User Interface

## *List of Figures*

# 1 Introduction

## 1.1 KIELER Framework

- layouter, structure based editing
- synccharts
- simulator
- execution manager

## 1.2 The KIELER Execution Manager

Execution Manager is used in KIELER as a framework to plug-in DataComponents for various tasks. Examples are:

- Simulation Engines
- Model Visualizers
- Environment Visualizers
- Validators
- User Input Facilities
- Trace Recording Facilities

These DataComponents can be executed using a graphical user interface (GUI). The scheduling order can also be defined by this GUI as well as other settings like a step/tick duration and properties of DataComponents. For information about KIEM see the wiki<sup>1</sup>.

## 1.3 Outline of this Document

The first part of this document is about the implementation of the Configuration plugin for the KIEM. The second part discusses the implementation of the Automated Execution plugin for the KIEM. Both parts will have the same structure described below. Each part starts with a detailed outline of the problems that are to be solved

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<sup>1</sup><http://rtsys.informatik.uni-kiel.de/trac/kieler/wiki/Projects/KIEM>

## *1 Introduction*

by this thesis. The next section introduces technologies used to solve the problem. After that there will be a section about the concepts of how to solve the problem and some design decisions that were made at a very early stage in the development. Sections 5 and 6 are about the actual implementation with section 5 outlining the changes that were made to the KIEM plug-in itself and section 6 describing the newly created Configurations for the KIEM (KIEMConfig) plug-in. The final section of each part will summarize the results of the thesis and outline a few projects that could be based on it.

# Part I

## Configuration Management



## 2 Used technologies

- before explaining solutions
  - short explanation about the technology in question
  - small sketch to get an idea of the context
  - full explanation goes beyond the scope of this work

### 2.1 Eclipse

- KIELER part of Eclipse framework
  - Java IDE but also lots of other languages (C++, Latex, ...)
  - can build other IDEs with it
  - citation: IDE an for anything, and nothing in particular [2]

#### 2.1.1 Plug-ins

- KIEM itself is a plug-in, this work plug-in dependent on KIEM
  - different components of an Integrated Development Environment (IDE)
  - can operate by themselves or depending on other plug-ins
  - in addition to Application Programming Interface (API) of each plug-in: extension point mechanism
    - extension points to interact with other plug-ins
    - extension point mechanism used by runtime environment to check which plug-ins to load
    - plug-ins can be used to plug into the standard Eclipse feature

#### Extension point mechanism

##### 2.1.2 Preference Pages

- One of the plug-ins used in this work in that fashion is the *org.eclipse.ui.preferencePage* plug-in. It is used to create new preference pages at a specific location inside the normal tree of preference pages accessible through Window>Preferences. The programmer only has to take care of the contents of the actual page and not worry about additional buttons or integrating it into the PreferenceDialog.

#### Preference Store

- Closely coupled with the preference pages is the Eclipse preference store. It is basically a text file for each plug-in where the plug-in can deposit simple Strings

## 2 *Used technologies*

under a given key to ensure that information is kept between execution runs.

For additional information about eclipse see the official Eclipse website<sup>1</sup> or literature [3]

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<sup>1</sup>[www.eclipse.org](http://www.eclipse.org)



## 3 Problem Statement

The objective of this project is to improve the configurability of the Execution Manager as outlined in the diploma-thesis by Christian Motika[1] :

KIEM currently does not have a preference page to save additional settings like DataComponent timeouts. Also execution schedulings might be similar for a common diagram type.

It may improve the usability further to allow the user to customize execution schedulings for specific diagram types. An interface for these kind of settings could be realized as an Eclipse preference page.

This will be explained in more detail in the following sections.

### 3.1 Configurations

Currently every property in the KIEM has a hard coded default value. There is a text box for setting the aimed step duration for the currently loaded execution file but that value is lost once a new execution is loaded. To solve this problem an extension to the KIEM should attempt to provide the following:

1. Find a way that execution files can store values like the aimed step duration and the timeout. This mechanism should be implemented in a way that ensures that old files can be upgraded and new files are still valid in instances of the KIEM that don't use the configuration plug-in.
2. Find a way to load the configurations into the different parts of the KIEM as soon as an execution file is loaded from the file system.
3. Ensure that the user can edit all properties and maybe even create his own custom properties. This should be implemented in a way that doesn't clutter up the current user interface too much.

#### 3.1.1 Default Configuration

The different properties stored in each execution file might sometimes not suit the users current needs and he might want to use a default value for some properties without having to manually set them in each new configuration. The solution could be implemented using the preference mechanism provided by Eclipse.

### 3 Problem Statement

1. There should be a way to set the default properties for all Execution Manager properties and possibly for user defined properties as well.
2. It should be possible for the user to set up which of these properties should override the value stored in the execution file and which should only be used if the execution file doesn't contain one.

## 3.2 Easier configuration loading

The last objective of this thesis is to make it easier to load execution files. Currently all execution files are stored in the workspace at a place of the users choice. In a very large workspace it can be very hard to find the execution file that you need for your current simulation. The list of recently used documents that Eclipse provides is of little use since all opened documents are placed there not just execution files. This problem leads to the in the following tasks:

1. Finding a way to track recently used execution files and make it easier for the user to load them without the need to locate them inside his workspace.
2. In addition to tracking recently used execution files the user might want to have a way to get a list of execution files that work for the currently active editor. This list should be sorted with the most likely candidates at the top to allow less experienced users to select an execution file that will most likely work.

## 4 Concepts

The solution to the problems outlined in chapter 3 can be achieved with the help of the Eclipse plug-in technology described in chapter 2.

### 4.1 Configurations

The first approach to save additional configuration information in the execution files would be to actually modify the format of those files and write the information into them. This would most likely be the easiest approach but would destroy backward compatibility of those files since the basic KIEM would not know how to deal with the modified files.

The approach taken in this thesis is based on the list of DataComponents. Each execution file carries a list of its own DataComponents and their properties to ensure that the component are properly initialized the next time the execution is loaded. That list can be loaded even if there are DataComponents contained in it that are not present in the current runtime configuration. The KIEM will show a warning indicating that it doesn't know the given component but proceed to load the rest of the execution.

These DataComponents basically just carry a list of KiemProperties which are basically (key, value) pairs. Hence, they are suited well for storing simple information like the value of a text field.

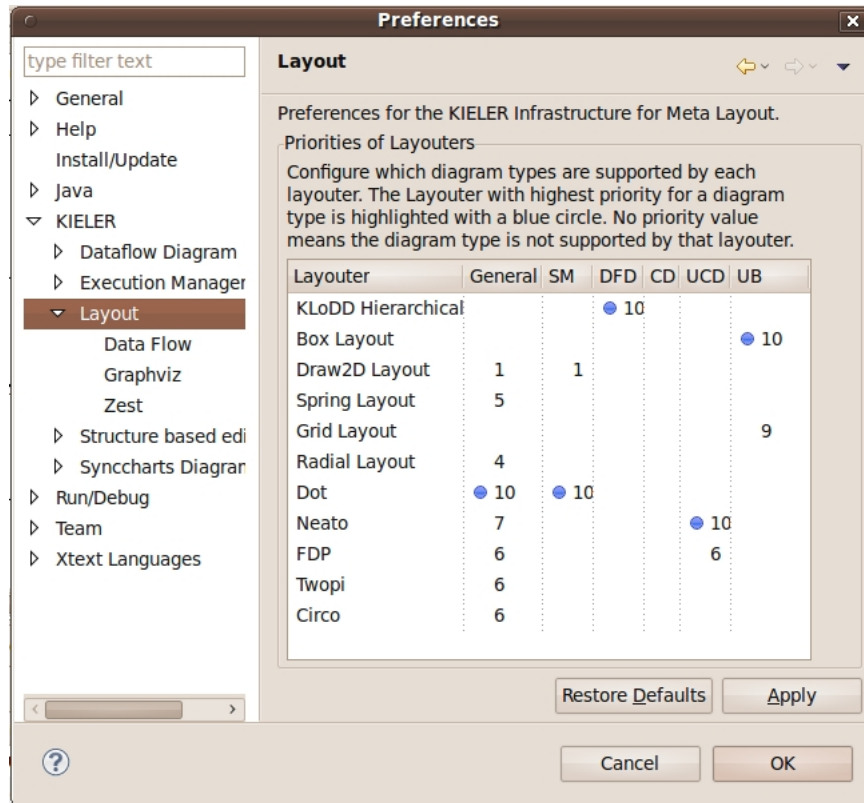
To solve the problem a new type of DataComponent will have to be constructed and registered through the extension point in the KIEM. This ensures that the component can be added to any execution file. The KIEM ensures that all properties contained in our component will be saved with the execution file and loaded the next time the file is opened. After that the configuration plug-in has find the component inside the DataComponent list, get the properties saved inside it and set them inside the KIEM.

#### 4.1.1 Default Configuration

In order to provide a place to manage the default configurations we will be using the Eclipse preference pages.

The root page for the KIEM should contain the basic KIEM properties like the aimed step duration, timeout and the view elements of the Configuration plug-in.

Then we will construct another page for managing the different schedules and their editors. For that we will adapt the LayoutPreferencePage by Miro Spönemann as

Figure 4.1: Layout Preference Page by Miro Spönemann<sup>1</sup>

seen in Figure 4.1 where we will just replace the layouts with the list of registered schedules.

For the purpose of sorting the schedules that match the currently opened editor they will need to have user defined priorities which can be easily set up with the table shown above.

The last page will be used to allow the user to set up his own properties and give them default values.

The values entered in those pages will be stored inside the Eclipse Preference Store.

## 4.2 Easier Configuration loading

For easier configuration loading we will add two ComboBoxes to the existing tool bar inside the KIEM view.

One of them will display the list of recently used schedules the other one the list of schedules that work for the currently active editor.

As soon as the user opens a new execution file through the normal workspace view we will be notified of that event by the KIEM. We will then create a new schedule

and store the path to the execution file in it along with the editor that was opened at the time that the schedule was created. The new schedule will also be added to the list of recently used schedules that we maintain through the use of the Eclipse preference store.

When the user selects one of the previously saved schedules in one of the ComboBoxes we will retrieve the saved path and offer it to the KiemPlugin to load it in the hopes that the execution file is still in the same location and wasn't deleted, renamed or moved by the user.



## 5 Code changes in the Execution Manager

Although the project attempts to realize most of the objectives without changing the KIEM itself minimal adaptations were necessary. This mostly involves adding new methods to the API in order to gain access to previously hidden properties.

Also some changes had to be performed where properties were loaded from hard-coded default values. These were refined and will now only be used if the KIEMConfig plug-in is not registered to supply previously saved properties.

However all changes that were made to the KIEM plug-in were merely additions and won't break any plug-ins relying on the old implementation.

### 5.1 Schema files and Interfaces

In order to provide additional functionality for other plug-ins we choose the extension point mechanism described in section 2.1.1. This is done in order to retain the old functionality of the plug-in while on the other hand giving options to ask extending plug-ins for their contributions.

The extension points are described in more details in the next sections. They consist of a schema file for defining the extension point and an interface that contains the methods that extending components have to supply.

#### 5.1.1 Toolbar Contribution Provider

The purpose of the toolbar contribution provider is to allow other plug-ins to put items onto the toolbar of the Execution Manager. There are two reasons for using the extension point mechanism rather than making the toolbar available and have other plug-ins put their contributions directly on it:

1. At the moment the toolbar and all contributions are created dynamically. Switching the entire native toolbar of the Execution Manager to adding the actions to the toolbar through the `org.eclipse.ui.toolbar` extension point would require major code changes and have major drawbacks.
2. A programatic approach gives control over the contributions to the Execution Manager. This means that the order of the native Execution Manager buttons is always the same and in the same place. It also means that the Execution Manager can choose to ignore contributions if the toolbar gets too crowded.



Figure 5.1: The interface for Toolbar Contribution Providers<sup>1</sup>

The schema file for components that want to add contributions to the toolbar is quite simple. It only requires them to implement the interface shown in figure 5.1. The implementing class provides an array with all **ControlContributions** they want to add to the toolbar. A **ControlContribution** for a toolbar can be almost any **swt.Widget** like Labels, Buttons, Comboboxes, ....

When the Execution Manager starts to build the views toolbar it will perform the following steps:

1. The contributors will be asked for the list of controls that they want to contribute.
2. That list will be added to the Execution Manager's toolbar.
3. After that the Execution Manager will add its own controls to the toolbar.

This order causes the toolbar to have the native elements always in the same order. The contributed elements will be added from left to right in the order that they occur in the array. However there is no guarantee on the order in which the extending plug-ins are asked. Figure 5.2 shows the Execution Manager toolbar with the two combo boxes belonging to **KIEMConfig** contributed through the extension point. Figure 5.3 shows the same toolbar without the contributions.

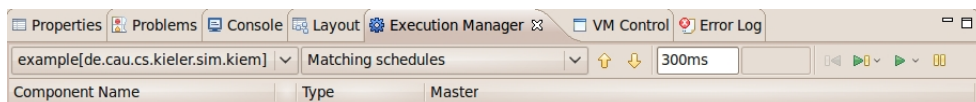


Figure 5.2: The Execution Managers Toolbar with two contributed Comboboxes<sup>2</sup>

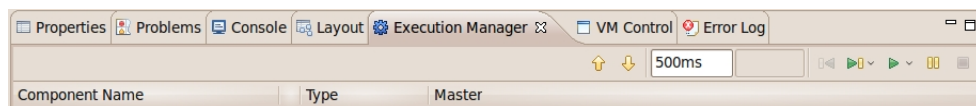
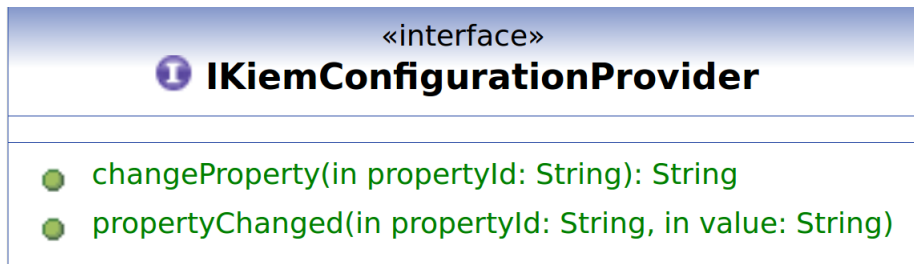
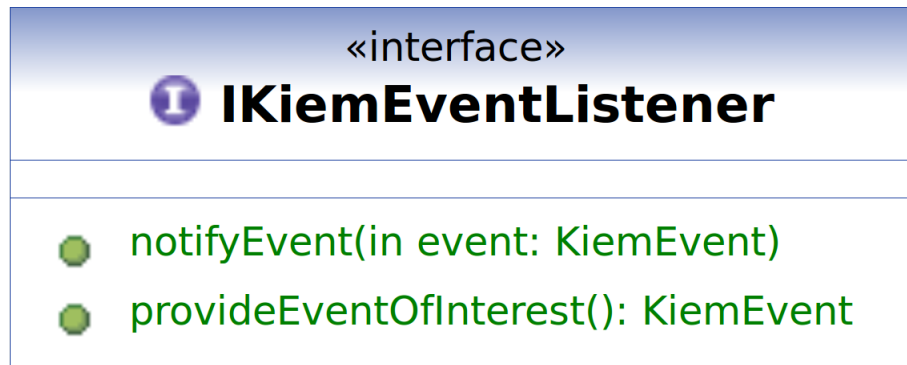


Figure 5.3: The Execution Managers Toolbar without contributions<sup>3</sup>



Figure 5.4: The Interface of the Configuration Provider<sup>4</sup>Figure 5.5: The Interface of the Event Listener<sup>5</sup>

### 5.1.2 Configuration provider

The purpose of the configuration provider is to allow internal attributes of the Execution Manager to be stored in another plugin.

This is achieved by another extension point to allow any plug-in to listen to changes in the Execution Manager's attributes. It also means that there may be multiple plug-ins that provide values for properties and not all plug-ins may have the value for a property needed by the Execution Manager. Through the plug-in mechanism the KIEM can ask all providers for values and choose the one he would like to use.

The two methods from the interface shown in Figure 5.4 work in the following way:

### 5.1.3 Event Listener

The main purpose of the Event Manager is to inform DataComponents of events happening in the Execution Manager during execution. This behavior has been modified to include events that occur while the execution is not running. This modification lead to the creation of another extension point in order to allow other plug-ins to be notified on any of these events as well. The classes implementing the interface (see Figure 5.5) required by this extension point will be notified on any event that happens inside the KIEM.

## 5 Code changes in the Execution Manager

The semantics of the methods will be explained in detail in the following two subsections.

### **provideEventOfInterest()**

This method is directly derived from the method with the same name in the `AbstractDataComponent` class of the KIEM plug-in. It is called by the `EventManager` to determine which events the implementing class is interested in. This is done to improve efficiency and not flooding components with events they are not interested in.

Based on the response, the `EventManager` puts the component into lists along with the `DataComponentWrappers` already inside.

### **notifyEvent(KiemEvent event)**

This method is called by the `EventManager` when something happens inside the KIEM that the implementing classes might be interested in.

## 5.2 KIEMPlugin.java

The main `Activator` class contains almost the entire API of the KIEM. Therefore any additions to that has to be performed in this class which means that most of the adjustments were made here.

1. A couple of methods were added to inform the listeners registered through the `ConfigurationProvider` extension point of changes the user made through the UI (UI) of the KIEM.
2. The method that takes care of loading an execution file was split. This was done to allow other plug-ins to pass an `IPath` object directly to the method and perform a load of that file without having to go through the UI. This method was also shifted around a little in order to detect missing execution files before the load enters the `UIThread`. This was necessary to make it possible for the callers of the method to catch the resulting exception. The method also had to be modified in order to be able to take files that are not inside the workspace but were added through an extension point.
3. getter for configuration elements
4. relay to `KiemView` to trigger updates

## 5.3 KIEMView

- changes to toolbar creation
- provide means to set view as dirty when changes happen

### 5.3 *KIEMView*

- refresh method to reload values, not needed before because no change except by user

## 5 *Code changes in the Execution Manager*

## 6 KiemConfigurationPlugin

- own plugin for modularity, reuse of old code, no interference with other plugins

### 6.1 Extension Point Implementation

#### 6.1.1 Implementing Classes

- toolbar provider: link to contribution manager, forward array of contributions
- configuration provider: link to configuration manager, forward requests
- event listener: handles events received by the configData component listen to load/save events, can be disabled when KIEMConf is about to trigger load/save

#### 6.1.2 Manager Classes

- bundled control behavior
- no cluttering up the main activator class
- singleton pattern

#### Abstract Manager Superclass

- provides methods that all managers need
- load/save through the plugins preference store
- add/remove/notify listeners

#### Schedule Manager

- all schedule data
- track recently used schedule Ids
- ask KIEMPlugin to load a saved schedule, deal with error
- add/remove schedules, update schedule priorities
- handle user load/save events

### Configuration Manager

- manages current/default configuration, supply filtered lists for preference components
- find current configuration and wrapper in data component wrapper list
- get values for properties (where to look, ignored keys, save to current when found)
  - check if there is a current configuration, check if the key is not on the ignored key list, try to find in current configuration
  - on failure: try to find in default configuration, update current configuration, return found value
  - on failure: if default value supplied, update default configuration, update current configuration, return default value
  - on failure: throw exception
- add/remove properties, update values
  - try to update saved values
  - if it doesn't exist create it
- restore default values

### Editor Manager

- all editor definitions
- add/remove/find editors
- default editors

### Other Managers

- contribution manager: create combos, save visibility
- property usage manager: track all keys where default config should be used rather than current

### 6.1.3 Utility and Data Classes

#### ConfigDataComponent

- extends AbstractDataComponent from KIEM, registers through extension point
- can be added and removed by the user to update old files or downgrade new ones
- contains an array of KIEMProperty (key, value pairs)

- contains methods to more easily modify the properties (update, remove, add, find)
- used as current/default configuration
- reference to wrapper file to get serialized properties and set for serialization
- delegate events received from the Kiem Event Manager

### **ScheduleData**

- tracks one specific .execution file
- contains file location and list of priorities of supported editors
- getting/setting supported priority, adding/removing editors

### **Other Data Classes**

- EditorDefinition: holds editorname, editorId pair gotten from plugin definition
- KiemConfigEvent: for event dispatching
- Wrapper classes: type safety, prevent null values

### **Tools**

- Tools class:
  - holds a lot of Strings used in multiple classes
  - methods for converting array to list and back
  - displaying error dialog
- MostRecentlyUsedList: list for tracking recent uses, adds new elements at index 0, pushes down rest, pulls element already in list to top

### **MostRecentlyUsedList**

The MostRecentlyUsedList 6.1 is a new list type that is can be used for simulating the behavior found in 'Open recent' menu item of almost any text editing application. To avoid the list growing too long it can be given a maximum capacity. After that capacity is reached the oldest entry will be deleted when a new one enters the list. The data of the list is stored in an ArrayList with an initial capacity of the maximum capacity of the list. Most operations are directly delegating to the operations of the underlying ArrayList. The only exception is the add(item : T) method that works in a different way:

1. check if the item is already in the list and remove it



Figure 6.1: MostRecentlyUsedList<sup>1</sup>

2. add the last item at the end of the list and increment the index of all other items
3. set the first index to the newly added item
4. remove the last item if the list has grown beyond the capacity

This list is used to track the most recently used schedules and display them in the corresponding combo box.

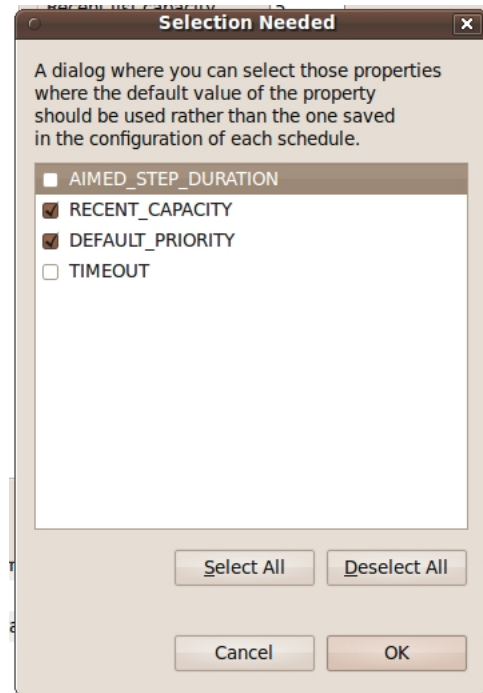
## 6.2 Preference pages

- place to easily configure settings, all KIELER preferences in one place
- integrated into eclipse look and feel

### 6.2.1 Configuration page

- changing default configuration for internal properties
- check boxes for changing visibility of the combos



Figure 6.2: The Property Usage Dialog<sup>2</sup>

### User defined properties page

- adding/removing properties
- modified from msp, table view with providers

### Property usage dialog

This dialog shown in figure 6.2 is used for selecting which properties should always be taken from the default configuration rather than the configuration component contained in every .execution file. The dialog used for this is a `ListSelectionDialog` which just receives the list of all keys as input and the list of `PropertyKeys` from the `PropertyUsageManager` as default selection. After the user is finished with selecting attributes and hit the 'Ok' Button the dialog passes the new list of selected items back to the `PropertyUsageManager`.

#### 6.2.2 Scheduling page

This preference page is used to manage the schedules and the editors that they belong to. This page is basically a modified version of the `LayoutPrioritiesPage` by msp.

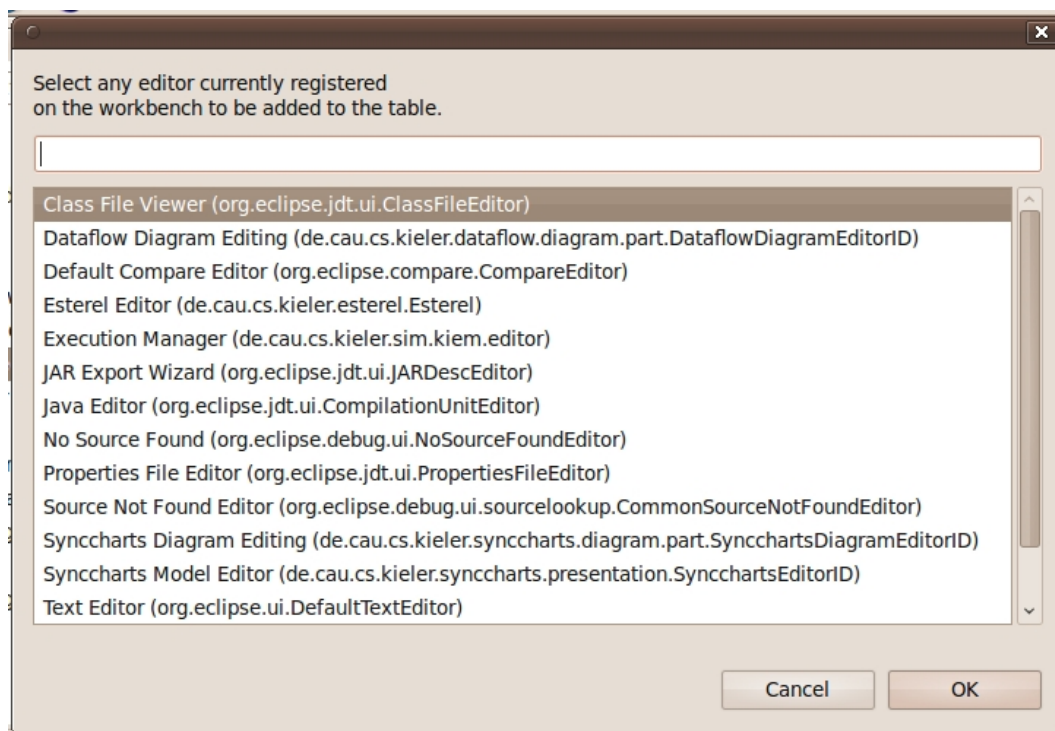
- table with schedules / editors and their priorities

- modified from msp , editors = diagram types, schedules = layouters
- modify priorities
- add/remove editors, remove schedules, selecting default editor

### **Adding and removing editors, Selecting a default editor**

On the scheduling preference page there are routines for adding and removing editors as well as selecting a default editor. All of these actions use the same basic method for displaying an `ElementListSelectionDialog` 6.3 that takes a list of editor ids and returns the one selected by the user.

- The editor adding dialog gets a list of all editors currently registered on the active workbench. The user can select a single editor which is then added to the table.
- The editor removal dialog gets a list of all editors currently available for assignment of support properties. The editor selected by the user is removed from the table. It is also removed from all schedules. This is done to prevent the schedule objects from growing to monstrous size over time when editors are getting added and removed.
- The default editor selection dialog gets the same list as the removal dialog. The selected editor is then set as default editor. The default editor is used when there is no currently active editor on the workbench. It is used:
  1. to determine which editors to show in the Matching combo box.
  2. when a new schedule is created as an editor id.

Figure 6.3: The Editor Selection Dialog<sup>3</sup>



# 7 Conclusion

## 7.1 Results

- problems solved

## 7.2 Further improvements

- allow Objects (Serializable) to be saved
- improve dynamic layout
- refactor entire execution manager to use the runtime mechanism

## 7 *Conclusion*

## Part II

# Automated Execution





## 8 Used Technologies

The technologies used in this thesis are basically the same as in the first part (see Chapter 2).

### 8.1 Eclipse WorkbenchJob API

Since we don't want the UI to block while we are doing our automated execution run we will use the Eclipse Job API to run our automated execution thread. The Job API is specifically designed to accommodate very long running tasks which makes it perfect for our purposes since an execution run with several model files and hundreds of trace files might take a whole night. An example for the use of jobs in the normal Eclipse architecture is the SVN commit operation seen in Figure 8.1.

### 8.2 Eclipse Wizards

To allow the user to set up the execution run we will be using the Eclipse Wizard API. Wizards are used to guide the user through the process of creating complex items by taking the information in a structured way and then generating the item from it. One example inside the Eclipse Architecture is the Java Class Creation Wizard (see Figure 8.2) In theory it is possible to just open a text file and enter all the information manually. However if the wizard is used the user only has to select the class he wants to extend and the interfaces he wants to implement, activate one check box and then the wizard will create the class body, all required methods and comments for each element (see Listing 8.1) This makes it very easy for even inexperienced users to create new classes without knowing the exact syntax.

Auflistung 8.1: Code generated by the wizard

```
package test;

import org.eclipse.jface.action.ControlContribution;
import org.eclipse.swt.widgets.Composite;
import org.eclipse.swt.widgets.Control;

public class MyClass extends ControlContribution
    implements Runnable {

    /**
```

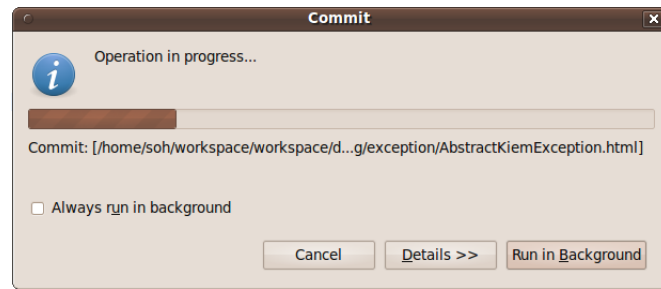


Figure 8.1: The SVN commit job

```

    * Creates a new MyClass.java .
    *
    * @param id
    */
public MyClass(String id) {
    super(id);
}

/**
 * {@inheritDoc}
 */
@Override
protected Control createControl(Composite parent) {
    return null;
}

/**
 * {@inheritDoc}
 */
public void run() {
}

/**
 * @param args
 */
public static void main(String[] args) {
}
}

```



Figure 8.2: The Class Creation Wizard



## 9 Problem Statement

The objective of this project is to find a way to automate the execution runs of the Execution Manager as described by Christian Motika in his diploma-thesis[1].

Currently the Execution manager works in a way that the user manually sets up a new execution run or loads a saved execution file. The components then have to gather all information they need themselves like model files, trace files and so on. Since there is no generic way to do that, this information is either hard-coded into the components or entered manually through the properties. After that the user has to manually control the execution. The execution runs until the user or a component stops it. The user then has to manually set up another execution run, possibly even rewriting his components if the model files and trace files are hard-coded or manually change the properties. This is very unsatisfactory if you have a large number of model files that should be tested with a one or more execution files and possibly hundreds of trace files (see Figure ). Performing runs like that manually is completely out of the question as even with the automation in place it would take several hours.

The task resulting from this problem can be broken down in 4 parts which are explained in detail in the following sections:

1. The setup of an automated run by the user.
2. The input of all the necessary information.
3. The control flow of the automated run.
4. The gathering of information after the run has finished and the display of that information.

### 9.1 Setting up a Run

The first objective is to find an easy way for the user to efficiently set up an automated run. This involves selecting the model files and execution files needed for the automation as well as entering initial properties.

### 9.2 Input for the Automation

The second objective is to enable the components to receive inputs. Each component should receive all information it needs prior to each execution run in order to make the components more dynamic. This mechanism would ensure that components can be written in a more generic way than is currently possible. We will have to define an

API for this information passing process as well as an API to trigger an automated execution from other plug-ins.

### 9.3 Automate the execution

The third objective is to automate the control flow of the execution itself. This would involve the following:

1. Loading the desired execution files, model files and trace files.
2. Determining how many steps should be performed and running the execution up the desired step.
3. Gathering the information produced by the components.
4. Properly shut down the execution so that a new one can be started.

### 9.4 Output execution results

The last objective is to display the information in a meaningful way. This should involve at least two methods of output:

1. A formatted string possibly in an XML fashion that can be parsed and used by other plug-ins for automated analysis.
2. Some graphic component that will display the information in a way that is easy to read for most users.

# 10 Concepts

## 10.1 Setting up a Run

There are several possibilities of how to solve the problem of accumulating large amounts of information prior to a long running action. The first possibility would be to have the user enter the paths to the necessary files in text files, parse those files and start a run with the parsed information. While this is a good method for performing static runs from a console environment it has several disadvantages inside the GUI of an Eclipse RCA:

- Manually entered file names in a text file are prone to have erroneous information. It is very hard to manually enter the correct file name of any file and the entered location only works on one OS. Aside from that it takes a long time to manually enter the possible vast amount of files used.
- There is no way to quickly adjust the file if other models or execution files should be used.
- It also means more files cluttering up the workspace.
- It is not very intuitive and the user has to know the exact syntax that the execution needs.

Another approach is the selection of the files through a dialog. Here the first option is to write a new dialog from scratch. While this option ensures flexibility since only the elements that are really needed are on it in exactly the way they are needed some disadvantages come along:

- It involves a lot of work since every widget has to be manually placed on the dialog.
- It involves even more work to get the layout of the dialog just right.

A more comprehensive approach would be to use one of the dialogs provided by Eclipse specifically the wizard type dialog. Eclipse itself uses a host of wizards as explained in [ref here]. The wizard has several advantages over the other methods explained here:

- Even inexperienced users can be guided to set up a valid execution run.
- The entered information is most likely valid since the wizard only displays valid files.
- It is quicker to program and easier to adjust than any of the other methods.

## 10.2 Input for the Automation

In order to send information to the DataComponents the first decision must consider the form of the information that will be supplied. The chosen form is that of a list of key, value pairs. It allows for most flexibility while still being very generic and simple to read and write on. This list of properties will at least include the path to the model file in order for components to be executed with several different model files without having to alter the code between runs.

The next decision involves how the components are getting the information. The first possibility would be to have the component ask the plug-in for the information in question. The upside of this would be that components are sure to get all the information they need before the execution can start since they can keep asking for it. However this would likely mean that the component has to poll multiple times as it has no knowledge about when the required information will be available which constitutes additional workload. Furthermore this situation would likely mean that multiple components might request information at the same time. This means that there would be the need for substantial synchronization mechanisms to ensure consistency of data.

Therefore the way chosen in this thesis is that the Execution Manager will inform interested components about all properties that were accumulated and then starts the execution run. This ensures that a run is started in any event and keeps communication between the components and the manager simple.

## 10.3 Automate the execution

Automating the execution itself requires the plug-in to interact with the KIEM. There is already an API defined for loading an execution file by supplying a path so that is what will be used in this project. Then it is necessary to initialize the execution and step through it using the API methods provided in the Execution. For this the EventListener extension point of the KIEM can also be used in order to determine when a step has finished executing and a new one can be dispatched. After the execution is finished all components should be called again to be given a chance to provide information for the display in the next step. This information will be gathered in the same form and way as described in Section 10.2.

## 10.4 Output execution results

On the subject of displaying the information several options are available.

The first option would be to open a dialog once the execution has finished and display the results in a tabular manner. This has the advantage that the users attention is immediately caught when the run finishes. However pop-up boxes should be used only when something very important happens and only with small messages as they tend to interrupt the users work flow. Aside from that the user might want



to look at the results from the execution and compare them with the actual model. An opened dialog is usually something sitting in front of the rest of the IDE and that user wants to get rid of as fast as possible.

The option taken in this project will utilize the view mechanism provided by Eclipse. This approach ensures that the user can place the displayed results where he wants them to be. It also makes it possible for the user to run an execution multiple times and compare the results by having them displayed in multiple views or next to each other in the same view. Another advantage of the view concept is that it provides a tool bar for adding actions. The user might want to control the automated run during its execution or interact with the displayed results. While a static dialog would have difficulties providing the control elements for those actions a view can easily display them in the tool bar.



## 11 Code changes in KIEMPlugin

In order for the Automated Executions for the KIEM (KIEMAuto) to operate successfully there were no changes necessary beyond the ones described in Chapter 5.

The KIEMAuto makes use of the event listener extension point (see Section 5.1.3) in order to get notified about events occurring during the current execution run.

It also uses the tool bar contributor extension point (see Section 5.1.1) to add new control elements to the Execution Managers tool bar.

## *11 Code changes in KIEMPlugin*

## 12 The Automated Executions Plug-in

- new plugin - handles the setup, control flow and display of automated execution - consists of 3 parts explained in detail below - wizard, manager, view

### 12.1 Automated Component

An automated component is any DataComponent that wants to interact with the automated execution plug-in. As seen in the diagram automated components have to implement three methods:

#### 12.1.1 provideProperties()

This method enables components to receive information prior to each execution run. The list is implemented as an array of key, value pairs stored inside KiemProperty objects. At the very least the list contains the location of the model file and the index of the currently running iteration (that is how many time the current model has already been executed with the current execution file). This allows components to load additional files that are always in the same path as the execution file and determine which of those to load based on the iteration index.

#### 12.1.2 wantAnotherStep()

This method is called after every step of the execution manager. All components are asked if they want to perform another step and if one components answers with TRUE the execution manager will perform another step. This makes it unnecessary to know the exact number of steps needed for the execution before the execution starts.

#### 12.1.3 wantsAnotherRun()

This method is the equivalent for the wantAnotherStep() method in the context of entire execution runs. After no component wants to perform another step all components are asked if they want to perform another run. If one component answers with TRUE the entire simulation is stopped and then started again with the same model file and execution file but an incremented iteration index. This can for example be used to execute the same model with a different set of trace files by just naming the trace files the same way as the model files with a number at the end.

## 12.2 Automated Producer

This interface extends the `AutomatedComponent` interface. In addition to the inherited methods it provided one additional method. This method is called after an iteration has finished and asks the components if they want to publish any information about the results of their execution. This information is gathered by the plug-in and the accumulated results are either passed to the calling plug-in or displayed in the specially designed view (see chapter about the view).

## 12.3 Automation Wizard

### 12.3.1 File Selection Page

- wizard is used to set up the execution run - extends `ResourceImportWizard` for displaying a folder/file structure for selecting files from - easily usable, select whole folders, filter file types - can be given an initial selection, on close will save the selection, store it in preference store and restore it on load - additional dialog for selecting execution files that are not in the workspace but imported - for simplicity assume that files ending `.execution` are execution files and all other selected ones are model files, wizard can not check if valid since formats are not known - only allow user to proceed if at least one execution and one model file is selected

### 12.3.2 Property Setting Page

- set up the additional arguments passed to the execution - simple adding and removing of key, value pairs - same as file page, on close results are saved to preference store and restored for initial selection on next open

### 12.3.3 Information Processing

- gather execution files and model files from file selection page - gather properties from property page - store information for next open - invoke the execution manager

## 12.4 Automation manager and Automation Job

- handles control flow during the automation - takes information from either call through the API or wizard

### 12.4.1 Automation Manager

- handles the overall control flow - takes the execution files, model files and properties as argument - if progress monitor is registered it is informed about the progress of the evaluation - The control flow:

- iterate over all execution files

- open execution file
- tell view to set up display for the first execution file
- iterate over all model files
- get first model file from list
- ask components how many more runs they need, take maximum and perform runs before asking again
- pass model file, execution file and index of iteration
- initialize the execution
- pass properties to components, at least receive model file and iteration
- start worker thread that listens for monitor canceling, step timing out
- ask components how many more steps they need, take maximum and perform steps before asking again
- perform one step, lock self inside semaphore, stay locked until either worker thread or event listener notifies (step done)
- when no component wants more steps pause
- gather information from all IAutomatedProducers
- tell view to show information for this iteration
- stop execution inside the KIEM and perform cleanup
- proceed to next iteration
- inform monitor of progress
- proceed to next model
- proceed to next execution
- when done inform monitor of done and terminate the job

### 12.4.2 Automation Job

- workbenchjob with progressmonitor - used to display the progress in the progress view and a dialog with progress bar - long running task, doesn't want to block the rest of the workbench - triggers execution in the manager

## 12.5 Automation View

- displays the information in a structured way - start a new table for each execution file - one row for each iteration with each model file - prerequisite needed here: always the same outputs throughout the entire execution file - first columns display model file name, iteration index and current status

### 12.5.1 Toolbar

- button to start the wizard - button for clearing the view - text field showing the step that was just processed



# 13 Conclusion

As stated in Chapter 9 the problem consists of four parts:

1. Find an easy way for the user to set up an automated run.
2. Input the information provided by the user into the data components.
3. Design a control flow for an automated run.
4. Organize the output of the automated run and display it to the user.

The following sections will summarize the results and provide some ideas for future work.

## 13.1 Results

- setup using the wizard
- input using new interfaces
- control flow with job mechanism
- output using a view with tables and methods to export

## 13.2 Further improvements

- allow the user to select which columns to export/display
- implement macro step support as soon as KIEM does

## 13 *Conclusion*

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