

CONSIDEO STANDARD EDITION Manual

Copyright 2006 Consideo GmbH

All Rights Reserved

Without prior written permission from Consideo GmbH no part of this manual may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means.

All Consideo software solutions, including software provided without charge, is provided under license. Therefore, distribution and sale as well as copying of any Consideo software solutions, including software provided without charge, or parts thereof is prohibited without the express written consent of Consideo GmbH.

Table of Content

Table of Content.....	2
1. Introduction	5
1.1 About CONSIDEO STANDARD EDITION.....	5
1.2 How to use this Manual?	6
1.3 User Interface	6
1.4 Installing CONSIDEO STANDARD EDITION/Registration	7
1.5 Starting CONSIDEO STANDARD EDITION.....	8
1.6 System Requirements	8
1.7 Preferences.....	8
2. Quick Guide	9
2.1 Workflow-Step Define.....	9
2.2 Workflow-Step Explore	10
2.3 Workflow-Step Connect	12
2.4 Workflow-Step Quantify.....	19
2.5 Workflow-Step Simulate	20
3. Tutorial.....	22
3.1 General Approach	22
3.2 Workflow-Step Define.....	23
3.2.1 Describe the Problem	24
3.2.2 Define Objectives	25
3.2.3 Determine System Boundaries	25
3.2.4 Determine the Time Horizon	25
3.3 Workflow-Step: Explore.....	26
3.3.1 Describe Target Factors.....	27
3.3.2 Use Brainstorming	27
3.3.3 Group Factors	28
3.3.4 Prioritize and Select Header Cards	28
3.3.5 Transfer Header Cards into a CLD	29
3.4 Workflow-Step Connect	29
3.4.1 Connect Key Factors	31
3.4.2 Detail the Model by Using Subsystems	33
3.4.3 Analyse the Structure of the System	34
3.4.3.1 Identify Dependencies	34
3.4.3.2 Identify Feedback Loops	36
3.4.3.3 Find and Analyse Balancing Loops.....	36
3.4.3.4 Find and Analyse Reinforcing Loops.....	37
3.4.3.5 Find Lever.....	38
3.5 Workflow-Step Quantify.....	40
3.5.1 Define Stocks and Initial Values.....	40
3.5.2 Quantify Connections	41
3.5.3 Describe the behavior over time of inputs.....	41
3.5.4 Model Validation and Optimization	42
3.6 Workflow-Step Simulate	44
3.6.1 Simulation	44
3.6.2 Model Validation	45
3.6.3 Strategy Development.....	46
4. General Functions	48
4.1 Help.....	48
To get help... ..	48
4.2 Working with Projects.....	48
To create a new project... ..	48

To open a project.....	48
To save a project... ..	48
To exit the application... ..	48
4.3 Navigation	48
To change the current workstep.....	48
To show an existing diagram... ..	48
4.4 Undo and Redo.....	49
To undo an action... ..	49
To redo an action.....	49
4.5 Other Functions.....	49
To annotate some part of the project... ..	49
To change the zoom of a diagram... ..	49
To print a diagram... ..	49
To create a project report... ..	49
5. Workflow - STANDARD EDITION	50
5.1 Workflow-Step Define.....	50
To enter a project name or text for another input field... ..	50
To enter the time horizon.....	50
5.2 Workflow-Step Explore	50
5.2.1 Identify Factors	50
To insert a new factor.....	50
To delete a factor.....	50
To move a factor... ..	51
To operate on a group of factors... ..	51
To rename a factor.....	51
To describe a factor.....	51
To set the unit for a factor... ..	51
To define expected or desired behavior for a factor... ..	52
5.2.2 Group Factors with Header Cards.....	53
To define header cards... ..	53
To group factors with header or other factors... ..	53
To regroup factors or header cards... ..	53
To inspect a factor within a stack... ..	53
5.2.3 Transfer Header Cards into a CLD	53
To transfer all header cards into a CLD... ..	53
5.3 Working with Units.....	53
To enter a unit with the keyboard... ..	54
To choose a unit already used elsewhere in the project.....	54
To define a new unit.....	54
5.4 Workflow-Step Connect	54
To insert a new factor.....	54
To delete a factor.....	54
To move a factor... ..	55
To rename a factor.....	55
To link a driving factor to a driven factor.....	55
To remove a link.....	55
To reconnect a link.....	55
To enter information about the dependency described by a link... ..	56
To change the polarity of a link.....	56
To set a delay for a link	56
To change the thickness of a link	57
To rename a diagram... ..	57
To rename the first level of a CLD... ..	57
5.5 Working with Subsystems	57
To create a new subsystem... ..	57
To navigate between subsystems.....	57
To navigate to the parent subsystem.....	57

To remove a subsystem.....	57
To add external factors to a subsystem... ..	57
To remove an external factor from a subsystem... ..	58
To connect an external factor... ..	58
To move a factor to another subsystem... ..	58
To rename a subsystem.....	58
To show an overview of all subsystems.....	58
5.6 Working with Copies of Internal Factors.....	58
To create a new copy of an internal factor.....	59
To remove a copy of an internal factor... ..	59
To connect a copy of an internal factor... ..	59
To enter information about a copy of an internal factor.....	59
5.7 Integrated function Analyse	59
To show the use/cause tree for a factor... ..	59
To show the Influence Matrix for a CLD.....	60
To enter information in the Influence Matrix.....	60
To show/highlight loops in its own diagram... ..	60
To change the position of a loop label.....	60
To change the name of a loop label.....	60
To list all loops including the ones crossing diagrams.....	60
5.8 Workflow-Step Quantify	60
To quantify connections,	60
To describe the behavior of an input over time,	61
To get help for quantifying and validating your model,	62
5.9 Workflow-Step Simulate	62
To start a simulation run,	62
To see the results of a simulation run,	62
To open a chart or table,	62
To change the size of a chart or table,	62
To move a chart or table,	62
To delete a chart or table,	62
To print a chart,	62
To save a chart,	62
To add a curve,	62
To delete a curve,	63
To change a color of a curve,	63
To change a range of a curve,	63
To change the zoom of a chart,	63
To reset the zoom of a chart,	63
To show chart details,	63
To save a chart as a scenario,	63
To change the order of columns of a table,	63
To change a scenario,	63
To add a manipulator,	63
To change the type of a manipulator,	63
To delete a manipulator,	64
To change the range of a manipulator,	64
6. References.....	65
7. Glossary	65

1. Introduction

1.1 About CONSIDEO STANDARD EDITION

CONSIDEO is an innovative product line consisting of

- CONSIDEO STANDARD EDITION (SE),
- CONSIDEO LIGHT EDITION (LE) and
- CONSIDEO COMMUNITY EDITION (CE - FREEWARE).

which enables the user to model and simulate complex problems in every business area!

Intuitive and easy-to-use: the workflow of CONSIDEO guides you through a series of steps to solve your problem by connecting different international recognized methods automatically for the first time worldwide. Having defined all relevant factors connected to your problem by using well-known brainstorming techniques (Brainstorming/Metaplantechnique), you can easily connect the factors by using simple arrows and analyse and communicate afterwards the underlying structure of your problem in the sense of cause-and-effect relationships with feedback loops (Concept- und Mind mapping, Mental Modelling). On the basis of this Causal Loop Diagram (CLD), you can easily analyse the structure of the system and find the most efficient lever to solve your problem (Systems Thinking). Finally, you can quantify your model in order to get a deeper understanding about the problem structure and to evaluate different strategies by testing different "what-happens-when?" scenarios (System Dynamics).

In general, the workflow in all versions is the same – but the following functions are limited compared to our CONSIDEO STANDARD EDITION:

	Import	Quantify/Simulate	Qualitative Analysis of the Model
LIGHT EDITION (LE)	max. 10 data sets per factor	max 20 factors	
COMMUNITY EDITION (FREEWARE)	max. 10 data sets per factor	max 20 factors	max 20 factors

Our general approach can be applied to different branches and topics like:

- Sales Forecast
- Optimization of Stocks
- Evaluation of Investment Plans
- Change Management
- Process Optimization
- Production Planning
- Socio-political Problems
- (Multi)p Project Management
- Product Development
- Regional Development
- Strategy Development and Implementation
- Transport & Logistics

A multi-layered clientele, which consists of multinational companies as well as of medium sized enterprises, representative bodies, political

organisations, ministries, administrations, scientific institutes and companies for regional development, profits from this.

You will find more information at our website www.consideo.com

1.2 How to use this Manual?

The manual is divided in the following parts:

Chapter 1 provides a short INTRODUCTION of the user interface and instructions for installing and starting the application.

Chapter 2 provides a QUICK GUIDE demonstrating the methodological approach of building and analysing a model of a problem by using a simple example.

Chapter 3 introduces the general approach by providing a TUTORIAL including all tasks, helpful notes, and an example.

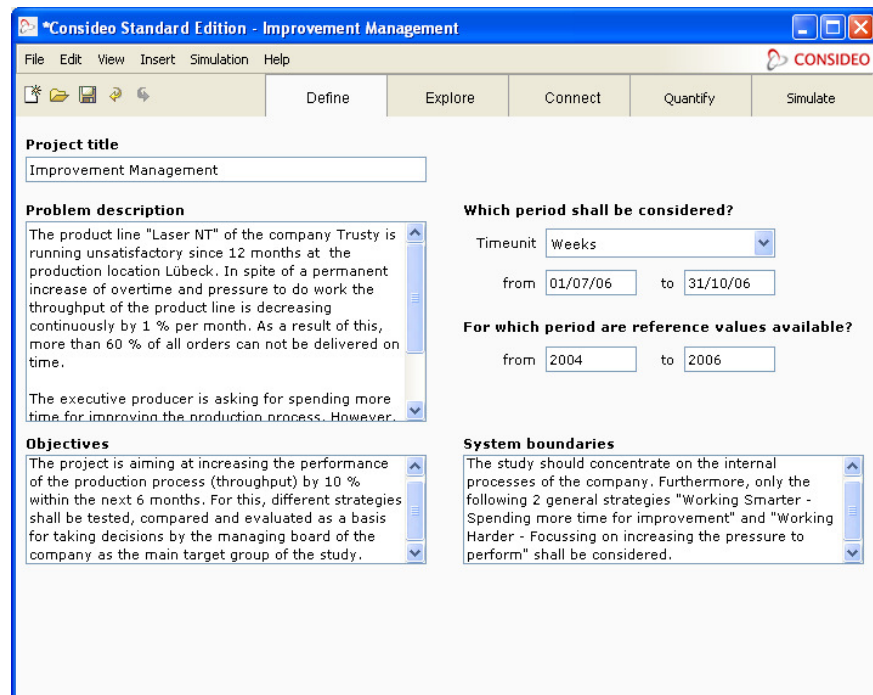
Chapter 4 describes how to use the GENERAL FEATURES of CONSIDEO STANDARD EDITION.

Chapter 5 describes how to accomplish all single features related to the workflow of building a System Dynamics model with CONSIDEO STANDARD EDITION.

1.3 User Interface

The main window of the CONSIDEO STANDARD EDITION consists of the following components:

Example



Menubar: You can access all functions of CONSIDEO STANDARD EDITION via menus. If a function is not applicable in a certain context, its menu item is grayed out.

Toolbar: The toolbar offers you the most common functions depending on context. If the cursor hovers over a button for a certain time, a tooltip explaining this function appears.

Workflow: The workflow guides you through a series of steps:

- Define - Define the scope of the project
- Explore - Find relevant factors
- Connect - Identify and analyse cause-and-effect relationships
- Analyse - Analyse the causal loop diagram and find the most efficient lever to solve your problem
- Quantify - Quantify your model in order to get a deeper understanding about the problem structure
- Simulate - Evaluate different strategies by considering different "what-happens-when?" scenarios

However, the process is not linear - it is an iterative approach. Most of the steps have to be revised according to the knowledge gained at later stages, which means you may have to go back and forth several times.

In addition, it is possible to skip steps. For instance, experienced modelers can start directly with the workflow-step CONNECT or QUANTIFY.

For this, the panel allows you to switch between worksteps. Each workstep offers a specialized perspective of the project based on the task at hand.

Work area: This area displays a sheet with a general project description. Depending on the selected workstep, other sheets appear (diagrams etc.).

Guidance: There are little notes which appear in empty text fields or empty sheets and explain what to do next.

Sheet tabs: At the bottom of the work area there are tabs to change quickly between different sheets.

Navigation: There are several ways how to navigate to other parts of your model:

- The menu "View->..." allows you to jump directly to some sheet.
- You can switch between already opened sheets by using the sheet tab.
- Changing the workstep may also change the sheet, if the current sheet is not applicable for this workstep.

1.4 Installing CONSIDEO STANDARD EDITION/Registration

- Download CONSIDEO or insert CD-ROM into your CD-ROM drive.
- On Windows, start the installer by double clicking on the file CONSIDEO_install.exe. Follow the wizard explaining the next steps.

For other systems, choose a folder and save the zip-file on your PC. Un-zip the file, choose a folder and save the application on your PC.

- For activating CONSIDEO LIGHT EDITION or CONSIDEO STANDARD EDITION it is necessary to register your installation. For this, click on "*Register*" from the help menu and follow the license wizard.

1.5 Starting CONSIDEO STANDARD EDITION

On Windows, just double click on the desktop or menu-group icon.

For other systems the application is contained in the file `consideo_be.jar`. To start, double click on its icon.

1.6 System Requirements

CONSIDEO STANDARD EDITION is a Java application and needs Java 1.5 or later installed on your computer. Java is included in your software-package. Otherwise, Java is available at the Internet: www.java.com.

1.7 Preferences

CONSIDEO is a multilingual system. You can choose between German and English by changing your general language settings of your PC.

2. Quick Guide

Introduction CONSIDEO STANDARD EDITION helps you to analyse and solve a complex system in a systematic and comprehensive way. CONSIDEO STANDARD EDITION provides an optimal methodological support for this task by providing a workflow and a user-friendly guidance. Below, you will get a short introduction on how to use CONSIDEO STANDARD EDITION by using the simple example "Quality Management".

2.1 Workflow-Step Define

Objectives For a successful project it is important to describe the problem, the objectives and the system boundaries in a detailed way as well as defining the time horizon.

Tasks **Project Title:** Click on the field and type in the project title.

Problem Description: Describe the phenomenon, occurring behavior pattern or issue to be addressed in this study. Describe it in a very precise and clear way so that everyone can understand the essence and details of the problem. The statement should be connected to a location, time horizon and perspective.

Objectives: Describe what you are hoping to understand about the problem and what the project is aiming at. In the case of defining targets, it is necessary to determine the target factors and how it should be altered over time (e.g. the study is aiming at a linear reduction of CO2 emissions in the city SOMEWHERE by 50 % till the year 2010). Be open-minded. Avoid any descriptions of possible solutions.

Time horizon: Determine the time horizon of the study as one of the main determinants of the system boundary including the past for evaluating the model by using available historical data.

System Boundaries: Determine what is included in the system and what has not to be considered in the project by defining the size, scope, and character of the problem being studied. For this, it is necessary to have a clear idea of what problem (Problem Definition) is addressed, what the study is aiming at (Objectives) and who is interested in the problem.

Example

***Consideo Standard Edition - Improvement Management**

File Edit View Insert Simulation Help

Define Explore Connect Quantify Simulate

Project title
Improvement Management

Problem description
The product line "Laser NT" of the company Trusty is running unsatisfactory since 12 months at the production location Lübeck. In spite of a permanent increase of overtime and pressure to do work the throughput of the product line is decreasing continuously by 1 % per month. As a result of this, more than 60 % of all orders can not be delivered on time.
The executive producer is asking for spending more time for improving the production process. However...

Which period shall be considered?
Timeunit: Weeks
from: 01/07/06 to: 31/10/06

For which period are reference values available?
from: 2004 to: 2006

Objectives
The project is aiming at increasing the performance of the production process (throughput) by 10 % within the next 6 months. For this, different strategies shall be tested, compared and evaluated as a basis for taking decisions by the managing board of the company as the main target group of the study.

System boundaries
The study should concentrate on the internal processes of the company. Furthermore, only the following 2 general strategies "Working Smarter - Spending more time for improvement" and "Working Harder - Focussing on increasing the pressure to perform" shall be considered.

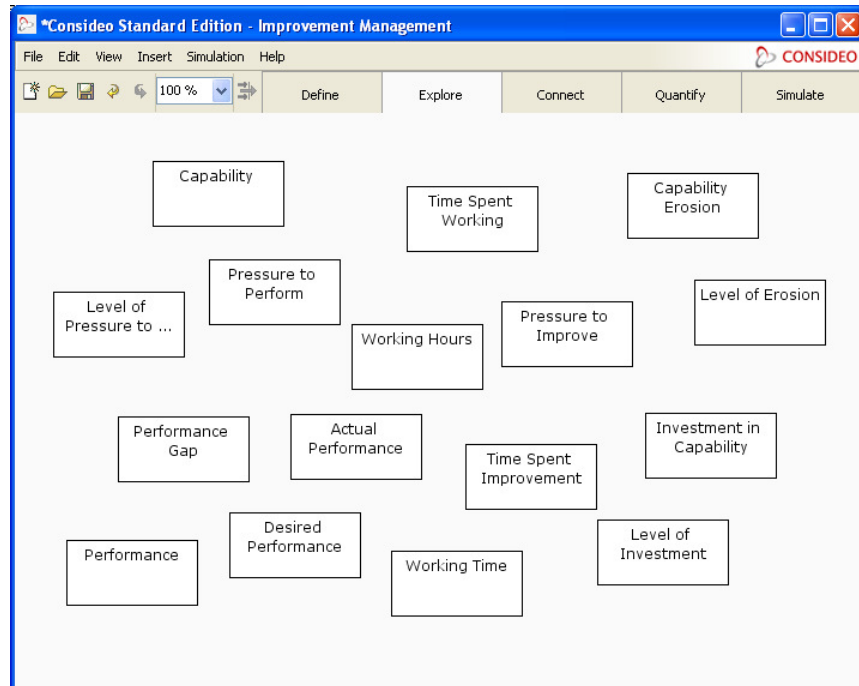
2.2 Workflow-Step Explore

Objectives This step aims at structuring and organizing knowledge about the problem and reducing the complexity by defining, grouping and prioritizing factors.

Tasks In the sense of Brainstorming, begin with all thinkable factors connected to the target factors/problem and sort out the important ones later. The important factors (header cards) should be translated into the CLD-Diagram as the next workflow-step. We are suggesting to choose just 6-10 factors to reduce the complexity first ensuring a clearly laid out structure.

1. Define target factors (just double click on the work area and type in the names) and describe its expected and desired behavior over time (double click on the factor).
2. Define all other important factors related to the problem/target factors in the same way.

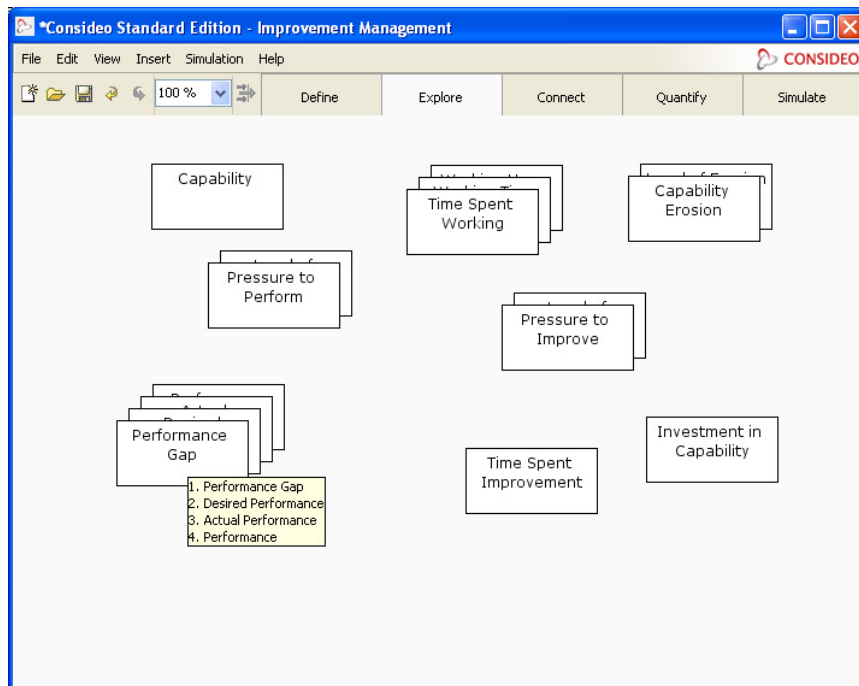
Example



Tasks

3. Group factors by affinity by clicking on the factor and moving it (like playing a solitaire card game).

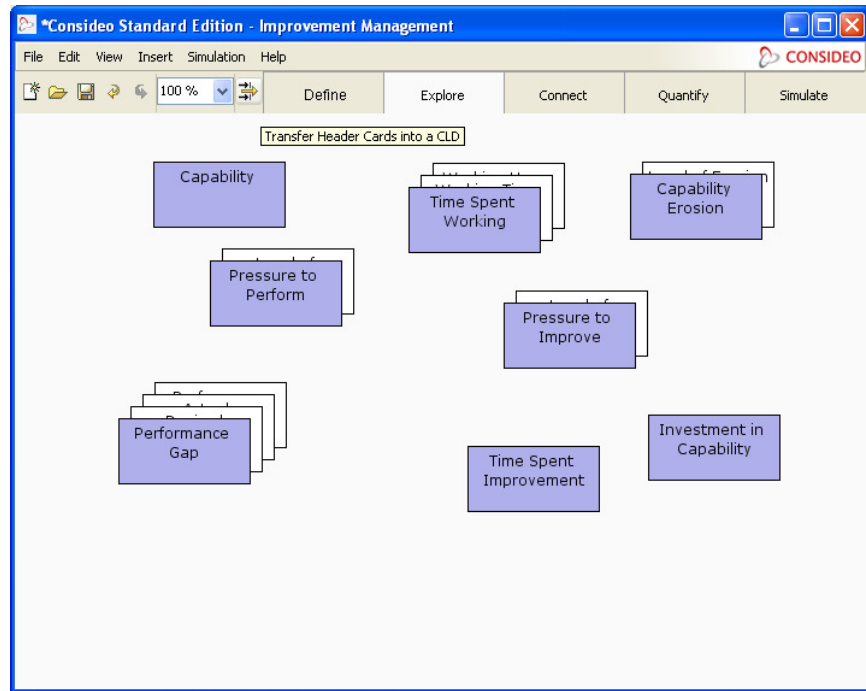
Example



Tasks

4. Prioritize and select key factors by defining header cards (right click on the factor) and select "Change Type..." from context menu.
5. Transfer the key factors into a Causal Loop diagram (CLD) by clicking on the Toolbar-Button "Transfer Header Cards into a CLD".

Example



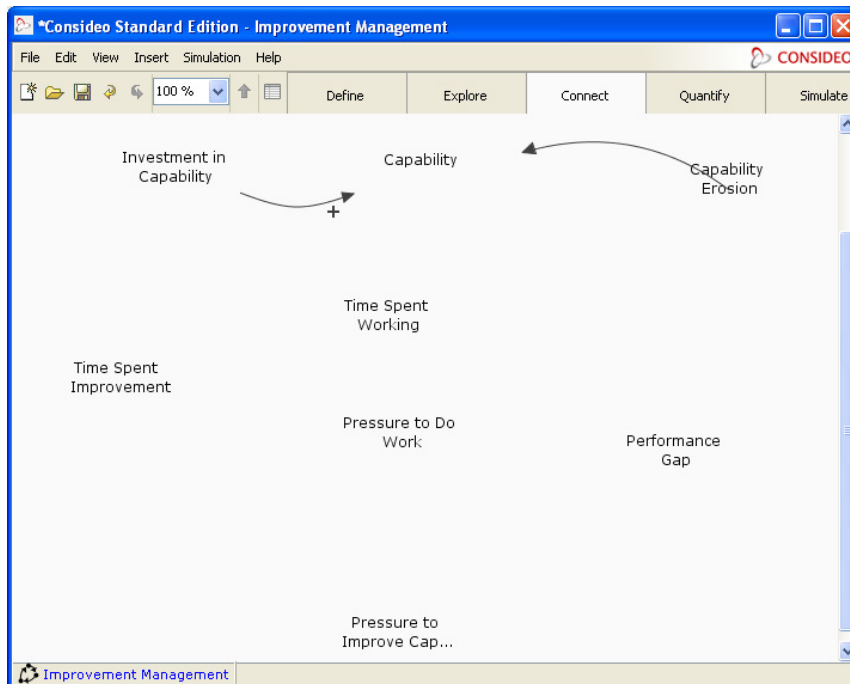
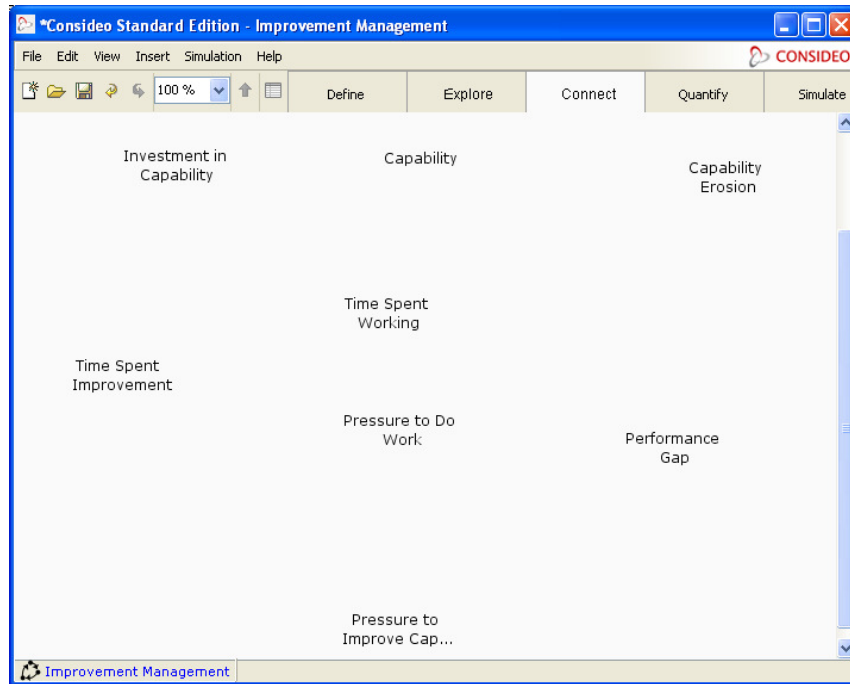
2.3 Workflow-Step Connect

Objectives This workflow-step is aiming at

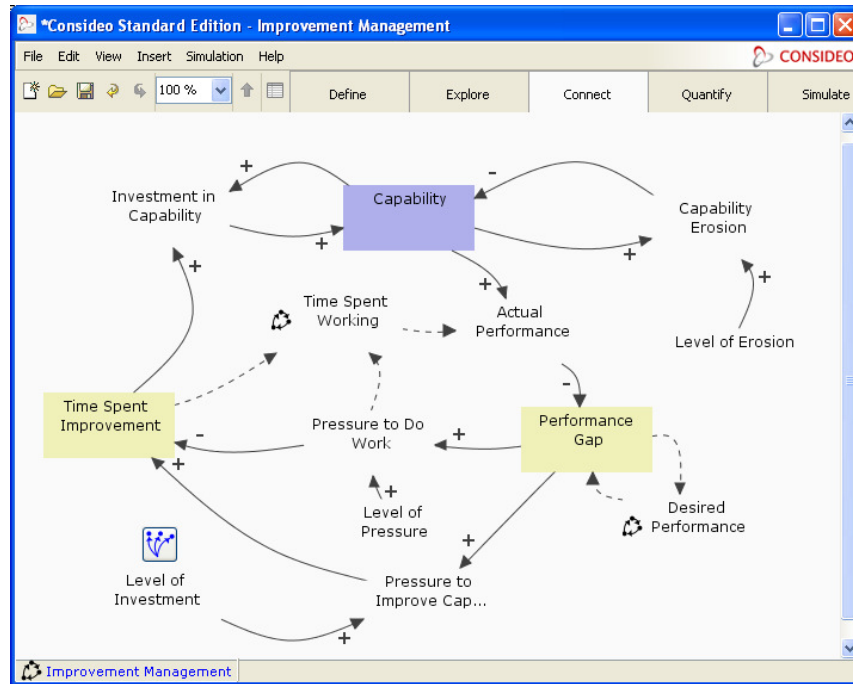
- developing and analyzing the structure of the problem by describing the mental models of the involved experts with the help of Causal Loop diagramming as well as
- finding the most efficient leverage for solving the problem.

Tasks **Mental Modeling**

1. Define the most important key factors by transferring the header cards from the previous workflow-step or by typing them in (double click on work area and type in the names). We are suggesting to choose just 6-10 factors to reduce the complexity first ensuring a clearly laid out structure.
2. Connect the main key factors of your problem area by drawing simple arrows between them. For this, move the mouse pointer over the driving factor until the connect button appears. Click on it, move the mouse pointer to the driven factor and click on it again.
3. Highlight time delays and define the polarity (+/-) by double clicking on the link.



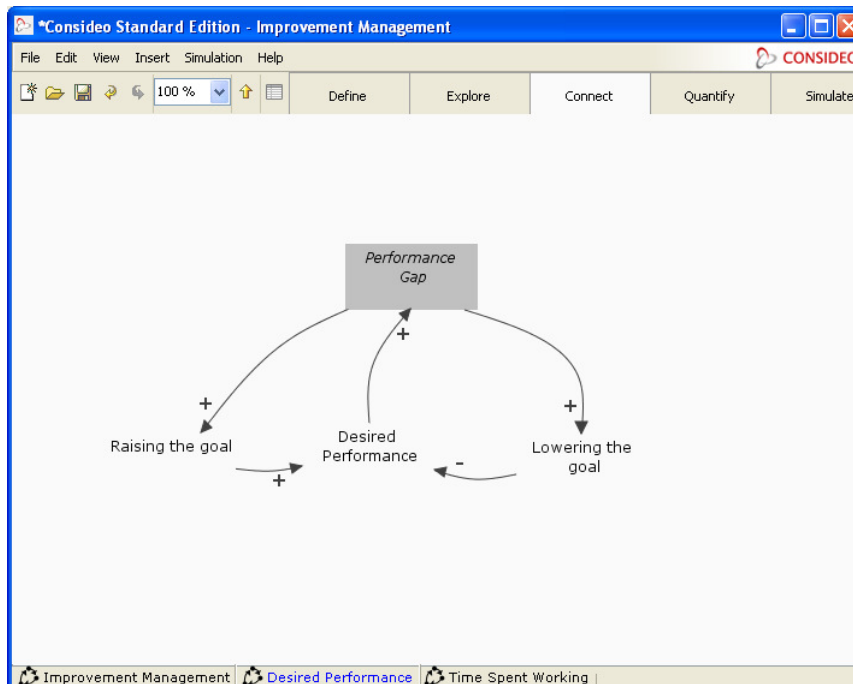
Example



Tasks

4. Double click on the factor, estimate and sketch roughly the expected behavior of the key factors over time (optional).
5. Detail the model by using subsystems (right-click on a factor and select "New Subsystem" from the context menu).

Example

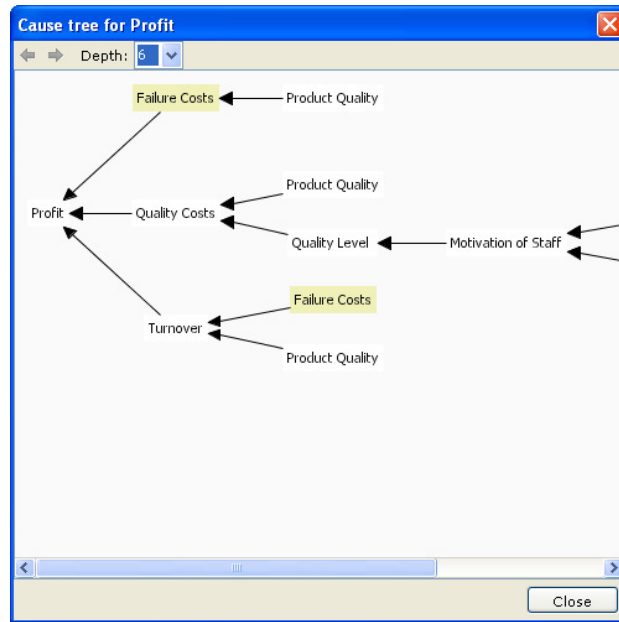


Tasks

Analysis

1. Define dependencies (causes and effects) by using Use-and-Cause Trees (right-click on a factor) and the Influence Matrix (menu-view or toolbar). Try to find "active" and "passive" factors. "Active" factors are mainly affecting other factors in the system. "Passive" ones will mainly be influenced by others.

Example

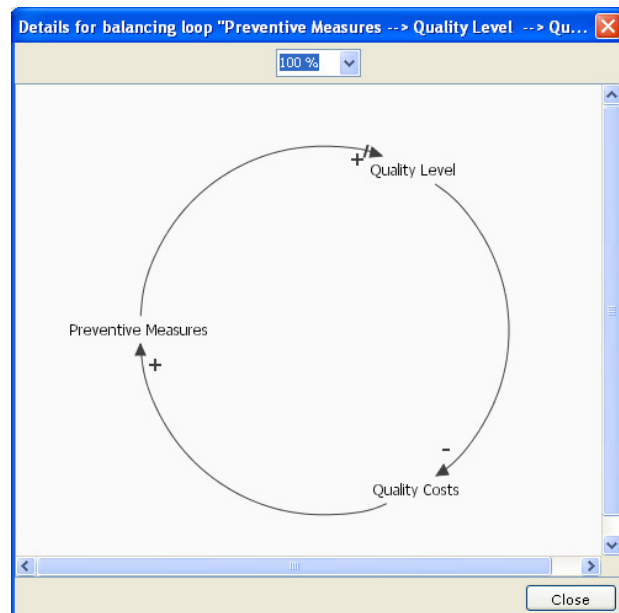


Tasks

2. Identify Feedback Loops. List all loops of the project (view menu). The total number of loops provides an important information about the problem structure. Many loops in a system indicate that the system is more or less self-regulating – driven by itself. A system consisting of just a few loops is mainly depending on external factors driving the system.

Analyse the length of all loops. Loops which contain many different factors are more critical because they are difficult to understand and to foresee due to the longer time lag between cause and effect. The more factors are involved in a loop, the longer the time lag and the more difficult it is to predict the behavior of the system.

Example



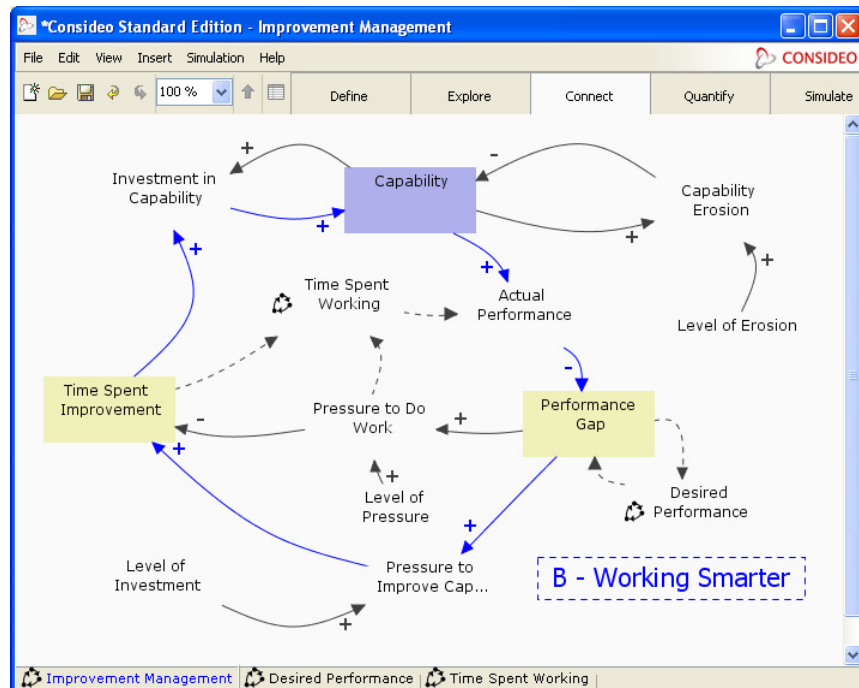
Tasks

3. Find and analyse Balancing Loops by selecting "Loops" from the context menu of the selected diagram. Balancing loops are "self-regulating" loops moving the system in the direction towards equilibrium or a fluctuation around the equilibrium point. This means

that a dominant balancing loop will stabilize a system by preventing any escalation of the system.

Analyse the behavior of the loop and evaluate whether the behavior will support or hinder the achievement of your objectives.

Example

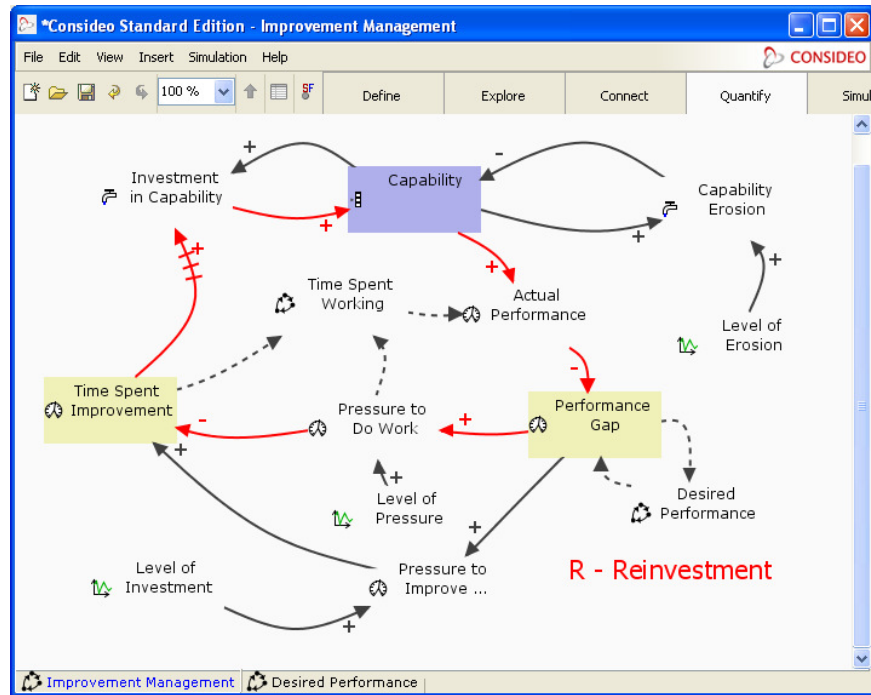


Tasks

4. Find and analyse Reinforcing Loops by selecting "Loops" from the context menu of the selected diagram. A reinforcing loop moves the system in the same direction, causing either a systematic growth or decline. It is a behavior that is moving away from the equilibrium point – having a strong effect on the system behavior over time. Therefore, it is important that you find the main factors driving this kind of reinforcing loop to use it as a lever to solve your complex problem.

Analyse the behavior of the loop and evaluate whether the behavior will support or hinder the achievement of your objectives. By doing this, analyse the length of all existing reinforcing loops again. The less factors are involved the faster the escalating process.

Example



Tasks

5. Estimate roughly the strength of relationships in the matrix. Indicate how strong the different factors influence each other by using rates measured in percentage (0-100). By doing this, the following general question is helpful: How strong is the direct impact of Factor A on Factor B in comparison to all other factors having a direct impact on Factor B?

Note: Only direct impacts should be considered. The total sum of all impact rates must be 100. If needed, insert a new factor (for instance "Other impacts") to close an existing gap.

Example

Quality Management								
	Impact to ->	1	2	3	4	5	6	7
1	Turnover		50					
2	Profit							
3	Motivation of Staff				20			
4	R&D Performance			50				80
5	Product Quality	50					100	20
6	Failure Costs		10					
7	Quality Costs		10		80	100		
8	Other	50	30					
9	Incentives			50				
	Sum	100	100	100	100	100	100	100

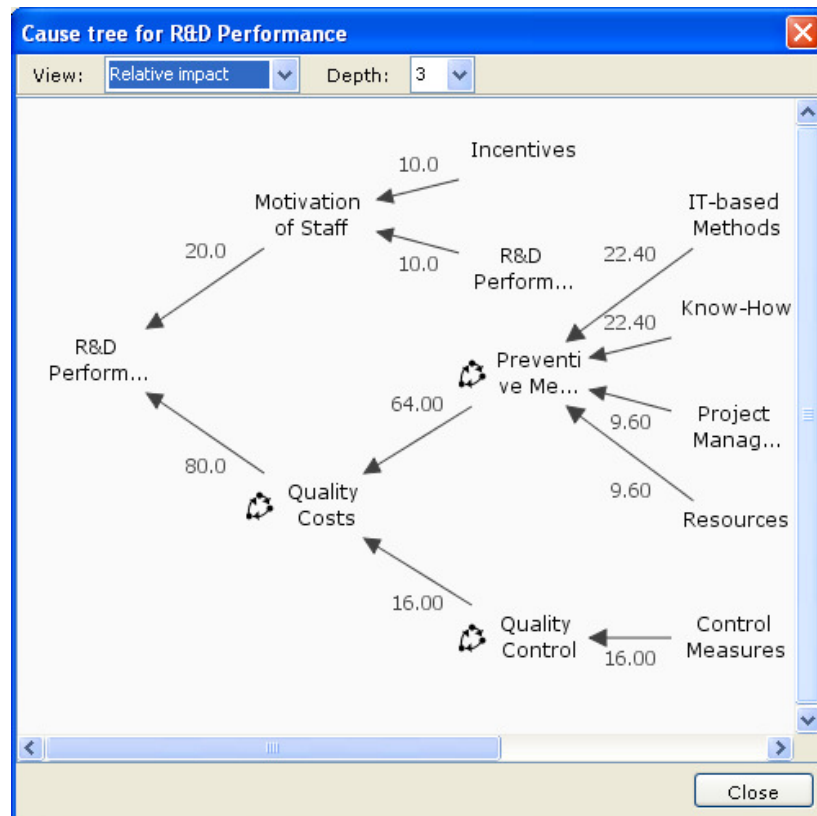
Tasks

The results will be illustrated in the CLD-Diagram and in the Use- and

Cause-Trees explaining the system structure of your problem.

In addition, the cause trees are showing all relative direct and indirect strength of relationships per selected factor. Consequently you will get an overview about all existing levers in your system. After a comparison you can choose the most efficient ones to solve your problem.

Example



2.4 Workflow-Step Quantify

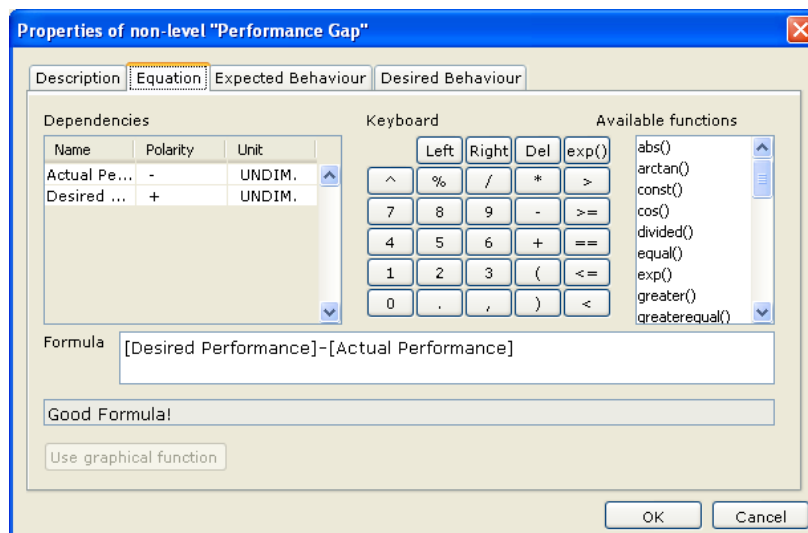
Objectives This workflow-step is aiming at quantifying the model in order to get a deeper understanding about the problem structure.

Tasks By using CONSIDEO, it is not necessary to study on how to build a system dynamics model. You just have to define the stocks in your system - other types of factors will be defined automatically by the system. The quantification of the model will also be supported by critics and quick fixes.

In addition, CONSIDEO is the first System Dynamics software worldwide which links Causal-loop-diagrams with the Stock-and-Flow view of System Dynamics and thus unites different approaches. It is possible to switch the views at any time.

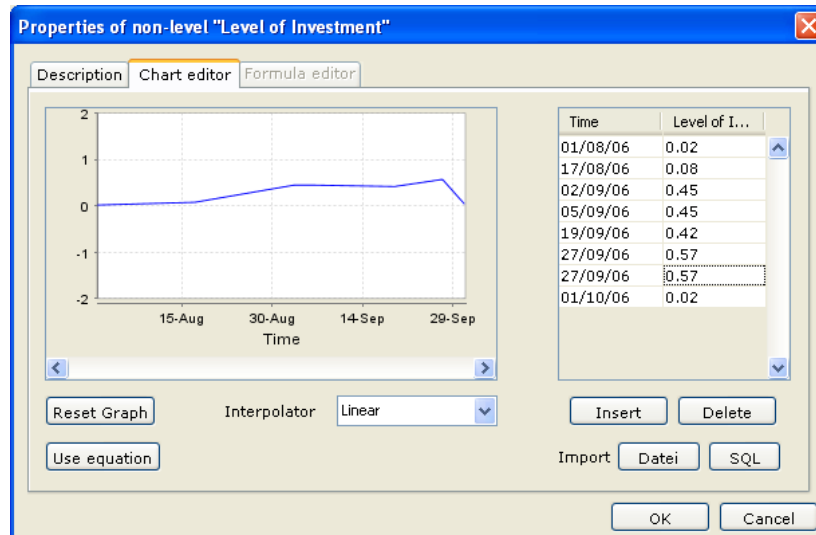
To quantify connections, just double click on a factor and quantify the connection by using the formula editor.

Example



Tasks To describe the behaviour over time for a selected factor, double click on a factor and draw directly into the chart with the mouse or enter numerical values into the table.

Example



2.5 Workflow-Step Simulate

Objectives This workflow-step is aiming at

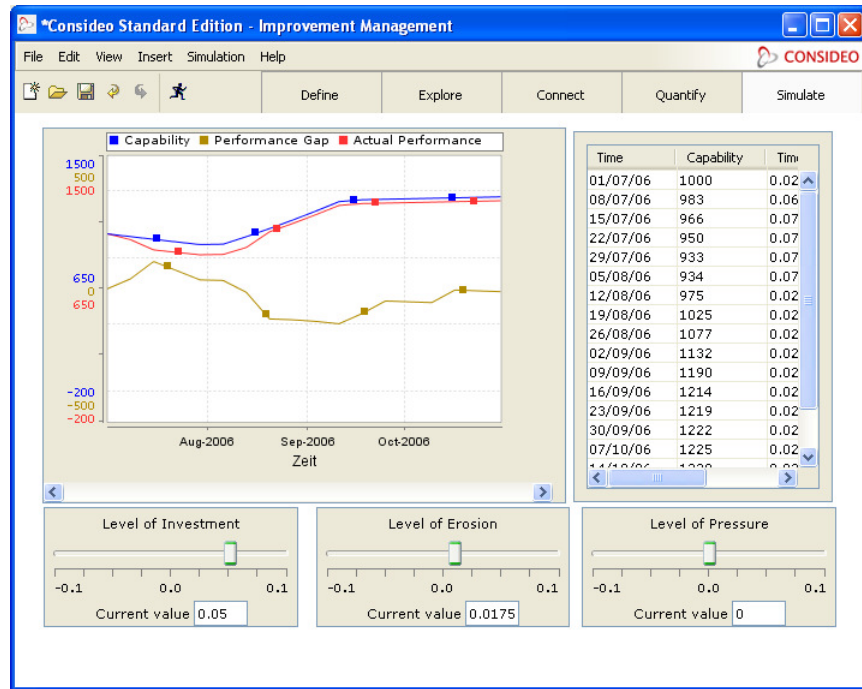
- analysing the systems behaviour over time (quantitative analysis) and validating the model,
- carrying out different "what-happens-when?" scenarios and
- testing, evaluating and comparing different strategies with regard to their efficiency and effectiveness by considering different scenarios.

Present your results in a user-friendly, understandable way by creating your own management cockpit.

Tasks Compile your own management cockpit. For this, right-click on the work area and select the action "Add chart", "Add table" and "Add manipulator". After this, choose the relevant curves by right-clicking on the chart or table and selecting the action "Add or remove curves". You can add up to 5 curves per chart – the tables are unlimited.

For testing, comparing and evaluating different strategies, change the manipulator by drawing directly into the chart with the mouse or by entering numerical values or by using the slider of the manipulator.

Example



Aufgaben

Finally, a project report will be created automatically after choosing the content of it (Menu – File - Export).

3. Tutorial

3.1 General Approach

Introduction CONSIDEO STANDARD EDITION provides an optimal methodological support for analyzing complex systems in a systematic and comprehensive way, consisting of a workflow, a guidance and a user-friendly interface.

The workflow guides you through a series of steps:

- Define - Define the scope of the project
- Explore - Find relevant factors
- Connect - Identify and analyse cause-and-effect relationships
- Analyse – Analyse the causal loop diagram and find the most efficient lever to solve your problem
- Quantify - Quantify your model in order to get a deeper understanding about the problem structure
- Simulate - Evaluate different strategies by considering different "what-happens-when?" scenarios

However, the process is not linear - it is an iterative approach. Most of the steps have to be revised according to the knowledge gained at later stages, which means you may have to go back and forth several times.

In addition, it is possible to skip workflow-steps. For instance, experienced modelers can start directly with the step Connect.

In general, the different workflow-steps support you to answer the following questions [1]:

1. Define	- What is the problem? - Who is having the problem? - What are the questions? - What is the desired outcome of the question? - How serious is the problem? - What is at stake? - Is the problem complex? - How complex? - Frequent? - Globally or locally occurring? - What is the scale of the problem? - How does the problem manifest? - What are the symptoms?
2. Explore	- What are the target factors? - What is the expected and desired behavior of the target factors? - What are the main factors of the problem? - What factors are influencing or will be affected by the target factors? - Who are involved? - What factors are important? - What external factors are influencing? - What factors can you or your client influence? - What varies over time?
3. Connect	- How are the factors connected? - Which connected factors are changing in the same direction? - Which connected factors are changing in opposite direction? - Are any connected factors linking back to the starting factor (Feedback Loops)?

	- Can you identify long and short feedback links and timelags? - Are there reinforcing loops? - Are there any balancing loops? - Which factor is the most efficient leverage for solving the problem?
4. Quantify	- Which factors are stocks – meaning what factors describe things that accumulate? - What processes make the things accumulate? - What are the initial values of the stocks? - What relationship is there between factors? - Which equations can be used to describe it? - Is there unit consistency? - How do inputs (external factors) behave over time? Constant or non-constant? - Which data sets are available for import? - Are there any problems/failures in the model?
4. Simulate	- What behavioural pattern is created over time? - Is the model output realistic (Reality Check) and does it correspond to the historical data (History Check)? - Does the model behave according to your expectations? (Expected Behavior) - Do you need to modify the model? - How do the target factors behave over time by carrying out different "what-happens-when?"-scenarios? - Which strategy is the most efficient and effective one to solve your problem?

This workflow can be carried out on different scales.

You can use it in the sense of a one-person project, trying to organize your thoughts about a problem.

Alternative, you can use it for group modeling sessions to ensure an interdisciplinary approach. By doing this, professionals from different fields of the problem domain can play a key role in describing, analyzing and solving the problem by their active participation during the conceptual part.

Especially for group modeling it is important to document and explain all assumptions and the whole discussion process for getting a high transparency and acceptance of the project results. For this, CONSIDEO STANDARD EDITION's annotation/discussion tool will support your documentation activities.

Below, the general approach and every single workflow-step will be described by using the simple example "Quality Management". It is easy to understand and demonstrates the methodological approach of building a model of a complex problem.

3.2 Workflow-Step Define

Objectives

For a successful project it is important to describe the problem, the objectives and the system boundaries in detail as well as considering the intended audience and time horizon. This workstep aims at answering the following questions [1]:

- What is the problem?
- Who is having the problem?
- What are the questions?
- What is the desired outcome of the question?

- How serious is the problem?
- What is at stake?
- Is the problem complex? How complex?
- Frequent? Globally or locally occurring?
- What is the scale of the problem?
- How does the problem manifest?
- What are the symptoms?

This information serves as an anchor and helps you to keep focus during the project.

Your project should be described with the following information:

- Problem description
- Definition of objectives
- System boundaries
- Time horizon

3.2.1 Describe the Problem

Tasks Describe the problem by summarizing the phenomenon, occurring behavior pattern or issue to be addressed in your study. The statement should be connected to a location, time horizon and perspective.

Example

Problem:

The product line "Laser NT" of the company Trusty is running unsatisfactory since 12 months at the production location Lübeck. In spite of a permanent increase of overtime and pressure to do work the throughput of the product line is decreasing continuously by 1 % per month. As a result of this, more than 60 % of all orders can not be delivered on time.

The executive producer is asking for spending more time for improving the production process. However, the managing board of the company worries about losing working hours resulting in an increase of the delay of delivery. Therefore, the managing board is asking for increasing the pressure to perform.

Notes In general, your problem statement should answer the following questions:

- Perspective: From whose point of view is the problem being seen? Note that a given situation may appear quite different to various viewers depending on their role and interest.
- Time horizon: Over what time period does the viewer perceive those changing aspects to be a problem? Note that time lags (time period between cause and effect) have to be considered. By doing this, the time scale for viewing the problem is often much longer.
Reference Mode: What is the pattern of change that constitutes the problem behavior? Is it a past or conjectured future behavior?

3.2.2 Define Objectives

Tasks There are two levels of objectives. On the meta level you should determine the target audience and the intended use of the study.

For example:

"Is the intended audience a group of experts or a student class?"

"Do you just want to clarify dependencies within a system or do you want to make predictions?"

On the concrete level, based on the problem description, explain what you are hoping to understand about the problem and what the project is aiming at. In the case of defining implementation goals, it is necessary to determine the target factors and what the goal for their future behavior is (e.g. the study is aiming at a proportional reduction of failure costs of the product TRUSTY by 25 % till the year 2005). Be open-minded and avoid any descriptions of possible solutions; otherwise you risk to exclude other solutions even before the study starts.

Example

Objectives:

The project is aiming at increasing the performance of the production process (throughput) by 10 % within the next 6 months. For this, different strategies shall be tested, compared and evaluated as a basis for taking decisions by the managing board of the company as the main target group of the study.

3.2.3 Determine System Boundaries

Tasks Most problems are related to open systems where the boundary between the system and its environment is not clear. Therefore you need to define the system boundaries for your study explicitly. This depends on the problem to be addressed (Problem Definition), what the study is aiming at (Objectives) and who is interested in the problem.

Example

System Boundaries:

The study should concentrate on the internal processes of the company. Furthermore, only the following 2 general strategies "Working Smarter - Spending more time for improvement" and "Working Harder - Focussing on increasing the pressure to perform" shall be considered.

Notes Analysts may disagree on where a system's boundary actually is, and a slight change in the way the study is defined may lead to a dramatic shift in the system boundary.

For example, our above mentioned example is focussing on internal processes of a company. However, if the problem was redefined slightly to focus on the impact of supplier and distributor then the boundary of the analysis would have to be expanded.

3.2.4 Determine the Time Horizon

Tasks The time horizon can be viewed as a special system boundary. It not

only includes the time period in the future you are interested in, but also the period in the past you are examining to find the relevant system behavior. If you have historical data of that period you can use it to test your model.

Example

Time Horizon:

The study should consider the next 6 months.
Historical data is available at least for the last 2 years.

Notes

The time horizon is usually related to the size and granularity of the studied objects. For example, when studying molecules, the time horizon might be on the millisecond scale, but when examining the drift of continents, the time horizon would likely be aeons.

Avoid looking at small objects with a large time horizon, since these problems are usually intractable; avoid having a too short time horizon for large or coarse grained objects, since these behave in a nearly constant way over short times and show interesting behavior only in the long run.

3.3 Workflow-Step: Explore

Objectives

This step aims at structuring and organizing knowledge about the problem and reducing the complexity by defining, grouping and prioritizing factors.

What factors does the system have? There are several different ways how to define them. One scheme is thinking about the problem in terms of how and why one or more target factors vary through time. For instance, a study of a CO₂ emission in the City SOMEWHERE would involve examining how and why the CO₂ emissions change over time. Such a study would include within its boundary all the factors necessary to explain why the CO₂ emissions change over time.

A factor is a system element which can be described as a quantity at any point of time. The change of this quantity over time is called the factor's behavior. To find all relevant factors, you ask the following questions [1]:

- What are the target factors?
- What is the expected and desired behavior of the target factors?
- What factors influence or will be affected by the target factors?
- Who is involved?
- What factors are important?
- What external factors are influencing?
- What factors can you or your client influence?
- Do the factors varies over time?

The exploration phase is best carried out in five steps:

1. Describe target factors
2. Use brainstorming to find additional factors
3. Group factors by affinity
4. Select most important factors
5. Start a CLD with the most important factors.

In the sense of Brainstorming, begin with all thinkable factors connected to the target factors and sort out the important ones later. The important factors (header cards) will be translated into the CLD-Diagram as the next workflow-step. We are suggesting to choose just 6-10 factors to reduce the complexity first ensuring a clearly laid out structure.

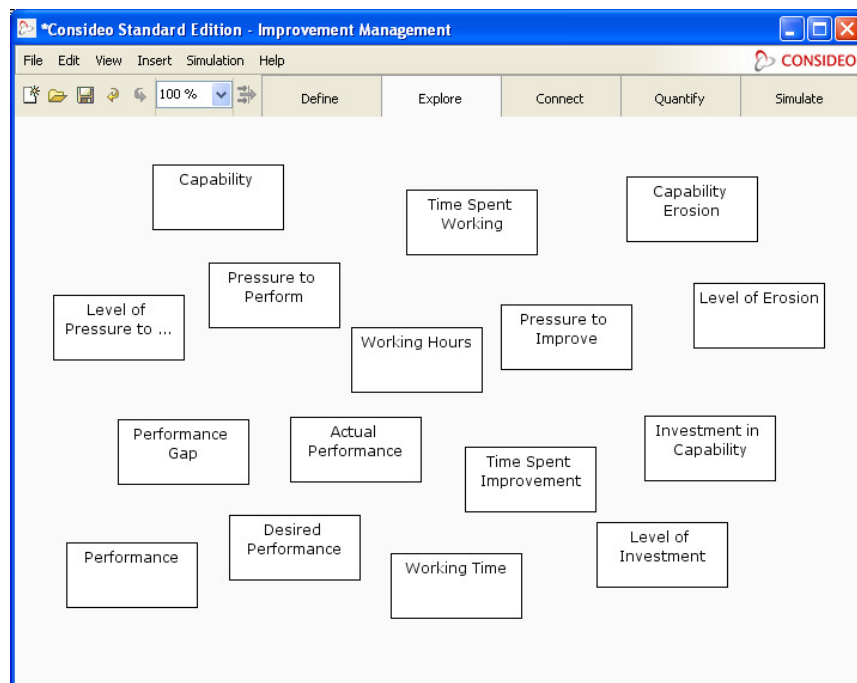
3.3.1 Describe Target Factors

Tasks Target factors can be derived from the problem description and the objectives. You should also provide the expected and desired behavior of all target factors. Just double click on the work area and type in the names.

3.3.2 Use Brainstorming

Tasks Starting with the target factors, you should do a brainstorming to define all other important factors related to the problem. For doing this the above mentioned questions are helpful. In the sense of brainstorming, just take all factors connected to the target factors you can think of - you will sort out the important ones later. Each factor found is inserted into the project by double clicking on the work area and typing in its name.

Example



Notes **Statement Length**
Be as concise as possible when you define the factor's name. It should state in one to three words the essence of the factor.

In order to avoid misinterpretation, each factor should be described with an additional short description (when you double click on the factor a dialog opens which lets enter this description).

Statement Clarity
The statement must be clearly defined - understandable for yourself and others. It must be possible for someone who has not been a

member of the modeling team to understand the essence and detail of the issues raised.

Existence of Quantity

A factor should be measurable. It helps to state the unit in which each factor is measured.

Tautology

Re-statements of the term itself should be avoided or eliminated.

Semantic

Try to use the same semantic and neutral terms. This means that a statement should not include any expected or desired behavior of the factor like a decrease or an increase.

3.3.3 Group Factors

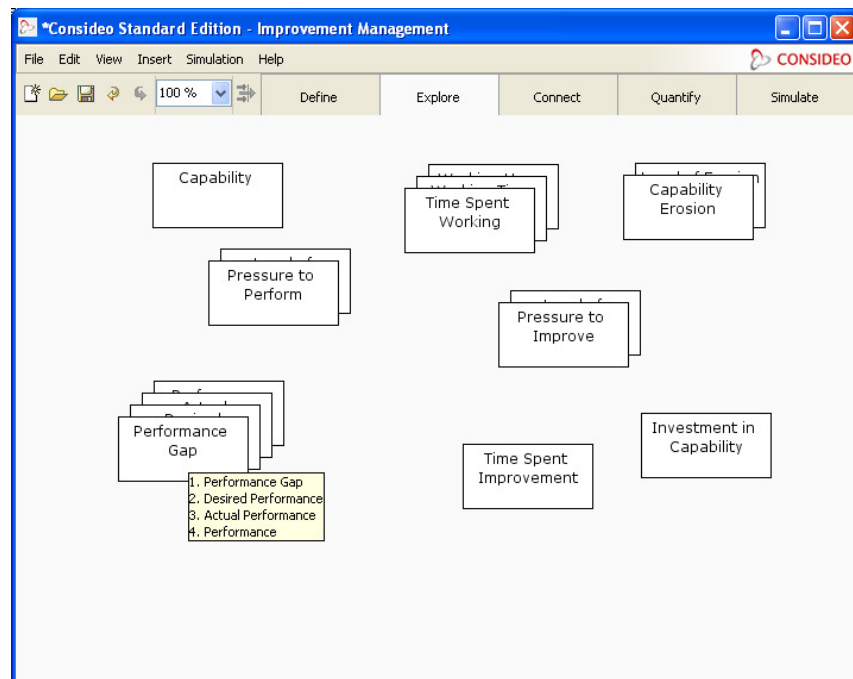
Tasks

This step organizes the defined factors into groups based on the natural relationship between each item, and defines groups of items in order to reduce the complexity (keep it short and simple first).

Look for two factors that seem to be related in some way. Build a group of them by dragging one to another one and dropping it (like playing a solitaire card game). Place the group to one side by clicking on it and moving it. Look for other factors that are either related to each other or to the original two factors that were set aside. Repeat this process until you have all the factors placed in different groups. Do not force-fit single factors into groups in which they do not belong.

If you decide that factors are not really relevant to the project, they should be deleted or documented as a system boundary – for instance by placing the factors into one group called system boundary.

Example



3.3.4 Prioritize and Select Header Cards

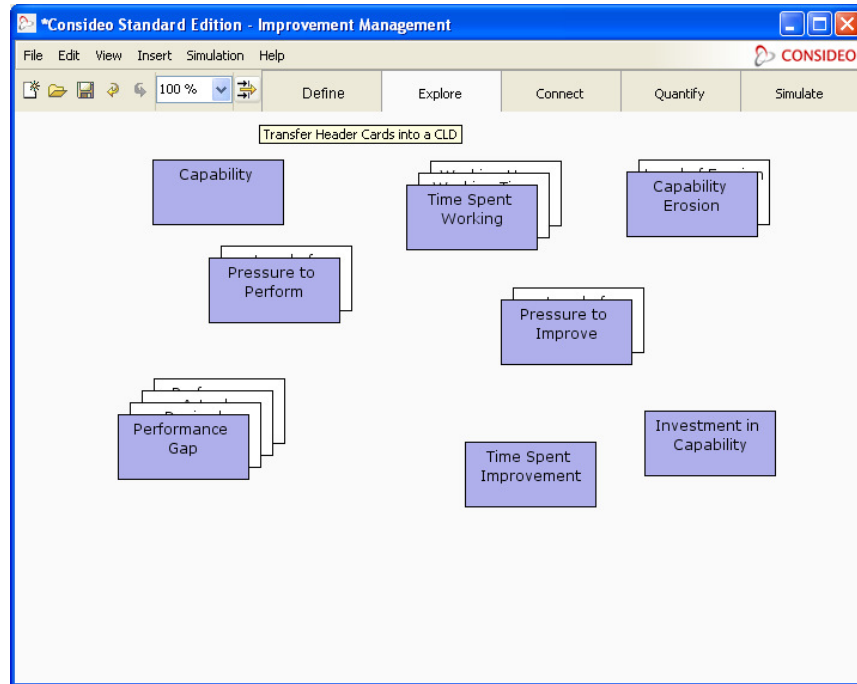
Tasks

Select one factor per group as a header card reflecting the contents of

the group. This factor is placed at the top of each grouping. If needed rename it or create a new one so that everybody (also not involved persons) can understand the essence of the group just by reading the title and description of the header card.

Try to keep it short and simple first. 6-10 groupings should be sufficient. When there are too many of them, try to merge related groupings.

Example



3.3.5 Transfer Header Cards into a CLD

Tasks Your top level system view for the next workflow-step comprises the main header cards which emerged after affinity grouping.

Notes Note, the top level system is describing your problem area in an abstract manner which will be refined later on. Try to be as abstract as possible and avoid a detailed description of subparts. You can introduce subsystems for that later. Your top level system should be as simple as possible first (KISS - Keep it short and simple first). This helps to keep your model understandable for yourself and others who are not involved in the project.

If you are sure you have more than our suggested 6-10 header cards, try to start with a subset which captures the most important relationships. The initial top level system is never right, so you will revise it according to the knowledge gained at later stages anyway.

3.4 Workflow-Step Connect

Introduction This workflow-step is aiming at

- developing and analyzing the structure of the problem by describing the mental models of the involved experts with the help of Causal Loop diagramming as well as

- finding the most efficient leverage for solving the problem.

A Causal Loop diagram (CLD) explains the cause-and-effect structure of the problem and its feedback loops.

The problem formulation and the definition of the key factors are the starting point of the mental modeling process. Then you look for cause-and-effect relationships between the factors and link the causes to effects with arrows.

The result of this step should describe your mental model about how the system is working in a qualitative way. With CONSIDEO STANDARD EDITION you can also quantify your model and simulate different scenarios which gives directions for further actions and optimal strategies.

This workstep asks the following questions [1]:

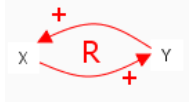
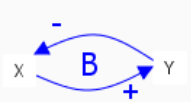
- How are the factors connected?
- Which connected factors are changing in the same direction?
- Which connected factors are changing in opposite direction?
- Are any connected factors linking back to the starting factor (feedback)?
- Can you identify long and short feedback links and time lags?
- Are there any reinforcing processes?
- Are there any balancing processes?
- Which factor is the most efficient leverage for solving the problem?

This phase is best carried out in three steps:

1. Describe the system on an abstract level by connecting the key factors.
2. Detail the model by using subsystems.
3. Analyse the structure of the system and find the most efficient leverage for solving your problem.

Notes

Causal Loop diagrams (hereafter called CLDs) or influence diagrams derive their name because each link has a causal interpretation. CLDs are useful in conceptualizing and developing structures and qualitative models. Causal Loop diagrams are used to document relevant factors and the causal relationship between them by drawing arrows.

The arrow shows a causality. A factor at the tail causes a change to the factor at the head of the arrow. A plus sign near the arrowhead indicates that the factor at the tail of the arrow and the factor at the head of the arrow change in the <i>same</i> direction. If the tail increases, the head increases; if the tail decreases, the head decreases.  A minus sign near the arrowhead indicates that the factor at the tail of the arrow and the factor at the head of the arrow change in the <i>opposite</i> direction. If the tail increases, the head decreases; if the tail decreases, the head increases. 	The letter R in the middle of a loop indicates that the loop is <i>reinforcing</i> a behavior in a same direction, causing either a systematic growth or decline. It is a behavior that is moving <i>away</i> from equilibrium point.  The letter B in the middle of a loop indicates that the loop is <i>balancing</i> and moves the system in the direction towards equilibrium or a fluctuation around equilibrium point. 
---	---

Summarized explanation of the Causal Loop concept (adapted from Roberts et al. [1])

3.4.1 Connect Key Factors

Tasks

Build the first level of your CLD by connecting the main key factors of your problem area. The key factors can be defined by transferring the header cards from the previous workflow-step. Alternatively, you can type them in by taking into account the general notes of the previous workflow-step. We are suggesting to choose just 6-10 key factors to reduce the complexity first ensuring a clearly laid out structure.

The connection between the key factors will be done by drawing simple arrows showing the causality between them. After drawing arrows, the polarity should be defined (double click on the link) by answering the following question (see above: language of Causal Loop):

Do the connected factors change in the same (positive polarity) or opposite direction (negative polarity)?

Do not feel forced to define the polarity if the polarity is unclear or both polarities are existing. In this case, the model is too abstract and the polarity has to be defined later by describing the process between the connected factors in a more detailed way with the use of a subsystem.

Highlight time delays in your model by double clicking on the link and

entering a value for the delay. Be aware that all connections are delayed in some way. Therefore only delays which are significant with respect to the time horizon should be mentioned.

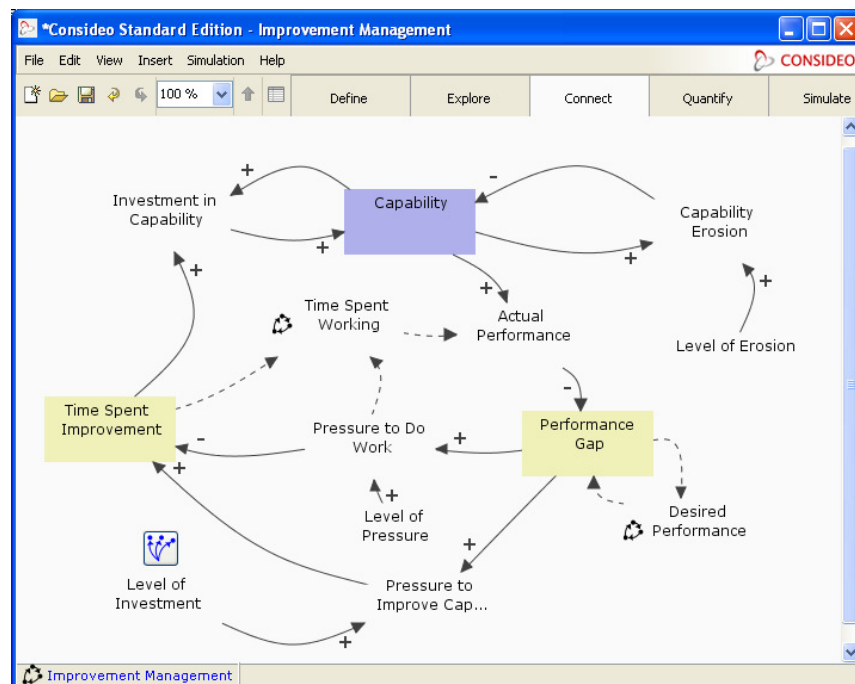
Notes

Note, many problems are non-linear - so meaning that feedback loops should be considered. Feedback loops are crucial, because they are often influencing the behavior of the system in an unexpected way. Through a feedback loop a factor will be affected by itself, since the effect links back to the cause.

Tasks

Sketch your preliminary top level CLD and discuss and improve it several times involving different participants (stakeholders, professionals from various disciplines). The goal of this iterative approach is to get a common understanding and to describe the mental model of the group on an abstract level.

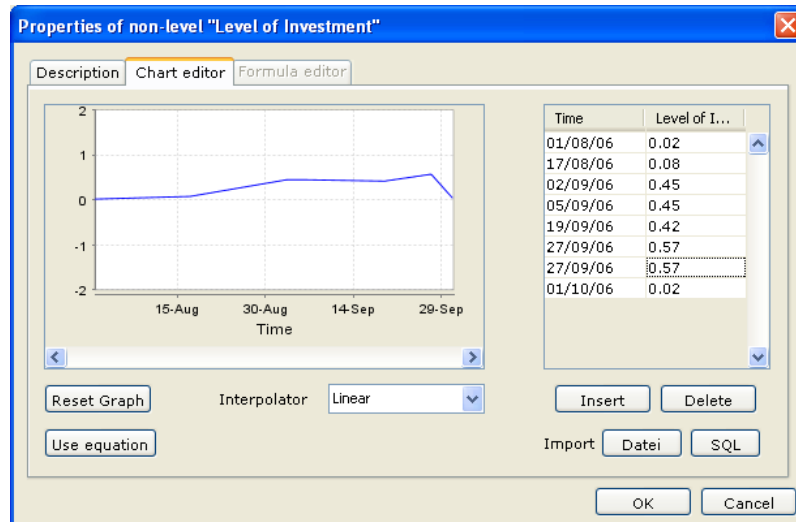
Example



Tasks

After creating the CLD, describe the expected behavior of the CLD by creating Reference Behavior Patterns (RBP). Double click on the factor, and estimate and sketch roughly how the expected behavior of the key factors will be in future times.

Example



3.4.2 Detail the Model by Using Subsystems

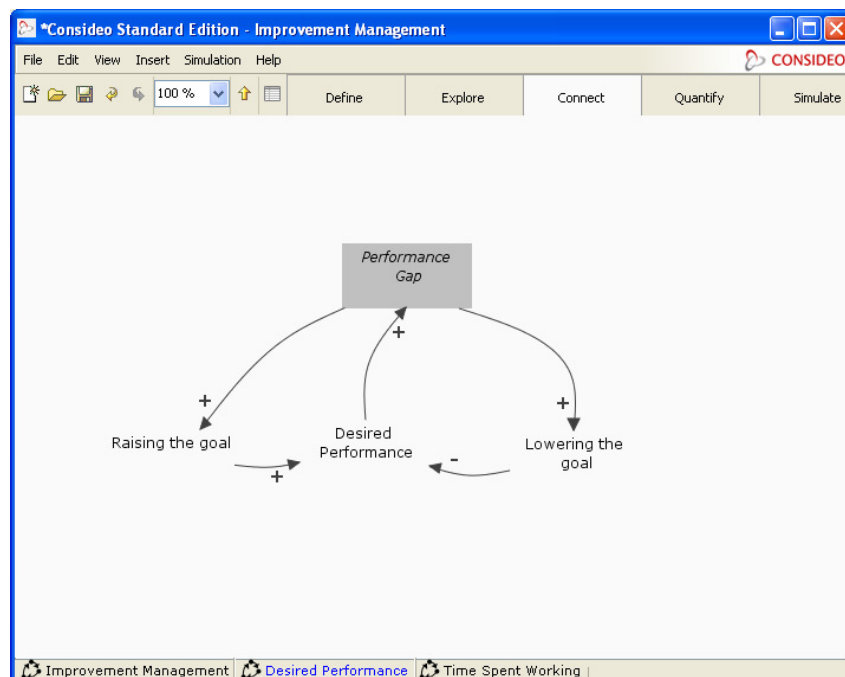
Tasks

Detail the first level of the CLD by using subsystems. A subsystem is describing the selected factor and its connections in a more detailed way.

Just right-click on a factor and select "*New subsystem*" to create a new subsystem. A new diagram will be created for this subsystem, showing the selected factor and all connected factors and corresponding links.

Add new factors and links that explain the selected factor more precisely. If this factor was a header for a group of factors in the previous workstep, consider including some or all of these factors. Describe the cause-and-effect structure between the selected factor and connected ones by examining the processes the selected factor is involved in.

Example



Notes

The newly added factors can affect or can be affected by external

factors as well. External factors are factors which belong to other subsystems or to the top level CLD. Before connecting the added factor with an external factor by using the same mechanisms described above (drawing arrows), a copy of the external factor has to be added to the subsystem first (right-click on the work area and choose "*Insert... – Copy of external factor*").

Factors of a subsystem can also be described in additional subsystems as well. The process of utilizing subsystems for describing factors and links more concretely continues in a hierarchy until the model is detailed sufficiently.

Complexity can not be solved through complexity - meaning that too many subsystems can overload your project resulting in an intransparent structure. Try to keep the depth of the subsystem tree low without overloading the single diagrams with too many factors. 1-2 additional subsystem levels with 6-10 factors each are usually sufficient to explain the problem structure. Try to avoid fillers, be as concrete as possible within the subsystems.

If you lack time, concentrate on the most critical factors and links. Do not waste your scarce time to explain "well-known" subsystems. But be aware, there is always a risk that some parts of your "well-known" subsystem behaves unexpected over time.

3.4.3 Analyse the Structure of the System

Introduction This workflow-step aims at analyzing the developed model in a qualitative way in order to check completeness of the model, gain understanding about the problem structure and to find the biggest leverage for solving the problem. The analysis can answer the following questions:

- What kind of feedback systems are influencing the behavior of the system?
- Are there reinforcing processes?
- Are there any balancing processes?
- Which feedback loop is dominating?
- Where are the leverages for solving the problem?

This phase is best carried out in 5 steps:

1. Identify Dependencies
2. Identify Feedback Loops
3. Find and analyse Balancing Loops
4. Find and analyse Reinforcing Loops
5. Find Lever

3.4.3.1 Identify Dependencies

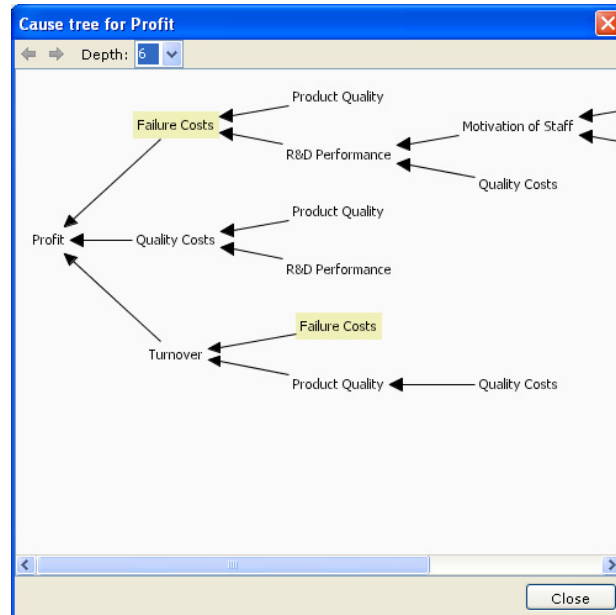
Tasks Define dependencies (effects and causes) by using Use-and-Cause Trees (right-click on a factor) and the Influence Matrix (view menu or toolbar). Try to find "active" and "passive" factors. "Active" factors are mainly affecting other factors in the system. "Passive" ones will mainly be influenced by others.

Notes

Cause Trees

A cause tree for a selected factor describes all other factors which influence the selected factor directly and indirectly. To analyse it, just right-click on the selected factor and select the action "Cause tree" from the context menu.

Example

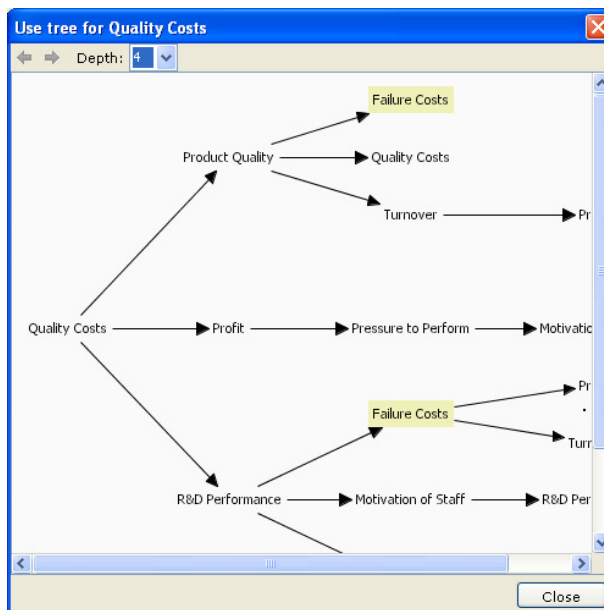


Notes

Use Trees

A use tree for a selected factor describes all other factors it influences directly and indirectly. Uses are the opposite of causes. To analyse it, just right-click on the selected factor and select the action "Use tree" from the context menu.

Example



Notes

Influence Matrix

The Influence Matrix gives a complete overview how each factor influences others. It gives the same information as the Causal Loop diagram but may be more suited to check completeness. To show the Influence Matrix for a CLD just select "*Matrix*" from the view menu or toolbar. Any changes in the Influence Matrix influence the diagram directly.

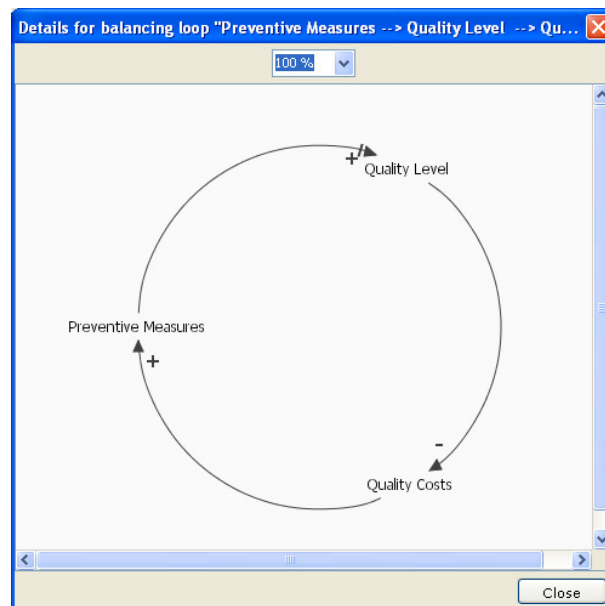
3.4.3.2 Identify Feedback Loops

Tasks

List all loops of the project (view menu). The total number of loops provides important information about the problem structure. Many loops in a system are demonstrating that the system is more or less self-regulating – driven by itself. A system consisting of just a few loops is mainly depending on external factors driving the system.

Analyse the length of all loops. Loops which are containing many different factors are more critical because they are difficult to understand and to foresee due to the longer time lag between cause and effect. The more factors are involved in a loop the longer the time lag and the more difficult to predict the behavior of the system.

Example



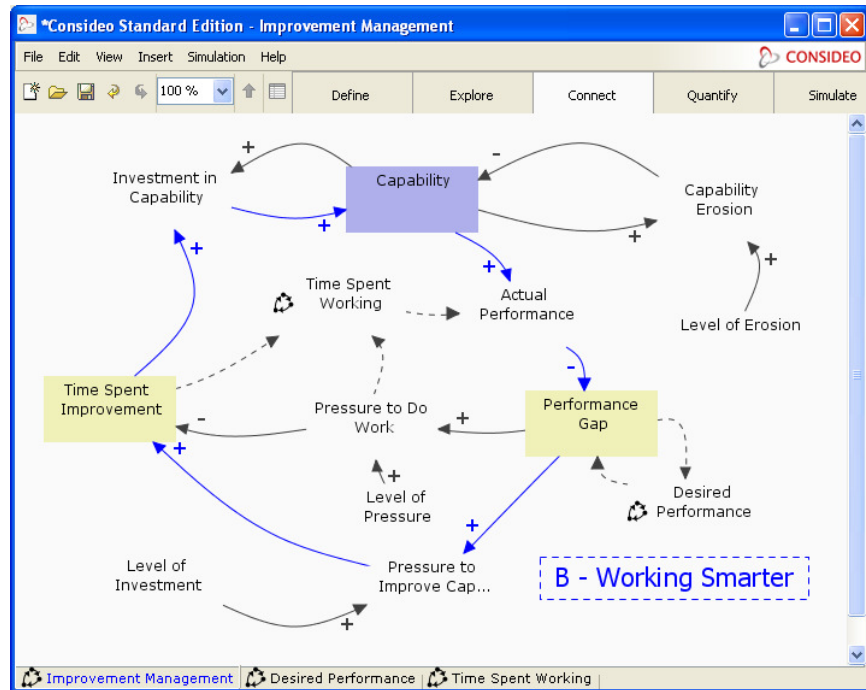
3.4.3.3 Find and Analyse Balancing Loops

Tasks

Find and analyse balancing loops by selecting "*Loops*" from the context menu of a selected diagram. Balancing loops are "self-regulating" loops moving the system in the direction towards equilibrium or a fluctuation around the equilibrium point. This means that a dominant balancing loop will stabilize a system by preventing any escalation of the system.

Analyse the behavior of the loop and evaluate whether the behavior will support or hinder the achievement of your objectives.

Example



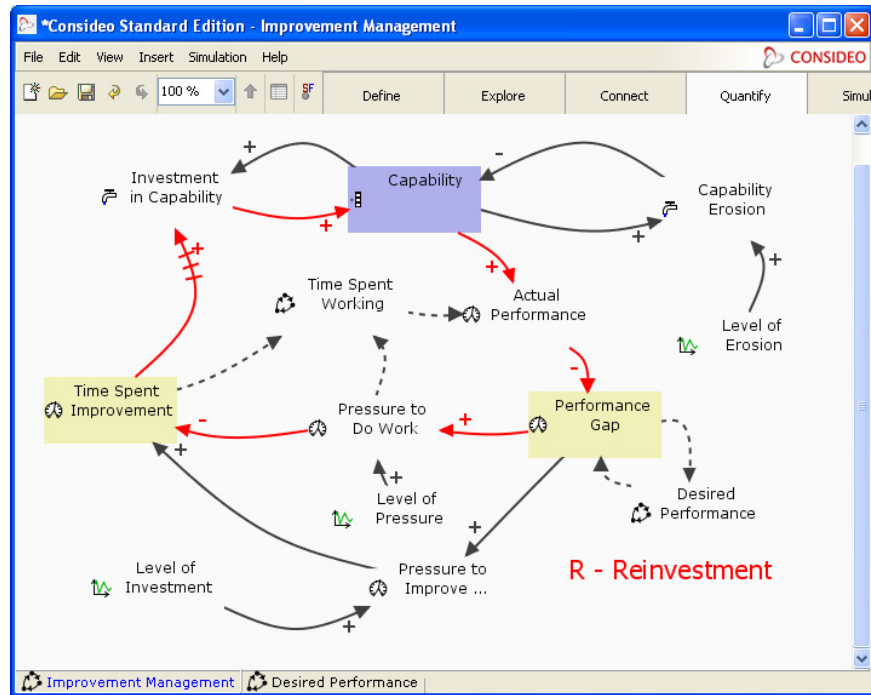
3.4.3.4 Find and Analyse Reinforcing Loops

Tasks

Find and analyse reinforcing loops by selecting "Loops" from the context menu of a selected diagram. A reinforcing loop moves the system in the same direction, causing either a systematic growth or decline. It is a behavior that is moving away from the equilibrium point – having a strong effect on the system behavior over time. Therefore, it is important that you find the main factors driving this kind of reinforcing loops to use them as a lever to solve your complex problem.

Analyse the behavior of the loop and evaluate whether the behavior will support or hinder the achievement of your objectives. By doing this, analyse the length of all existing reinforcing loops again. The less factors are involved the faster the escalating process.

Example



3.4.3.5 Find Lever

Tasks

Estimate roughly the strength of relationships in the matrix. Indicate how strong the different factors influence each other by using rates measured in percentage (0-100). By doing this, the following general question is helpful: How strong is the direct impact of Factor A on Factor B in comparison to all other factors having a direct impact on Factor B? Click on the selected field of the matrix and enter the polarity (+/-) and the strength of relationship (e.g. 30) without the unit (%) with your keyboard.

Note: Only direct impacts should be considered. The total sum of all impact rates must be 100 – otherwise a hint will appear. If needed, insert a new factor (for instance "Other impacts") to close an existing gap.

In addition, the strengths of relationships can also be entered in the property window of a selected arrow (context menu – properties).

Example

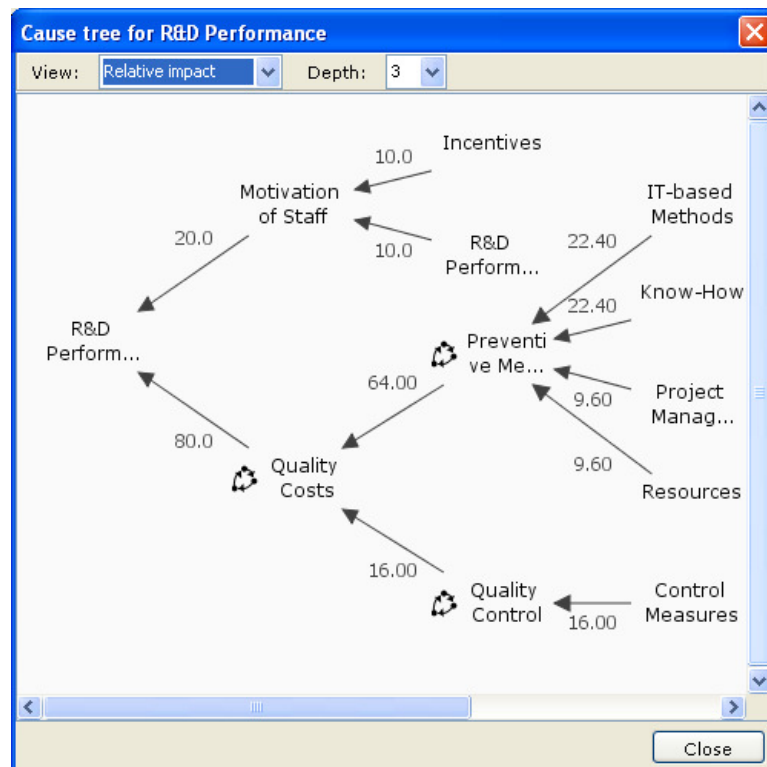
Quality Management									
	Impact to ->	1	2	3	4	5	6	7	
1	Turnover		50						
2	Profit								
3	Motivation of Staff				20				
4	R&D Performance			50				80	
5	Product Quality	50					100	20	
6	Failure Costs		10						
7	Quality Costs		10		80	100			
8	Other	50	30						
9	Incentives			50					
	Sum	100	100	100	100	100	100	100	

Tasks

The results will be illustrated in the CLD-Diagram and in the Use- and Cause-Trees explaining the system structure of your problem.

In addition, the cause trees are showing all relative direct and indirect strengths of relationship per selected factor. Consequently you will get on overview about all existing levers in your system. After a comparison you can choose the most efficient ones to solve your problem.

Example



3.5 Workflow-Step Quantify

Introduction This workflow-step is aiming at quantifying the model in order to get a deeper understanding about the problem structure

This phase is best carried out in four steps:

1. Define Stocks and Initial Values
2. Quantify Connections
3. Describe the behavior over time of inputs
4. Model Validation and Optimization

This workflow-step asks the following questions [1]:

- Which factors are stocks – meaning what factors describe things that accumulate?
- What processes make the things accumulate?
- What are the initial values of the stocks?
- What relationship is there between factors?
- Which equations can be used to describe it?
- Is there unit consistency?
- How do inputs (external factors) behave over time? Constant or non-constant?
- Which data sets are available for import?
- Are there any problems/failures in the model?

3.5.1 Define Stocks and Initial Values

Tasks By using CONSIDEO, it is not necessary to study on how to build a system dynamics model. You just have to define the stocks in your system - other types of factors will be defined automatically by the system.

After this, define the initial values of the stock by double clicking on the factor.

Notes A stock in a broader sense is some entity that is accumulated over time by inflows and/or depleted by outflows. Stocks can only be changed via flows. Mathematically a stock can be seen as an accumulation or integration of flows over time - with outflows subtracting from the stock. Stocks typically have a certain value at each moment of time - e.g. the number of population at a certain moment.

A flow changes a stock over time. Usually we can clearly distinguish inflows (adding to the stock) and outflows (subtracting from the stock). Flows typically are measured over a certain interval of time - eg. the number of births over a day or month. A flow is usually used as a sum up of different components that are increasing or draining a stock.

Example

Stock	Inflow(s)	Outflow(s)
Inventory	incoming goods	outcoming goods
guests in a hotel	guests arriving	guests leaving
Population	births	deaths
bank balance	paying in	withdrawals

fuel tank	refueling	fuel consumption
water in bathtub	water pouring in	water leaving through sink

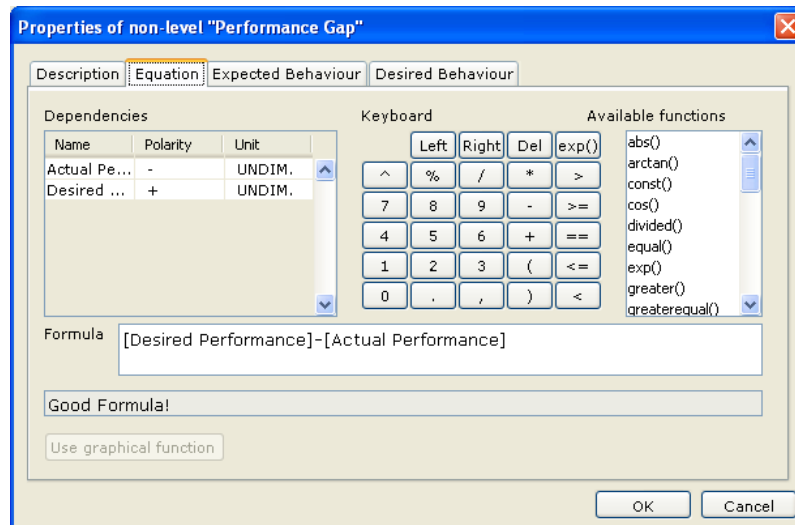
3.5.2 Quantify Connections

Tasks

To quantify connections, just double click on a factor and quantify the connection by using the formula editor. By doing this, all dependencies must be considered. Critics will inform you if the formula is not valid.

The formula for stocks will be developed automatically by CONSIDEO.

Example



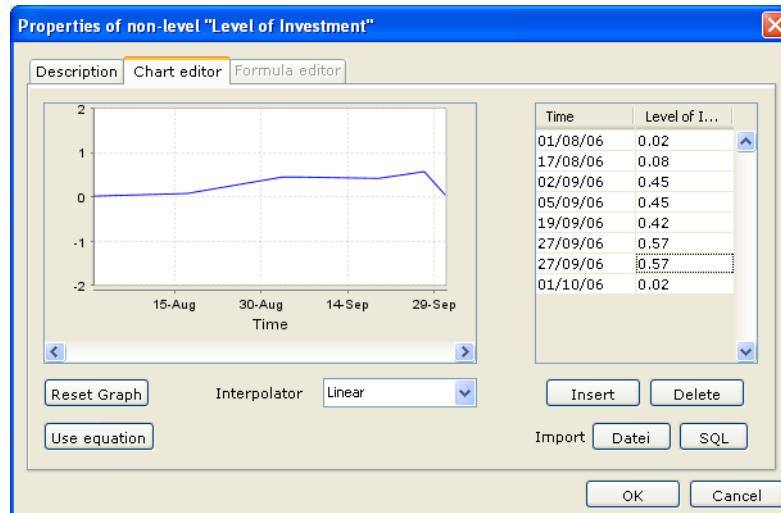
3.5.3 Describe the behavior over time of inputs

Tasks

To describe the behaviour over time for an input (external factor), double click on a factor and draw directly into the chart with the mouse or enter numerical values into the table. It is also possible to import data sets.

For constant inputs, use the formula editor. To switch between the formula editor and the chart editor, click on „Use graphical Function“ (chart editor) or „Use Equation“ (formula editor).

Example



3.5.4 Model Validation and Optimization

Tasks

A faulty model can not be simulated. CONSIDEO provides critics and quick fixes for optimizing your model.

To get help for validating and improving your model, open the list including all problems and failures in the model by clicking on the submenu "Show issues" from the help menu. Quick fixes (double click on a problem) will suggest you solutions for fixing some of the failures.

Failures indicated by the symbol have to be fixed before starting the simulation run. Problems indicated by the symbol are hints – giving some advice to optimize your model – but the solution of the problems is not a precondition for a simulation run.

1. Model Validation: In this section all invalid connections in the model will be listed – indicated by the symbol . CONSIDEO will provide some quick fixes after double clicking on the failure. After choosing a solution, the changes will be automatically carried out in the model.

The model will be validated based on the following rules:

- Stocks can only be changed via flows. Usually flows will be influenced by inputs (external factors).
- Stocks can not be directly connected to each other.
- Any loop must contain at least one stock.
- No delayed flow dependencies.

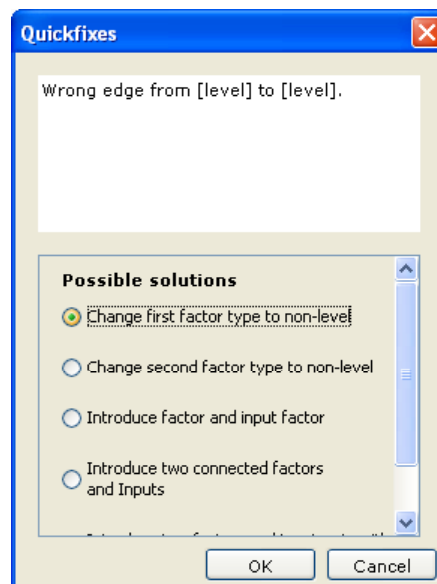
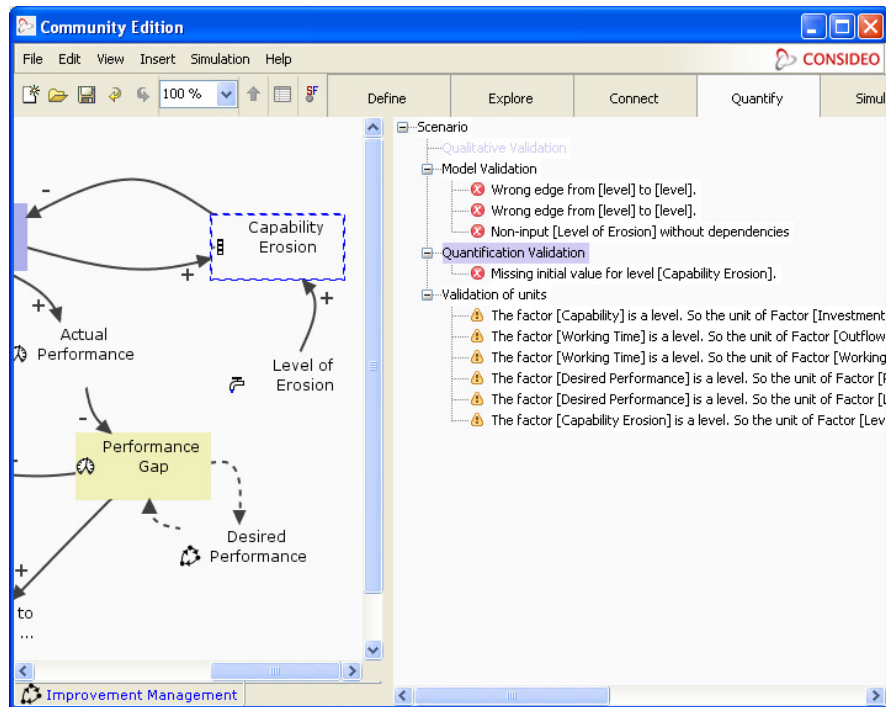
2. Quantification Validation: In this section all invalid formulas and missing inputs in the model will be listed – indicated by the symbol . The relevant factor will be highlighted automatically by clicking on the failure.

The model will be validated based on the following rules:

- All levels must have initial values.
- Model must have start and end time.
- All input values must have values between start and end time.
- All dependencies must be included in the formula.

3. Validation of units: In this section hints concerning the unit consistency will be listed – indicated by the symbol ⚠. The relevant factor will be highlighted automatically by clicking on the hint.

Example



3.6 Workflow-Step Simulate

Introduction This workflow-step is aiming at evaluating different strategies by considering different "what-happens-when?" scenarios and choosing the most efficient and effective one to solve your problem.

This phase is best carried out in three steps:

1. Simulation
2. Model Validation
3. Strategy Development

This workflow-step asks the following questions [1]:

- What behavioural pattern is created over time?
- Is the model output realistic (Reality Check) and does it correspond to the historical data (History Check)?
- Does the model behave according to your expectations? (Expected Behavior)
- Do you need to modify the model?
- How do the target factors behave over time by carrying out different "what-happens-when?"-scenarios?
- Which strategy is the most efficient and effective one to solve your problem?

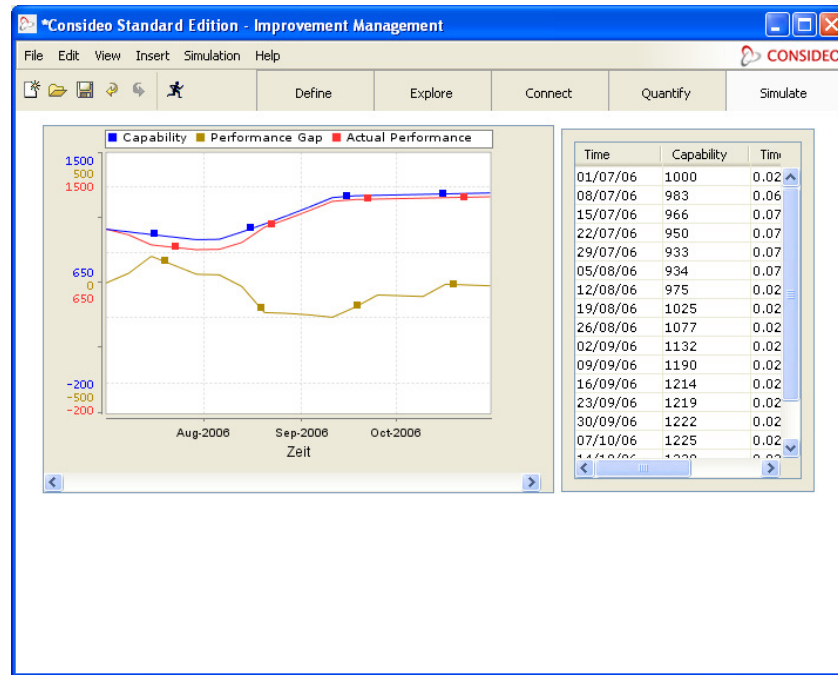
3.6.1 Simulation

Tasks Compile your own management cockpit. For this, right-click on the work area and select the action "Add chart", "Add table" and "Add manipulator". After this, choose the relevant curves by right-clicking on the chart or table and selecting the action "Add or remove curves". You can add up to 5 curves per chart – the tables are unlimited.

To start a simulation run, click on the Workflow-Step SIMULATE or select "Run Simulation." from the simulation menu or press the simulation button  in the toolbar.

Before starting the simulation run, define the time interval, the step size and the algorithm by clicking on "Simulation details" from the simulation menu.

Example



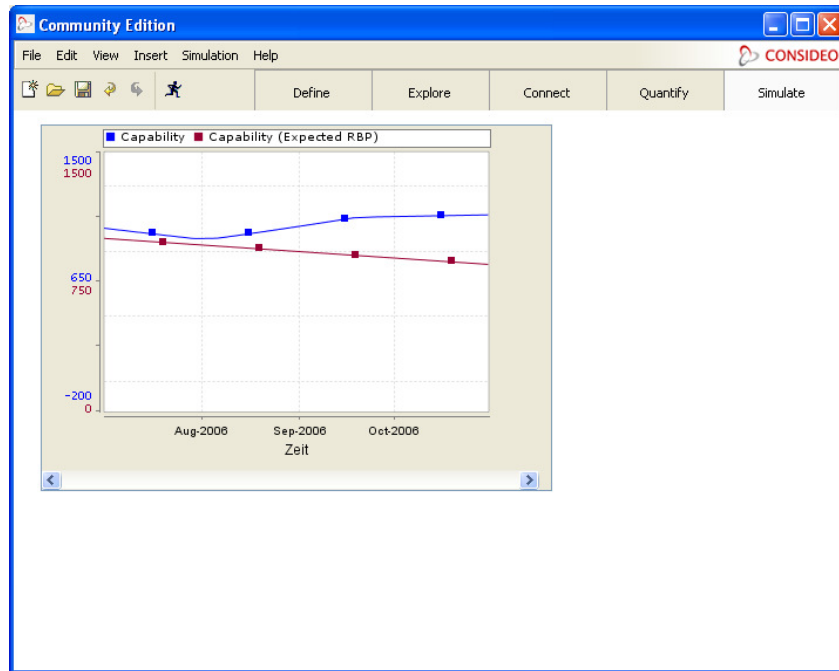
3.6.2 Model Validation

Tasks

There are two ways of validating the model:

1. Consider historical data and validate if the model output is realistic (Reality Check) and if it is corresponding to the historical data (History Check). For this, set the starting time of the model into the past and look if the model can simulate the development of the system from the past till today. If not, you have to modify the model.
2. Validate if the model behave according to your expectations. For this, compare the results of the simulation run with your expected behavior over time of selected factors (Expected Behavior). Think about deviations and the need to modify the model. Note, deviations can raise new questions about the problem itself and generate a totally new insight into the problem.

Example



3.6.3 Strategy Development

Tasks

On the basis of a valid model, different strategies can be tested, compared and evaluated by using manipulators.

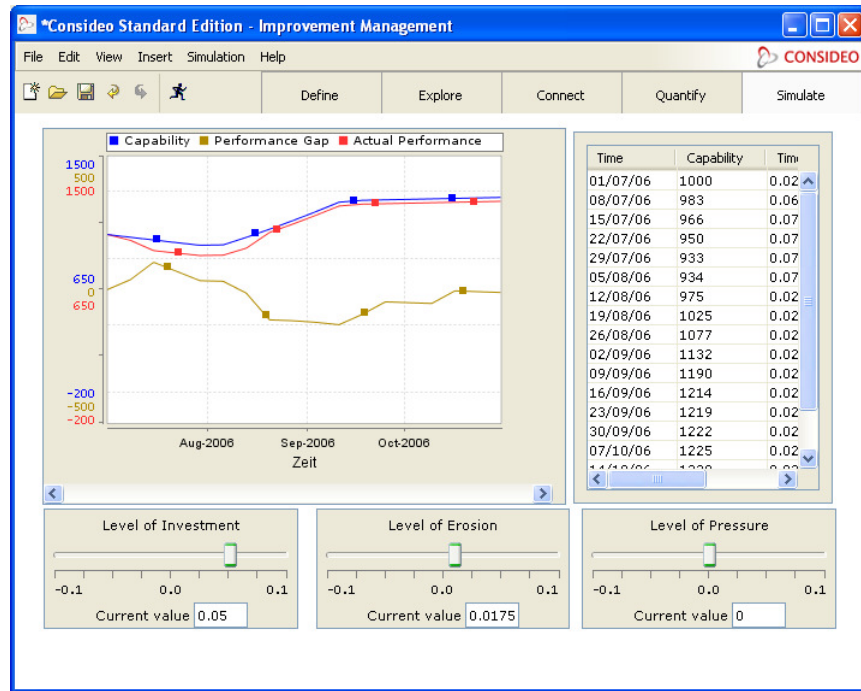
To add a manipulator, right-click on the work area and select the action "Add slide manipulator", "Add chart manipulator" or "Add table manipulator".

Choose the slide manipulator for changing an initial value of a stock or a constant value in your model. For all other, non-constant factors, you can choose a chart or table manipulator. Please note, you can only choose one manipulator per factor.

For testing, comparing and evaluating different strategies, change the manipulator by drawing directly into the chart with the mouse or by entering numerical values or by using the slider of the manipulator.

To save the results of a scenario in a chart, right-click on the chart and select the action "Freeze chart". By doing this, you will lock the chart. This means that simulation runs in the future will not affect the "locked" chart.

Example



Tasks

Finally, a project report will be created automatically after choosing the content of it (Menu – File - Export).

4. General Functions

4.1 Help

To get help...

...open file manual.pdf from installation directory with Adobe Acrobat Reader.

4.2 Working with Projects

Project files encapsulate all information about a particular model: the model itself, the problem description, annotations, simulation charts, etc. CONSIDEO STANDARD EDITION opens only one project at a time.

To create a new project...

...select "New project" from the File menu or press the "New project" button . If there are unsaved changes, you will be asked if you want to save or discard these changes.

To open a project...

...select "Open ..." from the File menu or press the "Open ..." button . If there are unsaved changes, you will be asked if you want to save or discard these changes.

To save a project...

...select "Save" or "Save as ..." from the File menu or press the "Save" button .

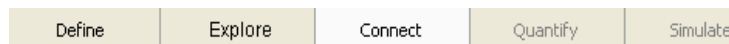
To exit the application...

...select "Quit" from the file menu. If there are unsaved changes, you will be asked if you want to save or discard these changes.

4.3 Navigation

To change the current workstep...

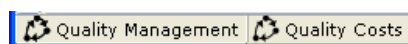
...click on the workstep's button in the workflow control.



The default sheet for the new workstep is activated. If you have not entered any information into this sheet before, a short guidance text will be displayed.

To show an existing diagram...

...click on the corresponding sheet's tab at the bottom of the screen.



The tab bar contains only sheets which are useful in the current workstep. If you need to see another sheet, use the view menu.

4.4 Undo and Redo

To undo an action...

...press the undo button  or select "Undo" from the edit menu. You can use the undo function repetitively up to 10 times. CONSIDEO STANDARD EDITION keeps track in what sheet the changes were made and will activate the correct sheet.

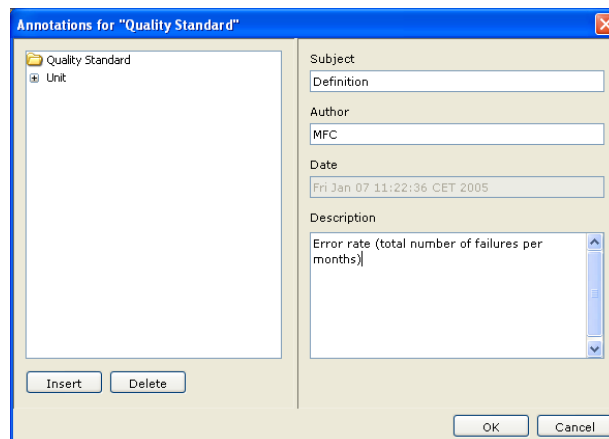
To redo an action...

...press the redo button  or select "Redo" from the edit menu. You can redo all undone steps unless you made a new change. In this case the list of undone steps is cleared and the redo function will be disabled until you use undo again.

4.5 Other Functions

To annotate some part of the project...

...select the action "Annotations" from the context menu of a factor or a link. A dialog appears which allows to enter a note. It also shows a list of existing annotations and you can relate your new note to one of those.



The existing annotations on the left-hand side are ordered by thread. On the right side you can view, delete and change annotations.

To change the zoom of a diagram...

... select one of the predefined zoom factors from the drop down list accessible in the toolbar. Alternatively you can enter a number (in percent) for the zoom factor.

The zoom function only affects the current sheet.

To print a diagram...

... select "Print" from the file menu. You are asked to select a printer. Then a print preview for the current sheet appears.

To create a project report...

... select "HTML-Export" from the file menu. You are asked to choose the content of your project report. After the selection you can export the report by choosing a folder and saving it.

5. Workflow - STANDARD EDITION

This chapter describes how to accomplish the tasks related to building a System Dynamics model with CONSIDEO STANDARD EDITION.

5.1 Workflow-Step Define

This workstep asks for a problem statement, the time horizon and aims. This information serves as an anchor and helps to keep focus in the following steps.

To enter a project name or text for another input field...

...click on the field and type. If the field is empty it shows a short guidance text which tells what information is expected. You can use the "Enter" key to start a new line in some input fields.

To enter the time horizon...

...provide the start date and end date for the time interval of interest and the unit.

The second interval describes for what time interval actual data is available. You can include this data in the model and use it for comparison.

5.2 Workflow-Step Explore

In this workstep you identify the key factors of the system. This typically involves three phases:

1. Identify a (possibly large) set of factors related to the problem.
2. Group these factors by affinity and introduce header cards.
3. Transfer header cards into a Causal Loop diagram.

The result of this workstep is a set of factors which are defined in a sufficiently exact manner and a subset of header cards.

5.2.1 Identify Factors

To insert a new factor...

...simply double click at the position where you want to place it. You can then immediately type in a name for the new factor.

Alternatively you can right-click on the background of the diagram and select the action "New factor" from the context menu.

If you select the action "New factor" from the insert menu, the new factor is inserted at a place near the top left corner of the diagram.

To delete a factor...

...right-click on the factor and select the action "Delete". The factor and associated information are deleted.

Alternatively, you can select the factor and then type the "Delete" key or select the action "Delete" from the edit menu.

To move a factor...

...click on the factor and drag it to a new position.

To operate on a group of factors...

...select the first factor and hold the "*Shift*" key pressed while selecting subsequent factors. You can then drag or delete the group of factors.

Alternatively, you can select a group of factors by pressing the left mouse button on the diagram background and dragging a so called rubber band box.

When you release the mouse button, all elements inside the rubber band box get selected. This can be combined with the "*Shift*" key to include the old selection.

To rename a factor...

...click on the factor and select the action "*Rename*" of the context menu (right-click on the factor) or of the edit menu. After editing you can commit the changes with the "*Enter*" key or revert to the old name with the "*Escape*" key. If you want to include a line break in the factor name, type Shift-Enter.

Alternatively you can change the name in the properties dialog (see section "To describe a factor").

To describe a factor...

...double click on the factor. A new dialog appears which displays a tab "*Description*" with entry fields for name, description and other information.

Hint: The description is shown as a tooltip if you hover over this factor later.

Alternatively, you can right-click on the factor and select "*Properties*" from the context menu.

To set the unit for a factor...

...double click on the factor. A new dialog appears which contains entry fields for its unit.

Properties of factor "Quality Standard"

Description | Equation | Expected Behaviour | Desired Behaviour

Name: Quality Standard

Description: Click here to enter stuff

Unit: NO DIM.

Dependencies:

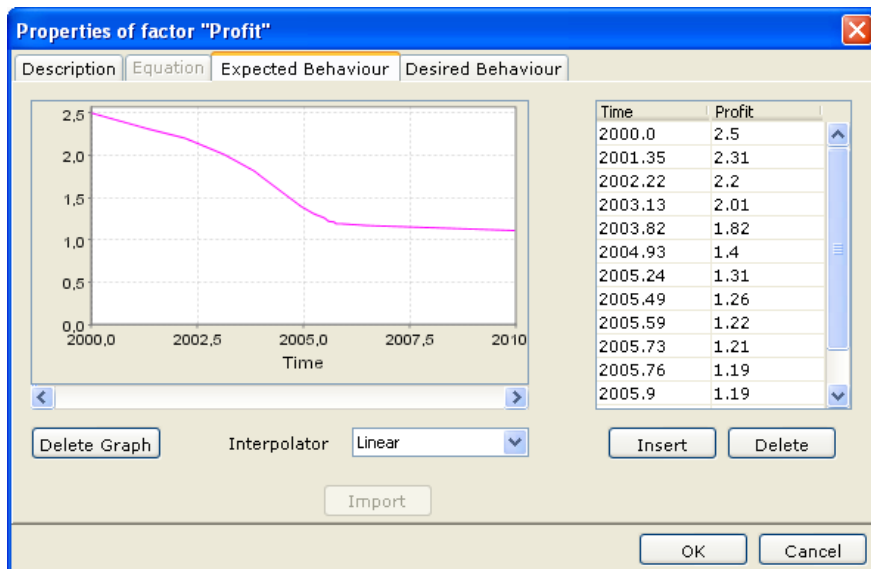
Name	Polarity
R&D Performance	+

OK Cancel

You can type in the unit directly with the keyboard or select a known unit from the drop down menu.

To define expected or desired behavior for a factor...

...double click on the factor. The properties dialog appears. Select the tab "Expected Behavior" or "Desired Behavior". Both tabs behave similarly.



They show a table and a chart which describes the factor's value at certain times. You can draw directly into the chart with the mouse or enter numerical values into the table. Changes to the table update the chart and vice versa.

Often you only define the expected behavior (for example if you do not really care about this factor's values). If you define both, the difference is that expected behavior describes the system without your intervention and desired behavior describes the results of some intervention (if successful).

5.2.2 Group Factors with Header Cards

Usually you will find too many factors to include into an initial model. Header cards help you to organize the factors. A header card provides a heading for several other related cards.

Header cards and related cards form a stack which can be moved as a unit. This makes it easy to reorganize your factors. If you are not satisfied with the grouping of factors, you can remove it from its stack and attach it to another header card.

To define header cards...

...right-click on a factor and select "*Change type to header card*". If this factor is already a member of a header card group, the factor will swap roles with the old header card.

Header cards are always displayed at the front of their stack.

To group factors with header or other factors...

...drag the factor to a header card or other factor and drop it. The factor is placed at the end of the stack.

If you drag a header card to a new header card, the whole stack of the dragged header card is placed at the end of the new stack. You can also select multiple factors and drag them to a new header card.

To regroup factors or header cards...

...drag the factor within a stack. If you drop it outside the stack or to a new stack, it is removed from the old stack.

To separate a header card from its stack, you first have to change the type of the factor by right-click on the factor (context menu – "*Change type to simple factor*").

To inspect a factor within a stack...

...if you hover with the mouse pointer over a factor, its text is displayed as a tooltip. The tooltip for a header card contains the text of all factors in the stack.

5.2.3 Transfer Header Cards into a CLD

To transfer all header cards into a CLD...

...select "*Transfer header cards*" from the edit menu or press the "*Transfer Header Cards into a CLD*" button . This opens a new Causal Loop diagram which contains each header card as a factor. The current workstep is changed to "Connect", so you can go on with connecting these factors.

If there already is a CLD, you are asked if you want to delete the existing CLD (including all subsystems).

5.3 Working with Units

Providing a unit for a factor also helps to find a clear definition for this factor: once you have a unit it's clear that

- the factor describes a quantity,
- this quantity is measurable, and
- usually how to measure this quantity.

To enter a unit with the keyboard...

...just type in the unit in the entry field of the factor's properties dialog.

The metric system units and other standard units are already known to the system. If you type in an unknown unit name, it will be marked with brackets to signal a user defined unit. This new unit is defined implicitly and can be used just like predefined units.

You can use the operators $*$, $/$, $^$ and parentheses to combine units. The unit will automatically be normalized. "UNDIM.", "1" and "X / X" denote all the dimensionless units.

Examples: $m \cdot s^{-2}$, km/h, [cows]/year

To choose a unit already used elsewhere in the project...

...select the unit from the drop down menu associated with the entry field.

To define a new unit...

...enter its name into the unit entry field, for example "fortnight". If you enter a name enclosed in brackets (for example "[week]") the system will define a new unit even if there already is a known system unit with this name. Beware that it can be very confusing to use the names of system units for user defined units!

5.4 Workflow-Step Connect

In this workstep you will connect the factors along their causal dependencies. This provides an initial Causal Loop diagram of the system.

The result of this workstep should describe your mental model about how the system is working.

To insert a new factor...

...simply double click at the position where you want to place it. You can then immediately type in the name of the new factor.

Alternatively you can right-click on the background of the diagram and select the action "*Insert...->New factor*" from the context menu.

If you select the action "*New factor*" from the insert menu, the new factor is inserted at a place near the top left corner of the diagram.

To delete a factor...

...select "*Delete*" from its context menu.

Alternatively you can select the factor and then type the "*Delete*" key or select the action "*Delete*" from the edit menu.

To move a factor...

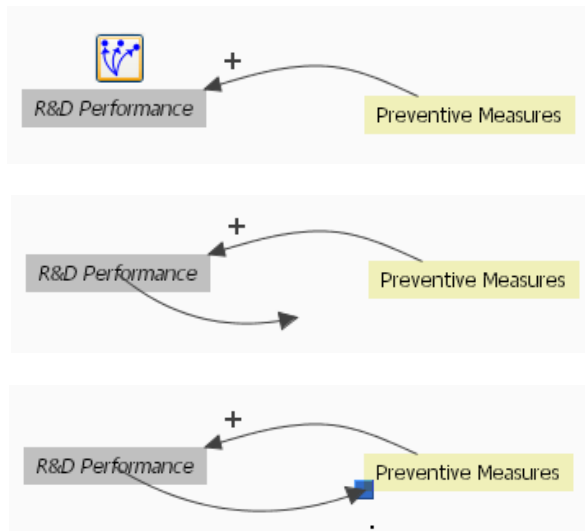
...see section 5.2.1.

To rename a factor...

...see section 5.2.1.

To link a driving factor to a driven factor...

...first move the mouse pointer over the driving factor until the "Connect" button appears. Then click on the "Connect" button. A new link appears with the open end connected to the mouse pointer. Now move the mouse pointer to the driven factor and click on it. The link's open end is now connected to the driven factor.



Hint: If you move the mouse pointer with the open end over the diagram, connectible factors will be highlighted when you hover over them. If the factor under the mouse is not highlighted, it is not possible to connect the link to this factor (for example, if there already is a link between these two factors).

Hint: If you click on the diagram's background while the mouse pointer is connected with the open end of the new link, the action is canceled and the new link deleted.

Yet another possibility to create or remove links is to use the Influence Matrix tool, see (section 5.7). If you select "Matrix" from the view menu, a table is presented in a new window. Each table cell represents a link between a driving factor (row) and a driven factor (column). With the mouse you can choose from the alternatives "positive polarity", "negative polarity" or "no connection". Any changes influence the diagram directly.

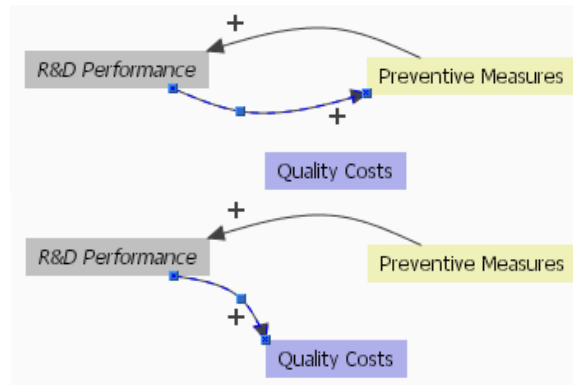
To remove a link...

...right-click on the link and select the action "Delete".

Alternatively, you can select the link and then type the "Delete" key or select the action "Delete" from the edit menu.

To reconnect a link...

...first select the link. The end points are shown as small squares.



Drag the square at the endpoint to another factor and drop it. Connectible factors will be highlighted when you hover over them.

To enter information about the dependency described by a link...

...double click on the link. A new dialog appears which has entry fields for name, description, polarity, delay and strength of relationship.

Hint: The description is shown as a tooltip if you hover over this factor later.

Alternatively, you can right-click on the link and select *"Properties"* from the context menu.

To change the polarity of a link...

...right-click on the link and select *"Change polarity to..."* from the context menu.

Alternatively, you can double click on the link and use the properties dialog (see section 5.2.1).

To set a delay for a link ...

... double click on the link and use the properties dialog (see section 5.2.1)

To change the thickness of a link ...

... double click on the link and change the strength of relationship.

To rename a diagram...

...right-click on the subsystem factor and choose "*Rename*" from the context menu.

To rename the first level of a CLD...

...rename the project title (Workflow-step Define; see section 5.1).

5.5 Working with Subsystems

To create a new subsystem...

...right-click on a factor and select "*New subsystem*". The factor is placed in a new subsystem and the new subsystem is shown in a new sheet. If the factor was connected, all external factors and the corresponding links are also shown.

You can edit the subsystem diagram in the same way as the main diagram. When you go back to the parent diagram, it displays a subsystem icon instead of the factor and all links from external factors are shown as dashed arrows.

To navigate between subsystems...

...click on the corresponding tab at the bottom of the screen.

Alternatively, you can double click on a subsystem icon to open its diagram; or you can choose the subsystem from the submenu "*View->Subsystem->List->...*".

To navigate to the parent subsystem...

...select "*View->Subsystem->Parent Subsystem*" or press the "*Go to parent subsystem*" button .

To remove a subsystem...

...right-click on its subsystem factor in the parent subsystem and select "*Delete*" from the context menu. After this the subsystem is permanently deleted as well as its contained factors and connected links.

Alternatively, you can select the subsystem factor and choose "*Delete*" from the edit menu.

To add external factors to a subsystem...

...right-click on the background of a diagram and select "*Insert...->Copy of external factor*" from the context menu. Choose a factor you want to see in this subsystem.

Note: The factor remains associated to its original subsystem.

To remove an external factor from a subsystem...

...select "*Delete*" from its context menu. The external factor disappears and any links connecting this factor within this diagram are deleted.

Alternatively you can select the factor and then type the "*Delete*" key or select the action "*Delete*" from the edit menu.

To connect an external factor...

...you can use the same mechanisms as with other factors. Note that you can not connect two external factors with each other - you have to place this link into one of the external factors containing subsystems.

Hint: Since a link from or to an external factor crosses subsystem boundaries, it shows up twice: once in this diagram, and another time in the diagram containing the external factor (with the role of internal / external reversed). Subsystem will also be connected with dashed arrows in any higher level diagrams.

To move a factor to another subsystem...

...right-click on the background of a diagram and select "*Move factor here*" from its context menu. The factor will become an internal factor of the new subsystem. If it is connected to other factors, these will become new external factors of this subsystem.

The factor will become an external factor in its old subsystem, unless the old subsystem is a direct or indirect parent of the new subsystem. In this case the factor is simply dropped from the old diagram and additional dashed arrows may be drawn to the corresponding subsystem icon in the old diagram.

To rename a subsystem...

...right-click on the subsystem factor and choose rename from the context menu (see section 5.2.1).

To show an overview of all subsystems...

...select "*Subsystem->Overview*" from the view menu. A new window appears which shows the tree of all subsystems.

5.6 Working with Copies of Internal Factors

Copies of internal factors allow this factor to appear at several places in the same diagram. You can recognize a copy of an internal factor by its dashed outline.

If you delete a copy of an internal factor, the original and other copies of the same internal factor are not affected. Only if you delete the original factor, all copies are also deleted.

A link can only be attached to a single factor - original or copy. Therefore, there are no "copy links". The main purpose of copies of internal factors is to avoid cluttering the diagram layout with connections which cross the whole diagram.

Copies of internal factors behave similarly to external factors: they do not allow conversion into subsystems and they have no own identity.

To create a new copy of an internal factor...

...right-click at the position of the diagram where you want to place it and select "*Insert...->Copy of internal factor*" from the context menu. A new copy is displayed. You can then move the copy to a new position and (re)connect links to it.

To remove a copy of an internal factor...

...select "*Delete*" from its context menu. The copy of the internal factor disappears and any links connected to this copy are deleted as well.

Alternatively, you can select the factor and then type the "*Delete*" key or select the action "*Delete*" from the edit menu.

To connect a copy of an internal factor...

...you can basically use the same mechanisms as with other factors.

To enter information about a copy of an internal factor...

...use the same options as for an original factor. Note that there is no separate information for a copy of an internal factor except for its set of connected links! Any changes to a copy factor's properties are reflected in the original and all other copies.

5.7 Integrated function Analyse

There are four concepts which are especially useful for analyzing a model:

Cause trees

A cause tree for a factor describes all other factors which influence this factor.

Use trees

A use tree for a factor describes all other factors it influences directly or indirectly.

Loops

A loop describes how the factors on this loop indirectly influence themselves. The analysis of loops is one of the most important aspects of System Dynamics.

Influence Matrix

The Influence Matrix gives a complete overview how each factor influences others. It gives the same information as the Causal Loop diagram but may be more suited to check completeness.

To show the use/cause tree for a factor...

...right-click on the factor and select the action "*Use tree*" or "*Cause tree*" from the context menu. A new window appears which shows a tree diagram with all factors which are driven by resp. drive this factor within the selected diagram. With the controls you can change the depth of the tree or toggle the view describing the polarity, the relative or absolute strength of relationship.

Hint: Loops are cut off when a factor is reached a second time (in the same branch).

To show the Influence Matrix for a CLD...

...select "*Matrix*" from the view menu. A table is presented in a new window. Each table cell represents a link between a driving factor (row) and a driven factor (column).

To enter information in the Influence Matrix...

...click on the selected field of the matrix and enter the polarity (+/-) and the strength of relationship (e.g. 30) without the unit (%) with your keyboard.

Note: Only direct impacts should be considered. The total sum of all impact rates must be 100 – otherwise a hint will appear. If needed, insert a new factor (for instance "Other impacts") to close an existing gap.

Any changes influence the diagram directly.

To show/highlight loops in its own diagram...

...select the context menu "*Loops-> ...*" from the background (right-click on the diagram) and choose a loop.

If you right-click on this label and choose "*Hide loop*" from its context menu, the loop is de-highlighted again.

To change the position of a loop label...

...drag it to a new position.

To change the name of a loop label...

...select "*Rename*" from its context menu.

To list all loops including the ones crossing diagrams...

...select the submenu "*Loops->...*" from the view menu. This shows all loops made of factors and links alone, without subsystems. If you select one loop from the list, its loop diagram will be shown in a new window.

5.8 Workflow-Step Quantify**To quantify connections, ...**

... open the formula editor by double clicking on a factor and type in the formula.

Eigenschaften - Nicht-Bestandsgröße "Performance Lücke"

Beschreibung Gleichung Erwartetes Verhalten Gewünschtes Verhalten

Abhängigkeiten

Name	Polarität	Einheit
Ist-Perfo...	-	UNDIM.
Soll-Perf...	+	UNDIM.

Tastatur

Links	Re...	Entf	exp()
^	%	/	*
7	8	9	-
4	5	6	+
1	2	3	(
0	.	,	)
			>
			>=
			=
			<=
			<

Verfügbare Funktionen

- abs()
- arctan()
- const()
- cos()
- divided()
- equal()
- exp()
- greater()
- greaterequal()

Formel [Soll-Performance]-[Ist-Performance]

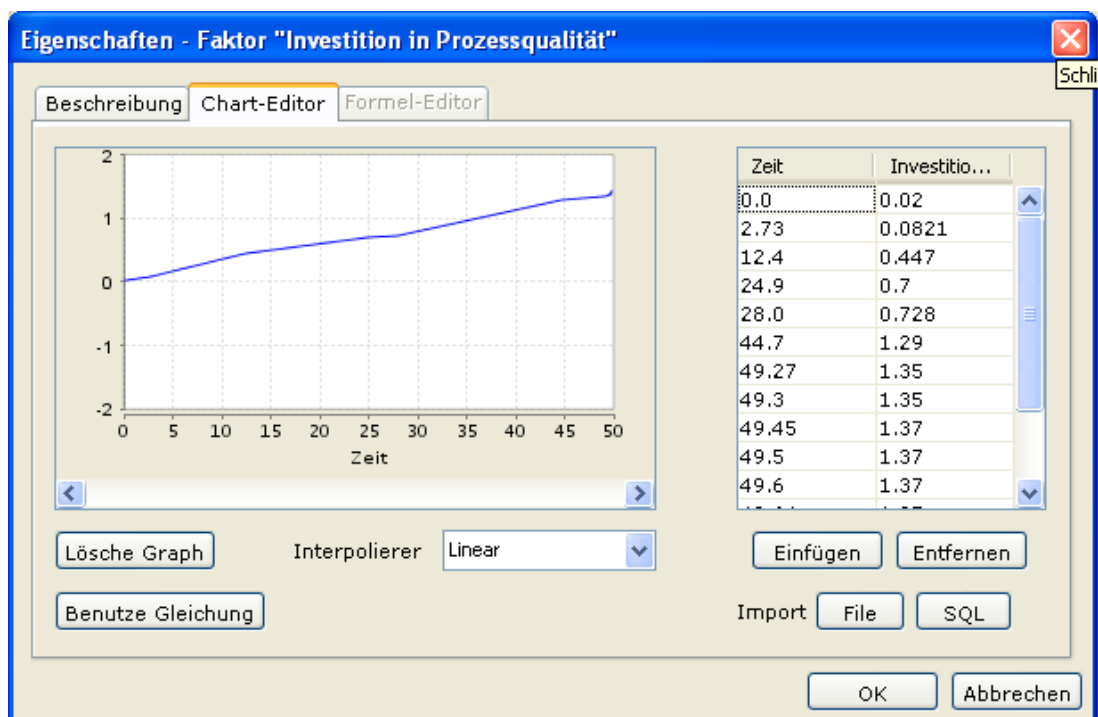
Gute Formel!

Benutze graphische Funktion

OK Abbrechen

To describe the behavior of an input over time, ...

... open the formula editor by double clicking on a factor and click on „Use graphical function“. Describe the behavior of the selected factor over time by drawing directly into the chart with the mouse or by entering numerical values into the table. Changes to the table update the chart and vice versa.



To get help for quantifying and validating your model, ...

... open the list including all problems in the model by clicking on the submenu "*Show issues*" from the help menu. Quick fixes (Double click on a problem) will suggest you some solutions for fixing the problem.

5.9 Workflow-Step Simulate**To start a simulation run, ...**

... click on the Workflow-Step SIMULATE or select "*Run Simulation.*" from the simulation menu or press the simulation button  in the toolbar.

Before starting the simulation run, define the time interval, the step size and the algorithm by clicking on "*Simulation details*" from the simulation menu.

To see the results of a simulation run, ...

... right-click on the work area and select the action "*Add chart*" or "*Add table*". After this, choose the relevant curves by right-clicking on the chart or table and selecting the action "*Add or remove curves*". You can add up to 5 curves per chart – the tables are unlimited.

To open a chart or table, ...

... right-click on the work area and select the action "*Add chart*" or "*Add table*".

To change the size of a chart or table, ...

... click on left corner at the bottom of a table or chart and move the size of it.

To move a chart or table, ...

... click on the diagram or table and drag it to a new position..

To delete a chart or table, ...

... right-click on the chart or table and select the action "*Delete chart*" or "*Remove table*".

To print a chart, ...

... right-click on the chart and select the action "*Print chart...*".

To save a chart, ...

... right-click on the chart and select the action "*Save chart as...*".

To add a curve, ...

... right-click on the chart or table and select the action *"Add or remove curves"*.

To delete a curve, ...

... right-click on the chart or table and select the action *"Add or remove curves"*.

To change a color of a curve, ...

... right-click on the curve and select the action *"Choose color"*.

To change a range of a curve, ...

... right-click on the curve and select the action *"Set range"*.

To change the zoom of a chart, ...

... right-click on the chart and select the action *"Zoom in"* or *"Zoom out"*.

To reset the zoom of a chart, ...

... .. right-click on the chart and select the action *"Zoom reset"*.

To show chart details, ...

... .. right-click on the chart and select the action *"Show details"*.

To save a chart as a scenario, ...

... .. right-click on the chart and select the action *"Freeze chart"*.

To change the order of columns of a table, ...

... click on the column and move to the desired position.

To change a scenario, ...

... change the manipulator by drawing directly into the chart with the mouse or by entering numerical values or by using the slider of the manipulator.

To add a manipulator, ...

... right-click on the work area and select the action *"Add slide manipulator"*, *"Add chart manipulator"* or *"Add table manipulator"*.

Choose the slide manipulator for changing an initial value of a stock or a constant value in your model. For all other, non-constant factors, you can choose a chart or table manipulator. Please note, you can only choose one manipulator per factor.

To change the type of a manipulator, ...

... open the properties of the factor by double clicking on the manipulator and change the behavior of the factor over time (constant or non-constant). After this, start the simulation run again.

To delete a manipulator, ...

... right-click on the manipulator and select the action "*Delete manipulator*"

To change the range of a manipulator, ...

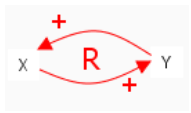
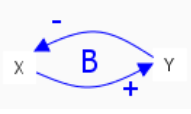
... right-click on the manipulator and select the action "*Set range*"

6. References

- [1] Haraldsson, H.; Svensson, M.: System Dynamic Decision System: Mental and quantitative model construction and implementaton; Lund 2004

7. Glossary

Balancing Loops	Balancing loops are "self-regulating" loops moving the system in the direction towards equilibrium or a fluctuation around the equilibrium point. This means that a dominant balancing loop will stabilize a system by preventing any escalation of the system (see also CLD).
Causal Loop diagram (CLD)	A Causal Loop diagram (CLD) explains the cause-and-effect structure of the problem and its major feedback loops. CLDs or influence diagrams derive their name from the fact that each link has a causal interpretation. CLDs are useful in conceptualizing and developing structures and qualitative models. Causal Loop diagrams are used to document relevant factors and the causal relationship between them by drawing arrows.

The arrow shows a causality. A factor at the tail causes a change to the factor at the head of the arrow. A plus sign near the arrowhead indicates that the factor at the tail of the arrow and the factor at the head of the arrow change in the <i>same</i> direction. If the tail increases, the head increases; if the tail decreases, the head decreases.  A minus sign near the arrowhead indicates that the factor at the tail of the arrow and the factor at the head of the arrow change in the <i>opposite</i> direction. If the tail increases, the head decreases; if the tail decreases, the head increases. 	The letter R in the middle of a loop indicates that the loop is <i>reinforcing</i> a behavior in a same direction, causing either a systematic growth or decline. It is a behavior that is moving <i>away</i> from equilibrium point.  The letter B in the middle of a loop indicates that the loop is <i>balancing</i> and moves the system in the direction towards equilibrium or a fluctuation around equilibrium point. 
---	---

Summarized explanation of the causal loop concept (adapted from Roberts et al. [1])

Cause Tree	Tree of all direct and indirect causes. More specifically, a cause tree for a selected factor describes all other factors which influence the selected factor directly and indirectly.
Diagram	A view which displays factors and interactions as a graph (nodes connected by edges).
External Factor	Each factor can only belong to one subsystem, but it is possible to refer to factors in a different subsystem as external factors.

Factor	A variable of the system
Feedback Loops	Feedback loops are crucial, because they are often influencing the behavior of the system in an unexpected way. Through a feedback loop a factor will be affected by itself since the effect links back to the cause.
Copy of an internal factor	Copies of an internal factor allow this factor to appear at several places in the same diagram. You can recognize a copy of an internal factor by its dashed outline. The main purpose of copy factor is to avoid cluttering the diagram layout with connections which cross the whole diagram.
Header Card	A header card is reflecting the content of a group of factors. Factors are grouped based on the natural relationship between each item in order to reduce the complexity as one of the objectives of the workflow-step Explore.
Influence Matrix	The Influence Matrix gives a complete overview how each factor influences other factors. It gives the same information as the Causal Loop diagram, but may be more suited to check completeness. Any changes in the Influence Matrix influence the diagram directly.
Interaction	A link between two factors (see also Link)
Link	A causal link describes a direct causal relationship in contrast to statistical relationships which are used for example in regression analysis. Also, indirect links are not modeled (e.g. if it is already known that "A causes B" and "B causes C", then you will not model "A causes C" explicitly, unless there is another, independent dependency). A good technique to find only the relevant links is to think about the real world process which manifests some causal dependency. Since causal links are not exclusive, the same real world process may be related to several causal links. Links have a polarity which describes whether an increase in the driving factor will cause an increase or a decrease in the driven factor (compared to the scenario where the driving factor does not change). Links may have a delay if the effect does not take place immediately after the cause.
Mental Modeling	Mental models are deeply rooted beliefs about how our surrounding world works. Our mental models do not only control how we interpret the world, but also how we act. They describe for instance assumptions about causes and their effects. But the most important thing is that mental models are active - they control our actions and influence what we see. Two persons with different mental models may observe the same event, but they will describe it differently according to their own selective perception. Many times this implies simplifications and generalizations. Solving complex problems requires to make oneself aware of these mental models, to discuss them and develop a shared model of the problem domain.
Reference Mode	same as Reference Behavior Pattern.

Reference Behavior Pattern	describes the desired or expected behavior of some factor over time. It is based on statistical data or assumptions.
Reinforcing Loops	A reinforcing loop moves the system in the same direction, causing either a systematic growth or decline. It is a behavior that is moving the system away from the equilibrium point – leading to an escalation of the system (see also CLD).
Subsystems	Subsystems are containers for a set of related factors and links. Each factor can only belong to one subsystem, but it is possible to refer to factors in a different subsystem as external factors. Subsystems themselves may belong to another subsystem, thus forming a tree structure with the main diagram as its root. Each subsystem is displayed in its own diagram. The list of all diagrams is shown as tabs at the bottom of the screen.
System Element	same as factor
Unit	Units describe on which scale a factor is measured, e.g. km and miles have quite different numbers for the same measurement. Units also must be consistent, for example you can not add kilograms (a weight) to liters (a volume). Instead you have to multiply the liters with the density of the measured substance.
Use Tree	Tree of all direct and indirect effects. More specifically, a use tree for a selected factor describes all other factors it influences directly and indirectly. Uses are the opposite of causes.