Overview

TMS Workflow Studio is a Delphi VCL framework for Business Process Management (BPM). With Workflow Studio you can easily add workflow and BPM capabilities to your application, by allowing you or your end-user to create workflow definitions and running them.

Here are some examples of business process that can be automated by using Workflow Studio:

- Order management
- Sales management
- Hiring process
- Help desk tasks
- Sales and marketing tasks
- Project management
- Quality checking
- Warranty management
- Software deployment
- Product requirement and specification
- Expense tracking

Main tasks you can do with Workflow Studio are:

- Design workflow definitions visually in a diagram
- Run the workflow definitions
- Manage tasks generated by the workflows

Rebuilding Packages

If for any reason you want to rebuild source code, you should do it using the "Packages Rebuild Tool" utility that is installed. There is an icon for it in the Start Menu.

Just run the utility, select the Delphi versions you want the packages to be rebuilt for, and click "Install".

If you are using Delphi XE and up, you can also rebuild the packages manually by opening the dpk/dproj file in Delphi/Rad Studio IDE.

Do NOT manually recompile packages if you use Delphi 2010 or lower. In this case always use the rebuild tool.

In this section:

Basic Concepts

How Workflow Studio works and key concepts around workflows and tasks.

Getting Started

Components overview and initial steps to setup Workflow Studio.

Database Structure

Underlying database structure for Workflow Studio.

Creating Workflow Definitions

Diagram objects and features of workflow definitions editor.

User interface windows

Interfaces for creating workflows and managing tasks.

Using Workflow Studio programmatically

How to run some common tasks from Delphi code.

Extending the scripting system

Take advantage of scripts for increasing integration between workflows and your application.

Basic Concepts

Some basic concepts are presented here, for your clear understanding of how Workflow Studio works and its main components.

Workflows and Tasks

Workflow Studio works with two major concepts: *workflows* and *tasks*.

A *workflow* is a representation of a business process. In Worklow Studio, the workflow concept is split in two more specific concepts: workflow definition, which is the specification of a business process, and workflow instance, which is a running business process.

A *task* is a pending work for a user. In Workflow Studio, the task concept is split in two more specific concepts: task definition, which is the specification of a task, and task instance, which is actually a existing pending task for a user.

Workflow Definition

A workflow definition is the representation of a business process. For easy understanding, we can compare the workflow definition to a flowchart which specifies how the business process work.

In a workflow definition you specify which actions are to be performed (update database, send e-mail, run a script and, more important, create a task), and in which order. If you are creating a workflow definition for order processing, for example, then you might want to check if the order amount is higher than 10 000. If not, then create an approval task for the local manager. If yes, create an approval task for the director. In any case of approval, send an e-mail for the financial department.

You can use the workflow designer to visually build the flowchart for the workflow definition. All the workflow definitions are kept in the database. Each workflow definition receives a name that uniquely identifies it (for example, "order processing", "software deployment", "help desk support", etc.).

Workflow Instance

A workflow instance is a running instance of a workflow definition. A single workflow definition will generate an unlimited number of workflow instances.

For example, you can have a single workflow definition for order processing, and for each order, you will have a workflow instance. In a workflow definition you might have a variable named "Order number". Each workflow instance will have its own order number, and the variable "Order number" will have a different value. Each workflow instance will have its own state and internal variable values.

A workflow instance can be started, running or finished. All workflow instance records are kept in the database, even the finished ones.

Task Definition

A task definition specifies a task to be created for a user. It's not the task itself, but a specification for the task.

In the task definition you specify the subject, task name, description, the user, a list of valid status, and other properties. A task definition is always "inside" a workflow definition. One of the actions you can define in a workflow definition is generating tasks, and the task definition is part of the action specification.

For example, in a workflow definition for order processing, you might want to create a task for the manager to approve the order. In this case, the task definition would be something like this:

Subject: Order approval
Description: Please approve the order [OrderNo]
User: Manager
Valid Status: Waiting approval, approved, rejected

Task Instance

A task instance is a task created for an user based on a task definition. A single task definition can generate several task instances.

A task instance is created when a workflow instance is run and reaches to a point where a task must be created, based on a task definition. At that time, the task instance is created for a specified user.

Each user has a list of his/her pending task instances. Once the task is finished it is removed from the list of pending tasks. There is still an option for listing the closed tasks, in the task list window.

Each task instance has its own record in the database. Even if the task is closed, the record is not deleted.

Workflow Engine

The workflow engine is the place where the workflow instances are run. It creates the instance, runs it, and terminates it when the workflow instance is finished. The workflow engine can run various instances at the same time.

In current version, the workflow engine is just an internal thread-based class that creates a thread for each running workflow instance, and manages those threads.

Workflow Users and Groups

Workflow Studio is strongly based on tasks, which in turn are always assigned to an user or a group of users. So, Workflow Studio does also need to use information about users and groups.

Workflow Studio does not provide a full user control system, it does not have login dialogs, add/remove user, group definition interfaces, etc.. You must build the user management available in your application, or use a 3rd party tool to do that, like TMS Security System.

However, Workflow Studio needs to know about users and groups. So, you must fill in a list of valid users and groups, that will be used by Workflow Studio. This can be done at the beginning of the program.

The code below is an example that shows how to add users and groups to Workflow Studio.

```
// Add users and groups
with WorkflowStudio.UserManager do
begin
  // Add all users
  Users.Clear;
  Users.Add('1', 'John', 'john@domain');
  Users.Add('2', 'Sarah', 'sarah@domain');
  Users.Add('3', 'Scott', 'scott@domain');
  Users.Add('4', 'Mario', 'mario@domain');
  Users.Add('5', 'Tina', 'tina@domain');
  // Add groups and specify which users belong to each group
  Groups.Clear;
  with Groups.Add('managers') do
  begin
    UserIds.Add('1'); //John
    UserIds.Add('2'); //Sarah
  end;
  with Groups.Add('programmers') do
  begin
    UserIds.Add('3'); //Scott
    UserIds.Add('4'); //Mario
    UserIds.Add('5'); //Tina
  end;
end;
```

Note that two groups were created, and each group contains a list of user id's that belong to that group. Workflow Studio uses the user information to assign tasks, send e-mails, and other user-based tasks.

Version Control

It's possible that two different users load the same task or workflow instance, modify it, and try to save it. This could cause one user overwrite the changes made by the other user. It could happen either in your application code (manipulating tasks and instances from code) or when two users have their task lists dialogs open, for example.

To prevent this from happening you can set *TWorkflowStudio.VersionControlEnabled* property to true:

```
WorkflowStudio1.VersionControlEnabled := true;
```

This will force version control, which means if a user tries to update a task or workflow instance that is outdated (another user modified it since it was loaded from the database), an error will be raised and the update will not be performed.

This feature requires extra fields to be added to existing workflow database structure, be sure to run the proper SQL scripts to create those fields.

Getting Started

Components Overview

Here is a brief summary of the installed components.

TWorkflowStudio component

This is the main component of the package. A single TWorkflowStudio instance should be added to the whole application, and from this component you have access to various methods and properties needed to work with Workflow Studio programatically.

The global variable WorkflowStudio contains a reference to the main TWorkflowStudio component of the application.

TWorkflowStudio component provides the following main object properties:

```
property WorkflowManager: TWorkflowManager;
```

The TWorkflowManager object provides methods to manipulate workflow definitions and workflow instances (creating, deleting, signaling, etc.).

```
property TaskManager: TTaskManager;
```

The TTaskManager object provides methods to manipulate tasks, specially task instances.

```
property WorkflowEngine: TWorkflowEngine;
```

The TWorkflowEngine object provides methods to the workflow engine, which runs the workflow instances.

```
property UserManager: TWorkflowUserManager;
```

The TWorkflowUserManager object is used to manipulate workflow users and groups.

```
property ScriptEngine: TWorkflowScriptEngine;
```

The TWorkflowScriptEngine object is used to parse and evaluate expressions and scripts.

```
property UserInterface: TCustomWorkflowUserInterface;
```

The TCustomWorkflowUserInterface object provides methods for displaying the predefined windows and dialogs of Workflow Studio, like the task list dialog, workflow definition editor and workflow definition dialog.

```
property WorkflowDB: TWorkflowDB;
```

The TWorkflowDB object is the component which makes the layer to save/load data to/from the database. You must specify which TWorkflowDB component you want to use to access database.

TWorkflowDB component

The TWorkflowDB component provides a layer between application-level workflow data and the database server. This component builds all SQL commands used to insert, delete and update data in the database, but when it comes to execute the SQL statements, it does nothing.

You must provide event handlers for the events *OnCreateQuery*, *OnExecuteQuery* and *OnAssignSQLParams*.

```
TCreateQueryEvent = procedure(Sender: TObject; SQL: string;
  var Dataset: TDataset; var Done: boolean) of object;
```

Here you must provide your own code to create a TDataset descendant which provides connection to the database. You must also set the SQL statement (SELECT) provided . You must return a TDataset object in the parameter Dataset, and set Done parameter to true.

```
TExecuteQueryEvent = procedure(Sender: TObject; Dataset: TDataset;
  var Done: boolean) of object;
```

Here you receive your created TDataset descendant and call its specific method to execute an SQL statement. The SQL statement should have already set in the component in the *OnCreateQuery* event.

```
TAssignSQLParamsEvent = procedure(Sender: TObject; Dataset: TDataset;
  AParams: TParams; var Done: boolean) of object;
```

Here you receive a list of parameters (AParams) and you must set the parameters in your TDataset descendant, provided in Dataset parameter. Each component has a specific issue with parameters, and here you might deal with those specific issues, specially with blobs and memos.

This way you have total flexibility to use the component package you want to access your preferable database.

Workflow Studio provides some TWorkflowDB descendants form some widely used component sets (like ADO and dbExpress). In that case, you just drop the component you want to use (like *TWorkflowADODB*), assign it to the TWorkflowStudio component, and that's it, you don't need to set anything else.

TWorkflowADODB component

Provides ready-to-use ADO layer to the database. Use it if you want to use ADO components to access your database.

All you have to do is to set the *Connection* property to a valid TADOConnection component.

TWorkflowDBXDB component

Provides ready-to-use dbExpress layer to the database. Use it if you want to use dbExpress components to access your database.

All you have to do is to set the *Connection* property to a valid TADOConnection component. Optionally, you can also set *DBType* property to the database you are going to use, this will provide specific issues treatment for each database.

TWorkflowpFIBDB component

Provides ready-to-use FIBPlus layer to the database. Use it if you want to use FIBPlus components to access your database.

All you have to do is to set the *Database* property to a valid TpFIBDatabase component.

Installing the component
Since not every Delphi environments have the FIBPlus components installed, TWorkflowpFIBDB component is not installed by default. To install it, do the following steps:

1. Add *{$WS}\source\drivers\fibplus* directory to the Delphi library path, where {$WS} is the root directory of Workflow Studio files.
2. Open package *wspFIBpck.dpk* located in the directory above and install it.
3. If Delphi suggests changes to the package like adding required packages (it will at least include FIBPlus package to the list of required packages), accept it and install again until all warnings are gone.

TWorkflowFireDACDB component

Provides ready-to-use FireDAC layer to the database. Use it if you want to use FireDAC components to access your database.

All you have to do is to set the *Connection* property to a valid TFDConnection component.

Installing the component
Since not every Delphi environments have the AnyDAC components installed, TWorkflowAnyDACDB component is not installed by default. To install it, do the following steps:

1. Add *{$WS}\source\drivers\anydac* directory to the Delphi library path, where {$WS} is the root directory of Workflow Studio files.
2. Open package *wsAnyDACpck.dpk* located in the directory above and install it.

3. If Delphi suggests changes to the package like adding required packages (it will at least include AnyDAC packages to the list of required packages), accept it and install again until all warnings are gone.

Auxiliary components

The following components are provided with Workflow Studio, although you might not need to use them. They are componentes and controls used internally by the Workflow Studio framework, and you can use them if you want to customize Workflow Studio, like building your own dialog windows.

TWorkflowDiagram

Contains the workflow definition diagram. It's used in the workflow definition editor. Although you will probably not add a new TWorkflowDiagram component to a form, you might often use some of its methods and properties when using Workflow Studio programatically.

TWorkDefListView

It's a TListView descendant which shows a list of the workflow definitions in the database. Used in the workflow definition dialog.

TTaskListView

It's a TListView descendant which shows a list of task instances based on some filters (assigned to a user, or belonging to a workflow instance). Used in the task list dialog.

TAttachmentListView

It's a TListView descendant which shows the attachment files in a specified attachment. It's used in the task definition properties windows and also in the task list dialog.

TTaskStatusCombo

It's a TComboBox descendant which shows the current status of a task instance, and the drop down list shows the available status. If user changes the combo value, it automatically changes the value of the status in the task instance object. It's used in the task list dialog.

TTaskLogListView

It's a TListView descendant which shows the audit log for the changes in a task instance. It's used in the task list dialog.

"Hello world" tutorial

Workflow Studio provides basic online tutorial in Flash which display the basic steps to get an application running. Watching that tutorial will help you to understand the basics to start. The link to the online tutorial is included in *tutorials* folder.

Here we will provide a very simple list of tasks you should do to get Workflow Studio to run:

1. **Install the product.**

2. **Create the tables and fields for Workflow Studio in your database.**

Workflow Studio provides several SQL scripts for creating needed tables and fields for some database vendors (e.g., Oracle, Microsoft SQL Server, etc.), but you can create yourself in the database server you want.

3. **Create a new VCL Application in Delphi.**

4. **Drop a TWorkflowStudio component.**

5. **Drop one of available TWorkflowDB components** (TWorkflowADODB for ADO, TWorkflowDBXDB for dbExpress, etc.).

6. **Drop a component for database connection and configure it to connect to your database** (TADOConnection if you're using ADO, TSQLConnection if you're using dbExpress, etc.).

7. **Associate your TWorkflowDB component to your database connection component using *Connection* property (or analog property).**

8. **Associate your TWorkflowStudio component to your TWorkflowDB component using *WorkflowDB* property.**

9. **Add valid users to your TWorkflowStudio component before application starts.**

It can be done in FormCreate method of application's main form, for example.

10. **That's it, you have it configured. Now you can use some methods to call the standard dialogs in Workflow Studio, like workflow definitions dialog and task list dialog.**

E-mail notifications

There are several points in the workflow definition where an e-mail can be sent. An example is when a task instance is created for an user. If the task definition properties of this task instance is marked as "Send e-mail notification", an e-mail will be sent to the user notifying him that the task instance was created and assigned to him.

However, there is no built-in code to send e-mails in Workflow Studio. When an e-mail is to be sent, the event *OnSendMail* of TWorkflowStudio component is fired. So, if you want your workflow so support e-mail sending, create an event handler for *TWorkflowStudio.OnSendMail* event, and send the e-mail yourself from there, using your own method.

The signature for the OnSendMail event is below:

```
type
  TEmailInformation = record
    ToAddr: string;
    From: string;
    Bcc: string;
    Cc: string;
    Subject: string;
    Text: string;
  end;

procedure(Sender: TObject; TaskIns: TTaskInstance; AUser: TWorkflowUser;
  AEmailInfo: TEmailInformation; var Sent: boolean) of object;
```

So, use *AEmailInfo* parameter to build your e-mail message, using ToAddr, From, Bcc, CC, Subject and Text properties.

Set *Sent* parameter to true when the e-mail is sent. For extra information (you will often use only *AEmailInfo*), you can use *TaskIns* and *AUser* parameters to know which task instance generated the e-mail, and for each workflow user the e-mail is about to be sent.

Monitoring expired tasks (task timeout)

Workflow Studio supports task expiration (timeout). It means you can define a lifetime for a task. After a task instance is created, the workflow waits for it to be finished. If the task doesn't finish until the expiration date, the task will expire automatically, and the workflow will follow the path you have defined for expired tasks.

In the task definition properties you can define the expiration settings.

For the tasks to be effectively expired, you must have some kind of monitor that checks for all pending tasks in a regular interval, and then perform the correct operations on the expired tasks. TWorkflowStudio component provides a single method to perform this operation, but nevertheless, you must build this monitor yourself. Read more in section "Running workflow instances for expired tasks".

Localization

Workflow Studio provides an easy way to localize the strings. All strings used in user interface (messages, button captions, dialog texts, menu captions, etc.) are in a single file names `wsLanguage.pas`.

In the *languages* folder, included in Workflow Studio distribution, there are several `wsLanguage.pas` files available for different languages. Just pick the one you want and copy it to the official directory of your workflow studio source code.

If the language you want does not exist, you can translate it yourself. Just open `wsLanguage.pas` file and translate the strings to the language you want.

As a final alternative, you can translate the `wsLanguage.txt` file, also included in *ws_languages.zip* file, and send the new file to us. The advantage of this approach is that this file is easier to translate (you don't have to deal with Pascal language) and can be included in the official Workflow Studio distribution. This way we keep track of changes in translable strings and all new strings are marked in the upcoming releases. This way, you will always know what is missing to translate, and do not need to do some kind of file comparison in every release of Workflow Studio.

So, in summary, to localize Workflow Studio strings:

Option 1

- Pick the correct `wsLanguage.pas` file from the *ws_languages.zip* file, according to the language you want.
- Replace the official `wsLanguage.pas` (in source code directory) by the one you picked.

Option 2

- Translate the official `wsLanguage.pas` directly.

Option 3

- Translate the `wsLanguage.txt` file and send it to us (support@tmssoftware.com).
- We will send you back a translated `wsLanguage.pas` file and this translation will be included in official release.

Database Structure

Workflow Studio saves and loads data into a database. It is database-based. You must create the needed tables and fields in your database in order to use Workflow Studio.

Workflow Studio distribution includes some SQL scripts for easy creation of tables in the database. The scripts are in the *dbscripts* folder. The scripts provide so far are:

- **wsSQLServer.sql**: for Microsoft SQL Server databases;
- **wsOracle.sql**: for Oracle databases;
- **wsFirebird.sql**: for Firebird/Interbase databases.

As an alternative, you can also manually create the tables and fields in your database, just use the same underlying database structure.

Underlying Database Structure

Below is the structure for the tables used by Workflow Studio.

The field types are described for Microsoft SQL Server, but you can just translate it for the database server you want.

For example, *Image* field is a blob field, while *Text* is a blob or memo field.

All Datetime fields must contain both date and time parts (not only date).

Table **wsattachment**

Field	Data type	Options
id	Int	Primary key, Required
workkey	Int	
createdon	Datetime	
filecontent	Image	
objecttype	Int	

Table **wstaskinstance**

Field	Data type	Options
id	Int	Primary key, Required
task	Text	
createdon	Datetime	
userid	VarChar(50)	

Field	Data type	Options
comments	Text	
name	VarChar(50)	
subject	VarChar(50)	
description	Text	
workflowinstancekey	Int	
workflowdefinitionkey	Int	
completed	VarChar(1)	
modifiedon	Datetime	
modifieduserid	VarChar(50)	
taskversion	Int	Default 0

Table **wsworkflowdefinition**

Field	Data type	Options
id	Int	Primary key, Required
workflow	Text	
name	VarChar(255)	

Table **wsworkflowinstance**

Field	Data type	Options
id	Int	Primary key, Required
workflow	Text	
workflowdefinitionkey	Int	
createdon	Datetime	
modifiedon	Datetime	
finishedon	Datetime	
nextruntime	Datetime	
instanceversion	Int	Default 0

Table **wstasklog**

Field	Data type	Options
taskinstancekey	Int	Primary key, Required
eventdate	Datetime	Primary key, Required
operation	VarChar(1)	Primary key, Required
userid	VarChar(50)	
info	VarChar(100)	
info2	VarChar(100)	

Table **wsconfig**

Field	Data type	Options
id	Int	Primary key, Required
dbversion	Int	

Upgrading database from previous versions

Some Workflow versions require updates in the database structure. Last versions to require it were **2.4** and **1.5**. If you have the database structure created for Workflow Studio in versions prior to any of those versions, some changes in structure are required to keep the component working properly.

Workflow Studio distribution includes some SQL scripts for easy updating the workflow tables in database, located in in *dbscripts* folder. The scripts provided so far are:

- To update from versions lower then **1.5**:
  - **wsSQLServerUpdate.sql**: for Microsoft SQL Server databases;
  - **wsOracleUpdate.sql**: for Oracle databases;
  - **wsFirebirdUpdate.sql**: for Firebird/Interbase databases.
- To update from versions lower then **2.4**:
  - **wsSQLServerUpdate2_4.sql**: for Microsoft SQL Server databases;
  - **wsOracleUpdate2_4.sql**: for Oracle databases;
  - **wsFirebirdUpdate2_4.sql**: for Firebird/Interbase databases.

Following are listed the database changes required to upgrade Workflow Studio version.

The field types are described for Microsoft SQL Server, but you can just translate it for the database server you want.

From previous versions to version **2.4**

1. New field in table **wsworkflowinstance**: **instanceversion** Int Default 0.
2. New field in table **wstaskinstance**: **taskversion** Int Default 0.
3. New table **wsconfig** with new record with field values **id = 1** and **dbversion = 1**.

From previous versions to version **1.5**

1. New field in table **wsworkflowinstance**: **nextruntime** Datetime.

Creating Workflow Definitions

One of the main tasks using Workflow Studio is to create workflow definitions that will represent the business process. You create a workflow definition in the workflow definitions dialog.

A workflow definition is basically a workflow diagram where you add diagram objects.

You can also define workflow variables and workflow attachments to be used in the workflow diagram. While building the workflow definition, you can take benefit from expressions and scripts to make it more flexible and adaptable to different situations.

Workflow diagram objects

A diagram object is something that you put inside a workflow diagram. It can be a block which perform a specified operation, a transition, or some special objects that control the execution flow, like connectors and forks.

Start block

Overview: indicates where the process starts.

Allowed inputs: 0
Allowed outputs: 1

Description:
Only one Start block can exist in a workflow diagram.

End block

Overview: indicates where the process ends.

Allowed inputs: many
Allowed outputs: 0

Description:
Only one End block can exist in a workflow diagram.

Error block

Overview: Error block is executed when an error occurs while executing the workflow diagram.

Allowed inputs: 0
Allowed outputs: 1

Description:
Only one Error block can exist in a workflow diagram.

Whenever an error occurs during the execution of the workflow diagram, the execution flow goes to the error block and then follow the path specified by it (the next block after the error block). You can use error block to perform some clean up and then finish the execution of workflow diagram.

Source connector

Overview: The source connector is a passthrough block to increase readibility of diagram. It makes execution flow to a target connector.

Allowed inputs: many
Allowed outputs: 0

Description:
If the execution flow reaches a source connector, then the diagram jumps to a target connector that is related to the source connector.

The "relation" between the source and target connector is done by the text inside them. If the text is the same, the connection is established. For example, when the execution reachs a source connector labeled "A", then it jumps to the target connector labeled "A". This way you can have several source-target connections in a single diagram.

Target connector

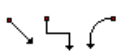
Overview: The target connector is a passthrough block to increase readibility of diagram. It receives execution flow from a related source connector.

Allowed inputs: 0
Allowed outputs: 1

Description:
If the execution flow reaches a source connector, then the diagram jumps to a target connector that is related to the source connector.

The "relation" between the source and target connector is done by the text inside them. If the text is the same, the connection is established. For example, when the execution reachs a source connector labeled "A", then it jumps to the target connector labeled "A". This way you can have several source-target connections in a single diagram.

Transition



Overview: Connects one block to another, indicating the execution flow of diagram.

Description:
You use a transition (line, or wire) to connect a block to another. The transition indicates the execution flow, meaning that it flows from the source block to the target block.

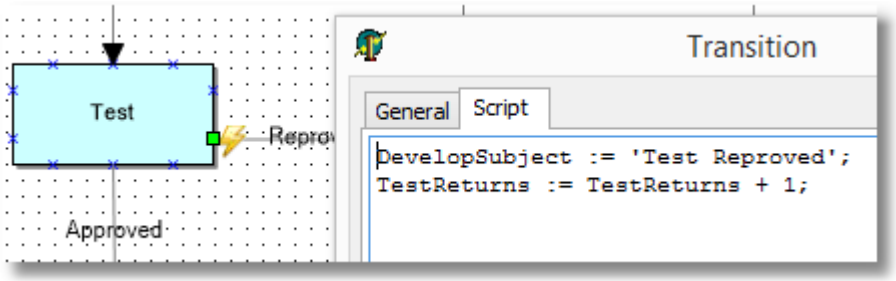
You create a transition by pressing down the mouse button at one link point (blue "x" in blocks) in the source block, dragging the mouse, and releasing the button at one link point in the target block. An arrow indicates the execution flow.

You can create a normal transition, a side transition or an arc transition. All behave the same, the difference is only visual.

You might not be able to attach a transition to a block, depending on the allowed inputs and outputs to the block. For example, if you try to create a transition that targets a Start block, you won't be able to do it, because a Start block does not allow inputs.

Some blocks allow multiple transitions as outputs. In this case, each transition must be labeled so that the diagram knows which transition must be used according to a specified condition. Only one transition is used for leaving a block. So, for example, two transitions might be connected to the output of a Decision block, but one should be labeled "yes" and the other should be labeled "no", so the diagram will know which transition to take according to the result of the decision condition.

You can also specify a script for a transition, so that if the execution goes through the transition, the script is executed. In the transition dialog editor there is a tab named "Script" where you can write the script to be executed.



When the transition has a script associated to it, a small lightning bolt icon is displayed at the beginning of the transition line.

Fork object

Overview: Creates parallel execution paths.

Allowed inputs: many
Allowed outputs: many

Description:
The fork object is used to create parallel execution paths. When a diagram of a workflow instance is started, there is a single execution path (started by the Start block). If the execution reaches a fork block, the flow is split in several parallel paths (depending on the number of outputs in the fork) the execute simultaneously.

At the end, all execution paths must finish at the same join object, otherwise the diagram is incorrect. Once all parellel execution paths finish, the main execution path starts again, from the join object.

Join object

Overview: Ends parallel execution paths created by a fork object.

Allowed inputs: many
Allowed outputs: 1

Description:
The join object is used to end and join parallel execution paths. When a diagram of a workflow instance is started, there is a single execution path (started by the Start block). If the execution reaches a fork block, the flow is split in several parallel paths (depending on the number of outputs in the fork) the execute simultaneously.

At the end, all execution paths must finish at the same join object, otherwise the diagram is incorrect. Once all parellel execution paths finish, the main execution path starts again, from the join object.

The main execution path will restart in the join object, going through the next block connected to its output. The main execution path will not restart until all execution paths created by the fork object are finished.

Decision block

Overview: Changes the execution flow according to a boolean condition.

Allowed inputs: many
Allowed outputs: 2 ("yes" and "no")

Description:
Use a decision block to change the execution flow according to a boolean condition. When execution flow reaches a decision block, the condition of the block is evaluated. If it is true, then the execution path goes through the transition labeled "yes". If it is false, it goes through the transition labeled "no".

Task block

Overview: Creates task instances for users based on its task definitions.

Allowed inputs: many
Allowed outputs: many (restricted to status list)

Description:
The task block is one of the more important block types in a diagram. With task block you can specify task definitions to be created for users. When the execution flow reachs a task block, it creates task instances for each task definition.

The task block itself is nothing but a set of task definitions. So, to use the task block, just create one or more task definitions and set the task definition properties.

The workflow execution will stop at the task block until all task instances are finished. A task instance is finished when its status change to a completion status.

After all task instances are finished, the execution flow continues, according to these rules:

- *Task block has only one output*: The execution flow goes through that path.
- *Task block has two or more outputs*: Each output transition must be labeled with the name of a completion status. The execution path goes through the transition which is labeled with the same text as the task block output, which is the completion status of the task instance, i.e., if the task instance was completed as "approved" (a valid completion status, for example), then the execution path goes through the transition labeled "approved".

If more than one task instance was created by the task block, either from the same task definition or from different task definitions, then the task block output will be the most common completion status among the task instances. For example, if two task instances finish as "rejected" and one task instance finishes as "approved", then the task block output will be "rejected" and the execution path will follow the transition labeled the same.

Task definition properties

The task definitions are created in the task definition editor (Tasks dialog) for the Task block. When you double-click a Task block, the dialog is shown.

You can use *Add* and *Delete* buttons to add or delete task definitions. The list view at the left of the dialog displays the existing task definitons for the block. The name of task definition is displayed.

Name
Valid identifier that uniquely identifies the task definition. In the example below, "SetDateTask".

General

Subject
Contains the subject of the task. Used as a summary for e-mail messages or for the task list. Accepts expressions.

Description
Multi-line description of the task. Here all the instructions about the task should be inserted. Accepts expressions.

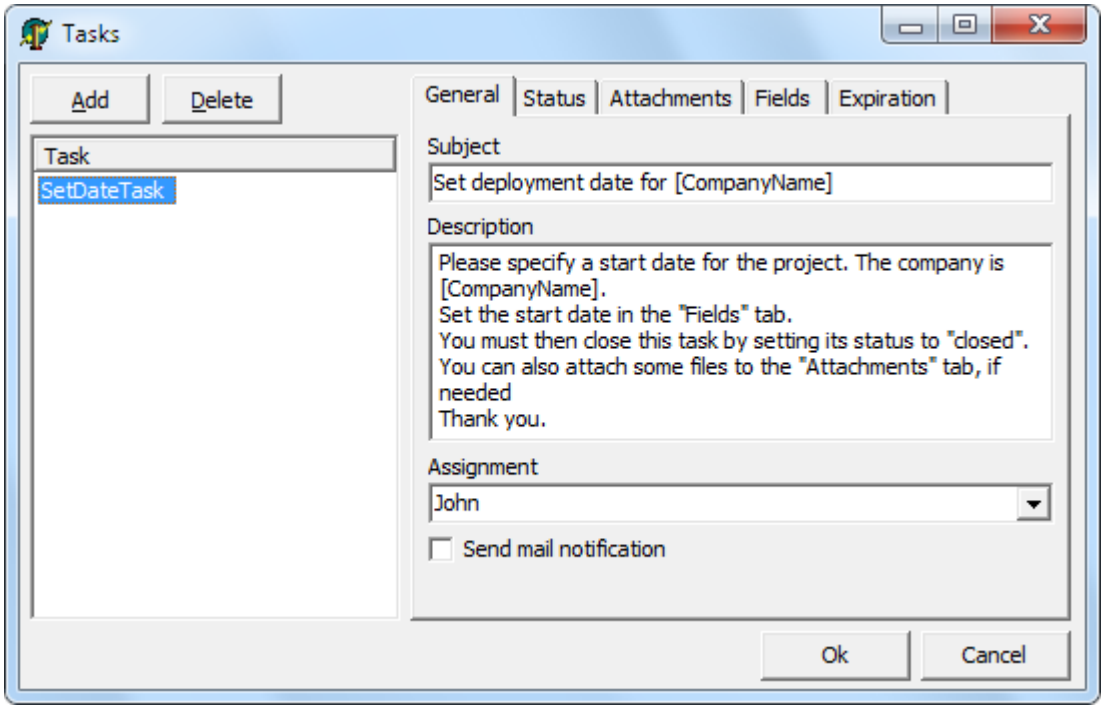
Assignment
The name of the user (or group) that the task instance will be assigned to. If it is a user, a single task instance will be created and will be assigned to that user. If it is a group, then the behaviour depends on the value of *TWorkflowStudio.GroupAssignmentMode* property:

- *gamMultipleTasks*: This is default value. A task will be created for each user in the group. So, if a group has users "john" and "maria", one task will be created for John, and antoher to Maria, and the tasks will be independent (both will have to be concluded).
- *gamSingleTask*: A single task will be created that will be visible for all users in the group. If you later include/remove users to/from the group, the existing tasks will become not visible for users removed from the group, and will become visible to users added to group. Any user from the group can update the task, including finishing it.

You can override the *GroupAssignmentMode* settings by using any(*groupname*) or all(*groupname*) in assignment. For example, suppose you have a group named "developers".

- Filling "developers" in Assignment will either create a task for each member in "developers" group, or will create a single task for any member in the group to handle it. It willl depend on value of *GroupAssignmentMode*.
- Filling "any(developers)" will create a single task for any member in the group to handle (regardless of *GroupAssignmentMode*).
- Filling "all(developers)" will create one task for each member in the group to handle (regardless of *GroupAssignmentMode*).

Send mail notification
If true (checked), then an e-mail notification will be sent to the user when the task instance is created.



Status

Status list

Contains a list of the valid status for the task.

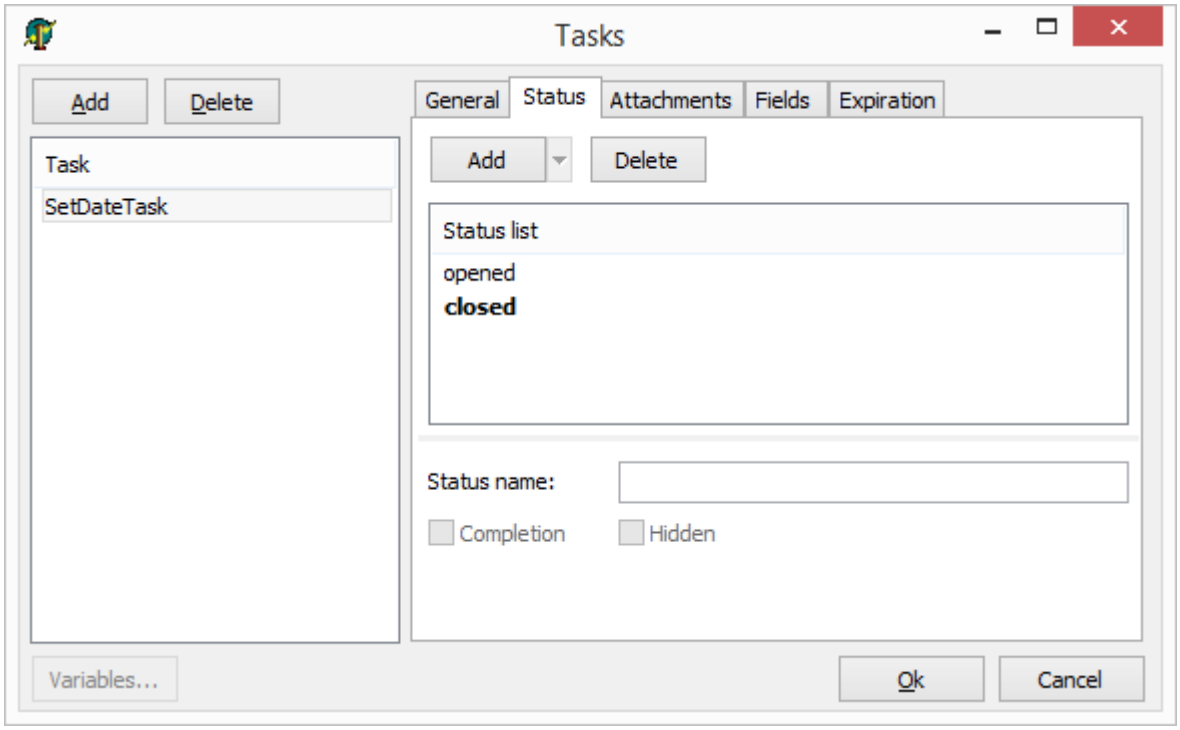
The initial status of the task will be the first status in the list.

Some status can be marked as *completion status*, by checking the "Completion" option. When the status of a task instance changes to a completion status, the task is considered finished. You can have more than one status marked as a completion status.

Status with the "Hidden" option checked is a possible status to the task, but will not be displayed in user interface for changing the task status (like in the status combo box).

When a task instance is created, the valid status are displayed in a combo box in the task list dialog, and then user can change the status of a task.

If you have status templates predefined in your application, the user will be able to choose one of the templates by using the down arrow button at the right of the "Add" button.



Attachment permissions

Defines the permissions for the users when handling attachments.

Show attachments

Shows the attachments tab in the task list. If false (unchecked), the user will not be able to do anything related to attachments (add, view, etc.). If true (checked) the user will be able to, at least, open and view attachments.

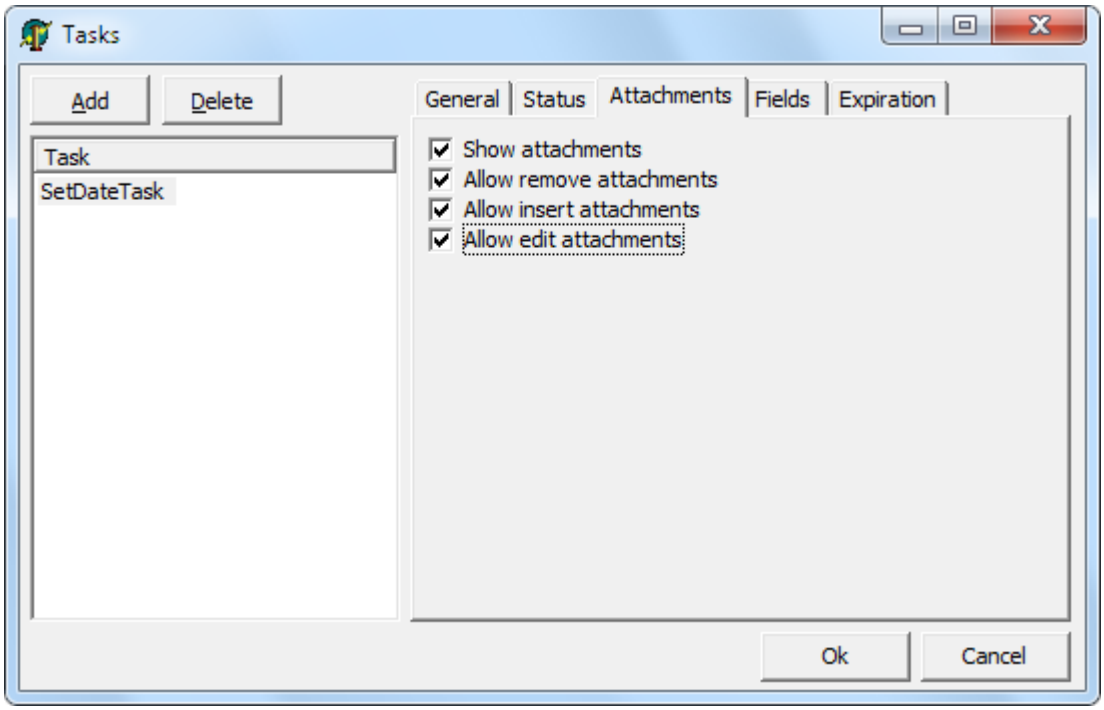
Allow remove attachments

If true (checked), allows the user to remove attachments from the task instance.

Allow insert attachments

If true (checked), allows the user to insert new attachments to the task instance.

Allow edit attachments
If true (checked), allows the user to open an existing attachments for editing, and updating its content.



Fields

Defines fields for the task instance. One or more fields can be defined for a task. A field is a placeholder for a value. All task fields are shown when a task instance is being displayed for a user in the task list dialog. Fields can be useful for users to see extra information related to the task, or for users to input valuable information. They add an extra level of flexibility.

A field is always related to a workflow variable, which is the real container for the field value. A field does not have a "value" it just reads/writes values from/to a workflow variable.

Text caption
It is the name of the field which will be displayed for the user.

Workflow variable
The name of the workflow variable related to the field. Fields read the value from the workflow variable, and write back the value to the workflow variable, if the user changes the value.

Read only
Mark the field as read-only, so the information is visible but not editable.

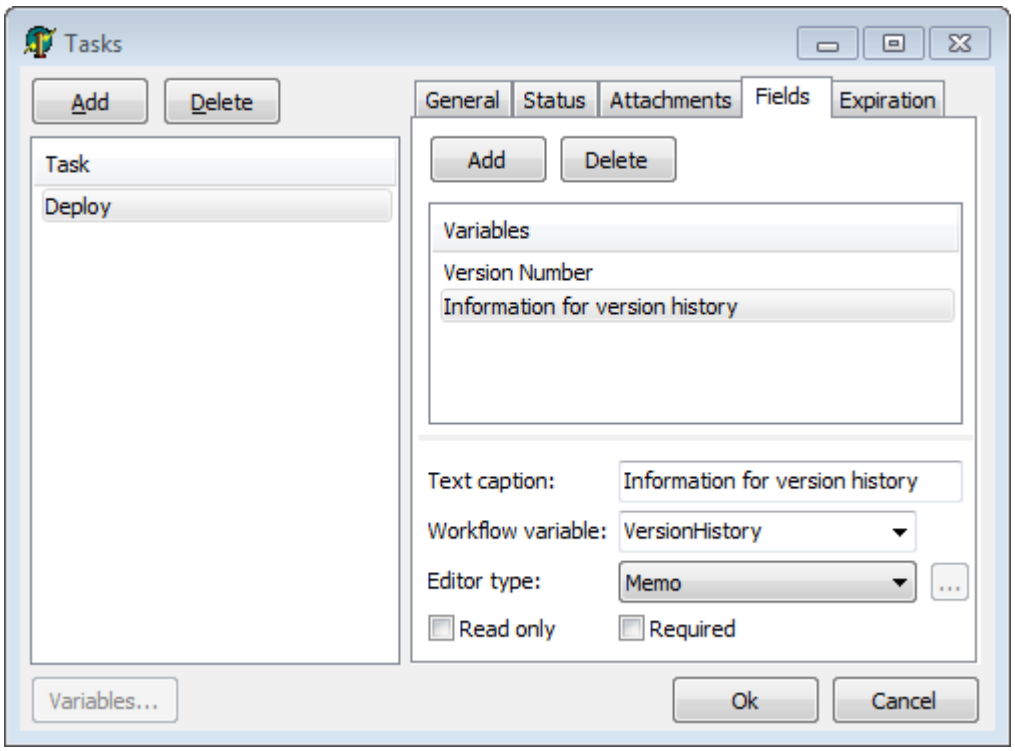
Editor type
Chooses the type of editor control used to edit/view the value of the variable when the user is editing the task.

Valid values can be:

- *Text*: edit box for free text editing;
- *Check*: checkbox for boolean values;
- *Date*: date picker for date values;

- *Memo* memo for free multiline text editing;
- *DropDown*: combobox with a list of items to choose (you can define the items to be displayed in combobox).

Required
When a field is required, the task instance can not be saved (altered) until a value is filled in the field. So, users cannot add, remove, edit attachments, or change task status, or change any other information in the task instance, if the field specified as required is empty.



Expiration

Defines the date/time for expiration of a workflow task. If a task has a defined expiration date/time, when it exceeds this date/time without being closed by an user (changed to a completion status), its status is automatically changed to an expiration status. To use this feature check the section Running workflow instances for tasks expiration.

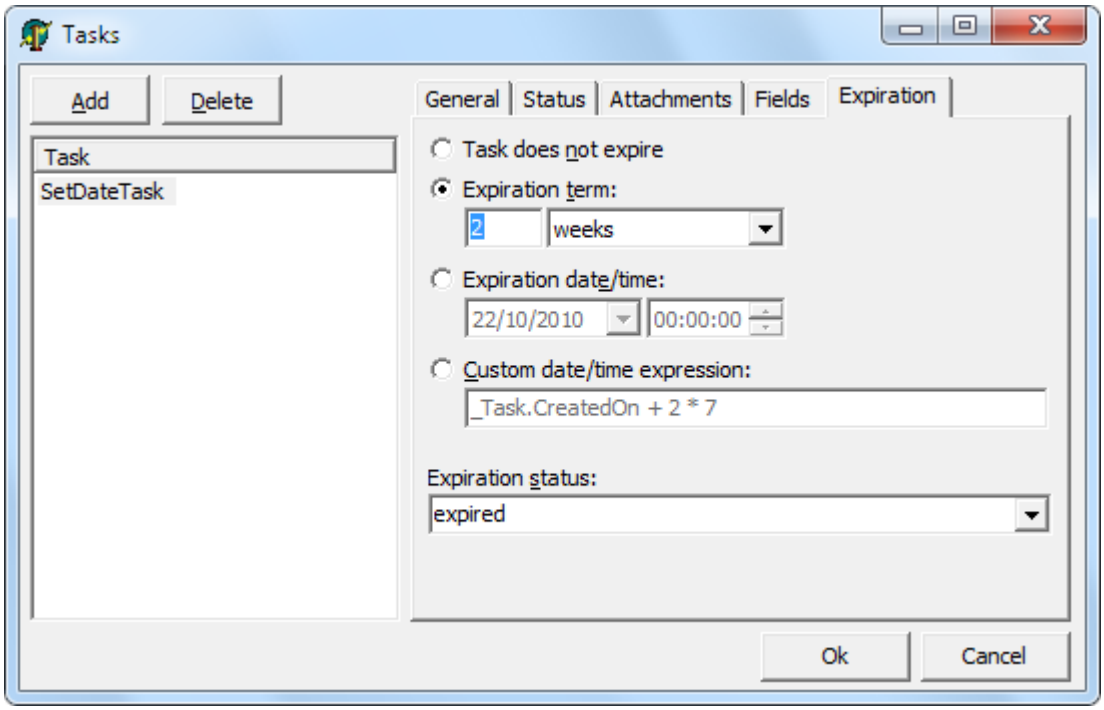
Task does not expire
This is the default option. If checked, the task will never expire, and will keep assigned to the current user/group until finished (changed to a completion status).

Expiration term
Check this option to enter an expiration term for the task, and enter the amount of days, weeks or months (integer or floating point value). The expiration date will be calculated from the creation date of the task.

Expiration date/time
Check this option to enter a fixed due date/time for the task.

Custom date/time expression
This option allows to enter a custom expression to evaluate the task expiration date/time. The expression must return a DateTime value and may use variables from the current workflow, task properties (is common to use *_Task.CreatedOn* property to retrieve the task creation date/time and calculate the expiration date), as well as all the features allowed in expressions.

Expiration status
Determines the status to which the task will be automatically changed after expiring. It must be a completion status.



Approval block

Overview: It's a special task block which has a single approval task definition.

Allowed inputs: many
Allowed outputs: many (restricted to status list)

Description:
The approval block is just a task block which has a single task definition. This task definition is an approval task definition and it's a regular task definition with the difference that some properties are already initialized, with the subject, description, and specially the status list.

The approval task comes with three valid status in status list: "opened", "approved" and "rejected". The approved and rejected status are completion status for the task.

You can change the approval task definition properties as you want, just like in a task block. The only difference to the task block is that you cannot create more than one task in the approval block.

Script block

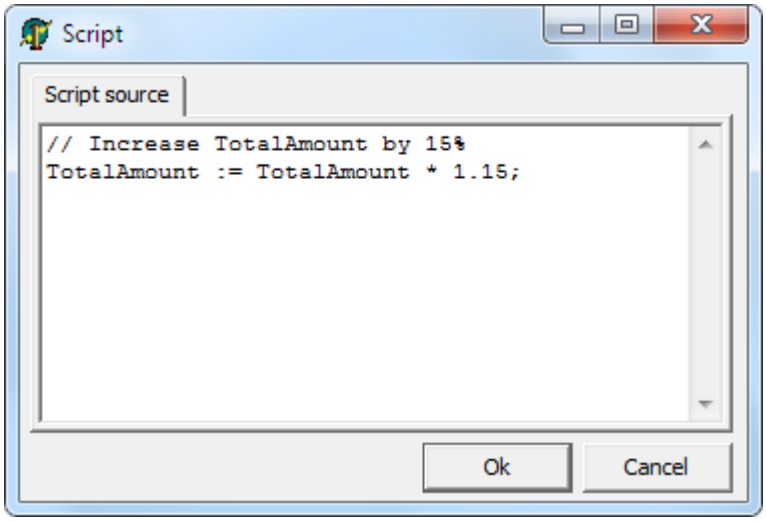
Overview: Executes a script code.

Allowed inputs: many
Allowed outputs: one (if the script does not return any value) or many (depending on possible script results)

Description:
The script block just executes a script code. In most cases, the script block will have only one output. But you can also use multiple outputs from script block, it will depend on script result. You can define the script result by using *result* variable:

```
result := 'result1';
```

If you have more than one output, each leaving transition should have a label, and the execution flow will take the transition which label is the same as the script result. In the example above, you must have a transition labeled "result1" so the execution will follow that path.



Run workflow block

Overview: runs a separated workflow instance.

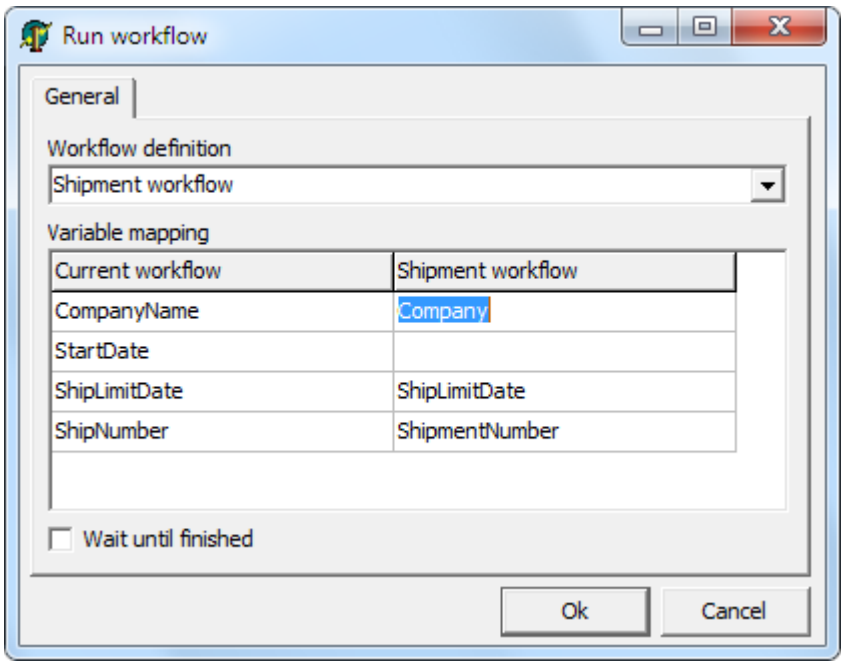
Allowed inputs: many
Allowed outputs: 1

Description:
The run workflow block allows running a new workflow (subworkflow), separated from the current instance, in a synchronous or asynchronous way. To exchange information between the workflow instances, a variable mapping should be specified in the block definition.

If "Wait until finished" flag is checked, the current workflow will wait the subworkflow to finish, in order to continue. The variable mapping is bidiretional in this case.

If "Wait until finished" flag in unchecked, the current workflow will continue execution normally regardless of subworkflow status. Variable mapping is unidirectional only.

The variable mapping lists which variables in the subworkflow will be updated. In the screenshot example below, variable "Company" in Shipment workflow (subworkflow) will receive the value of variable "CompanyName" in the current workflow. In the case of bidirectional mapping, when Shipment workflow finishes, the value of "CompanyName" will be updated again, with the value of variable "Company".



Database SQL Block

Overview: Run an SQL statement in the database.

Allowed inputs: many
Allowed outputs: 1

Description:
This block allows the you to specify an SQL statement in the database. You can use expressions in the SQL statement.

Parameters

- *SQL Statement*: Contains the SQL statement to be executed in the database. Supports expressions. Example:

```
Update Invoice Set Status = 3 Where InvoiceId = [InvoiceId]
```

Send Mail Block

Overview: Sends an e-mail message.

Allowed inputs: many
Allowed outputs: 1

Description:
This block sends an e-mail using the existing e-mail notification settings.

Parameters

- *To*: The e-mail address to send the e-mail (recipient). Supports expressions. Examples:
  - `[UserEmail]`
  - `john@foo.com`
- *Cc*: E-mail address that will receive a copy of e-mail message (carbon copy). Supports expressions.
- *Bcc*: E-mail address that will receive a blind carbon copy of e-mail message (blind carbon coby). This means this e-mail address will not be visible to other recipients. Supports expressions.
- *Subject*: The subject of the e-mail message. Supports expressions. Example:
  - `Please review invoice #[InvoiceId]`
- *Message*: The content (body) of e-mail. Supports expressions.

Comment Block

Overview: Shows a comment.

Allowed inputs: none
Allowed outputs: none

Description:
Adds a visual element to the diagram containing a fixed text. This block doesn't affect the behavior of diagram and is just used for visual indication. If you want text that supports expressions, use Text Block.

Text Block

Overview: Displays a dynamic text in diagram.

Allowed inputs: none
Allowed outputs: none

Description:
Use this block to display a text in any place of the diagram which can change according to workflow context. The main difference between this block and Comment block is that it supports expressions and has no other visual elements besides the text itself. So you can use it to display dates, variable values, etc., over or close any other diagram object.

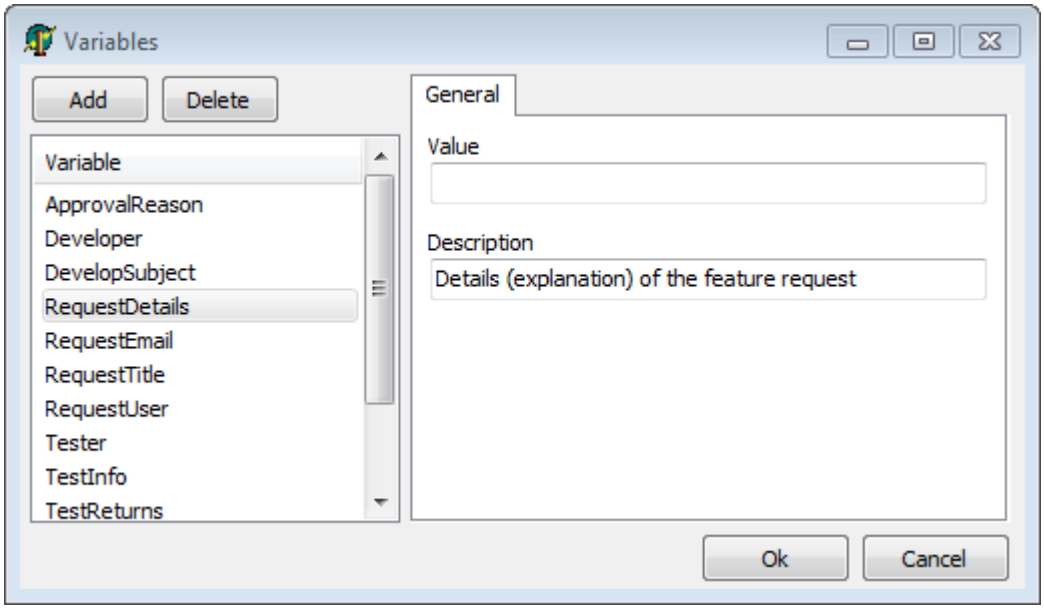
Workflow variables

A workflow variable is a named "slot" in a workflow where you can save information, just like a variable in a program.

You create the variable in the workflow definition, and each workflow instance created from the workflow definition will have a copy of that workflow variable. So, for example, a workflow definition for order processing might have the workflow variable "OrderNo". Once a workflow instance is created, the OrderNo variable will be there, and you can read/write values from/to that variable, and it's valid only for that workflow instance.

To define a workflow variable:

1. Open the workflow definition editor.
2. Open the menu option *Workflow* | *Variables...*
3. The variable editor will be displayed.



The variable editor shows a list of defined workflow variables. You can add and delete variables using "Add" and "Delete" buttons.

All you need to do is define a name for the variable (in this example, two variables named "CompanyName" and "StartDate"). Optionally you can define a start value for the variable, in the "Value" edit box.

You can also use the "Description" field to add comments to variable explaining what is it used for (documentation of the variable).

Once a workflow variable is defined you can use them in expressions and scripts.

Attachments

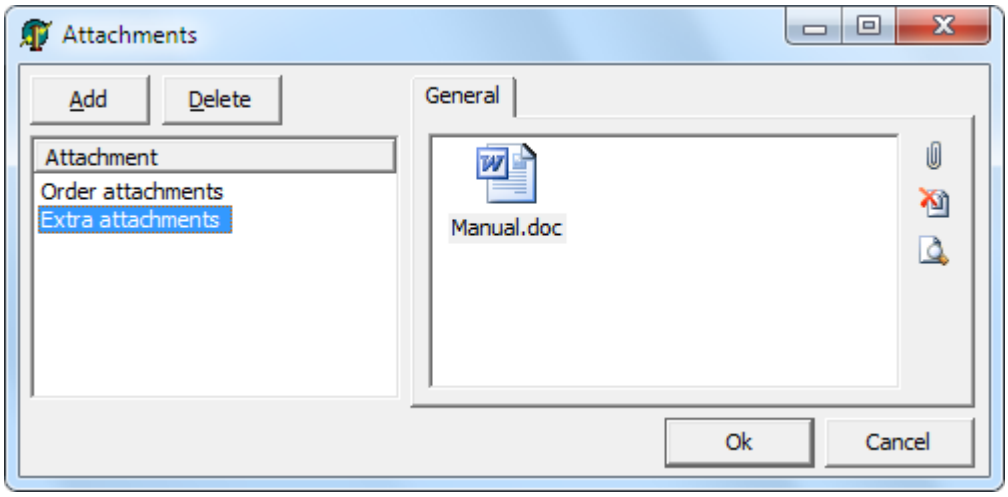
Attachments are a powerful feature that allows each workflow instance to have one or more files associated with it. Users can add, edit or remove attachments (depending on their attachment permissions) while dealing with the tasks.

As an example, a user can attach a file (or a set of files) to a task, and then another task can be created for another user, and this new user can see the file attached by the previous one. Or, users can edit and update attachments along the workflow execution. This makes stronger collaboration between users while a workflow instance is being executed.

An *attachment* is actually a container for a group of files (*attachment items*). These "containers" (attachments) can created in the workflow definition, and several attachments can be created. By default a single attachment is always created in the workflow definition, named "Attachments".

To define attachments in a workflow definition:

1. Open the workflow definition editor.
2. Open the menu option *Workflow* | *Attachments...*
3. The attachment editor will be displayed.



Here you can create several attachments, and name each one. In the example above, two attachments were created: "Order attachments" and "Extra attachments".

Note that you can add attachment items (files) in the attachment in this window. But remember that this is a workflow definition, several workflow instances will be created from this one. If you add a file here, that file will be present in each workflow instance created. So, in general, you only create empty attachments here, and each workflow instance will have its own files in there, if any.

While an attachment is at a workflow instance level and you can manipulate attachments any time, they are strongly related to task instances. When a task instance is created, it is listed in the task list dialog. The attachments are also displayed in that dialog (if the task definition allowed it in the attachment permissions). And then users can add, edit or remove attachments. When the task instance is saved by the user, the files (attachment items) are updated in the attachment and are saved together with the workflow instance.

Expressions

Expressions are a powerful way to customize the workflow definition. You can use expressions in several properties of some blocks, specially in task definition properties of a task block. When the property is about to be used, all expressions in the text are converted to their values. Expressions are identified by brackets "[" and "]". Below are examples of expression usage:

Subject: This is a subject about order number [OrderNo].
Description: Please mr. [UserName], solve this task until date [DateToStr(StartDate + 30)].

In these examples we have three expressions: `OrderNo`, `UserName` and `DateToStr(StartDate + 30)`. Note that expressions use workflow variables. The value of the workflow variable is evaluated and used in the expression. As an example, the result text, after evaluating the expressions, would be:

Subject: This is a subject about order number 1042.
Description: Please mr. Smith, solve this task until date 12-05-2020.

Besides workflow variables, expressions also accept:

- Aritmetic operators
  - +, -, /, *, div, mod
- Boolean/logical operators
  - and, or, not, xor
- Relational operators
  - <>, =, <, >, <=, >=
- Bitwise operators
  - shl, shr
- Numeric constants
  - 153 (integer), 152.43 (decimal), $AA (hexa)
- String constants
  - 'This is a text'
- Char constants
  - #13 (return character)
- Delphi-like functions and procedures
  - Abs
  - AnsiCompareStr
  - AnsiCompareText
  - AnsiLowerCase
  - AnsiUpperCase
  - Append
  - ArcTan
  - Assigned
  - AssignFile
  - Beep
  - Chdir
  - Chr
  - CloseFile
  - CompareStr
  - CompareText
  - Copy
  - Cos
  - CreateOleObject
  - Date
  - DateTimeToStr
  - DateToStr
  - DayOfWeek

- Dec
- DecodeDate
- DecodeTime
- Delete
- EncodeDate
- EncodeTime
- EOF
- Exp
- FilePos
- FileSize
- FloatToStr
- Format
- FormatDateTime
- FormatFloat
- Frac
- GetActiveOleObject
- High
- Inc
- IncMonth
- InputQuery
- Insert
- Int
- IntToHex
- IntToStr
- IsLeapYear
- IsValidIdent
- Length
- Ln
- Low
- LowerCase
- Now
- Odd
- Ord
- Pos
- Raise
- Random
- ReadLn
- Reset
- Rewrite
- Round
- ShowMessage
- Sin
- Sqr
- Sqrt
- StrToDate
- StrToDateTime
- StrToFloat
- StrToInt

- StrToIntDef
- StrToTime
- Time
- TimeToStr
- Trim
- TrimLeft
- TrimRight
- Trunc
- UpperCase
- VarArrayCreate
- VarArrayHighBound
- VarArrayLowBound
- VarIsNull
- VarToStr
- Write
- WriteLn

Scripts

You can use scripts in Workflow Studio, like in the Script Block, for example.

Scripts are a powerful way to customize your workflow definition. You can do various tasks with a script block that would not be possible to do with other blocks. The default syntax language for script is Pascal. So, you can do almost everything you can do in regular Pascal.

Scripts are also a way to manipulate workflow variables. In scripts they are just regular variables. For example, if you have defined a workflow variable named "TotalAmount", you can read the variable value using this code:

```
//Calculate comission for the sale
Comission := TotalAmount * 0.2;
```

and also change the variable value using this code:

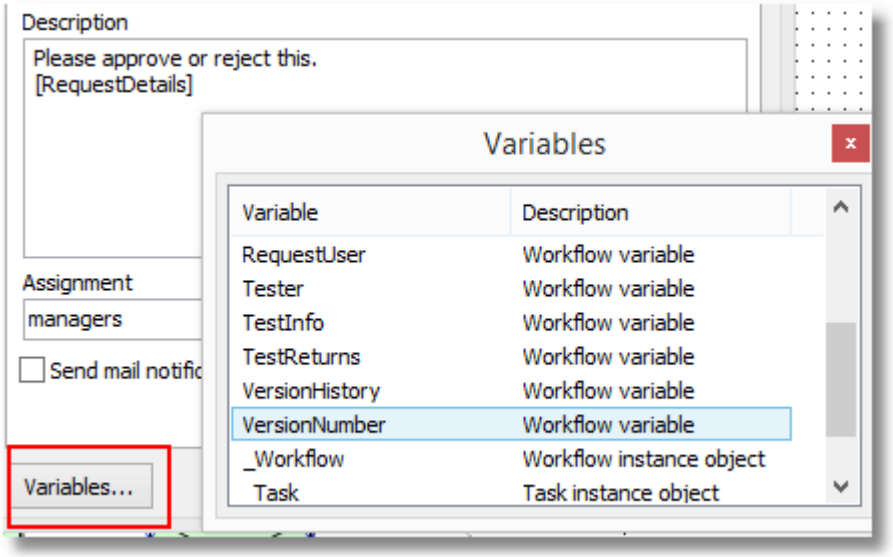
```
//Increase TotalAmount by 15%
TotalAmount := TotalAmount * 1.15;
```

Avoid to use message boxes and other dialogs or windows that requires user interaction for the script to continue, this might cause problems. Keep in mind that the workflow is running in background in a thread, and all actions performed by the workflow should be silent and smooth. If you need user interaction you often need to use a task block to create a task for the user.

Variables Dialog

When visually creating a workflow definition, you will use dialogs to edit the properties of several different blocks. Each of those blocks might have parameters that accept expressions.

In every dialog that has parameters supporting expressions you will find a button named "Variables..." which opens the Variables Dialog. This dialog shows all the variables that can be used in expressions, and allows you to drag and drop a specified variable to the parameter control. This will create an expression with the variable name in the control.



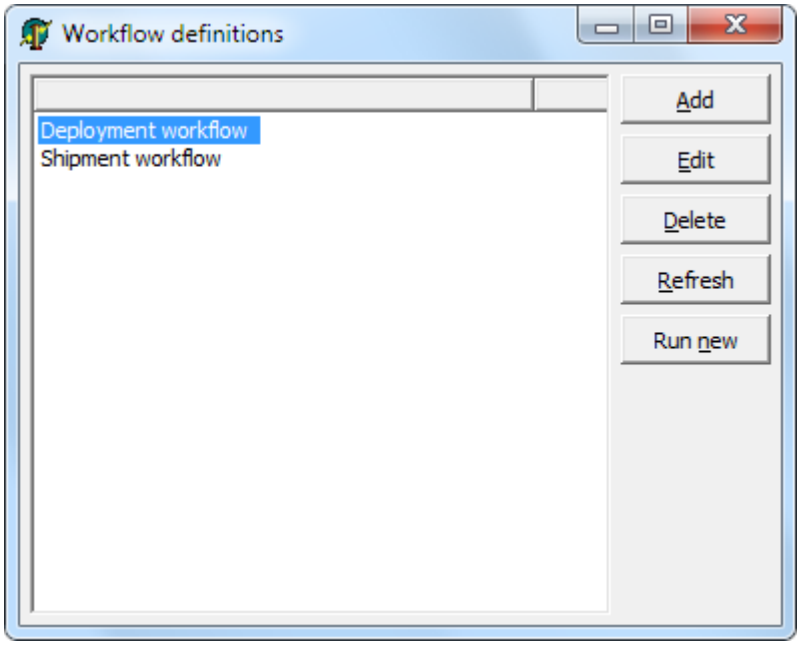
User interface windows

Workflow definitions dialog

The workflow definitions dialog lists all the workflow definitions saved in the database. You can open it by using *TWorkflowUserInterface* component:

```
WorkflowUserInterface1.ShowWorkflowDefinitionsDlg;
```

A windows like this will open:



In this window you can add, edit and delete workflow definitions. Buttons available:

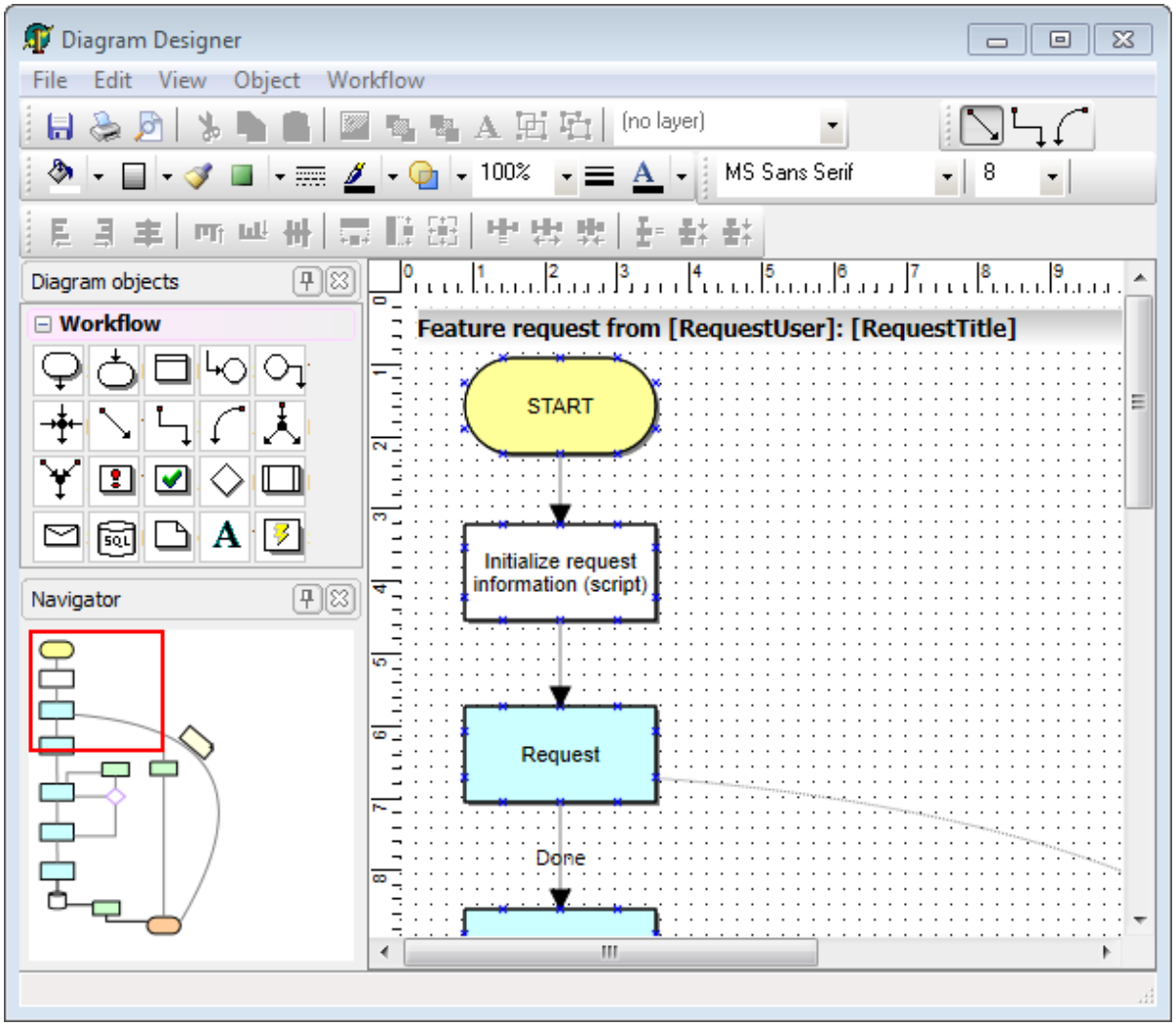
- **Add:** Adds a new workflow definition to database.
- **Edit:** Opens the workflow definition editor to edit the selected item.
- **Delete:** Removes the workflow definition from the database
- **Refresh:** Updates the list of workflow definitions from the database
- **Run new:** Creates and runs a new workflow instance based on the selected workflow definition.

Workflow definition editor

The workflow definition editor is where you create and edit workflow definitions. You can open it to edit a workflow definition by using *TWorkflowUserInterface* component:

```
WorkflowUserInterface1.EditWorkflowDefinition(MyWorkflowDefinitionObject);
```

A windows like this will open:



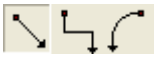
In the workflow definition editor you can do several tasks. Below are the most common ones:

Adding objects to diagram

To add objects to diagram, click one of the objects in the object toolbar, and then click in the diagram at the position you want the object to be inserted (or press the mouse button, move the mouse and release the button, to insert the object with a specified size).

Creating transitions between objects

You can create a transition between block by choosing one of the transitions types in the transition toolbar:



If a transition type is already selected (button pressed), you don't need to reselect the transition type every time you want to create a transition.

Once a transition type is selected, press the mouse button in any link point of the source block (a link point is the blue "x" displayed in the diagram object), drag the mouse, and then release the mouse button in any link point of the target block. A transition will be created connecting the source block to the target block.

Changing visual appearance of diagram objects

You can change visual appearance of diagram objects by using some options in the menu and/or the toolbars. You can change background color, border color, border style, brush style, pen width, font, and more. The appearance of diagram objects do not affect the way the workflow definition will behave, it's just for visual purposes.

Saving

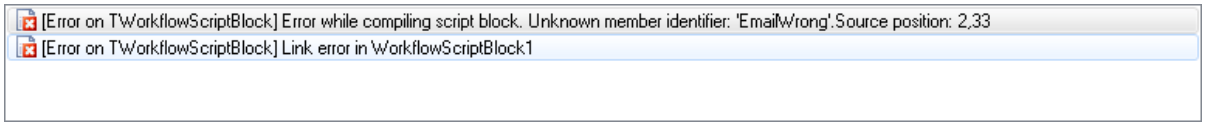
Once the diagram is built, save it by choosing the menu option *File* | *Save*, or pressing the save button in the toolbar.

Workflow definition options

Using the menu *Workflow*, you can click one of the submenu options to define some specific options for the workflow definition, like workflow variables and workflow attachments.

Workflow validation

By pressing *Ctrl+F9* or choosing menu option "*Workflow* | *Check Workflow*", you invoke the workflow definition validator which will check for problems in the workflow. If there are any issues with the workflow definition, a panel with errors and warnings will be displayed at the bottom of editor:



Other operations

The workflow definition editor also provides:

- preview/printing capabilities;
- clipboard operations;
- diagram navigator;
- top and left rulers;
- grid;
- and other features.

Task list dialog

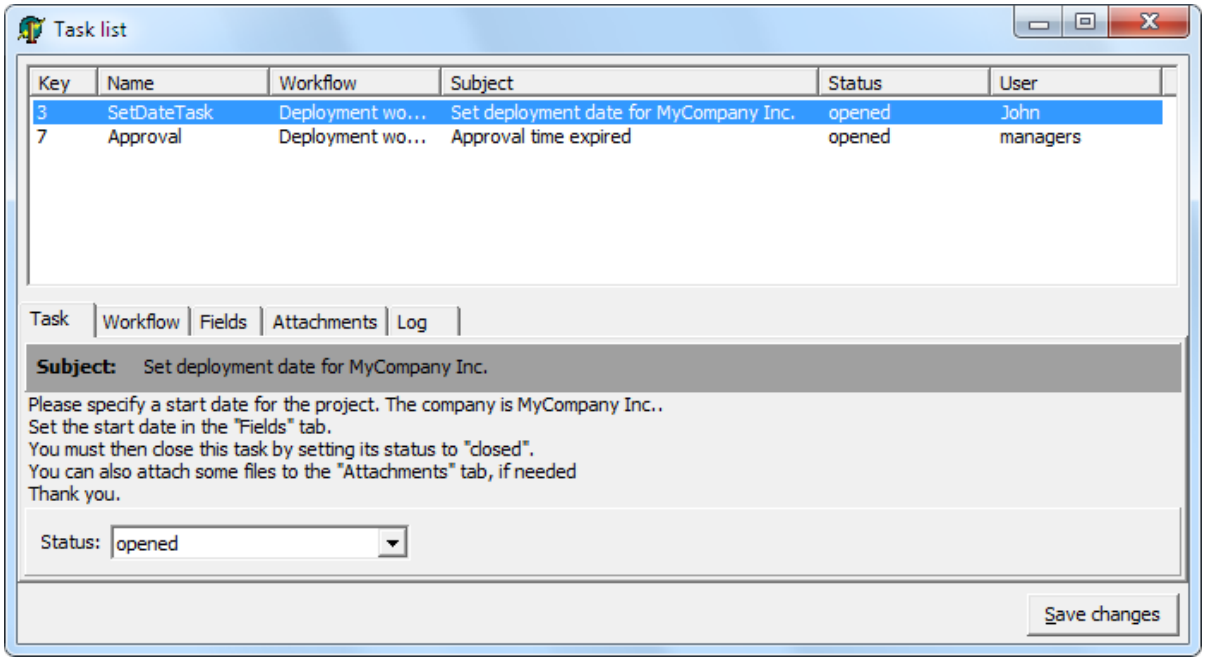
The task list dialog is the main window for user interface. It displays all the task instances assigned to an user or to a specific workflow instance. In a production environment, this dialog will be used daily by users to check the pending tasks for all current business processes.

To open the task list dialog, use the *TWorkflowUserInterface* component:

```
//Shows all tasks assigned to the user 'scott'
WorkflowUserInterface1.ShowUserTasksDlg('scott');
//Shows all tasks assigned to users scott, tina and john
WorkflowUserInterface1.ShowUsersTasksDlg('scott,tina,john');
//Shows all tasks created from a specific workflow instance (key 29)
WorkflowUserInterface1.ShowWorkInsTasksDlg('29');
```

Note that you must pass the user id to the function, not the user name. To make the example above more clear, we considered that the user name is also the user id.

The following window will open:



Task list view

The task list view shows all the pending tasks for the user (it can also show closed tasks by using popup menu *View* | *Show all tasks*). The information displayed is:

- **Key:** The unique id for the task.
- **Name:** The name of the task definition which generated the task.
- **Workflow:** The name of the workflow definition which generated the workflow instance which the task belongs to.
- **Subject:** The subject of the task, as specified in the task definition.
- **Status:** Current status of the task.

- **User:** The user which the task is assigned to.

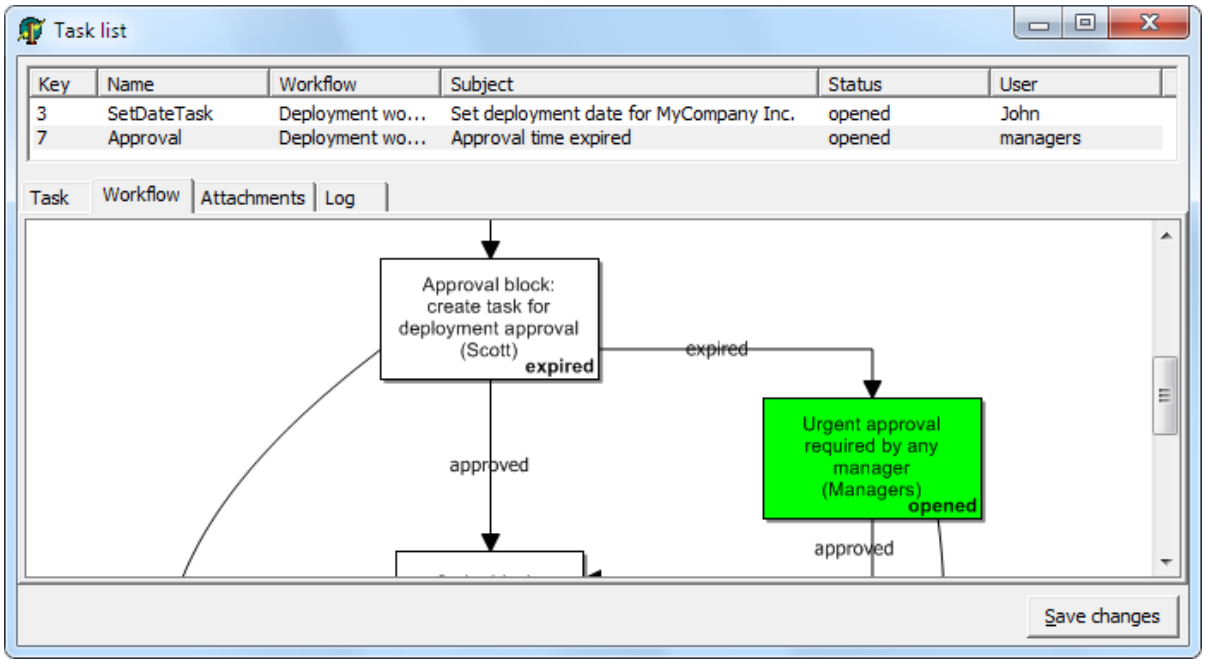
Task tab

The task tab shows the details of the task selected in the task list view. It shows the subject, the description of the task and the current status of the task.

Users can change the status by changing the combo value.

Workflow tab

The workflow tab shows the workflow diagram and in which situation the diagram is, related to the selected task in the task list view. It's the status of the workflow instance, not the task status. In general, if a task is opened, the workflow diagram is in a task block, because the task block waits for the task to be completed.



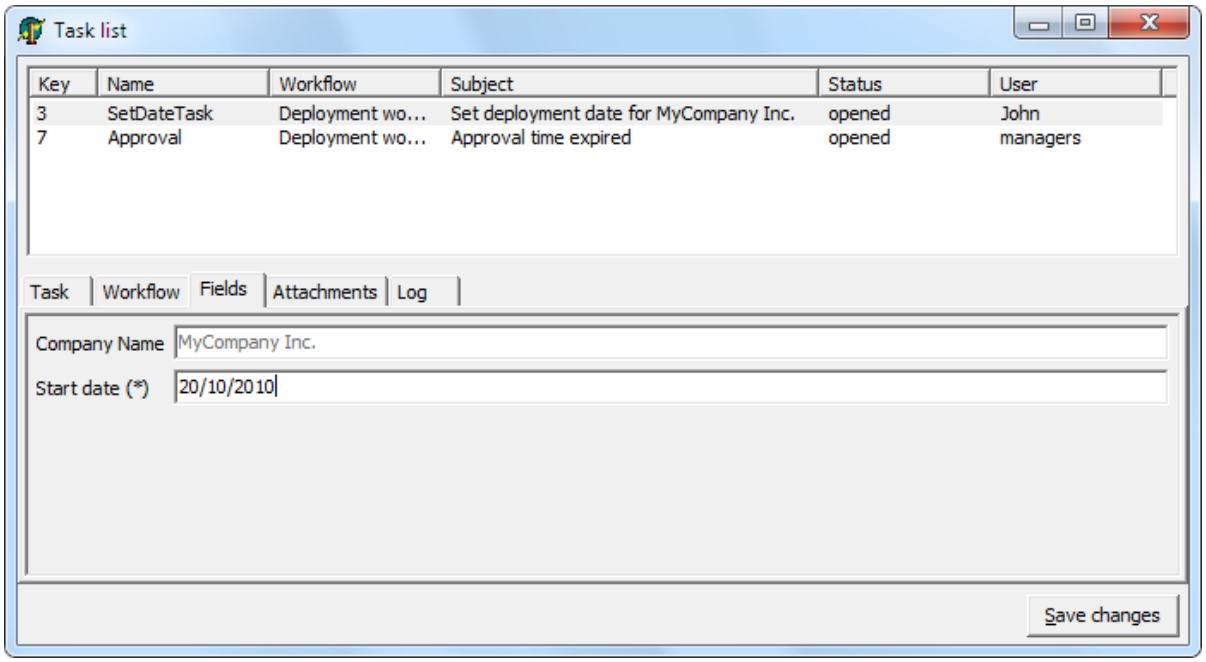
Fields tab

The fields tab shows the available fields for the current selected task. The fields are defined in the task definition properties.

Here users can see the value and also change the value of fields (if the field is not read-only).

Are mentioned in the task definition properties section, field values are read and written from/to workflow variables.

Fields marked with an asterisk (*) are required, and users cannot save changes to the task until such fields are filled.

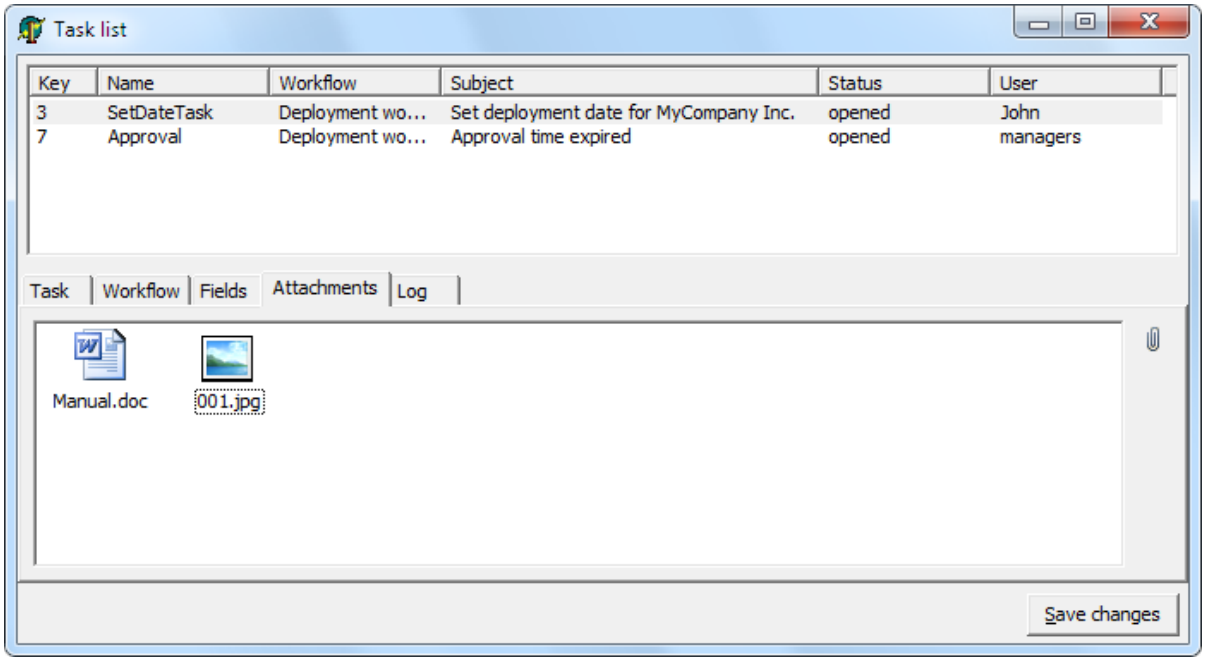


Attachments tab

The task list dialog shows a tab for each attachment in the workflow instance. In the screenshot below, a single attachment named "Attachments" was created, that's why the tab is named "Attachments". But you can have as many tabs as the number of attachments defined.

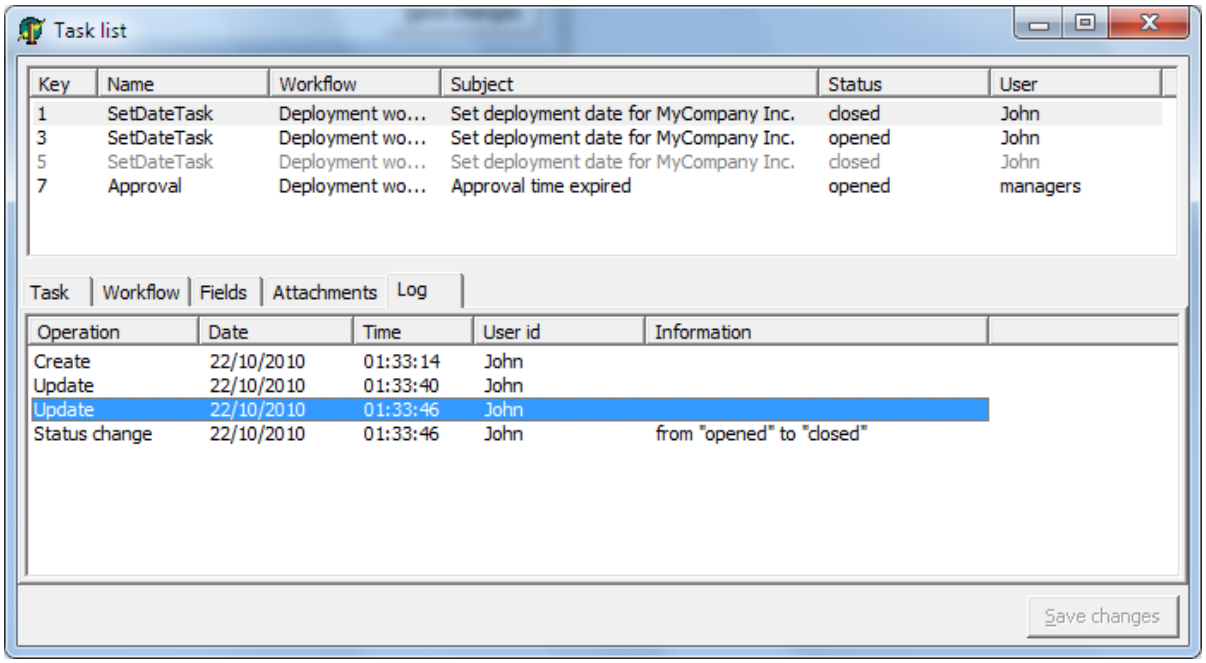
In each attachment tab you can add, remove, open and also edit attachments (depending on the attachment permissions defined in the task definition properties). You use the buttons at the right to perform these operations. You can also drag and drop files to the attachment area to add new attachment files.

The changes made to the attachment files are only saved when the user clicks the "Save changes" button.



Log tab

The log tab shows all operations performed in the task by users. It's a log view where you can see when the task was created, updated, finished, and which user did that. The log also shows the status changes of the task.



Using Workflow Studio programmatically

This chapter describes how to use Workflow Studio programatically. It lists some common tasks and how to do them from Delphi code.

Running an instance based on a definition name

It might be a common task to run a workflow instance based on a workflow definition name. The code below shows how to do that. See also the full example of running a workflow instance from Delphi code.

```
function TForm1.RunSomeWorkflow(ADefinitionName: string);
var
  wdf : TWorkflowDefinition;
  wfi : TWorkflowInstance;
begin
  wdf := WorkflowStudio.WorkflowManager.FindWorkflowDefinitionByName(ADefinitionN
ame);
  wfi := WorkflowStudio.WorkflowManager.CreateWorkflowInstance(wdf);
  WorkflowStudio1.WorkflowEngine.RunWorkflow(wfi);
end;
```

Workflow with workflow instance variables

Workflow variables are a very used feature. You will often need to set or read workflow variable values to/from Delphi variables in order to make a strong integration of workflow with your application. The code below ilustrates how to set a variable value. See also the full example of running a workflow instance.

```
var
  wfi : TWorkflowInstance;
  wvar: TWorkflowVariable;
begin
  wvar := wfi.Diagram.Variables.FindByName('OrderNo');
  if Assigned(wvar) then
    wvar.Value := AOrderNo;
end;
```

Running an instance from code: full example

The following procedure below is a small example which shows how to run a workflow instance from Delphi code.

It runs the instance based on a workflow definition name, passes an order number so that it is included as a variable in the workflow instance (the variable "OrderNo" must already exist in the workflow definition), runs the instance and retrieve the record id for the newly created instance.

```
// Run a workflow definition from a specified definition name, and return the
record key
// in the function result. Set the workflow variable "OrderNo" from the AOrderNo
parameter
function TForm1.RunSomeWorkflow(ADefinitionName: string; AOrderNo: integer): stri
ng;
var
  wdf : TWorkflowDefinition;
  wfi : TWorkflowInstance;
  wvar: TWorkflowVariable;
  i: integer;
begin
  wdf := WorkflowStudio.WorkflowManager.FindWorkflowDefinitionByName(ADefinitionN
ame);
  wfi := WorkflowStudio.WorkflowManager.CreateWorkflowInstance(wdf);
  result := wfi.Key;
  wvar := wfi.Diagram.Variables.FindByName('OrderNo');
  if Assigned(wvar) then
    wvar.Value := AOrderNo;
  WorkflowStudio1.WorkflowEngine.RunWorkflow(wfi);
end;
```

Retrieve the list of tasks for a specified user

The code below retrieves the list of tasks for a specified user. You can also check the Count property of the list to see if the user has no open tasks assigned to him/her (Count = 0 means no tasks).

```
function TForm1.CreateTaskListForUser(UserID: string): TTaskInstanceList;
begin
  result := TTaskInstanceList.Create(TTaskInstanceItem);
  WorkflowStudio.TaskManager.LoadTaskInstanceList(result, tfUser, UserID, true);
end;
```

Creating and editing a workflow definition

The code below creates a new workflow definition in database named "order processing" and opens the workflow definition editor for editing the newly created defition.

```
procedure TForm1.CreateAndEditDefinition(AName: string);
var
   wdf : TWorkflowDefinition;
begin
  // First check if the workflow definition already exists
  wdf := WorkflowStudio.WorkflowManager.FindWorkflowDefinitionByName(AName);
  if not Assigned(wdf) then
  begin
    wdf := TWorkflowDefinition.Create(nil);
    wdf.Name := AName;
    WorkflowStudio.WorkflowManager.SaveWorkflowDefinition(wdf);
  end;
  // Optionally set dimensions of workflow editor window
  WorkflowStudio.UserInterface.WorkflowEditorWidth := 1024;
  WorkflowStudio.UserInterface.WorkflowEditorHeight := 800;

  // Open the editor
  WorkflowStudio.UserInterface.EditWorkflowDefinition(wdf);
  wdf.Free;
end;
...
begin
   CreateAndEditDefinition('order processing');
end;
```

Running workflow instances for expired tasks

Workflow tasks can have defined a date/time for expiration. If a task has a defined expiration date/time, when it exceeds this date/time without being closed by an user (changed to a completion status), its status is automatically changed to an expiration status.

However, this expiration of tasks is not done automatically by Workflow Studio. Since it requires a monitor being executed periodically to run the pending workflows and check for the tasks to be expired, you have to implement this monitor in your application, according to your needs (for example, a program scheduled in system task scheduler, a service, or even a timer inside the application).

All that needs to be done by this monitor is call a method from workflow engine:

```
WorkflowStudio.WorkflowEngine.RunPendingWorkflowInstances;
```

Status Templates

You can programatically create status templates to make it easy for your end-user to define a list of status when using Task blocks.

A status template is just predefined named list of status items like "Open", "Approved" and "Rejected". When the user is creating status items in the task definition properties, he can select one of the templates to automatically define all the status items without needing to insert each one individually. To indicate a status is a completion status you must prefix the status name with "*" (asterisk) character.

To create the templates, you use *WorkflowManager.Templates* property of TWorkflowStudio object, this way:

```
uses
  {...}, wsClasses;

var
  Template: TWorkflowTemplate;

Template := WorkflowStudio1.WorkflowManager.Templates.Add(wttTaskStatus, 'Approva
tion');
Template.Lines.Add('Open');
Template.Lines.Add('*Approved'); // completion status
Template.Lines.Add('*Rejected'); // completion status

Template := WorkflowStudio1.WorkflowManager.Templates.Add(wttTaskStatus, 'Open/
Done');
Template.Lines.Add('Open');
Template.Lines.Add('*Done'); // completion status
```

Extending the scripting system

Workflow Studio provides a scripting system which can be used in several places of Workflow Studio framework. Expressions use the scripting system, and the script block as well, which runs scripts. You can increase integration between Workflow Studio and your Delphi application by extendeding the scripting system.

You can register your own classes, methods, properties, variables, functions and procedures so they can be accessible from script. The following topics describe some common tasks to extend the scripting system.

The examples shown in the following topics use a Scripter object and describe how to register new components, methods, classes and properties to a scripter component by using methods like DefineClass, DefineProp, etc.. However, Workflow Studio creates a new scripter component instance for each script block that is used in a workflow instance. Due to that, you must use *OnGlobalScripterCreate* event to make sure you initialize all scripter components in the system. The following steps show how to do that. The OnGlobalScripterCreate is a global variable of type TNotifyEvent declared in `Wf.Script.pas` unit. First of all, you need to set that global variable to a method in your application:

```
// PrepareScripter is a method in any of your existing and instantiated classes
OnGlobalScripterCreate := PrepareScripter;
```

Then you declare your global initialization method PrepareScripter. The *Sender* parameter is the scripter component, so you just need to typecast it to a generic TwfCustomScripter class. Here is an example:

```
procedure TMyDataModule.PrepareScripter(Sender: Tobject);
begin
  with TwfCustomScripter(Sender) do
  begin
    // Examples:
    AddComponent(Form1);
    DefineMethod(...);
  end;
end;
```

Accessing Delphi objects

The following topics show how to register Delphi objects in the scripting system.

Registering Delphi components

One powerful feature of scripter is to access Delphi objects. This way you can make reference to objects in script, change its properties, call its methods, and so on. However, every object must be registered in scripter so you can access it. For example, suppose you want to change caption of form (named *Form1*). If you try to execute this script:

SCRIPT:

```
Form1.Caption := 'New caption';
```

you will get "Unknown identifier or variable not declared: Form1". To make scripter work, use *AddComponent* method:

CODE:

```
Scripter.AddComponent(Form1);
```

Now scripter will work and form's caption will be changed.

Access to published properties

After a component is added, you have access to its published properties. That's why the caption property of the form could be changed. Otherwise you would need to register property as well. Actually, published properties are registered, but scripter does it for you.

Class registering structure

Scripter can call methods and properties of objects. But this methods and properties must be registered in scripter. The key property for this is *TatCustomScripter.Classes* property. This property holds a collection of registered classes (*TatClass* object), which in turn holds its collection of registered properties and methods (*TatClass.Methods* and *TatClass.Properties*). Each registered method and property holds a name and the wrapper method (the Delphi written code that will handle method and property).

When you registered *Form1* component in the previous example, scripter automatically registered *TForm* class in *Classes* property, and registered all published properties inside it. To access methods and public properties, you must registered them, as showed in the following topics.

Calling methods

To call an object method, you need to register it. For instance, if you want to call *ShowModal* method of a newly created form named "Form2". So we must add the form it to scripter using *AddComponent* method, and then register *ShowModal* method:

CODE:

```
procedure Tform1.ShowModalProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ReturnOutputArg(TCustomForm(CurrentObject).ShowModal);
end;

procedure TForm1.PrepareScript;
begin
  Scripter.AddComponent(Form2);
  with Scripter.DefineClass(TCustomForm) do
  begin
    DefineMethod('ShowModal', 0, tkInteger, nil, ShowModalProc);
  end;
end;
```

SCRIPT:

```
ShowResult := Form2.ShowModal;
```

This example has a lot of new concepts. First, component is added with *AddComponent* method. Then, *DefineClass* method was called to register *TCustomForm* class. DefineClass method automatically check if *TCustomForm* class is already registered or not, so you don't need to do test it.

After that, *ShowModal* is registered, using *DefineMethod* method. Declaration of DefineMethod is:

```
function DefineMethod(AName: string; AArgCount: integer; AResultDataType: TatType
Kind;
  AResultClass: TClass; AProc: TMachineProc; AIsClassMethod: boolean = false): Ta
tMethod;
```

- **AName** receives 'ShowModal' - it's the name of method to be used in script.
- **AArgCount** receives 0 - number of input arguments for the method (none, in the case of ShowModal).
- **AResultDataType** receives *tkInteger* - it's the data type of method result. ShowModal returns an integer. If method is not a function but a procedure, AResultDataType should receive tkNone.
- **AResultClass** receives nil - if method returns an object (not this case), then AResultClass must contain the object class. For example, *TField*.
- **AProc** receives *ShowModalProc* - the method written by the user that works as ShowModal wrapper.

And, finally, there is *ShowModalProc* method. It is a method that works as the wrapper: it implements a call to *ShowModal*. In this case, it uses some useful methods and properties of *TatVirtualMachine* class:

- property **CurrentObject** - contains the instance of object where the method belongs to. So, it contains the instance of a specified *TCustomForm*.

- method **ReturnOutputArg** - it returns a function result to scripter. In this case, returns the value returned by *TCustomForm.ShowModal* method.

More method calling examples

In addition to previous example, this one illustrates how to register and call methods that receive parameters and return classes. In this example, *FieldByName*:

SCRIPT:

```
AField := Table1.FieldByName('CustNo');
ShowMessage(AField.DisplayLabel);
```

CODE:

```
procedure TForm1.FieldByNameProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ReturnOutputArg(integer(TDataset(CurrentObject).FieldByName(GetInputArgAsStri
ng(0))));
end;

procedure TForm1.PrepareScript;
begin
  Scripter.AddComponent(Table1);
  with Scripter.DefineClass(TDataset) do
  begin
    DefineMethod('FieldByName', 1, tkClass, TField, FieldByNameProc);
  end;
end;
```

Very similar to Calling methods example. Some comments:

- *FieldByName* method is registered in *TDataset* class. This allows use of FieldByName method by any TDataset descendant inside script. If FieldByName was registered in a *TTable* class, script would not recognize the method if component was a *TQuery*.
- *DefineMethod* call defined that *FieldByName* receives one parameters, its result type is *tkClass*, and class result is *TField*.
- Inside *FieldByNameProc*, *GetInputArgAsString* method is called in order to get input parameters. The 0 index indicates that we want the first parameter. For methods that receive 2 or more parameters, use GetInputArg(1), GetInputArg(2), and so on.
- To use *ReturnOutputArg* in this case, we need to cast resulting *TField* as integer. This must be done to return any object. This is because ReturnOutputArg receives a *Variant* type, and objects must then be cast to integer.

Acessing non-published properties

Just like methods, properties that are not published must be registered. The mechanism is very similar to method registering, with the difference we must indicate one wrapper to get property value and another one to set property value. In the following example, the "AsFloat" property of *TField* class is registered:

SCRIPT:

```
AField := Table1.FieldByName('Company');
ShowMessage(AField.Value);
```

CODE:

```
procedure TForm1.GetFieldValueProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ReturnOutputArg(TField(CurrentObject).Value);
end;

procedure TForm1.SetFieldValueProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    TField(CurrentObject).Value := GetInputArg(0);
end;

procedure TForm1.PrepareScript;
begin
  with Scripter.DefineClass(TField) do
  begin
    DefineProp('Value', tkVariant, GetFieldValueProc, SetFieldValueProc);
  end;
end;
```

DefineProp is called passing a *tkVariant* indicating that *Value* property is *Variant* type, and then passing two methods *GetFieldValueProc* and *SetFieldValueProc*, which, in turn, read and write value property of a *TField* object. Note that in SetFieldValueProc method was used *GetInputArg* (instead of *GetInputArgAsString*). This is because GetInputArg returns a variant.

Registering indexed properties

A property can be indexed, specially when it is a *TCollection* descendant. This applies to dataset fields, grid columns, string items, and so on. So, the code below illustrates how to register indexed properties. In this example, *Strings* property of *TStrings* object is added in other to change memo content:

SCRIPT:

```
ShowMessage(Memo1.Lines.Strings[3]);
Memo1.Lines.Strings[3] := Memo1.Lines.Strings[3] + ' with more text added';
```

CODE:

```
procedure TForm1.GetStringsProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ReturnOutputArg(TStrings(CurrentObject).Strings[GetArrayIndex(0)]);
end;

procedure TForm1.SetStringsProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    TStrings(CurrentObject).Strings[GetArrayIndex(0)] := GetInputArgAsString(0);
end;

procedure TForm1.PrepareScript;
begin
  Scripter.AddComponent(Memo1);
  with Scripter.DefineClass(TStrings) do
  begin
    DefineProp('Strings', tkString, GetStringsProc, SetStringsProc, nil, false,
1);
  end;
end;
```

Some comments:

- *DefineProp* receives three more parameters than *DefineMethod*: **nil** (class type of property, it's nil because property is string type), **false** (indicating the property is not a class property) and **1** (indicating that property is indexed by 1 parameter. This is the key param. For example, to register *Cells* property of the grid, this parameter show be 2, since Cells depends on Row and Col).
- In *GetStringsProc* and *SetStringsProc*, *GetArrayIndex* method is used to get the index value passed by script. The 0 param indicates that it is the first index (in the case of *Strings* property, the only one).

Retrieving name of called method or property

You can register the same wrapper for more than one method or property. In this case, you might need to know which property or method was called. In this case, you can use *CurrentPropertyName* or *CurrentMethodName*. The following example illustrates this usage.

```
procedure TForm1.GenericMessageProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    if CurrentMethodName = 'MessageHello' then
      ShowMessage('Hello')
    else if CurrentMethodName = 'MessageWorld' then
      ShowMessage('World');
end;

procedure TForm1.PrepareScript;
begin
  with Scripter do
  begin
    DefineMethod('MessageHello', 1, tkNone, nil, GenericMessageProc);
    DefineMethod('MessageWorld', 1, tkNone, nil, GenericMessageProc);
  end;
end;
```

Registering methods with default parameters

You can also register methods which have default parameters in scripter. To do that, you must pass the number of default parameters in the *DefineMethod* property. Then, when implementing the method wrapper, you need to check the number of parameters passed from the script, and then call the Delphi method with the correct number of parameters. For example, let's say you have the following procedure declared in Delphi:

```
function SumNumbers(A, B: double; C: double = 0; D: double = 0; E: double = 0): d
ouble;
```

To register that procedure in scripter, you use *DefineMethod* below. Note that the number of parameters is 5 (five), and the number of default parameters is 3 (three):

```
Scripter.DefineMethod('SumNumbers', 5 {number of total parameters},
  tkFloat, nil, SumNumbersProc, false, 3 {number of default parameters});
```

Then, in the implementation of *SumNumbersProc*, just check the number of input parameters and call the function properly:

```
procedure TForm1.SumNumbersProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
  begin
    case InputArgCount of
      2: ReturnOutputArg(SumNumbers(GetInputArgAsFloat(0), GetInputArgAsFloat(1))
);
      3: ReturnOutputArg(SumNumbers(GetInputArgAsFloat(0), GetInputArgAsFloat(1),
           GetInputArgAsFloat(2)));
      4: ReturnOutputArg(SumNumbers(GetInputArgAsFloat(0), GetInputArgAsFloat(1),
           GetInputArgAsFloat(2), GetInputArgAsFloat(3)));
      5: ReturnOutputArg(SumNumbers(GetInputArgAsFloat(0), GetInputArgAsFloat(1),
           GetInputArgAsFloat(2), GetInputArgAsFloat(3), GetInputArgAsFloat(4)));
    end;
  end;
end;
```

Acessing Delphi functions, variables and constants

The following topics describe how to register regular procedures, functions and global variables in scripting system.

Overview

In addition to access Delphi objects, scripter allows integration with regular procedures and functions, global variables and global constants. The mechanism is very similar to accessing Delphi objects. In fact, scripter internally consider regular procedures and functions as methods, and global variables and constants are props.

Registering global constants

Registering a constant is a simple task in scripter: use *AddConstant* method to add the constant and the name it will be known in scripter:

CODE:

```
Scripter.AddConstant('MaxInt', MaxInt);
Scripter.AddConstant('Pi', pi);
Scripter.AddConstant('MyBirthday', EncodeDate(1992, 5, 30));
```

SCRIPT:

```
ShowMessage('Max integer is ' + IntToStr(MaxInt));
ShowMessage('Value of pi is ' + FloatToStr(pi));
ShowMessage('I was born on ' + DateToStr(MyBirthday));
```

Access the constants in script just like you do in Delphi code.

Acessing global variables

To register a variable in scripter, you must use *AddVariable* method. Variables can be added in a similar way to constants: passing the variable name and the variable itself. In addition, you can also add variable in the way you do with properties: use a wrapper method to get variable value and set variable value:

CODE:

```
var
  MyVar: Variant;
  ZipCode: string[15];

procedure TForm1.GetZipCodeProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ReturnOutputArg(ZipCode);
end;

procedure TForm1.SetZipCodeProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ZipCode := GetInputArgAsString(0);
end;

procedure TForm1.PrepareScript;
begin
  Scripter.AddVariable('ShortDateFormat', ShortDateFormat);
  Scripter.AddVariable('MyVar', MyVar);
  Scripter.DefineProp('ZipCode', tkString, GetZipCodeProc, SetZipCodeProc);
  Scripter.AddObject('Application', Application);
end;

procedure TForm1.Run1Click(Sender: TObject);
begin
  PrepareScript;
  MyVar := 'Old value';
  ZipCode := '987654321';
  Application.Tag := 10;
  Scripter.SourceCode := Memo1.Lines;
  Scripter.Execute;
  ShowMessage('Value of MyVar variable in Delphi is ' + VarToStr(MyVar));
  ShowMessage('Value of ZipCode variable in Delphi is ' + VarToStr(ZipCode));
end;
```

SCRIPT:

```
ShowMessage('Today is ' + DateToStr(Date) + ' in old short date format');
ShortDateFormat := 'dd-mmmm-yyyy';
ShowMessage('Now today is ' + DateToStr(Date) + ' in new short date format');

ShowMessage('My var value was "' + MyVar + '"');
MyVar := 'My new var value';

ShowMessage('Old Zip code is ' + ZipCode);
ZipCode := '109020';

ShowMessage('Application tag is ' + IntToStr(Application.Tag));
```

Calling regular functions and procedures

In scripter, regular functions and procedures are added like methods. The difference is that you don't add the procedure in any class, but in scripter itself, using *DefineMethod* method. The example below illustrates how to add *QuotedStr* and *StringOfChar* methods:

SCRIPT:

```
ShowMessage(QuotedStr(StringOfChar('+', 3)));
```

CODE:

```
{ TSomeLibrary }
procedure TSomeLibrary.Init;
begin
  Scripter.DefineMethod('QuotedStr', 1, tkString, nil, QuotedStrProc);
  Scripter.DefineMethod('StringOfChar', 2, tkString, nil, StringOfCharProc);
end;

procedure TSomeLibrary.QuotedStrProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ReturnOutputArg(QuotedStr(GetInputArgAsString(0)));
end;

procedure TSomeLibrary.StringOfCharProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ReturnOutputArg(StringOfChar(GetInputArgAsString(0)[1],
GetInputArgAsInteger(1)));
end;

procedure TForm1.Run1Click(Sender: TObject);
begin
  Scripter.AddLibrary(TSomeLibrary);
  Scripter.SourceCode := Memo1.Lines;
  Scripter.Execute;
end;
```

Since there is no big difference from defining methods, the example above introduces an extra concept: *libraries*. Note that the way methods are defined didn't change (a call to *DefineMethod*) and neither the way wrapper are implemented (*QuotedStrProc* and *StringOfCharProc*). The only difference is the way they are located: instead of *TForm1* class, they belong to a different class named *TSomeLibrary*. The following topic covers the use of libraries.

Using libraries

Libraries are just a concept of extending scripter by adding more components, methods, properties, classes to be available from script. You can do that by manually registering a single component, class or method. A library is just a way of doing that in a more organized way.

Delphi-based libraries

In script, you can use libraries for registered methods and properties. Look at the two codes below, the first one uses libraries and the second use the mechanism used in this doc until now:

CODE 1:

```
type
  TExampleLibrary = class(TatScripterLibrary)
  protected
    procedure CurrToStrProc(AMachine: TatVirtualMachine);
    procedure Init; override;
    class function LibraryName: string; override;
  end;

class function TExampleLibrary.LibraryName: string;
begin
  result := 'Example';
end;

procedure TExampleLibrary.Init;
begin
  Scripter.DefineMethod('CurrToStr', 1, tkInteger, nil, CurrToStrProc);
end;

procedure TExampleLibrary.CurrToStrProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ReturnOutputArg(CurrToStr(GetInputArgAsFloat(0)));
end;

procedure TForm1.Button1Click(Sender: TObject);
begin
  Scripter.AddLibrary(TExampleLibrary);
  Scripter.SourceCode := Memo1.Lines;
  Scripter.Execute;
end;
```

CODE 2:

```
procedure TForm1.PrepareScript;
begin
  Scripter.DefineMethod('CurrToStr', 1, tkInteger, nil, CurrToStrProc);
end;

procedure TForm1.CurrToStrProc(AMachine: TatVirtualMachine);
begin
  with AMachine do
    ReturnOutputArg(CurrToStr(GetInputArgAsFloat(0)));
end;

procedure TForm1.Button1Click(Sender: TObject);
begin
  PrepareScript;
  Scripter.SourceCode := Memo1.Lines;
  Scripter.Execute;
end;
```

Both codes do the same: add *CurrToStr* procedure to script. Note that scripter initialization method (*Init* in Code 1 and *PrepareScript* in Code 2) is the same in both codes. And so is *CurrToStrProc* method - no difference. The two differences between the code are:

- The class where the methods belong to. In Code 1, methods belong to a special class named *TExampleLibrary*, which descends from *TatScripterLibrary*. In Code 2, the belong to the current form (*TForm1*).
- In Code 1, scripter preparation is done adding *TExampleLibrary* class to scripter, using *AddLibrary* method. In Code 2, *PrepareScript* method is called directly.

So when to use one way or another? There is no rule - use the way you feel more confortable. Here are pros and cons of each:

Declaring wrapper and preparing methods in an existing class and object

- Pros: More convenient. Just create a method inside form, or datamodule, or any object.
- Cons: When running script, you must be sure that object is instantiated. It's more difficult to reuse code (wrapper and preparation methods).

Using libraries, declaring wrapper and preparing methods in a *TatScripterLibrary* class descendant

- Pros: No need to check if class is instantiated - scripter does it automatically. It is easy to port code - all methods are inside a class library, so you can add it in any scripter you want, put it in a separate unit, etc..
- Cons: Just the extra work of declaring the new class.

In addition to using *AddLibrary* method, you can use *RegisterScripterLibrary* procedure. For example:

```
RegisterScripterLibrary(TExampleLibrary);
RegisterScripterLibrary(TAnotherLibrary, True);
```

RegisterScripterLibrary is a global procedure that registers the library in a global list, so all scripter components are aware of that library. The second parameter of RegisterScripterLibrary indicates if the library is load automatically or not. In the example above, *TAnotherLibrary* is called with Explicit Load (True), while *TExampleLibrary* is called with Explicit Load false (default is false).

When explicit load is false (case of TExampleLibrary), every scripter that is instantiated in application will automatically load the library.

When explicit load is true (case of TAnotherLibrary), user can load the library dinamically by using *uses* directive:

SCRIPT:

```
uses Another;

// Do something with objects and procedures register by TatAnotherLibrary
```

Note that "Another" name is informed by *TatAnotherLibrary.LibraryName* class method.

The TatSystemLibrary library

There is a library that is added by default to all scripter components, it is the *TatSystemLibrary*. This library is declared in the `uSystemLibrary` unit. It adds commonly used routines and functions to scripter, such like *ShowMessage* and *IntToStr*.

Functions added by TatSystemLibrary

The following functions are added by the *TatSystemLibrary* (refer to Delphi documentation for an explanation of each function):

- Abs
- AnsiCompareStr
- AnsiCompareText
- AnsiLowerCase
- AnsiUpperCase
- Append
- ArcTan
- Assigned
- AssignFile
- Beep
- Chdir
- Chr
- CloseFile
- CompareStr
- CompareText
- Copy
- Cos
- CreateOleObject
- Date
- DateTimeToStr

- DateToStr
- DayOfWeek
- Dec
- DecodeDate
- DecodeTime
- Delete
- EncodeDate
- EncodeTime
- EOF
- Exp
- FilePos
- FileSize
- FloatToStr
- Format
- FormatDateTime
- FormatFloat
- Frac
- GetActiveOleObject
- High
- Inc
- IncMonth
- InputQuery
- Insert
- Int
- Interpret (*)
- IntToHex
- IntToStr
- IsLeapYear
- IsValidIdent
- Length
- Ln
- Low
- LowerCase
- Machine (*)
- Now
- Odd
- Ord
- Pos
- Raise
- Random
- ReadLn
- Reset
- Rewrite
- Round
- Scripter (*)
- SetOf (*)
- ShowMessage
- Sin

- Sqr
- Sqrt
- StrToDate
- StrToDateTime
- StrToFloat
- StrToInt
- StrToIntDef
- StrToTime
- Time
- TimeToStr
- Trim
- TrimLeft
- TrimRight
- Trunc
- UpperCase
- VarArrayCreate
- VarArrayHighBound
- VarArrayLowBound
- VarIsNull
- VarToStr
- Write
- WriteLn

All functions/procedures added are similar to the Delphi ones, with the exception of those marked with a "*", explained below:

```
procedure Interpret(AScript: string);
```

Executes the script source code specified by Ascript parameter

```
function Machine: TatVirtualMachine;
```

Returns the current virtual machine executing the script.

```
function Scripter: TatCustomScripter;
```

Returns the current scripter component.

```
function SetOf(array): integer;
```

Returns a set from the array passed. For example:

```
MyFontStyle := SetOf([fsBold, fsItalic]);
```

Removing functions from the System library

To remove a function from the system library, avoiding the end-user to use the function from the script, you just need to destroy the associated method object in the *SystemLibrary* class:

```
MyScripter.SystemLibrary.MethodByName('ShowMessage').Free;
```

About

This documentation is for TMS Workflow Studio.

In this section:

Copyright Notice

What's New

Getting Support

Breaking Changes

Copyright Notice

TMS Workflow Studio components trial version are free for use in non-commercial applications, that is any software that is not being sold in one or another way or that does not generate income in any way by the use of the application.

For use in commercial applications, you must purchase a single license or a site license of TMS Workflow Studio. A site license allows an unlimited number of developers within the company holding the license to use the components for commercial application development and to obtain free updates for a full version cycle and priority email support. A single developer license allows ONE developer within a company to use the components for commercial application development, to obtain free updates and priority email support. A single developer license is NOT transferable to another developer within the company or to a developer from another company. Both licenses allow royalty free use of the components when used in binary compiled applications.

IMPORTANT
TMS Workflow Studio components, trial or registered versions, cannot be used to create a commercial general purpose workflow application. The main purpose of applications created using TMS Workflow Studio components must as such be different from the generic workflow capabilities offered by the components.

The component cannot be distributed in any other way except through free accessible Internet Web pages or ftp servers. The component can only be distributed on CD-ROM or other media with written autorization of the author.

Online registration for TMS Workflow Studio is available at https://www.tmssoftware.com/site/orders.asp. Source code & license is sent immediately upon receipt of check or registration by email.

What's New

Version 2.20 (Nov-2023)

- **New: Delphi 12 Support.**

Version 2.19 (Feb-2023)

- **Improved**: Dutch translation updated.
- **Fixed:** Opening attachments was rarely opening the wrong file.
- **Improved:** Temporary attachment file now deleted after being edited/viewed.

Version 2.18 (Apr-2022)

- **New:** SendMail block now allows to setup the From field.
- **New:** SDAC driver and PostgreSQL script to create required tables and fields (both kind contributions from Adan).
- **Fixed:** Errors raised while executing script transitions were being ignore by the engine or error block not being executed when present.

Version 2.17 (Sep-2021)

- **New:** Delphi 11 / RAD Studio 11 support.
- **Fixed:** Task list taking too much memory for workflow definitions with many script blocks.

Version 2.16 (Mar-2021)

- **Improved:** Updated Dutch translation.
- **Fixed:** Setting `ThreadedExecution` to `True` by default to return to previous default behavior (regression).

Version 2.15 (Aug-2020)

- **Improved:** Workflow dialogs are now presented in correct size in HDPI and scaled forms.

Version 2.14 (Jun-2020)

- **New: Support for RAD Studio 10.4 Sydney.**

- **Improved:** In task view dialog, the combo to update task status was moved to the bottom panel, being accessible at all time, regardless of the tab selected in the dialog.

Version 2.13 (Jan-2020)

- **New: Czech language translation.**
- **New: French language translation.**
- **Improved:** Updates in Dutch translation.
- **Fixed:** Task expiration in hours, minutes or seconds was causing workflow definition error.
- **Fixed:** Workflow editor could not remove all attachments or all variables in a workflow definition.
- **Fixed:** Units in drivers folder caused Delphi IDE to hang due to include files.

Version 2.12 (Dec-2018)

- **New: Support for Delphi/C++Builder 10.3 Rio.**
- **New: ShowUserTasksDlg and similar functions now have an option "wfmNonModal" that allows showing the task window as non-modal.**

Version 2.11 (Mar-2018)

- **New: TWorkflowStudio.EnableAssignmentExpression for custom group assignment any(group), all(group).**
  If you set this property to True (it's False by default), you can choose the Group Assignment Mode in each task, using an expression in the "Assignment" field in Task definition properties dialog. For example, suppose you have a group named "developers".
  - Filling "developers" in Assignment will either create a task for each member in "developers" group, or will create a single task for any member in the group to handle it. It willl depend on value of GroupAssignmentMode.
  - Filling "any(developers)" will create a single task for any member in the group to handle (regardless of GroupAssignmentMode)
  - Filling "all(developers)" will create one task for each member in the group to handle (regardless of GroupAssignmentMode)
- **New: TaskListKeySortMode global config allows changing the way task lists are ordered when sorting by the (task) "Key" column.**
  This actually fixes a bug in task list order. When sorted by key, the task list was keeping the order of records retrieved by the database. This sometimes would not be the ideal order. Now you can change it using this global config. For example, use the code below to make sure tasks are listed by the actual integer value of the "Key" column (correct ordering):

```
uses {...}, wsControls;

TaskListKeySortMode := tsmInteger; // or tsmString;
```

- **New: TTaskListView.OnItemCompare event.**
  Allows performing custom comparison of task items for ordering when a column is clicked in the task list view.

Version 2.10 (Oct-2017)

- **Improved:** Dutch translation updated.

Version 2.9 (Jul-2017)

- **Improved:** Workflow validation now shows errors in expressions of task definition, like expressions in subject, description, assignmentrule, etc.
- **Improved:** Task block validation checks for missing expiration status when there is an expiration date defined.
- **Improved:** Fork/join paths now can have internal cyclical paths.
- **Fixed:** Next run time (date to check for expired tasks) was being wrongly calculated when there were task instances with expiration date running in parallel (in fork paths).

Previous Versions

Version 2.8 (Mar-2017)

- New: RAD Studio 10.2 Tokyo.
- Improved: Added TEmailInformation.Instance property, contains TWorkflowInstance reference.

Version 2.7 (Mar-2017)

- New: Allow reordering of task fields in task definition dialog using Ctrl+Arrow keys or drag/drop.
- New: TTaskListView.SortOnColumnClick property.
- New: Task expiration by hours, minutes or seconds.
- Improved: Updated German and Spanish translations.
- Fixed: Sort order of task list was being reset after the list was refresh (upon task update for example).

Version 2.6 (Aug-2016)

- New: Clickable column titles in task list allows reordering tasks.
- Improved: While editing a task, name is truncated to 50 characters at interface level.
- Fixed: Task block with a self-transition (leaving from and entering the same task block) was not creating a new task through that transition.
- Fixed: Compilation for AnyDac and FIB Plus drivers.

Version 2.5 (Apr-2016)

- New: Support for Delphi/C++Builder 10.1 Berlin
- Improved: For better user experience, when there is a version conflict when saving a task, user is offered the option to refresh the task list right away
- Improved: Upgrade Dutch language
- Fixed: Tasks/instances that were taking long time to run were causing too much conflicts when version control was enabled.
- Fixed: event TWorkflowStudio.BeforeSaveTaskInstance not being fired when task was automatically created by workflow execution
- Fixed: Fibplus and AnyDac drivers did not compile after latest version
- Fixed: Error in resources when using C++ with runtime packages
- Fixed: FIBPlus driver causing errors when using blob fields to save workflow data

Version 2.4 (Nov-2015)

- New: TWorkflowStudio.VersionControlEnabled allows version control on workflow and task instances.
- New: FireDAC database adapter.
- New: Refresh (F5) popup menu option in task list dialog.
- Improved: Transition editor now only being displayed automatically when the source block has output options to be selected from.
- Improved: Updated German and Spanish languages.
- Fixed: Transition script indicator icon was being displayed even when the transition script was not supposed to be executed.
- Fixed: Date-time editor not working when bound to variables with empty values.
- Fixed: Regression error when using Database Block.

Version 2.3.1 (Sep-2015)

- New: RAD Studio 10 Seattle support.

Version 2.3 (Aug-2015)

- New: Dutch translation.
- New: MySQL script for workflow tables.
- New: TWorkflowStudio.OnDesignerCreated allows direct access to the designer form for low-level customization.
- Improved: Workflow verification now warns if a task block has a completion status that doesn't have a corresponding transition.
- Improved: Updated translations for German, Spanish and Portuguese languages.
- Improved: User interface tweaks for better handling of non-English text.
- Improved: Status templates button disabled if no templates are available.
- Improved: A warning is displayed if user changes a task status and tries to leave the form without saving.
- Fixed: In expiration tab of task/approval block, list of completion status were not being listed.
- Fixed: "Send Mail Notification" check box state was not being saved when editing Approval Task Block.
- Fixed: Text block not displaying text in workflow instance if text was edited directly in the block (not using editor).

Version 2.2 (May-2015)

- New: Editor types allow choosing the control used to edit a task field.
- New: Workflow validation panel shows all erros and warnings when checking a workflow definition.
- New: Descriptions in workflow variables allow better documentation and understanding the purpose of a variable
- New: TWorkflowUserInterface.WorkflowEditorWidth and WorkflowEditorHeight properties allow setting default workflow definition editor size.
- New: Delphi/C++Builder XE8 support (2.1.1).
- Improved: Warning on duplicated variable names in workflow definition.
- Improved: Transition scripts now allowed in any transition (previously only task transitions could have scripts).
- Improved: German translation updated.
- Fixed: Error when using scripts in definitions with duplicated variable names.
- Fixed: TTaskInstance.CreatedOn property not being saved when task was inserted (2.1.1).

Version 2.1 (Mar-2015)

- New: Variables Dialog helps creating variable expressions in several parameter controls.
- New: Database SQL block to execute an SQL statement in the database.
- New: Send Mail block to easily send an e-mail message.
- New: Scripts in transitions allow adding custom logic whenever the workflow execution goes through a specific transition.
- New: Comment and Text blocks improves visual indications in the workflow diagram.
- New: Status templates for predefined set of status makes it fast to create new task blocks with same status items.
- New: Popup menu with "Copy as Image" option when visualizing the diagram in task list.
- Improved: Variables are now sorted by name in the Workflow Variables form.

Version 2.0 (Mar-2015)

- New: Full TMS Diagram Studio now included in TMS Workflow Studio.
- New: Packages structure changed. Now it allows using runtime packages with 64-bit applications. It's a breaking change.

Version 1.9.3 (Sep-2014)

- New: RAD Studio XE7 support.
- Fixed: "Save as.." menu option should not be visible in workflow definition editor.
- Fixed: Field values in task list were not being updated in some situations.

Version 1.9.2 (Apr-2014)

- New: RAD Studio XE6 support.

version 1.9.1 (Mar-2014)

- New: Diagram Navigator in workflow editor.
- New: TWorkflowUserInterface.BeforeTaskListShow event allows you to have access to TaskList form and perform visual modifications in it before it's displayed.
- New: TWorkflowDB.UseBase64 property can be used to improve performance in Delphi XE2 and lower versions.
- Fixed: Expiration Combo box items in expiration frame now being properly translated.
- Fixed: Issue with loading workflow definitions from sql server using ADO.
- Fixed: Error Handler block now also executed after some internal errors (like script execution).

- Fixed: Issues when running more than one subworkflow simultaneously and waiting for both to complete (when using forks for example).

Version 1.9 (Oct-2013)

- New: TAttachmentViewMode allow displaying attachments and task info in a single pane instead of different tabs.
- New: Delphi/C++Builder XE5 support.
- Improved: Better performance for saving/loading workflow definitions, instances and tasks when using ADO.
- Fixed: Workfklow blocks not displayed when language different than English was used.
- Fixed: Empty "Basic" category removed from toolbar.

Version 1.8.1 (Mar-2013)

- New: Delphi/C++Builder XE4 support.
- Fixed: Wrong text in file filter in open file dialog when adding attachments.

Version 1.8 (Sep-2012)

- New: Delphi/C++Builder XE3 support.
- Improved: Task list window now refreshes automatically when a workflow execution is finished.
- Fixed: Issue when using ODBC + SQLDirect (parameter order was incorrect).
- Fixed: ScriptEngineInitialized not being called when executing workflow validation.
- Dropped support for Delphi 5, 6, 2005, 2006 and C++Builder 6, 2006.

Version 1.7 (Apr-2012)

- New: 64-bit support for Rad Studio XE2.
- New: German, Chinese and Italian translation for Workflow user interface.

Version 1.6 (Sep-2011)

- New: Delphi/C++Builder XE2 support.
- Improved: Optimization when using blob fiels with ADO.

Version 1.5.0.1 (Oct-2010)

- Fixed: Issues installing Workflow Studio on RAD Studio XE.

Version 1.5 (Oct-2010)

- New: Timeout feature for automatic expiration of workflow tasks.
- New: "Run workflow" block to run a separated workflow instance.
- New: RAD Studio XE support.
- New: Option to define hidden status in workflow tasks.
- New: Property DisplayTaskStatus in workflow diagram.
- New: Administrator privilege in user groups to allow updating of tasks assigned to different users.
- New: High level properties to handle with task status programmatically.
- New: Support for AnyDAC components.
- New: Event OnInitializeScriptEngine to initialize Script Engine object.
- New: Event BeforeSaveTaskInstance in WorkflowStudio.
- Improved: User interface for defining status in workflow tasks.
- Fixed: Issues with multiple outputs from script blocks.
- Fixed: Flickering when moving blocks on Workflow diagram.
- Fixed: Issues with wsClasses unit in C++Builder.

Version 1.4.1 (Jul-2010)

- New: Event "OnGetNow" to retrieve current date/time.
- Improved: Small visual changes in several forms.
- Fixed: Error on Redo after undoing a transition line insertion.
- Fixed: Field labels are not painted when using XP Manifest (Delphi 7).
- Fixed: Error adding attachments to workflow definition.

Version 1.4 (Jan-2010)

- Improved: WorkflowStudio global variable removed, allowing multiple instances of the component to be used.
- Improved: TCustomWorkflowDB.ComponentToString and ComponentFromString methods made protected.
- Improved: Several methods in TCustomWorkflowDB made virtual.

Version 1.3 (Feb-2009)

- New: Redesigned workflow definition editor now based on internal diagram editor.
- New: More modern toolbar in workflow definition editor (Delphi 2005 and up).

- New: Workflow definition editor now support grouping blocks for easier design.
- New: "_Workflow" variable available from scripts allowing access to the workflow diagram and its methods and properties.
- New: TWorkflowStudio.OnRunFinished event - being fired when a workflow instance execution is finished.
- Fixed: Minor bug fixes.

Version 1.2 (Oct-2008)

- New: Delphi 2009/C++Builder 2009 support.
- New: TWorkflowStudio.GroupAssignmentMode property allows to create a single task for multiple users in group.
- Improved: Prevent users from changing tasks assigned to other users.
- Fixed: AV happening in threads in some situations.

Version 1.1 (May-2008)

- New: Support for C++Builder 6, 2006 and 2007.
- New: Support for FIBPlus database components.
- New: Spanish translation added.
- New: OnTaskCreated and OnTaskFinished events in TWorkflowStudio component.
- New: OnBeforeExecuteNode and OnAfterExecuteNode events in TWorkflowStudio component.
- New: TTaskInstance.CreatedOn property.
- New: TWorkflowInstance status: wsFinishedWithError.
- New: TWorkflowStudio.OnWorkInsError event allows higher control of errors raised from an workflow execution.
- New: It's possible now to use expressions in the "Assigned To" field in a task definition so that the task is assigned dinamically to an user/group.
- New: Task List dialog now can be called in MDI mode, beside the existing modal mode. You can use, e.g., *ShowUserTasksDlg('john', wfmMDI)*.
- Improved: Error handling while executing workflows. An error message is displayed when workflow is finished with error (can be avoided with OnWorkInsError).
- Improved: Thread performance to execute workflow instances.
- Fixed: Minor bugs in TWorkflowADODB and TWorkflowDBXDB caused AV when deleting a connection component at design time.

Version 1.0 (Oct-2007)

- First release.

Getting Support

General notes

Before contacting support:

- Make sure to read the tips, faq and readme.txt or install.txt files in component distributions.
- Make sure you have the latest version of the component(s).

When contacting support:

- Specify with which component you have a problem.
- Specify which Delphi or C++Builder version you're using and preferably also on which OS.
- In case of IntraWeb or ASP.NET components, specify with which browser the issue occurs.
- For registered users, use the special priority support email address (mentioned in registration email) & provide your registration email & code. This will guarantee the fastest route to a solution.

Send email from an email account that

1. allows to receive replies sent from our server;
2. allows to receive ZIP file attachements;
3. has a properly specified & working reply address.

Getting support

For general information: info@tmssoftware.com

Fax: +32-56-359696

For all questions, comments, problems and feature request for VCL components : help@tmssoftware.com.

To improve efficiency and speed of help, refer to the version of Delphi, C++Builder, Visual Studio .NET you are using as well as the version of the component. In case of problems, always try to use the latest version available first.

Breaking Changes

List of changes in each version that breaks backward compatibility.

Version 2.0

- There was a big package restructuration in version 2.0. More info in the dedicated topic.
- TMS Workflow doesn't use TMS Scripter units anymore. They were replaced by similar units with different names.

Version 1.5

- Workflow Studio version 1.5 include some new features that required small changes in underlying database structure.
    - Before upgrading Workflow Studio from previous versions to version 1.5, the database structure must be updated.
    - For details about the needed changes, see the section Upgrading database from previous versions.

Version 1.4

- The global variable WorkflowStudio was removed. Replace any reference to WorkflowStudio by a reference to the component TWorkflowStudio you are using.
- The class TWorkflowDiagram was moved to the unit wsDiagram.
- Components derived from TListView (like TTaskListView) now have a WorkflowStudio property that must be set to reference the TWorkflowStudio component being used.
- The component TWorkflowDiagram also has a new property WorkflowStudio that must refer to a TWorkflowStudio component.

Version 2.0 - Package Restructuration

TMS Workflow packages have been restructured. The packages are now separated into runtime and design-time packages, allowing a better usage of them in an application using runtime packages (allows it to work with 64-bit applications using runtime packages, for example). Also, Libsuffix option is now being used so the dcp files are generated with the same name for all Delphi versions. Here is an overview of what's changed:

Before version 2.0, there was a single package named *workflowstudio<version>.dpk* (where <version> is the "name" of delphi version), which generated BPL and DCP with same names:

Previous versions:

Version	Package File Name	BPL File Name	DCP File Name
Delphi 7	workflowstudio7.dpk	workflowstudio7.bpl	workflowstudio7.dcp
Delphi 2007	workflowstudio2007.dpk	workflowstudio2007.bpl	workflowstudio2007.dcp
Delphi 2009	workflowstudio2009.dpk	workflowstudio2009.bpl	workflowstudio2009.dcp
Delphi 2010	workflowstudio2010.dpk	workflowstudio2010.bpl	workflowstudio2010.dcp
Delphi XE	workflowstudio2011.dpk	workflowstudio2011.bpl	workflowstudio2011.dcp
Delphi XE2	workflowstudioxe2.dpk	workflowstudioxe2.bpl	workflowstudioxe2.dcp
Delphi XE3	workflowstudioxe3.dpk	workflowstudioxe3.bpl	workflowstudioxe3.dcp
Delphi XE4	workflowstudioxe4.dpk	workflowstudioxe4.bpl	workflowstudioxe4.dcp
Delphi XE5	workflowstudioxe5.dpk	workflowstudioxe5.bpl	workflowstudioxe5.dcp
Delphi XE6	workflowstudioxe6.dpk	workflowstudioxe6.bpl	workflowstudioxe6.dcp
Delphi XE7	workflowstudioxe7.dpk	workflowstudioxe7.bpl	workflowstudioxe7.dcp

From version 2.0 and on, there are two packages:

- TMSWorkflow.dpk (runtime package)
- dclTMSWorkflow.dpk (design-time packages)

DCP files are generated with same name, and only BPL files are generated with the suffix indicating the Delphi version. The suffix, however, is the same used by the IDE packages (numeric one indicating IDE version: 160, 170, etc.). The new package structure is as following (note that when 6.5 was released, latest Delphi version was XE7. Packages for newer versions will follow the same structure):

Version	Package File Name	BPL File Name	DCP File Name
Delphi 7	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow70.bpl dclTMSWorkflow70.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp
Delphi 2007	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow100.bpl dclTMSWorkflow100.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp
Delphi 2009	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow120.bpl dclTMSWorkflow120.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp
Delphi 2010	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow140.bpl dclTMSWorkflow140.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp
Delphi XE	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow150.bpl dclTMSWorkflow150.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp
Delphi XE2	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow160.bpl dclTMSWorkflow160.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp
Delphi XE3	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow170.bpl dclTMSWorkflow170.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp

Version	Package File Name	BPL File Name	DCP File Name
Delphi XE4	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow180.bpl dclTMSWorkflow180.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp
Delphi XE5	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow190.bpl dclTMSWorkflow190.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp
Delphi XE6	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow200.bpl dclTMSWorkflow200.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp
Delphi XE7	TMSWorkflow.dpk dclTMSWorkflow.dpk	TMSWorkflow210.bpl dclTMSWorkflow210.bpl	TMSWorkflow.dcp dclTMSWorkflow.dcp