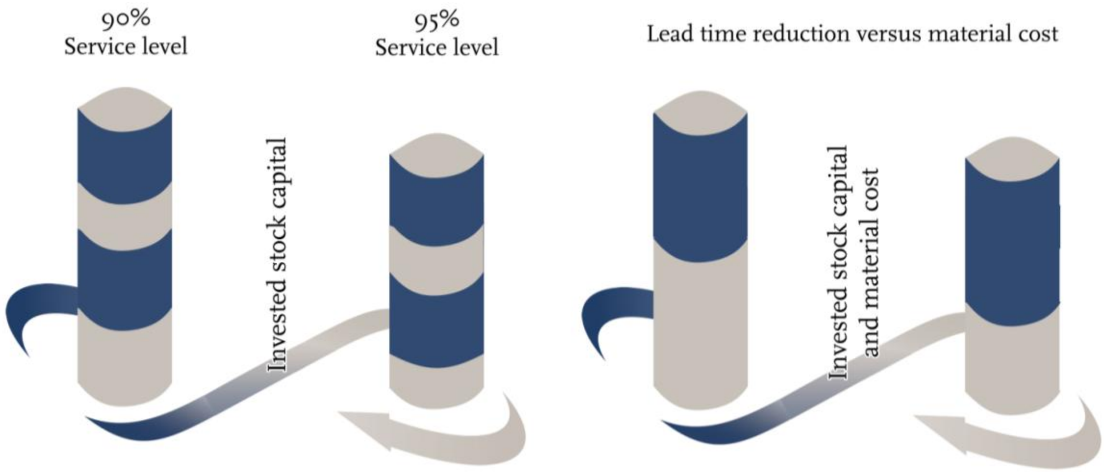
Chainscope

User Manual



June, 2008

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Preface

What is in the user's manual

Manual structure

The ChainScope user manual provides a global overview of how to use ChainScope itself. The first chapter is aimed at first time users and will introduce ChainScope and the benefits of ChainScope. The getting started chapter is sufficient for a quick start with ChainScope and will provide all the information needed for working with ChainScope. The second chapter also includes many screenshots of ChainScope and a way of working for many functions. The last chapter of this manual is the definitions chapter where all the terms used in ChainScope are defined.

Modeling, validation and interpret output data

The third chapter will provide a better and thorough understanding in the ChainScope world. The overall principles needed for ChainScope modeling, optimization and decision support are explained in this chapter.

Case example

In the fourth chapter the functionalities and way of modeling in ChainScope are shown with an example case of a bike manufacturer. Reading this chapter will give you a simple real business example of the possibilities with ChainScope and how real business can be translated into a ChainScope model.

Searching the documentation

With the index of this manual one can search for ChainScope screens, buttons or term explanations in this manual. In the manual hyperlinks are inserted for quick references and ease of searching through the manual.

Supported platforms

Supported platforms

Licenses

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The developers

Prof. dr. de Kok

Chapter 1

Introduction to ChainScope

What is ChainScope

ChainScope is a stand-alone tool that identifies the relationship between inventory capital invested and operational customer service in complex value networks and supports optimisation. ChainScope can generate the control parameters for complex operational planning systems. Because of this functionality the last part of the name ChainScope is an abbreviate for:
Supply **C**hain **O**ptimization **P**lanning **E**ngine

This Chapter

This chapter is written for first time users of ChainScope and users who want to acquire a quick insight in supply chain operations planning.

1.1 What is ChainScope used for?

Supply Chain Operations Planning

ChainScope can be used for design of the Supply Chain Operations Planning function in a company. The objective of Supply Chain Operations Planning (SCOP) research is to coordinate the release of materials and resources in the supply network The most widespread implemented SCOP function is MRP I, The SCOP function should be designed such that customer service constraints are met at minimal costs. ChainScope can be used to build a supply chain model for evaluation of as-is situations and optimization towards to-be situations. From such a model it is a small step to the design and implementation of the company-specific SCOP function within currently available ERP systems and associated work processes.

Decision support

In ChainScope it is possible to build different scenarios and compare them. For example scenarios with different suppliers and different lead times or the use of different distribution centers. Decisions with influence on the input parameters of the supply chain operations planning function can be evaluated by ChainScope and based on the evaluation of these different scenarios the optimal scenario can be selected. Next to this scenario selection, the SCOP function can be optimized for given service constraints.

ChainScope and Material Requirement Planning

The forecasting of the demand, the supply chain design and bill of material structure can be seen as input for ChainScope. Based on these input ChainScope is able to evaluate different scenarios and different supply chain designs. ChainScope can also be used as an optimization engine for the output of this engine is very relevant for the parameter setting of your MRP system. In figure 1.1 one can see the relevance and influence of the output of the ChainScope software on the material requirement planning framework.

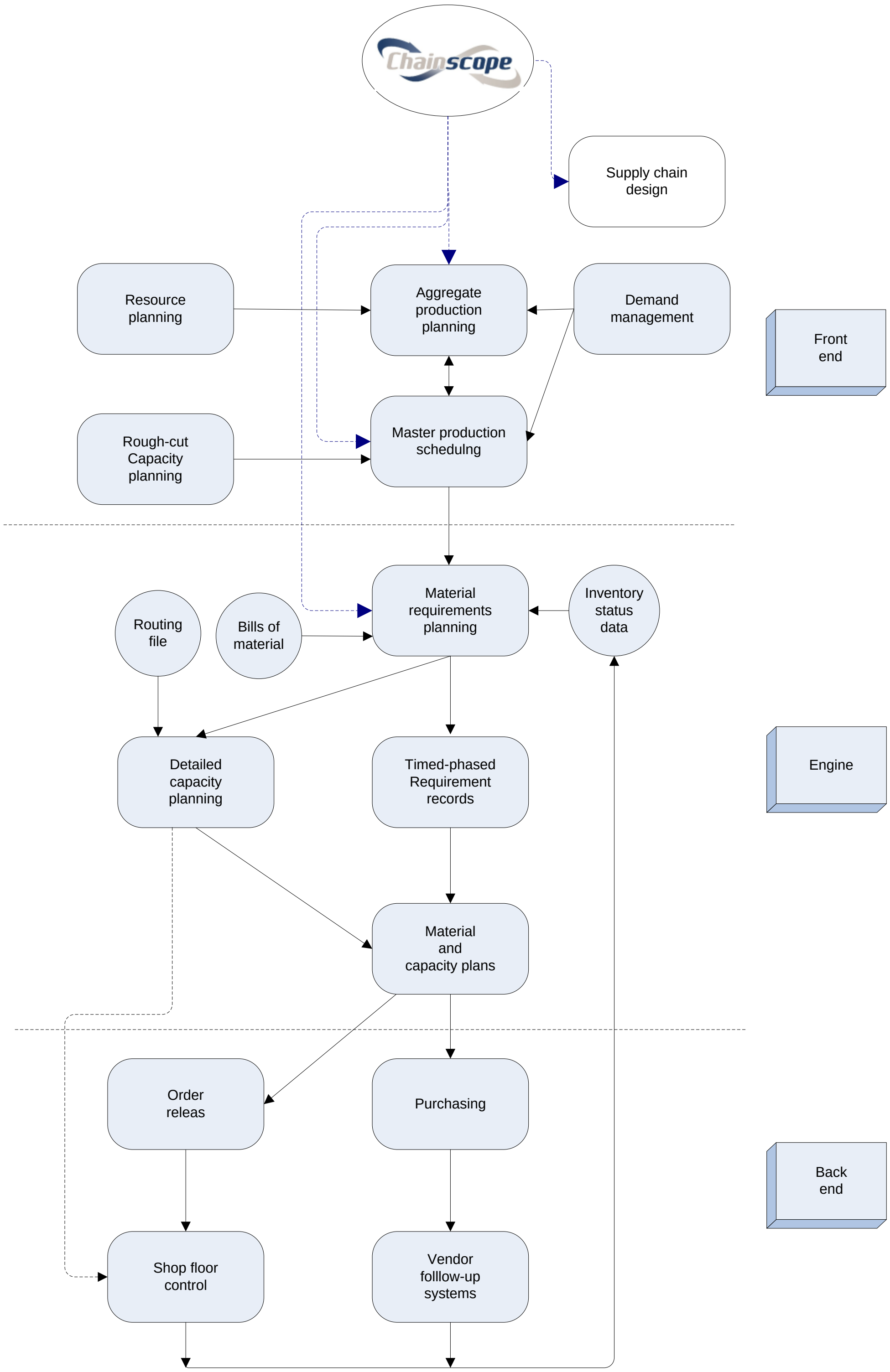


Figure 1.1: ChainScope and the Material Requirement Planning

1.2 Why use ChainScope?

Performance loop

Exaggerated one can suppose that the objective for each company is to make as much profit as possible. ChainScope focuses on the capital spend in the supply chain and the service levels for customers. The amounts of capital spend on stock keeping effects the customer service level and both will influence the cost or revenues. Based on these effects the invested stock capital and customer service level will influence the business performances. In figure 1.2 this performance loop is presented. ChainScope will influence and will search for the perfect balance between invested stock capital and the customer service level.

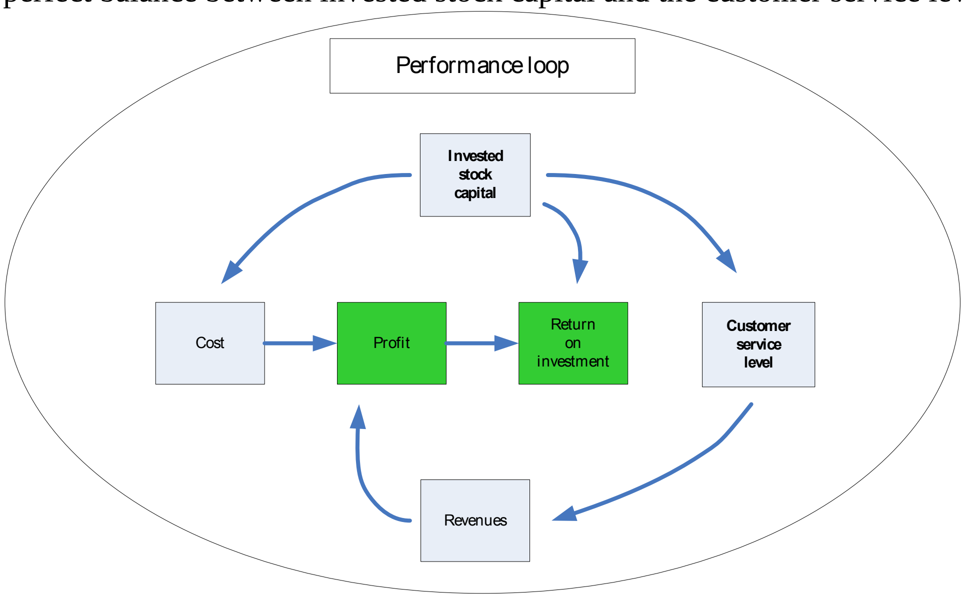


Figure 1.2: Business performance loop

Invested stock capital and service levels

Like one sees in the performance loop there is an optimal balance between the invested stock capital and the service level. ChainScope delivers you the optimal situation where the invested stock capital and service level are balanced. With each value of the invested stock capital a maximum service level can be achieved but not the total amount of invested capital will automatically lead to this maximum service level. The allocation of this stock capital among the stock points is very important and will influence the achieved performance level. In the figures 1.3 and 1.4 the invested capital, service level and stock allocation are graphically presented. The current situation is in these figures presented as the red dot and the location of this red dot can be found with ChainScope evaluations.

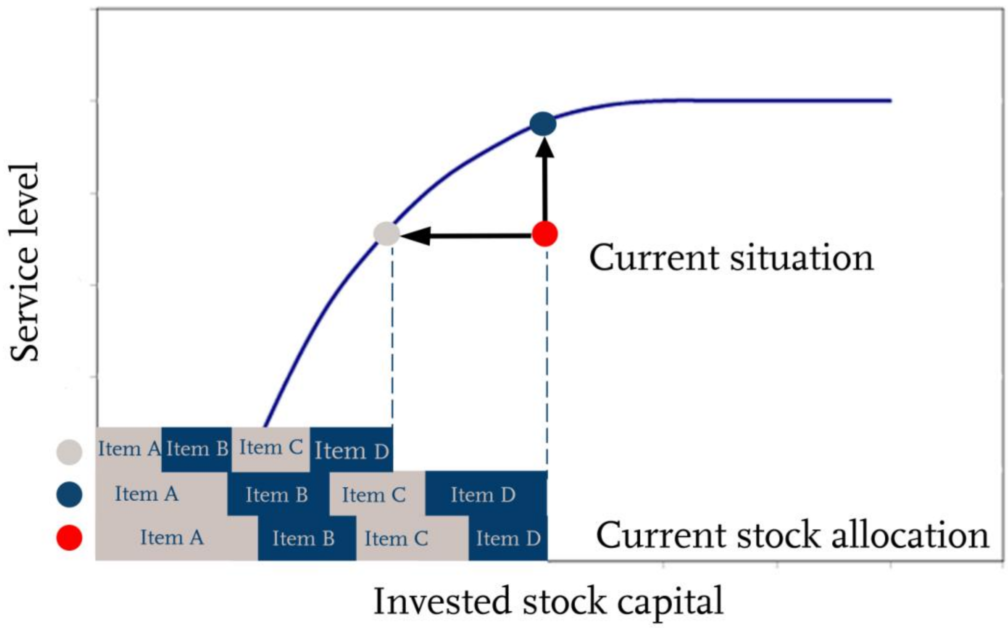
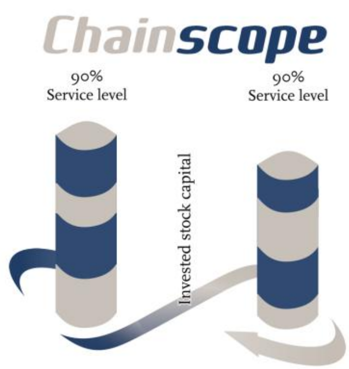


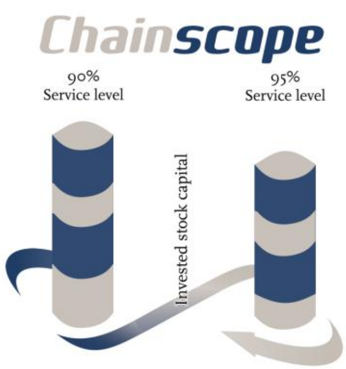
Figure 1.3: Service level versus invested stock capital and allocation 1

Reduce inventories while maintaining service level

Like one can see in figure 1.3 there is a situation where one can achieve the same service level as in the current situation but the invested stock capital is reduced. This situation is in figure 1.3 represented with a gray dot, the bars on the horizontal-axis of figure 1.3 represent the stock allocation over the different stock items. The picture on the right also represents the current situation and a situation with a new stock capital allocation, the same service level and less invested capital.



Higher service level with identical inventory



The blue dot in figure 1.3 represents a situation where no extra capital is invested in the stock but a higher service level is achieved. This service level can be achieved with a smarted and synchronized stock allocation. ChainScope is able to lead your company from the red dot to the gray or blue dot in figure 1.3 of 1.4. The picture on the left also represents the new allocation where with the same total amount of invested capital a higher service level is achieved.

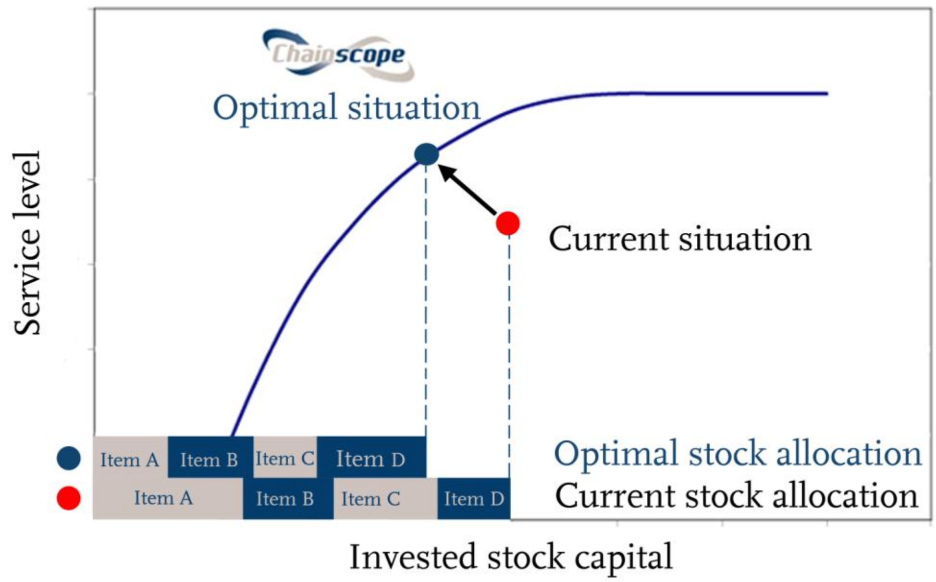
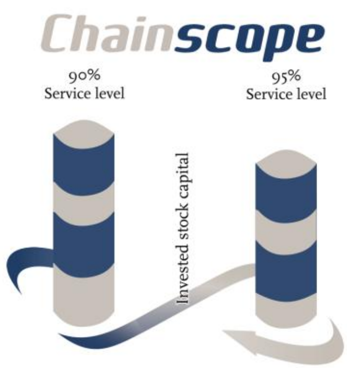


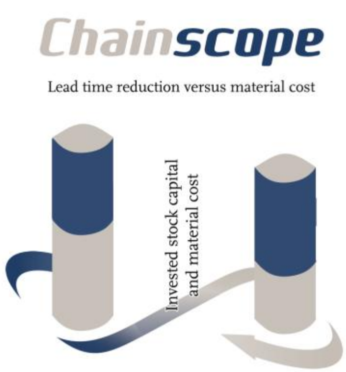
Figure 1.4: Optimal situation

The optimal inventory and service level

The maximum achievable service level with the current spend capital can be too expensive for the considered pay off for this service level. The achieved service level can also be too low and thus another service level has to be optimal. ChainScope can also deal with this situation an will lead you to the blue dot situation represented in figure 1.4. In this case ChainScope will give you the control parameters for an optimal situation where the service level is higher and less capital is invested in the supply chain. Due smart and synchronized stock reallocation ChainScope will lead you to this optimal situation.



Evaluate changes in the supply chain



A supply chain is always subject to change and for example lead times, margin or demand will change. By generating scenarios in ChainScope one can evaluate these different scenarios. Many changes in the supply chain will influence your supply chain performance and will change the position in figure 1.4. With ChainScope you can monitor and evaluate these changes and determine the new optimal control parameters for your supply chain. In the figure. On the left a new scenario with lead time reduction due a new and more expensive supplier is presented. The capital invested in stock is presented in blue and the total production cost in gray. In ChainScope one can easily evaluate both scenarios and from the picture on the left we could conclude that a contract with the new supplier would be advisable.

1.3 Installation

Installation

Chapter 2

Getting started

This chapter

In this chapter we will give you guidelines how to get started with ChainScope. We do not give extensive information about how to determine the input parameters for supply chain models in this chapter, extensive information about this topic can be found in chapter 3. We recommend every beginning user to glance through this "Getting started" chapter

2.1 Guidelines for users

Beginning users

As a beginning user of ChainScope the best starting point to learn ChainScope is working through this chapter and reading the case example chapter. For a thorough understanding of the meaning and how to collect the value of the input parameters chapter three is strongly recommended.

Constructing a supply chain

ChainScope starts from a supply chain structure consisting of items and a market structure consisting of customers. 1. Items and the bill of materials 2. Customer-item combinations. As starting point each item-successor relation has to be known. For beginning users and small supply chains it is advisable to make a drawing of the supply chain with all the item successor relations, lead times and demand. In figure 2.1 a simple example of such drawings is given. In the figure each triangle represents a stock point and each arrow a transformation process where value is added. On the arrows the lead times and the number of input items are presented. In our simple example the transformation process to create one item of "subassembly" will take 2 weeks and needs 2 items of "Raw 1" and 3 of "Raw 2."

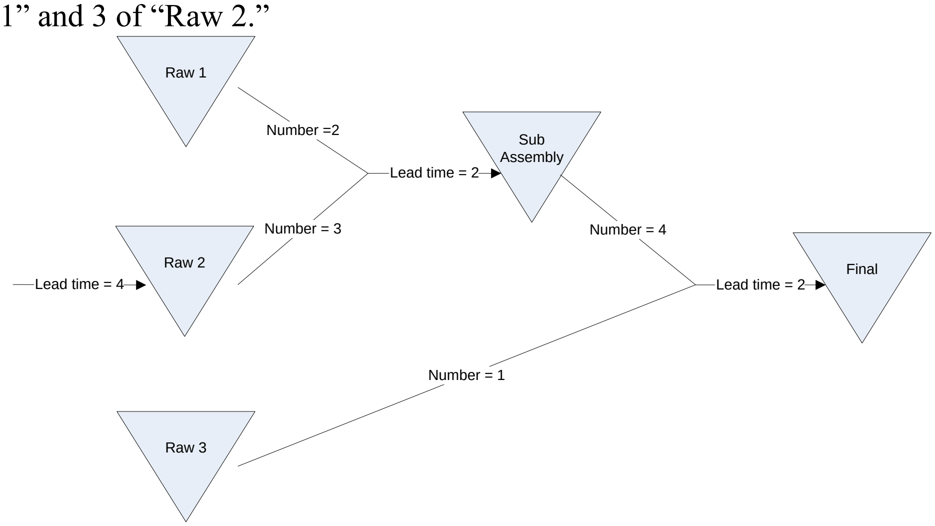


Figure 2.1: Graphical representation simple supply chain case 1

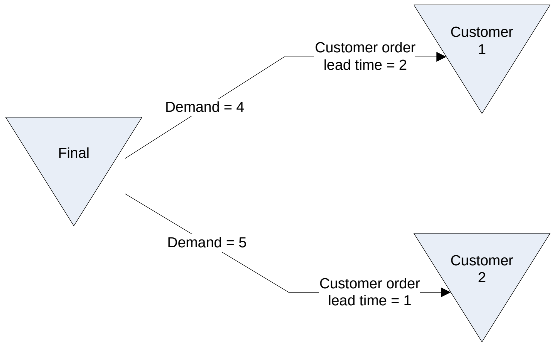


Figure 2.2: Graphical representation simple customer demand case 1

Next to the parameters and structure presented in the above figures it is important to know the added values, yield, review period and current target stocks for each item. For end items it is also important to know the demand, standard deviation of demand, customer order lead time, margin and target ready and fill rate as service level for each of these items. With this information one can create a supply chain model for ChainScope. A complete schematic representation of the input parameters is given in figure 2.3. The input parameters are presented in a colored box or arrow. In this figure the input parameters for a part of the supply chain of figure 2.1 and 2.2 are presented. In the next sections of this chapter the procedure to create such model and denotation of each parameter will be given.

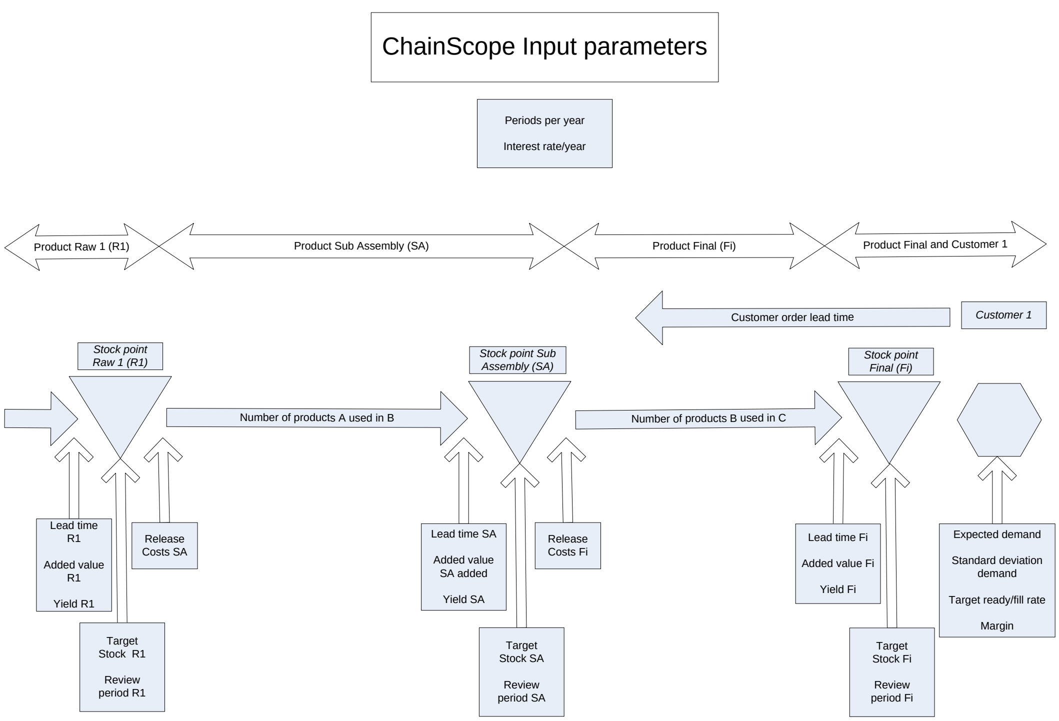


Figure 2.3: Schematic representation input parameters

2.1.1 Starting ChainScope

Starting ChainScope

After staring ChainScope the warning presented below will occur:

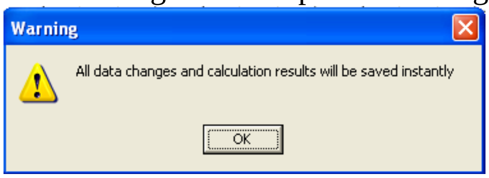


Figure 2.4: Start warning

The occurrence of this warning is normal and wants to make the user clear that ChainScope will save every change instantly. This means that every input change will overwrite the earlier input. When one wants to work with different settings for a project one has to create different scenarios. Before one can really start working with ChainScope a project has to be created in the standers Excel project format. Section 2.2 will explain how to create your first project for ChainScope.

When ChainScope is started one will see the window of figure 2.5 and one is located in the “Set active project” screen.

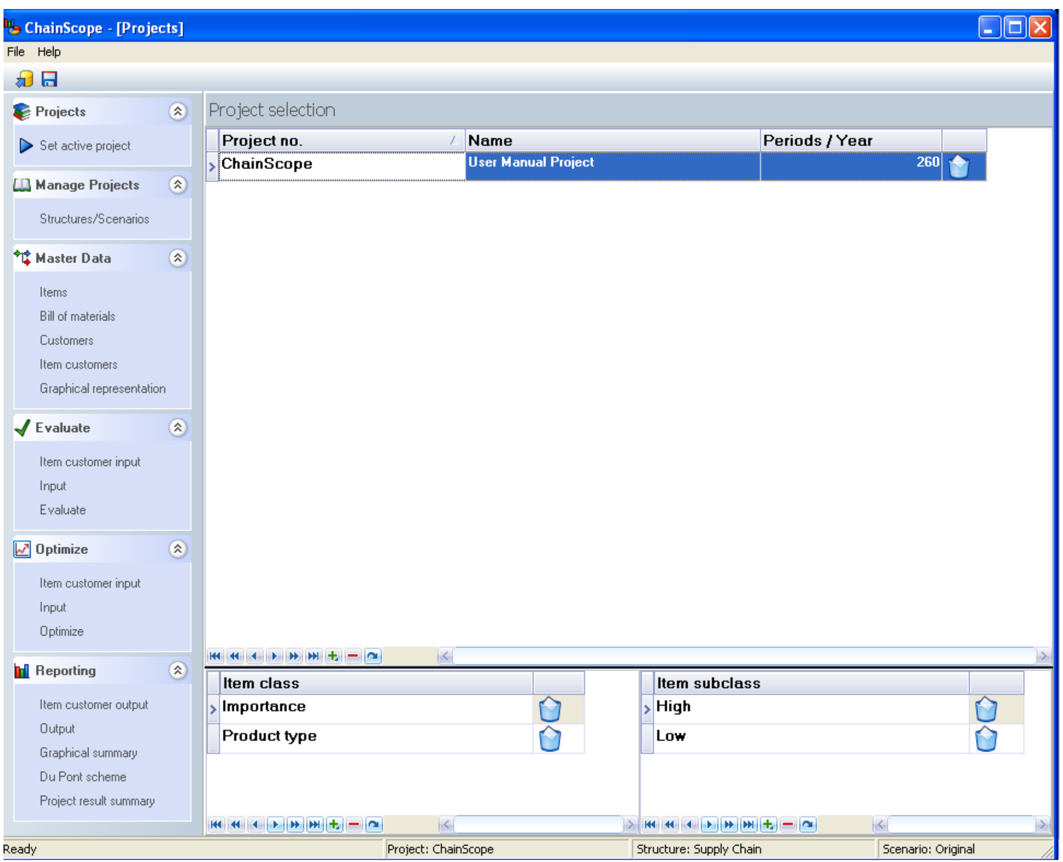


Figure 2.5: ChainScope start screen

Frequently used concepts

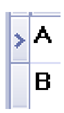
In this manual and in ChainScope we use a lot of logistic terms like supply chain, stock point, item and bill of material. For the consistency we want to state here the definitions of these terms. ChainScope is used to model and optimize your supply chain and our formal definition of a supply chain is “The functions inside and outside a company that enable the value chain to make products and provide service to the customer.” And with value chain in this definition we mean “the function within a company that add value to the goods or services that the organization sells to customers and for which it receives payment.
In the supply chain we have items and stock points and in ChainScope these two terms are coupled and an item without a stock point is no ChainScope item and vice versa. Items in ChainScope are physical products in a unique form and place combination with a stock point. For the transform of an item into another item a so called transformation process is needed.
With the term bill of materials we mean the list of input items for each item which also describes the relations between all the items in the supply chain. In this bill of materials one can find for example the number of products B that are needed to create one unit of item A.

ChainScope buttons

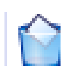
In ChainScope some buttons are used in different screens, a summation and description of these buttons is given below.

Import – With this button a project and scenario in the Excel format can be imported or updated (overwritten).

Save as scenario – With this button the active project and scenario can be saved in the ChainScope Excel format.



Select – With clicking on the blank field before a record this record will be selected. A selected record can be recognized by the “>” sign inside the field before the record. In our example the record “A’ is selected.



Delete – Using this butting and confirming your choice will delete the selected record.

Append record – Add a record to the selected “Item class” or “Item subclass.”

2.2 Projects

2.2.1 Create a new project

Create a new project

Before one can work with ChainScope a project has to be created in Microsoft Excel. There is a standard Excel format in which the project has to be created. *This format file can be found in your ChainScope directory with the name CHAINSCOPE_PROJECTFORMAT.XLS.* In figure 2.6 this structure is presented with the column headings on each of the four sheets of the Excel workbook.

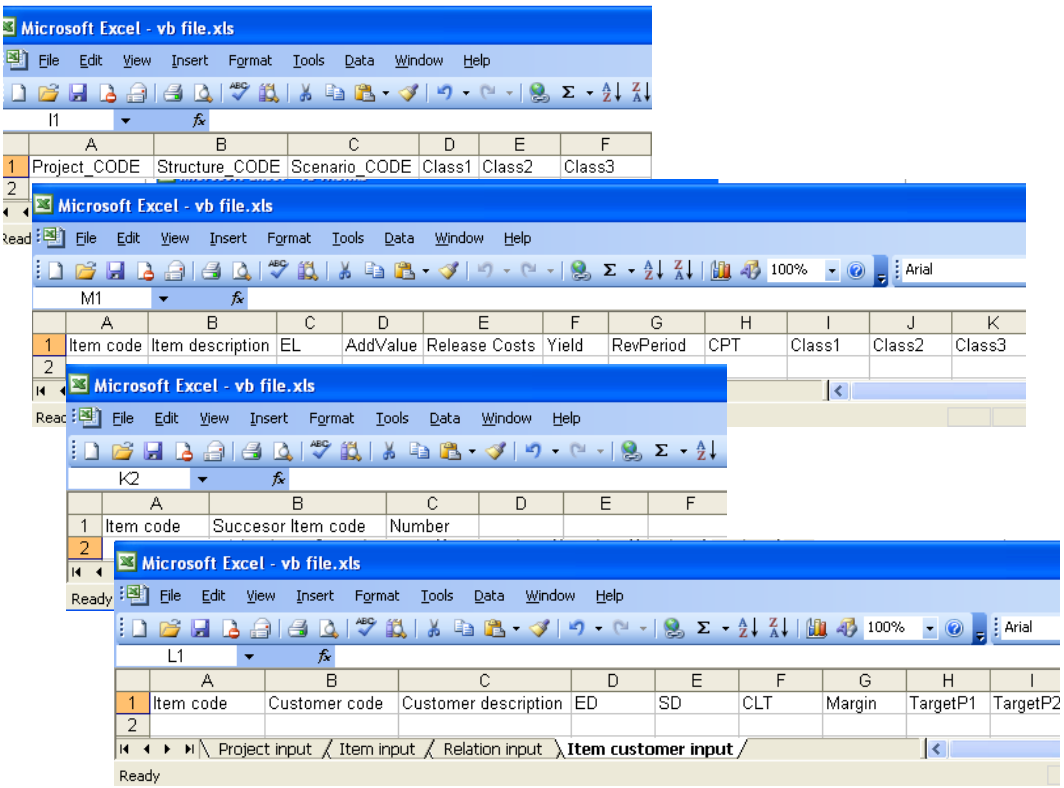


Figure 2.6: Standers Excel format overview

The Excel project format

Project and scenarios can be imported in ChainScope but first they have to be made in the specific ChainScope Excel project format. This standard format consists of four sheets with the names: “Project input”, “Item input”, “Relation input” and “Item customer input.” The table 2.1 till 2.4 shows the structure of the standard Excel format and a brief description of each column.

Sheet:	Column name:	Description:

Project input		
A1	Project_CODE	Name for the project
B1	Structure_CODE	Identity name of the structure
C1	Scenario_CODE	Identity name of the scenario
D1	Class1	Name of item class 1
E1	Class2	Name of item class 2
F1	Class3	Name of item class 3

Table 2.1: Project input sheet

Sheet: Item input	Column name:	Description:
A1	Item code	Item no.
B1	Item description	Item description
C1	EL	Expected lead time
D1	AddValue	Added value of the item
E1	Release Costs	Cost of releasing the item
F1	Yield	The yield of the item
G1	RevPeriod	Review period
H1	CPT	Target stock
I1	Class1	The subclass of class 1 of which the item is part of.
J1	Class2	The subclass of class 2 of which the item is part of.
K1	Class3	The subclass of class 3 of which the item is part of.

Table 2.2: Item input sheet

Sheet: Relation input	Column name:	Description:
A1	Item code	Item no.
B1	Successor Item code	Item no. of the successor of the item stated in column A.
C1	Number	Number of successors of the item stated in column B of the item stated in column A

Table 2.3: Relation input sheet

Sheet: Item customer input	Column name:	Description:
A1	Item code	Item no.
B1	Customer code	Customer no.
C1	Customer description	Customer description
D1	ED	Expected demand
E1	SD	Standard deviation of the demand

F1	CLT	Customer order lead time
G1	Margin	Margin on one item of the item stated in column A
H1	TargetP1	Target ready rate level
I1	TargetP2	Target fill rate

Table 2.4: Item customer input sheet

Graphical representation input parameters

In figure 2.7 all the input parameters needed to create an Excel project file are schematic located. Each input parameter is presented in one of the colored boxes. The number of the Excel sheet on which the parameter is stated can be found between brackets after the parameter name.

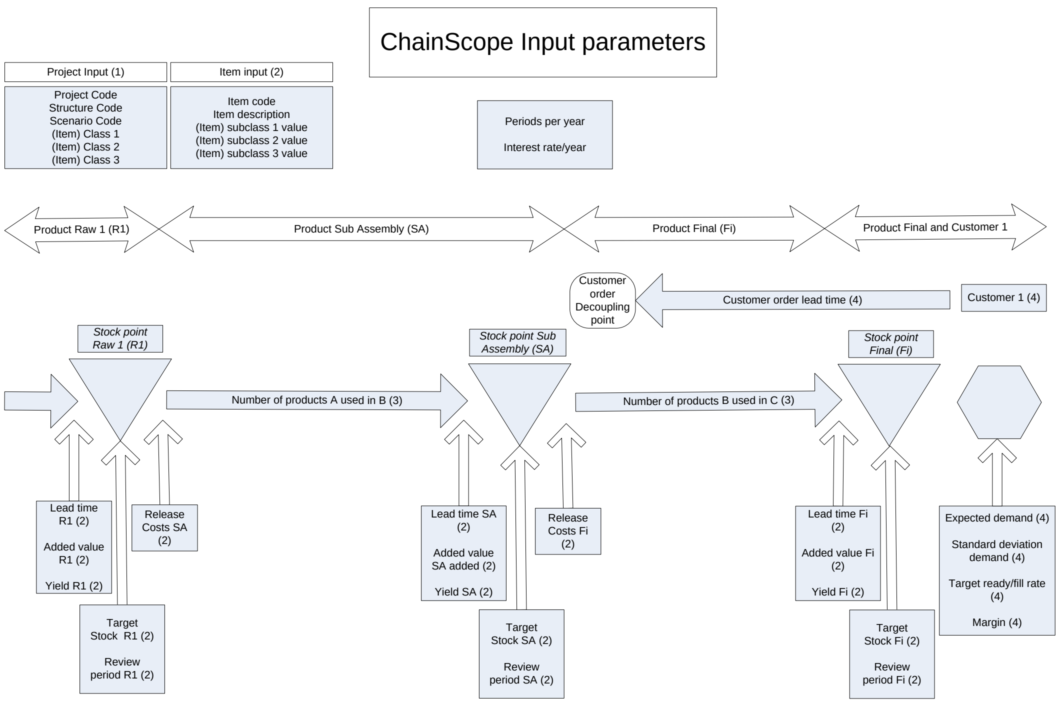


Figure 2.7: Graphical representation Excel input parameters

In the sections 2.2.2 till 2.2.4 one can find thorough definitions and explanations of the input parameters presented in figure 2.7.

2.2.2 Item input

Item code and description

The “Item code” is the name or number for an item. In the “Item description” field a more extensive description of the item can be given.

Item lead time

The lead time is the throughput time between the moment of release of an order for the item and the moment at which the ordered item is available for usage in other items and/or delivery to customers.

If we have a transformation process for a final item which needs 2 raw materials. The process starts only with the first raw material and after 1 week the second raw material is needed in the process and after another week of “transforming” the final item is finished. The lead time for the transformation process will then be 2 weeks. For determining the lead time one has to assume that there is enough stock of the input items at the moment of ordering.

Added value

The added value is the value that is added to the item during the transformation process that creates the item. One can also say that the added value is the monetary value of the specific item minus all the values of the input items. In ChainScope the added value of a product is added in a linear way, so the value of an item halfway during the transformation process is the cumulative value of al the input items for the item plus half of the added value of the item. Items which are ordered from other suppliers have an added value that is equal to the total price one pays for the items and for the pipeline investment these added values are not added in a linear way but immediately after the order is placed.

Release costs

The release costs are the costs for releasing an order for the item, this are fixed costs for each order. If for example an outside supplier has 100€ fixed transport costs per order regardless of the order size this 100€ has to be modeled as the release costs for the item ordered by the outside supplier.

Yield

During the transformation process an item can get broken and becomes useless. The yield value is the ratio of the number of products which are not broken. Broken products are not brought to the stock points and immediately after the transformation process removed from the supply chain. The yield ratio in ChainScope works independent on every single item and a defect item has no effect on other items in the supply chain.

Added value

The added value is the value that is added to the item during the transformation process that creates the item. In ChainScope the added value of a product is added in a linear way, so the value of an item halfway during the transformation process is the cumulative value of al the input items for the item plus half of the added value of the item.

Release costs

The release costs are the costs for releasing an order for the item. If for example an outside supplier has 10€ fixed cost per order the release cost for this item are 10€.

Review period

The review period is the period between subsequent release decisions for an item. If one checks the inventory only once a month or an outside supplier only delivers once a month one can state that the review periods is then 1 month.

Item target stock

The item target stock is the targeted average number of items in the stock point. Based on stock policies and parameter setting an average stock quantity can be achieved.

For reporting and analysis it can be helpful to create classes, for example the class importance or type of product.

Item class

2.2.3 Relation input

For the relation input it is important to know the structure of the supply chain and the complete bill of material for every product. In figure 2.8 a simple structure with item-successor relations is given. In each arrow the number of items needed in the transformation process for creating the item at the end of the arrow is stated. In figure 2.8 two items of “Raw 1” and three items of “Raw 2” are needed in the transformation process for creating one item of “Sub Assembly.”

Structure

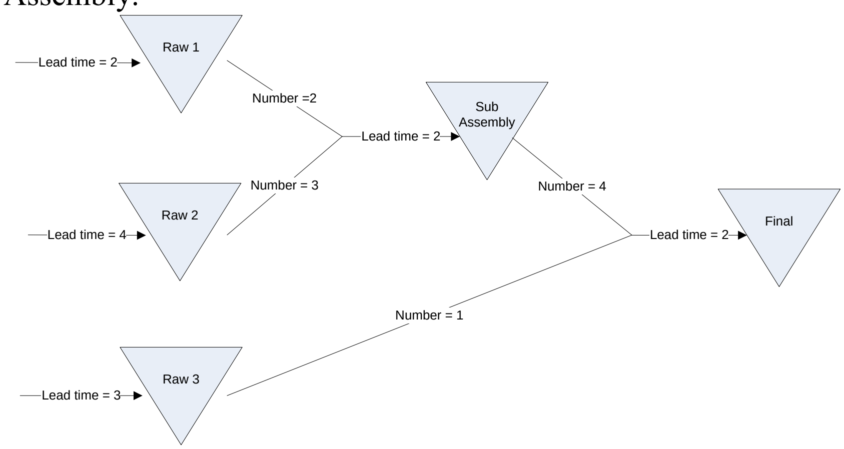


Figure 2.8 Supply chain successors structure example case 1

In ChainScope a successor of item i is an item for which item i is needed during the transformation process to create the item (the successor). In figure 2.8 the item “Sub Assembly” is a successor of the items “Raw 1” and “Raw 2” and the item “Final” is successor of the items “Sub Assembly” and “Raw 3.” In the standard Excel project format the Supply chain of figure 2.8 would look like table 2.5.

Successor

Item code	Successor item code	Number
Raw 1	Subassembly	2
Raw 2	Subassembly	3
Raw 3	Final	1
Sub Assembly	Final	4

Table 2.5: Example case 1 structure in the Excel standard format

2.2.4 Item customer input

Customer

In the last sheet of the standard Excel project format the parameters which concern the item-customer relation are stated. Customers with their code and description can be created in this sheet by stating them in the customer code column.

Demand

The demand is the number of products per period the customer wants to receive. The standard deviation of the demand indicates the demand uncertainty. The standard deviation can be calculated with a formula where all the difference between the known demand and average demand is squared and shared through the total number of periods minus one. All these values are summed and square rooted and the result is the standard deviation. In formula format with Xi as the demand in each period the formula for the standard deviation will be:

$$\sqrt{\sum_{i-1}^{n} \frac{(X_i - AverageDemand)^2}{n-1}}$$

Customer order lead time

The customer order lead time are the number of periods between the moment a customer places an order and wants to receive the ordered items. A customer-item relation can only have one lead time for example if you modeled the Dutch market as one customer but the Dutch Queen has a shorter lead time than the other Dutch people you have to model the Dutch Queen as one separate customer.

Margin

The margin is a ratio of the total value added which is the profit for the supply chain owner on every item sold to a specific customer. If the margin value is 2 the value added by the supply chain will be sold for three (1+margin) times the added value.

TargetP1

The TargetP1 is the target value for the ready rate service level. The ready rate is the fraction of time during which the net stock is positive.

TargetP2

The TargetP2 is the target fill rate, the target fraction of customer demand that is met routinely, without backordering.

2.2.5 Set active project

Set active project

The “Set active project” screen is the first screen of ChainScope and the screen where one can select the project to work with. A project can be selected by clicking on the row of the project or on the select box in front of the row. In the “Set active project” screen the project no, name or the number of periods per year can be changed. And an item class or subclass can be added by clicking the  (append record) button on the bottom of the screen.

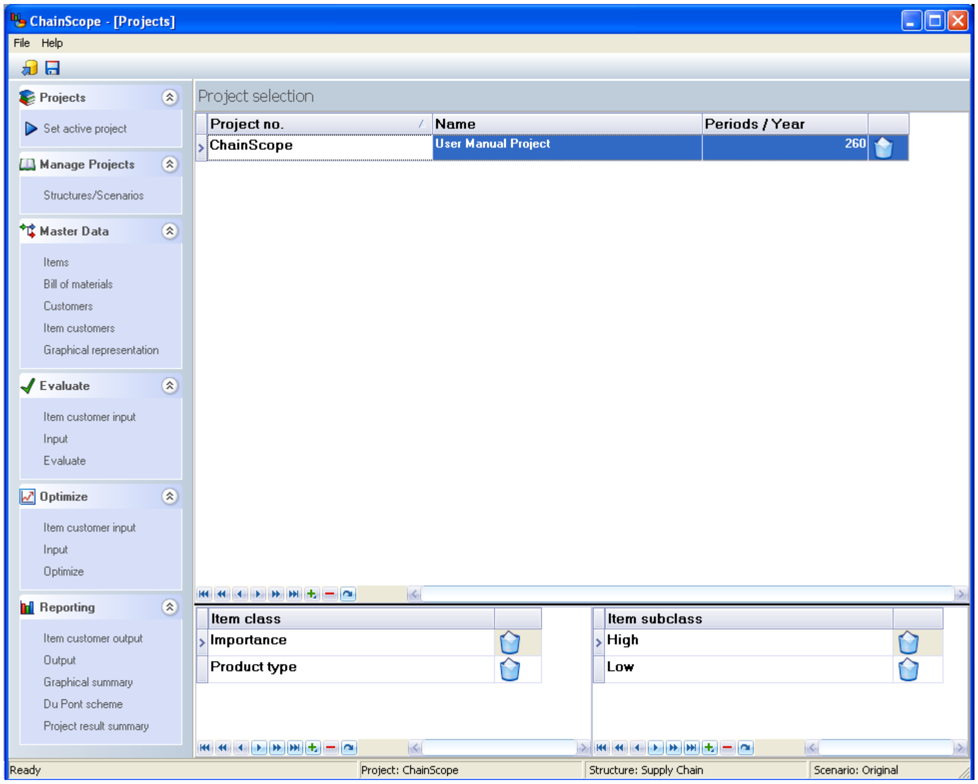


Figure 2.9: The set active project screen

Periods per year

In the periods per year field one can determine the standard time unit used in ChainScope. If one states here for example 2 periods per year the amount of demand per customer (and all the other parameters) should be per half year.

Import project

A project file made in the standard Excel format can be imported in ChainScope with the import button  This button can be found in the upper left corner of the screen.

2.3 Manage projects

Data structure

Supply chain projects in ChainScope have a data structure with projects, scenarios and evaluation input. In figure 2.10 this data structure is presented in hierarchical blocks. As one can see in the figure a project structure can have more than one scenario and each scenario has optimization and evaluation input.

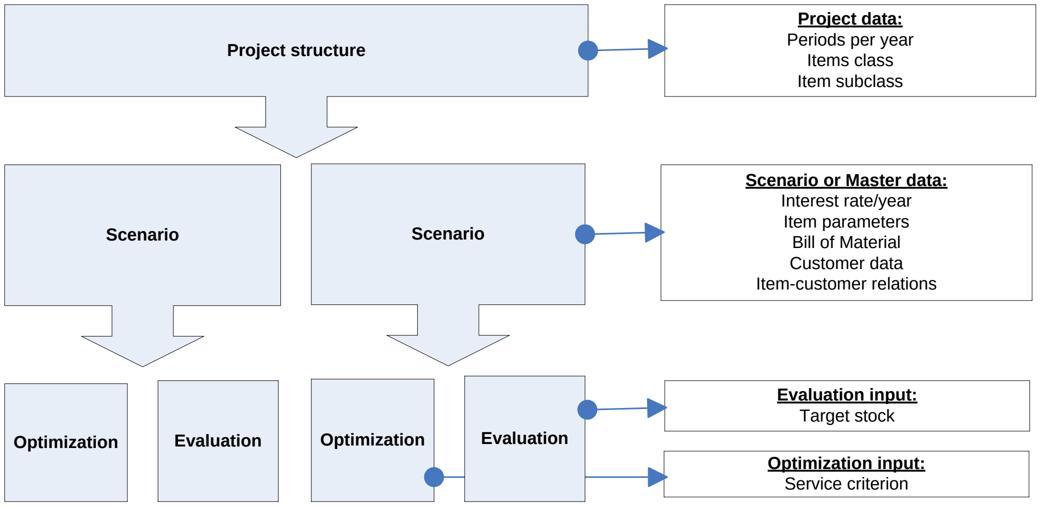


Figure 2.10: Data structure ChainScope

The project data will be in affect for al the scenarios below the project. The scenario data can be changed in the "Master data" screens and so is also called: master data. For an optimization additionally the service criterion is needed and for an evaluation the target stock values need to be known.

Structure / Scenarios

After selecting a project one can select a scenario. A scenario is part of a project and the input parameters are part of the selected scenario and can be different for each scenario of the project. In figure 2.11 the "Structure/Scenarios" screen is shown, in our example there is an Alternative and Original scenario.

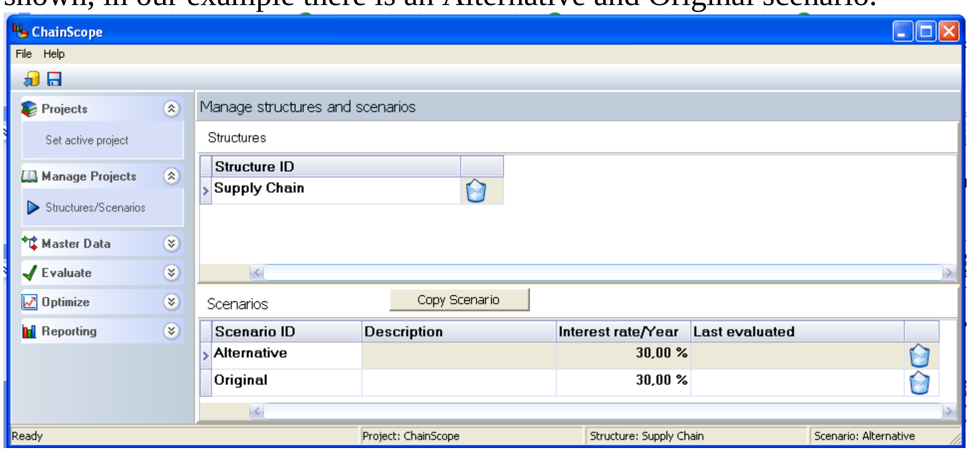


Figure 2.11: Manage projects screen

A selected scenario can be copied with the "Copy Scenario" button. After entering the new scenario name the selected scenario will be identically copied. In this copy of the original scenario one can make changes in the input data or supply chain structure. The different scenarios can be evaluated or optimized to compare these different scenarios. The date of the last evaluation can be found in the last column of the scenarios table.

Interest rate

The interest rate per year is the percentage interest on capital invested. This invested capital also includes the capital in the stock points and in the so called pipe lines.

2.4 Masters Data

Data structure

Supply chain projects in ChainScope have a data structure with projects, scenarios and the evaluation or optimization input. In figure 2.10 on page 18 this data structure was presented in hierarchical blocks. In this section we will discuss the master data. The master data can also be seen as the scenario data.

2.4.1 Items

Items

An item is a unique product or state in the supply chain. This unique item has to be created due a transformation process or can be ordered from an outside supplier. For example product X in distribution centre Europe is in a different state than product X in distribution centre America so they are different items in ChainScope models. The “Items” screen is shown in figure 2.12. In the third and fourth column heading of this figure the item classes “Importance” and “Product type” of our example case 1 can be found. In these columns the item class value can be found, the item subclass to which the products belongs. The value of this subclass can be changed due clicking on the value and select another subclass. The item class or item subclasses names can be changed in the “Project” screen.

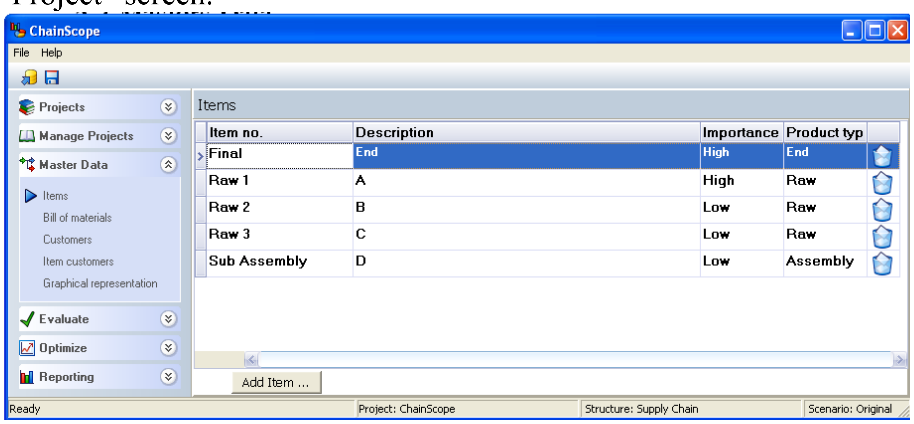


Figure 2.12: Items screen

Add item

In the left bottom of the “Items” screen one can find the “Add item …” button. If one wants to add an item to the supply chain one can click the button and the screen shown in figure 2.13 will appear.

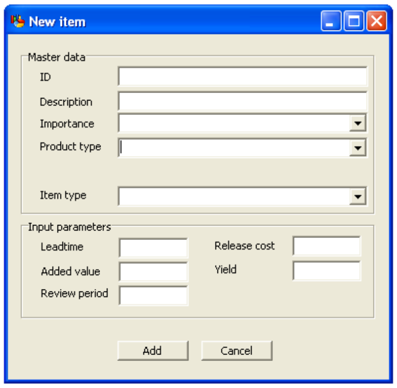


Figure 2.13: Add new item input screen

In the first field an identity and in the second a description for the item can be entered. The third and fourth field are for the item classes, in the example case 1 the item subclass for "Importance" and "Product type" can be chosen with a dropdown menu. In the "Item type" field one can choose for "End", "Middle" or "Start" item.

Item input parameters

In the bottom of the "Add new item" screen the values of the item input parameters can be entered. In section 2.2.2 more information about these parameters can be found.

2.4.2 Bill of Materials

Bill of materials

In the "Bill of materials" screen one can change the supply chain structure and number of input items required for a transformation process for the creation of the stated successor. In figure 2.14 the "Bill of materials" screen is shown for the example case 1. In figure 2.14 there are two successor items: "Final" and "Subassembly." In the "Bill of materials" screen one can change the successor item description and the number of items needed for the creation of the successor.
In figure 2.14 one can see that the successor item "Final" is a successor of the items "Raw 3" and "Subassembly." The description of the successor item relation between "Subassembly" and "Final" is described as "End" and 4 items of the item "Subassembly" are needed for one item of "Final."

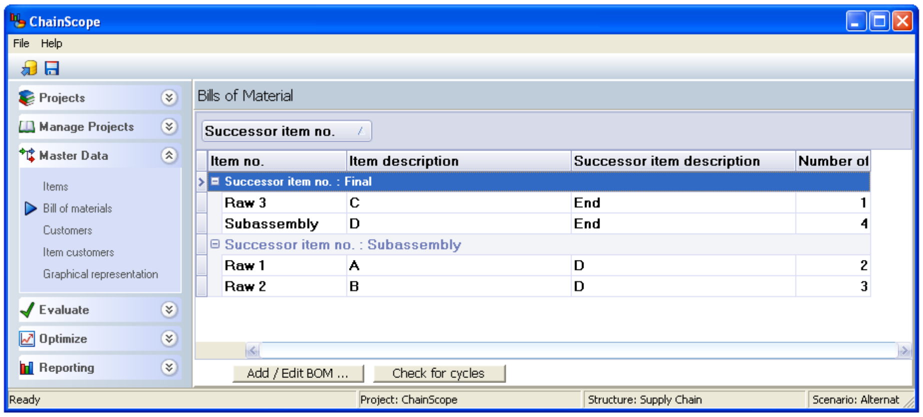


Figure 2.14: The Bill of materials screen

Edit bill of materials

With the “Add/Edit BOM” button in the left bottom of the screen one can change the bill of materials. In the “Output Item” dropdown menu one can select the successor item. In figure 2.15 the successor “Final” is selected. After selecting an item from the “All available Items:” list one can make that item an input item with the ▷ (blue right arrow) button. Likewise with the double blue right arrow button all the items in the “All available Items:” list will be added to the “Input Item(s):” list. With the blue left arrows items can be deleted from the “Input Item(s)” list.

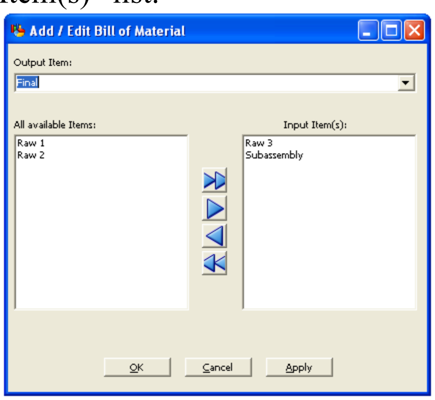


Figure 2.15: Add / Edit Bill of Material screen

Cycles in bill of materials

If one made a mistake with the bill of material a so called cycle could be created. If there are items direct or indirect successors of each other and thus an item would be an success of itself this is called a cycle in the bill of material. If one would make the “Final” item an input item for “Raw 1” this would create a cycle in the bill of material in the example case 1.

2.4.3 Customer relations

Add customer

In the “Customers” screen one can add customers with the “Add customer ..” button on the bottom of the screen. In figure 2.17 the “Add customer” screen is presented where one is able to create new customers identity and give a description of the customers.

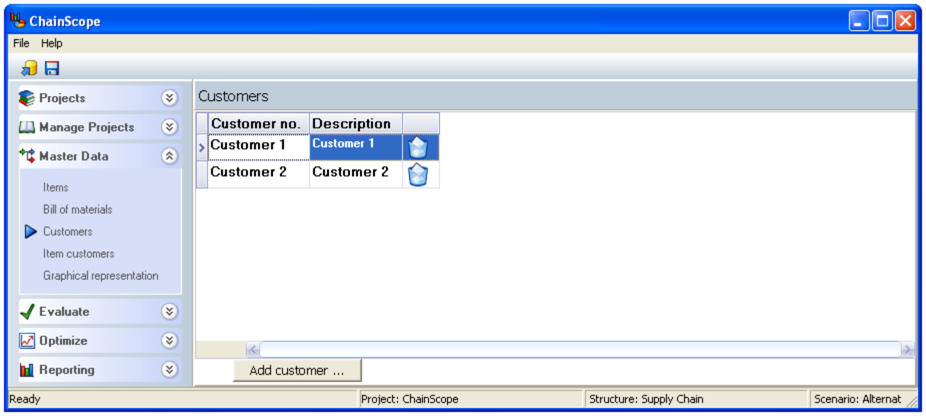


Figure 2.16: Customers screen

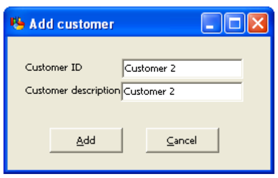


Figure 2.17: Add customer screen

Item customer relation

In the "Item customers" screen the relation between customers and items can be created or changed. Item customer relations can be added with the "Add item customer combination" button.

In figure 2.19 the "Add item customer combination" screen is presented. One can select an item and customer with the dropdown menus and one has to enter all the input parameters values for the selected item customer relation.

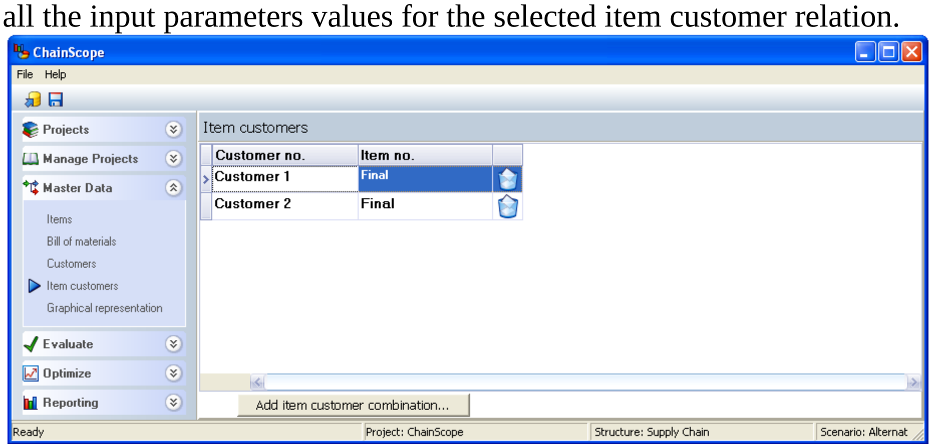


Figure 2.18: Item customers screen

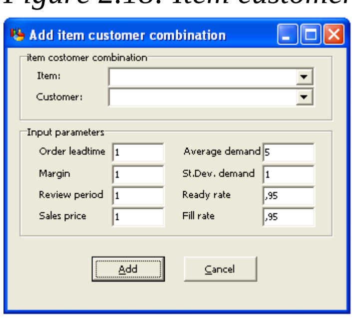


Figure 2.19: Add item customer combination screen

2.4.4 Graphical Representation

A graphical representation of the bill of material structure with lead times and number of successor relations can be found in the "Graphical representation" screen. With a click on the "Draw" button a graphical representation will be shown. With a click on the "more zoom options" hyperlink text the scale of the triangle, length, height and font size of the graphical representation can be adjusted. A copy of the representation can be made with a right mouse click and a click on "copy."

Graphical representation

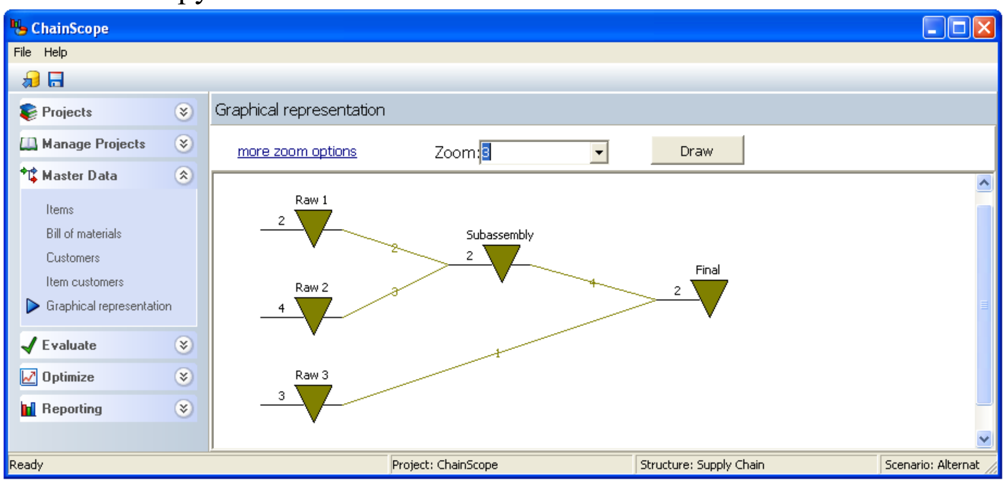


Figure 2.20: Graphical representation screen

2.5 Evaluation and optimization

The evaluation and optimization screens in ChainScope have the same sub screens. A change in the parameter values in the evaluation section will also change the parameter values in the optimization section and vice versa. In this chapter of the manual we will give information about how to create a quick evaluation or optimization.

Evaluation and optimization

2.5.1 Item customer input

In the "Item customer input" screen one can see and change the values of parameters that describe an item-customer relation. As one can see in figure 2.21 the item customer parameters are the demand, standard deviation of the demand, target ready and fill rate, margin and order lead time. More information about these parameters can be found in section 2.2.

Item customer input screen

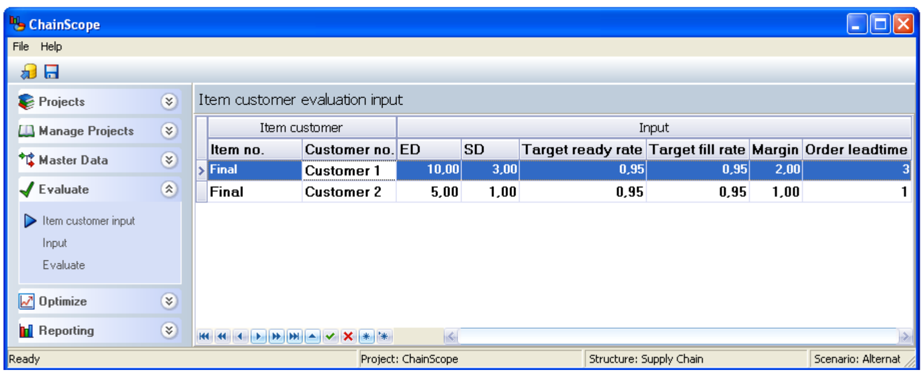


Figure 2.21: The item customer input screen

2.5.2 Input

All the important item input variables for an evaluation or optimization can be found in the input screen. As presented in figure 2.22 these parameters are the review period, lead time, added value, target stock, release cost and yield, information about these parameters can be found in section 2.2.
For the evaluation the target stocks are important but for the optimization no target stocks are needed because the optimization will determine the new and optimal target stocks.

Input screen

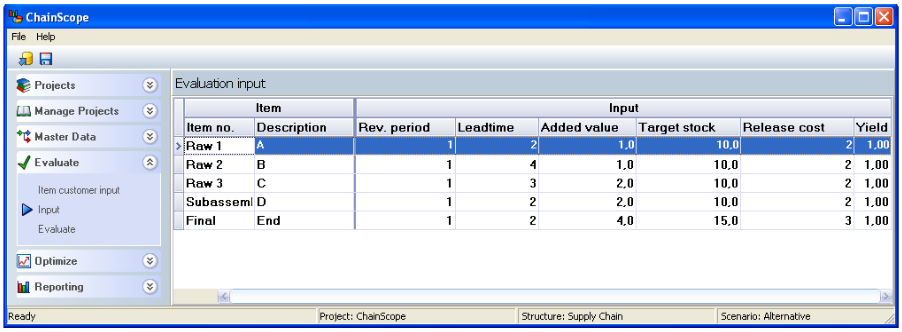


Figure 2.22: The input screen

2.5.3 Evaluation

In the evaluation screen there is only one button: the "Evaluate" button. For the evaluation the selected service criterion is not important and the interest rate will only influence the annual capital costs but not the stock on hand or investment costs. In the table one can change the value of the "fixed asset investment" which refers to the investment in fixed capital and in general this is the investment in fixed assets like machinery. In figure 2.23 one can see the evaluation for the example case 1. *Evaluation*

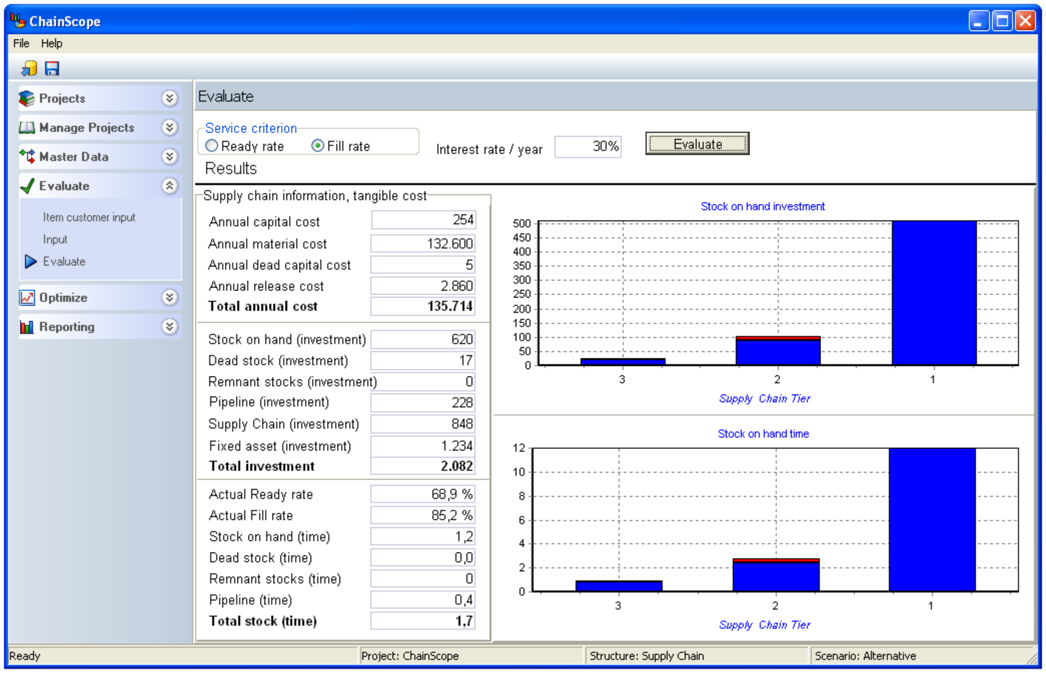


Figure 2.23: The evaluation screen for the example case 1

The red parts in the graph represent dead stock, in our evaluation there is dead stock in the "Raw 3" stock point. The numbers in the graph on the horizontal axe represent the level code of the products presented in the column. The end products have level code 1 and all the input products for the end products have level code 2 and so on. In our example case 1 the items "Raw 1" and "Raw 2" *Level code* have the level code 3 and “Subassembly” and “Raw 3” the level code 2. If “Raw 3” was also an input item for “Subassembly” the level code of “Raw 3” won’t change because an item will take the lowest as possible level code (low level code).

Result and validation

If all the parameter values are correct the result of the evaluation describes the modeled scenario situation. More information about the presented output values can be found in section 2.6.5. In our example case 1 the current performance of our service levels should be around the 71.5% and 88.2%. If the measured service levels in the business are completely different the model can not be validated. Validation is the process of establishing documented evidence that provides a high degree of assurance that the modeled supply chain with the input parameter values are correct. One can validate the modeled supply chain in ChainScope with a comparison of the output parameters like service levels and the capital or investment costs of an evaluation with the real measured output parameters. More information about validation will be given in chapter 3.

2.5.4 Optimization

Optimization

Before optimization one has to select the service criterion. The value of the selected service criterion will be used as a constraint for the optimization. In figure 2.24 the optimal situation for the example case 1 is presented. There are differences between the evaluation and optimization (figure 2.23 and 2.24), in the optimal situation there will be less inventory of the end items but more inventory for the level code 2 items. More information about the level codes can be found in section 2.5.3. The table and graphs can be copied with a right mouse click.

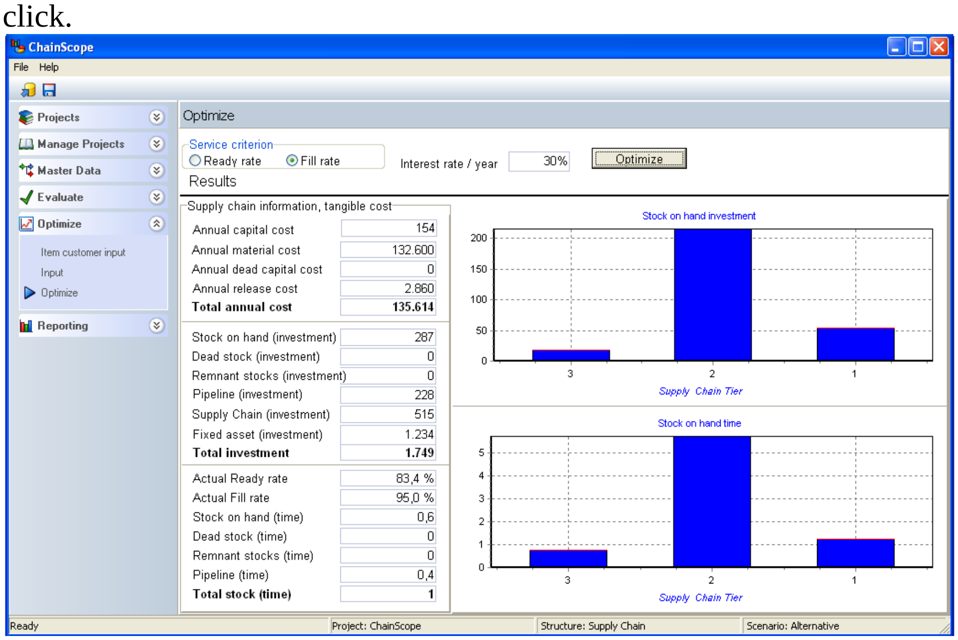


Figure 2.24: The optimization screen for example case 1

Result

The results for the annual costs, investments and stock performances of the optimization can be found in the optimization screen but the values of the parameters to create the optimal situation can be found in the Reporting screens.

2.6 Reporting

Reporting

The last section of ChainScope is the reporting section where one can find the results of the last performed evaluation or optimization. The tables or graphs can be copied with a right mouse click and "Copy."

2.6.1 Item customer output

Item customer output

The "Item customer output" screen will show the values of output parameters which describes the item customer relation. In figure 2.25 output of example case 1 is presented. The actual ready and fill rate show the gained values in the evaluated or optimized scenario. Figure 2.25 shows the optimization of the example case 1 with the fill rate as service criterion. Due the service criterion setting the ready rate for customer 2 can be below the value of 0.95.

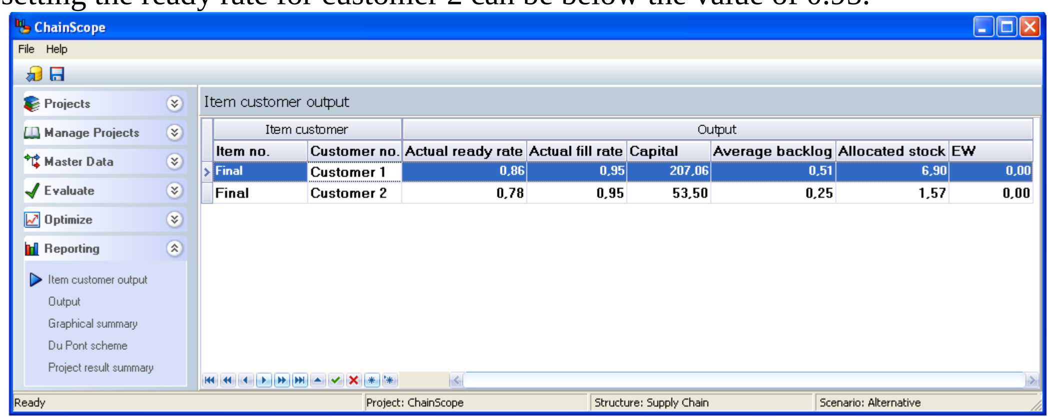


Figure 2.25: Item customer output screen

Capital and allocated stock

The values of the capital column represent the value of the products in the stock point which are in the stock point because of the customer. In our example 106.74€ of the "Final" item are in the stock point because of "customer 1" demand. The allocated stock is like capital but in numbers instead of euros.

Average backlog and waiting time

The average backlog value is the number of items a customer ordered but not receives on time. The abbreviation EW stands for the expected waiting time; this is the average time a customer has to wait if an order can not be delivered on time.

2.6.2 Output

Output

On overview of the output parameters of ChainScope can be found in figure

2.26. The values of all these output parameters can be found in the ChainScope "Output" screen. In figure 2.27 the output screen for the example case 1 is presented.

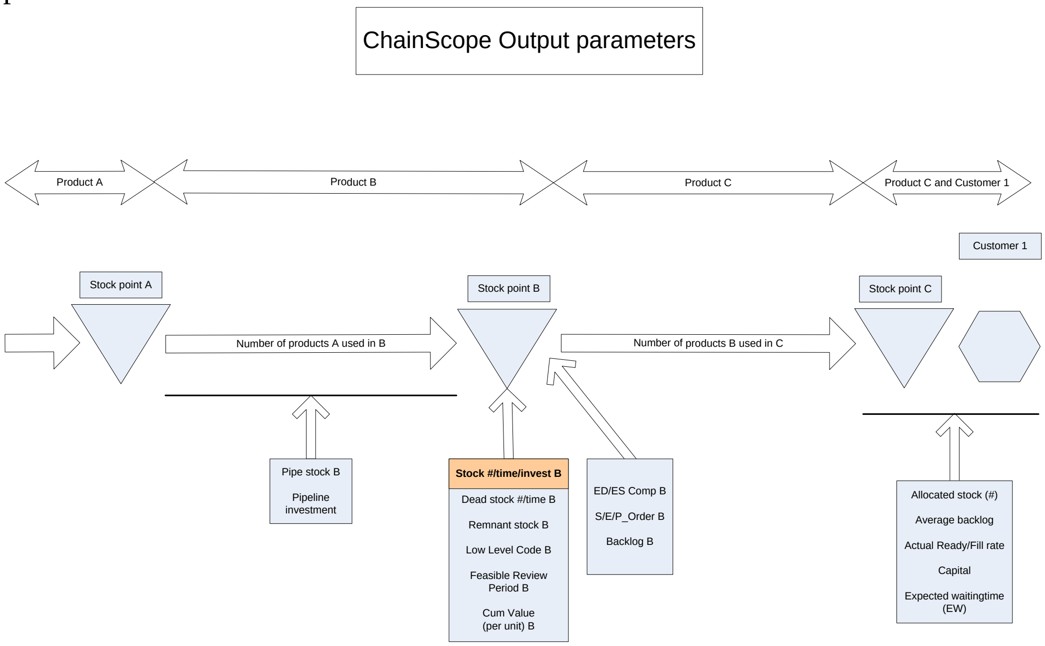


Figure 2.26: ChainScope output parameters

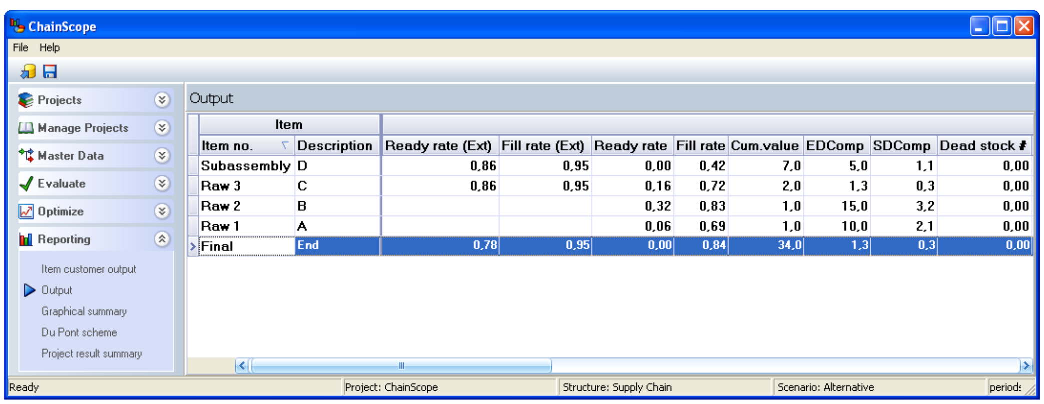


Figure 2.27: Output screen

Service criterion

For the value of the service criterion we make distinction between the external and internal value. The external service level can be recognized by the (Ext) extension in the column name and these are the service level values which the customer will experience. For items with customer demand the ChainScope algorithm creates an extra stock point for the items before they are dedicated to the customers. The internal service levels for end items are the service levels of the factiously by ChainScope created stock points.

Cumulative value

The cumulative value is the total value of one piece of the item. One can calculate the cumulative value by summing up all the added values of all the input items.

The average demand and the standard deviation of the item demand are stated in the EDComp and SDComp columns. *Component Demand*

In the "Stock #" column one can find the average number of items in each stock point in the optimal situation. This average stock quantity for each stock point is the changeable variable in an optimization and after the optimization this is the input parameter for the new situation by which one can achieve the optimal situation. *Stock quantity*

The stock in time is the average number of periods of stock held in each stock point. If the demand for an item is 2 items per period and the average stock in the stock point is 6 items the stock in time will be 3 periods. *Stock in time*

The stock invest is the value of the average stock. In our example case 1 the stock invest value of the item "Subassembly" is 200€ this is because the average stock (Stock #) is 28.59 and the cumulative value (Cum. value) of one item "Subassembly is 7€ and 7 x 28.59 = 200€. *Stock invest*

Dead stock is surplus inventory of items and thus useless items in a stock point. The dead stock does not tribute to customer service and in the output table the dead stock is expressed in time, value and numbers. *Dead stock*

The remnant stock value is the number of items which are in the stock point because other items are not available and also needed for a transformation process. If in the example case 1 items of "Raw 1" are backlogged and the items of "Raw 2" are not backlogged and ready in the stock point these items of "Raw 2" is called remnant stock. *Remnant stocks*

In the pipe stock column one can find the average number of items of a product that are in the transformation process before they are in the stock point of the item. If a transformation process would take 2 weeks and every week one product is ordered the pipe stock of the product would be 2 items. *Pipe line stock*

In the output table one can find the abbreviation BL which stands for backlog. The number of items presented in the BL column is the average number of items backordered in each period. *Backlog*

The abbreviation LLCode stands for "Low Level Code" which represents the hierarchical level code of the item. End products have level code 1 and all the input products for the end products have level code 2 and so on. In our example case 1 the items "Raw 1" and "Raw 2" have the level code 3 and "Subassembly" and "Raw 3"the level code 2. If "Raw 3" was also an input item for "Subassembly" the level code of "Raw 3" will not change because an item will take the lowest as possible level code. *Low Level Code*

In the columns with Order in the heading one can find information about the *Order quantity* average ordered quantities of the items. The column name "E_Order" stands for expected average order size and "S_Order" stands for standard deviation of the expected average order size. *information*

The P_Order of an item is the change that in one period one has to order the item. In our example case all the P_Order values are 1 this means that every item will be ordered every period, if the P_Order value would be 0,50 than on average one in the two periods the item would be ordered.

Feasible review period

The column name "Rev. Period F" stands for feasible review period. The review period value is the number of periods between subsequent release decisions for an item in the supply network. If in our example case the review period for the "Final" item would be 2 periods, the feasible review periods for "Raw 3" would become 2 periods because items of "Raw 3" would only be ordered once in the two weeks because of the review period of the "Final" item.

Effective Stock

The effective stock is the opposite of the dead stock; the effective stock is the stock which does contribute to the customer service. The total stock investment is the dead stock plus the effective stock. The effective stock is in the output table expressed in value and time.

2.6.3 Graphical summary

Graphical summary

In the graphical summary screen one can create graphs with the stock presented in value or time with the items divided in the selected subclasses. Above the graphs one can select "Value" or "Time" and on the left of the graph one can select one item class and more item subclasses of the selected item class. In figure 2.28 the graphs represent the effective stock in time and the item class "Product type" is selected with all the item subclasses of the item class. In the graphs the dead stock is colored red; the dead stock is the surplus inventory and thus the useless items in the stock point which do not contribute to the achieved service level.

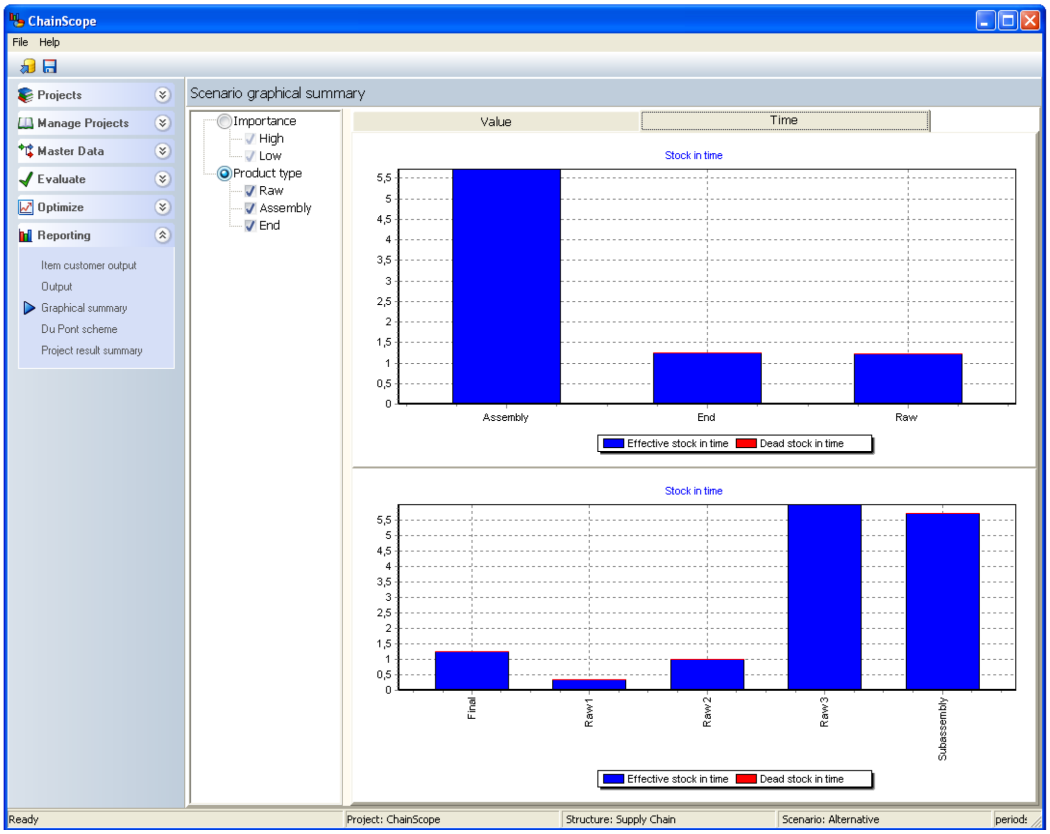


Figure 2.28: Graphical summary example case 1

2.6.4 Du Pont Scheme

What is the Du Pont scheme?

The Du Pont scheme is a method of performance measurement that was started by the Du Pont Corporation in the 1920s. With this method, assets are measured at their gross book value rather than at net book value in order to produce a higher return on investment (ROI). The Du Pont identity breaks down return on equity (that is, the return to equity that investors have contributed to the firm) into three distinct elements. This analysis allows the analyst to understand where superior (or inferior) return is derived from by comparison with companies in similar industries (or between industries).

Return on equity

The return on equity (ROE) ratio is a measure of the rate of return to stockholders. In the DuPont system the ROE is decomposed into various factors influencing company performance. The ROE will be determined with the return on assets multiplied with the equity multiplier. The equity multiplier is the amount of percentage of assets owned by each euro of equity invested in a business.

Du Pont scheme

In figure 2.29 the Du Pont scheme for the example case 1 is presented. The red values can be changed in the ChainScope screen and the black values are determined based on the evaluation or optimization. In the screen many abbreviations are used and in table 2.6 these abbreviations are described.

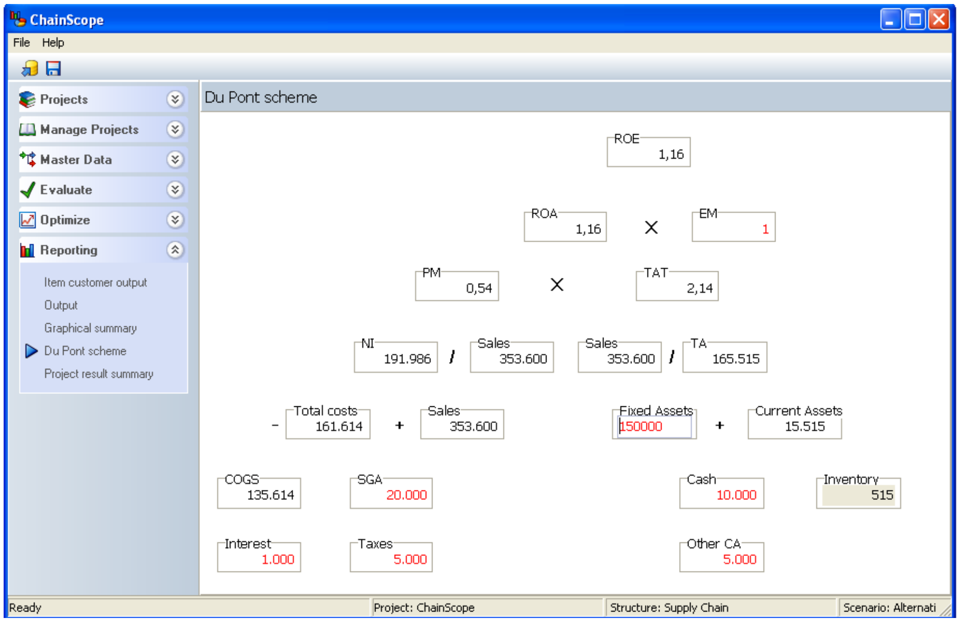


Figure 2.29: The Du Pont scheme

Abbreviation	
ROE	Return on equity
ROA	Return on assets
EM	Equity multiplier
PM	Profit margin
TAT	Total asset turnover
NI	Net income
TA	Total assets
COGS	Costs of goods sold
SGA	Selling, general and administrative expenses
Other CA	Other current assets

Table 2.6: Du Pont abbreviations

Net income

The net income are the sales minus the total costs and the total costs is the sum of the costs of goods sold, interest, taxes and selling, general and administrative expenses.

Total assets

The sum of al the assets can be found in the TA block. The value of the total assets is the fixed assets plus cash plus the (other) current assets.

In the ChainScope Du Pont screen one can see the terms and operations which lead to the return on equity. In formula form the Du Pont scheme can be described as follow:

Du Pont system

$$ROE = ROA * EM = PM * TAT * EM = \frac{NI}{Sales} * \frac{Sales}{TA} * EM$$

$$ROE = \frac{Sales - TotalCosts}{FixedAssets + CurrentAssets} * EM$$

$$ROE = \frac{Sales - COGS - SGA - Interest - Taxes}{FixedAssets + Inventory + Cash + OtherCA} * EM$$

2.6.5 Project result summary

The last screen in ChainScope is the "Project result summary" here one can find a graph or table. In the "Project result summary" one can select more scenarios to compare them.

Project result summary

The graph and table are exactly the same as the table and graph in the "evaluation" or "optimization" screen. In figure 2.30 and 2.31 the results of the example case 1 are compared with an alternative scenario with the only difference that the review period for the "Final" item is 2 periods.

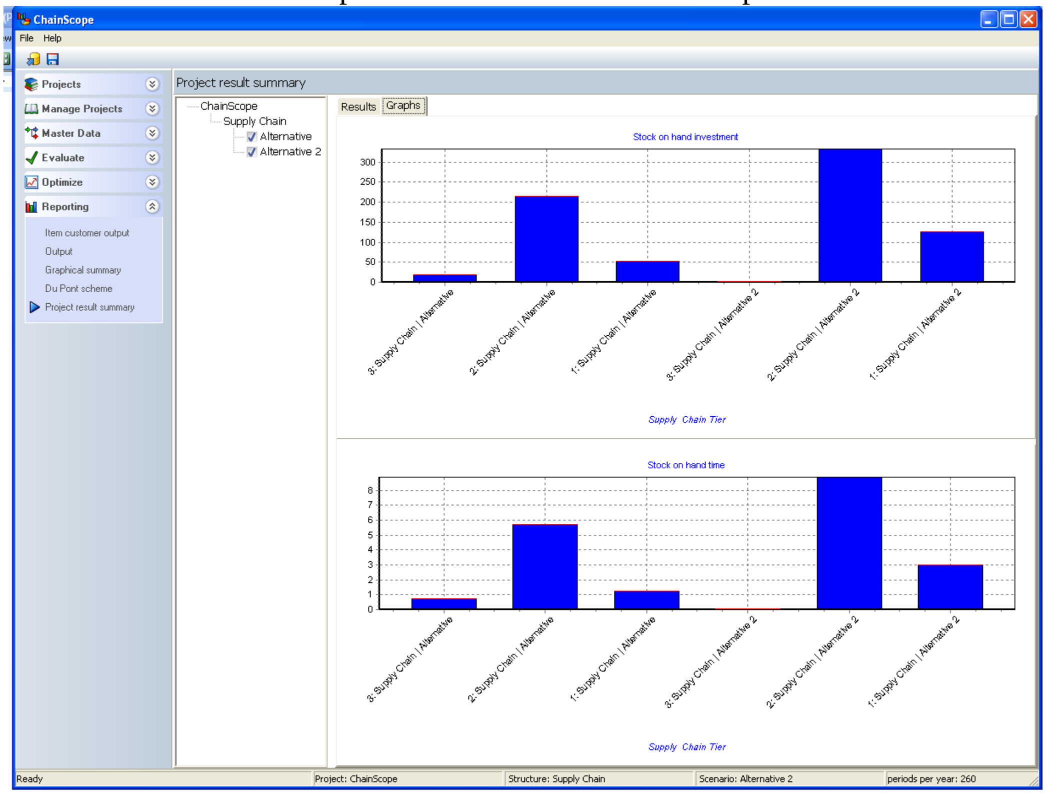


Figure 2.30: Project result graphical summary

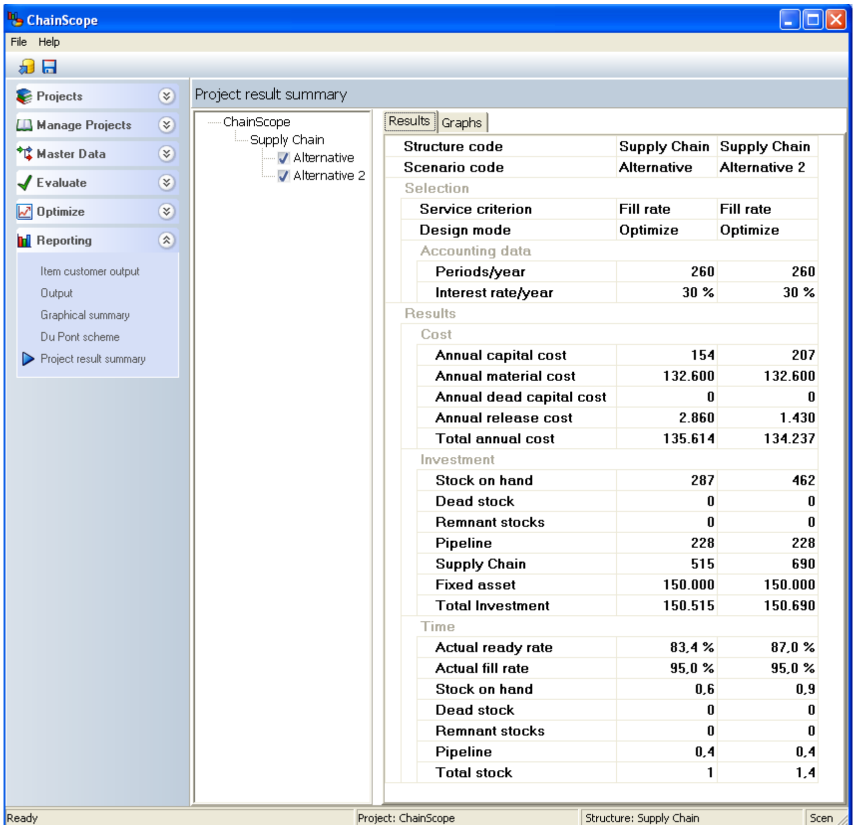


Figure 2.31: Project result table summary

Annual capital cost

The annual capital costs are the cost for holding inventory in the stock points and the "stock" in the pipelines. The capital in the stock points is equal to the stock invest output parameter and is equal to the average number of items in the stock multiplied with the total value of one item. The capital in the pipeline for items with no other item input is equal to the added value multiplied with the pipe stock quantity. For items with input items the capital in the pipeline is equal to the sum of all the input item values plus half of the item added value multiplied with the average number of items in the pipeline.
Over the total number of items in stock and pipelines one has to pay the interest costs. The total capital in stock and the capital in the pipelines multiplied with the interest rate will give the annual capital cost.
The annual dead capital cost is the interest paid over the dead stock and is calculated with the number of dead stock items multiplied with the cumulative value of the item and multiplied with the interest rate.

Annual material cost

The annual material cost is the total costs in one year for producing all the expected demand in one year. For our example case the total average demand per period is 15 units (260 periods/year) and the cumulative value of one "Final" item is 34€ thus we have annual material cost of 132.600€ (15*260*34).

Annual release cost

For each order of an item one has to pay the release cost. If one releases 100 orders a year one has to pay 100 times the release costs. In our example we order every item every period (P_Order is always 1) thus we order each item 260 times. The order for the "Final" item costs 3€ and the release cost for the other four items is 2€. This will lead to the annual release cost of 28.620€ (260*3+4*260*2).

Stock investment

The stock on hand investment is the average value of your total stock. If there is only one stock point with on average 10 number of items in stock and the cumulative value of one item is 10€ the stock on hand investment will be 100€. In our example case the stock on hand investment is 620€ (1*10+1*10+2*10+(2*1+3*1+2)*10+(4*7+2+4)*15) where we multiplied the cumulative added value of each item with the average stock of each item.

The dead stock investment is the same as the stock on hand but only for the number of items which are part of the dead stock. In our example case we have dead stock for item "Raw 1" and "Raw 3" what will make the dead stock investment of 17€. Remnant stock investment is calculated in the same way for the average remnant stock per item.

The pipeline investment is the average number of items in the pipeline multiplied with the average value of one item in the pipeline. For items with no input items the pipeline value is equal to the total added value of the item and for items with input items that pipeline value is equal to the sum of the added values of all the input item plus half of the added value of the item. Thus the pipeline value of one item of "Sub assembly" is 6€ (2*1+3*1+1/2*2) and the total pipeline investment for our example case is 228€ (20*1+60*1+3,75*2+10*6+2,5*32).

Most of the above explained output parameters are also expressed in time in the same table. The conversion from quantity or investment to time is made with the demand per period for each item.

Supply Chain investment

The supply Chain investment is the stock on hand investment plus the pipeline investment. In our example case the total supply chain investment per period is 848€ (620+228).

Fixed asset

The fixed asset investment is the sum of all the investments in fixed assets and can be inserted in the evaluation or optimization screens. If different scenarios have different fixed assets this is an influential parameter, for example the fixed asset for an extra distribution centre.

Chapter 3

Modeling, validation and interpret output data

This chapter

In this chapter the modeling steps and language are explained in a more abstract way. After a model is build it has to be validated and in the middle part of this chapter the validation will be discussed. The last part of this chapter we will discuss the understanding and effects of the ChainScope output data.

3.1 Modeling and collecting the input data

Modeling

Modeling refers to the process of generating a model as a conceptual representation of some phenomenon. A model in science is a physical, mathematical, or logical representation of a system entity, phenomenon, or process. It is a type of formal interpretation which deals with empirical entities, phenomena, and physical processes in a mathematical or logical way. Typically a model will refer only to some aspects of the phenomenon in question, and two models of the same phenomenon may be essentially different, that is in which the difference is more than just a simple renaming. Models are, like this manual, created in a specific language. To create a model in ChainScope one has to use the ChainScope language thus the ChainScope definitions, process linkage and bill of material structure. It is important that you are conscious of the fact that you have to model a supply chain in ChainScope and not just entering parameters from you Enterprise Resource Planning (ERP) software. The different steps before one has created a ChainScope model are presented in figure 3.1.

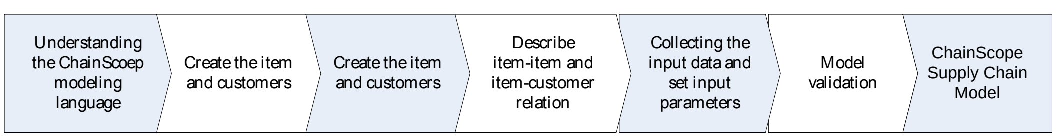


Figure 3.1: The ChainScope modeling steps

3.1.1 ChainScope modeling

The ChainScope modeling language

A modeling language is any artificial language that can be used to express information or systems in a structure that is defined by a consistent set of rules. The rules are used for interpretation of the meaning of components in the structure. With the ChainScope language we want to describe the supply chain with stock point and inventory characteristics, demand quantities and uncertainties and the transformation processes and bill of material structures. Chapter 5 of this manual can be seen as the dictionary for all the words and definitions in the ChainScope modeling language.

The ChainScope input

In figure 3.1 all the input parameters for ChainScope models are presented. The input parameters give information about the whole supply chain or an item. Before one can give information about the supply chain or item the items have to be defined and the structure of the supply chain has to be constructed. In figure 3.1 this basic structure of a supply chain is presented in orange.

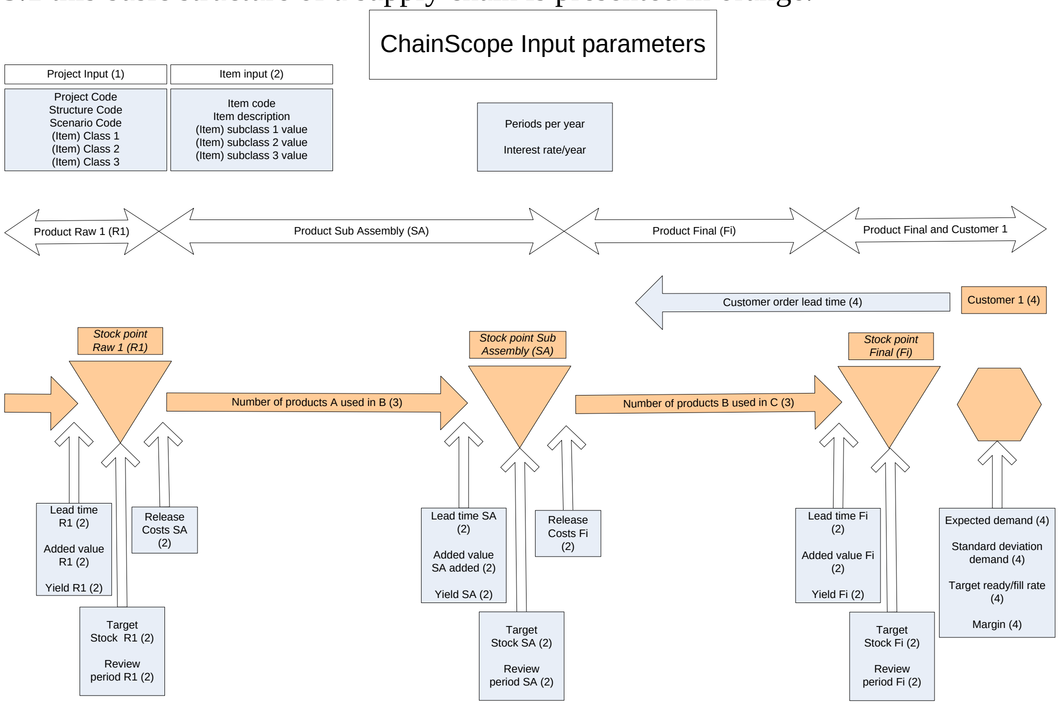


Figure 3.1: The ChainScope input parameters

The items, customers and basic structure

Before one can enter the input parameters the basic structure with items and customers has to be constructed. In ChainScope items are physical products in a unique form and place combination with a stock point. Each ChainScope item must have the possibility to be dropped in a stock point and an item without a stock point cannot be modeled as an item in ChainScope. For the transformation of an item into another item a so called transformation process is needed.
Customers in ChainScope are entities which demand minimal one ChainScope item, a ChainScope customer's entity could just be one single person but one can also model an entire country as one ChainScope customer.
If all the ChainScope items are modeled the next step is to create the bill of materials where one can describe the relations between the items. In the supply chain we want to describe the successor relations and the thus the number of pieces of each item that are needed in other items. After the first three modeling steps it should be possible to create a drawing of your supply chain like figure 3.2.

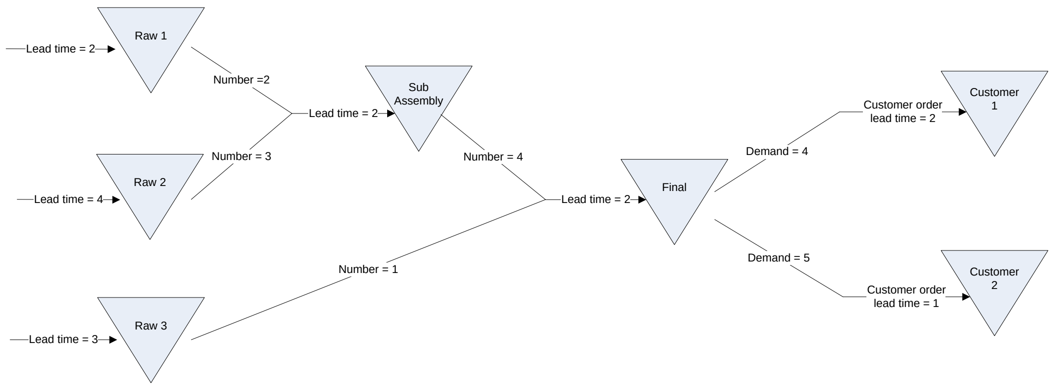


Figure 3.2: Basic structure of a ChainScope model

3.1.2 Collecting the input parameters data

Collecting the input data

After the items and the basic structure is modeled one can start searching for the right values for each input parameter. In figure 4.1 all the parameters are presented in blue boxes with an arrow leading to the place where the parameter has effect. It is very important to have a thorough understanding of the definitions of each parameter and to perform a consistency check if you take over parameter values from your ERP/MRP software. In the next part of this section we will discuss all the input parameters.

Lead times

The lead time is the throughput time between the moment of release of an order for the item and the moment at which the ordered item is available for usage in other items and/or delivery to customers. The lead time is equal to the, in ChainScope modeling language, transformation time.
If we have a transformation process for a final item which needs 2 raw materials. The process starts only with the first raw material and after 1 week the second raw material is needed in the process and after another week of “transforming” the final item is finished. The lead time for the transformation process will then be 2 weeks. For determining the lead time one has to assume that there is enough stock of the input items at the moment of ordering.
The customer order lead time are the number of periods between the moment a customer places an order and wants to receive the ordered items. A customer-item relation can only have one lead time for example if you modeled the Dutch market as one customer but the Dutch Queen has a shorter lead time than the other Dutch people you have to model the Dutch Queen as one separate customer.

Added value

The added value is the value that is added to the item during the transformation process that creates the item. One can also say that the added value is the monetary value of the specific item minus all the values of the input items. In ChainScope the added value of a product is added in a linear way, so the value of an item halfway during the transformation process is the cumulative value of al

the input items for the item plus half of the added value of the item. Items which are ordered from other suppliers have an added value that is equal to the total price one pays for the items.
Items at the beginning of the supply chain (raw materials) also have an added value but this value is not added in a linear way during the lead time. The added value for raw materials is added immediately after an order is released. The pipeline investment for raw materials is the added value multiplied with the average pipe stock of the item.
In ChainScope the stock holding costs are based on the total value of the item and partly based on the stock holding costs ChainScope can deliver you the optimal target stocks for each item.

Release costs

The release costs are the costs for releasing an order for the item, this are fixed costs for each order. If for example an outside supplier has 100€ fixed transport costs per order regardless of the order size this 100€ has to be modeled as the release costs for the item ordered by the outside supplier.

Yield

During the transformation process an item can get broken and becomes useless. The yield value is the ratio of the number of products which are not broken. Broken products are not brought to the stock points and immediately after the transformation process removed out of the supply chain. The yield ratio in ChainScope works independent on every single item and a defect item has no effect on other items in the supply chain. In for example SAP this phenomena is described with the assembly scrap parameter.

Review period

The review period is the period between subsequent release decisions for an item. If we can order items once a day the review period is one day but if we could only order once a week the review period would be 5 (work)days. It is possible that ordering and reviewing your stock point is done daily but that an outside supplier collects all the orders on Fridays and delivers the next week on Friday. In ChainScope this can be modeled as a review period of 5 days and a lead time of one day.

Item target stock

The target stock is the average number of items one wants to have in the stock point.

Demand

The demand is the number of products per period the customer wants to receive. The standard deviation of the demand indicates the demand uncertainty. The standard deviation can be calculated with a formula where all the difference between the known demand and average demand is squared and shared through the total number of periods minus one. All these values are summed and square rooted and the result is the standard deviation. In formula format with X_i as the demand in each period the formula for the standard deviation will be:

$$\sqrt{\sum_{i-1}^{n} \frac{(X_i - AverageDemand)^2}{n-1}}$$

Margin

The margin is a ratio of the total value added which is the profit for the supply chain owner on every item sold to a specific customer. If the margin value is 0.20 the value added by the supply chain will be sold for 120% (1+margin) of the added value.

Target service levels

The TargetP1 is the target value for the ready rate level. The ready rate level is the fraction of cycles in which the on hand stock does not drop to zero. The TargetP2 is the target fill rate, the target fraction of customer demand that is met routinely, without backordering.

Entering the data

Information about how to enter the data in ChainScope is presented in chapter 2 of this manual. The sixth step on the road to a ChainScope model is the validation and this step will be discussed in the next section (section 3.2 Validation and verification.)

3.2 Validation and verification

Validation and verification

Validation is the process of establishing documented evidence that provides a high degree of assurance that a product, service, or system accomplishes its intended requirements. It is sometimes said that validation ensures that 'you built the right thing' and verification ensures that 'you built it right'. In the case example chapter one can find a validation example in section 4.2.

Validation in ChainScope

It is impossible to have a simple button in ChainScope to check if the constructed supply chain model is valid and it is possible that the validation process will take more time than the model construction time. For a model without validation an optimization or decision support will be doubtful and thus useless. Before one can validate, the scenario has to be modeled and evaluated in the evaluation mode. The outcomes of the evaluation and the performances in real business of the modeled scenario will be used as input for the validation.

Validation parameters

Like stated before the input for the validation process are the output parameters of the ChainScope evaluation and the values of these parameters in real business. It is important that the validation parameter in ChainScope has the same meaning and way of calculating than the parameter value in real business. For example if the "Ready rate" in the business means the percentage of the total time orders are on time, it does not make sense to validate this business "ready rate" value with the ChainScope evaluation ready rate. In most scenarios it is advisable to use the fill and ready rate as the important validation parameters.

Honest comparison

For an honest comparison it is important to notice that ChainScope evaluates models under normal conditions and the model in ChainScope are only influenced by the input parameters. The meaning and measurement method of the input parameters for the validation have to be the same and both measured only under influence of the ChainScope input parameters. If for example your warehouse was closed for two weeks due a hurricane and the total demand for these two week was backordered the performance in real business logically will be lower than the expected service level. ChainScope does not have a hurricane change input parameter thus the influence of the hurricane has to be eliminated out of the validation process. To eliminate the hurricane influence the demand and backorders in the hurricane weeks has to be removed from the fill rate calculations.

3.3 Interpret the output data

The output data

After an evaluation or optimization ChainScope generates many important output parameters. In figure 3.3 the output parameters are graphically presented in colored boxes. The “Stock B” parameter is presented in an orange box because this parameter is used as the variable in an optimization.

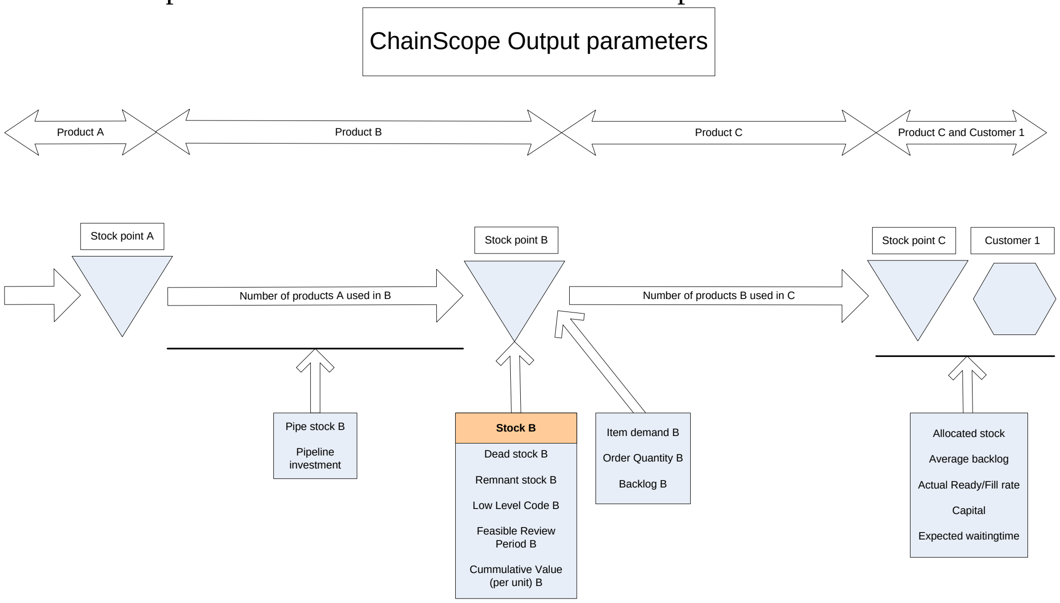


Figure 3.3: the ChainScope output parameters

Evaluation output

All the parameters presented in figure 3.3 except the (target) Stock parameter are part of the output of an evaluation. Based on this output one can for example evaluate the service performance of different scenarios. Parameters that indicate a performance in terms of costs are summed in the total annual cost and if the different scenarios have different fixed asset investments the fixed asset investment is also important for the output evaluation. Information and definitions of all the output parameters can be found in section 2.6 and in chapter 4 the output is interpret for an example case.

Optimization output

Like stated earlier the (target) Stock value for each items is used as variable for the optimization. Implementing the new target stock values would lead to the optimal situation with minimal annual cost and achieved service levels. Information and definitions of all the output parameters can be found in section 2.6 and in chapter 4 the output is interpret for an example case.
In the last part of this subsection we will discus the most important overview output parameters.

Annual capital cost

The annual capital costs are the cost for holding inventory in the stock points and the “stock” in the pipelines. The capital in the stock points is equal to the stock invest output parameter and is equal to the average number of items in the stock multiplied with the total value of one item. For The capital in the pipeline for

items with no other item input is equal to the added value multiplied with the pipe stock parameter value. For items with input items the capital in the pipeline is equal to the sum of all the input item values plus half of the item added value multiplied with the average number of items in the pipeline.
Over the total number of items in stock and pipelines one has to pay the interest costs. The total capital in stock plus the capital in the pipelines multiplied with the interest rate will give the annual capital cost.
The annual dead capital cost is the interest paid over the dead stock and is calculated with the number of dead stock items multiplied with the cumulative value of the item and multiplied with the interest rate.

Annual material cost

The annual material cost is the total costs in one year for producing all the expected demand in one year. For our example if the total average demand per period is 15 units (260 periods/year) and the cumulative value of the item is 34€ we have annual material cost of 132.600€ (15*260*34).

Annual release cost

For each order of an item one has to pay the release cost of an order. If one releases 100 orders a year one has to pay 100 times the release costs. In our example we order every item every period (P_Order is always 1) thus we order each item 260 times.

Total annual cost

The annual capital, material and release cost together are the total annual cost. In figure 3.4 the output parameters concerned with the pipeline and stock investment are graphically presented.

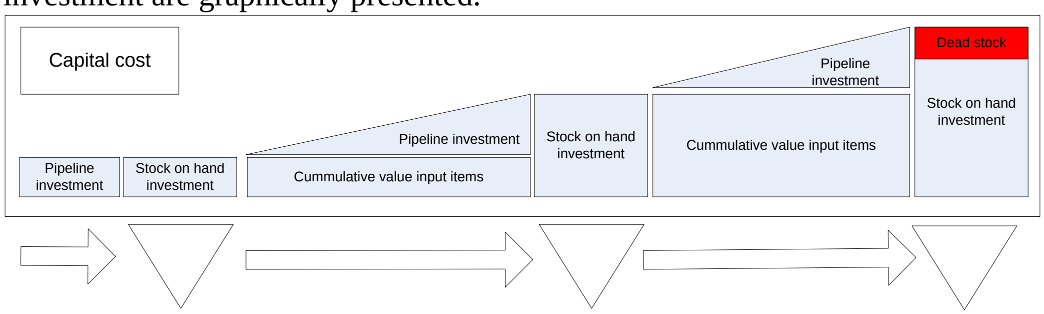


Figure 3.4: Graphical representation pipeline and stock investment

Actual ready/fill rate

The actual service criterion describes the achieved service levels. The achieved ready rate is the achieved fraction of time during which the net stock is positive. The fill rate describes the fraction of customer demand that is met routinely, without backordering or lost sales.

Chapter 4

ChainScope case example

This chapter

In this last chapter of the ChainScope user's manual we discuss a fictitious case about a bike manufacturer GrandBike. With this simple case we want to give you some feeling with the ChainScope parameters, modeling and output. The first part of the chapters starts with a case description and how to build the project and at the end of this chapter after validation the outcomes of the case study are presented.

4.1 Building a project

Case description

Our example case is of a Dutch company called GrandBike which makes and sells only one type of bikes called the Granbike. By outside suppliers GrandBike orders front wheels, back wheels, handle bars and frames by which the pedals and chain is included. In the GrandBike factory the frames are painted by a contractor but GrandBike is responsible for the inventory before and after the painting process. After the painting the frames are assembled with the front and back wheel and stored in a stock point. The last step is the assembly of the handle bar on the bike.

GrandBike has two distribution centers (DC), one in the Netherlands and one in Belgium. Both distribution centers deliver the national demand. The demand of the last two years of the Dutch (NL) and Belgium (BE) market can be found in table 4.1.

The time between GrandBike releases an order for frames and receives is 4 weeks, for wheels this is 3 weeks and for the handle bars 2 weeks. The prices for the frame, front wheel, back wheel and handles bar are 40€, 15€, 20€ and 10€. The frames are painted inside the GrandBike factory by a contractor which has the responsibility of the paint inventory. The paint contractor has to deliver orders within one week and charges 5€ for each frame during the painting process 5% of the frames become useless. After the frame is painted it will be stored in a stock point and waits before it will be used in the assembly where the wheels and frames will be combined. In this first assembly process it takes 2 weeks before an ordered frame with wheels will be received in the specific stock point. The last assembly before the Granbike is finished is placing the handle bar on the bike. An order for a Granbike in the factory will have a lead time of 2 week. From the stock point in the factory the Granbike's are transported to one of the distribution centers. For the Dutch distribution center the lead time is 1 week and for the Belgium center 2 weeks. The selling price in the Netherlands is 143€ and in Belgium 163€.

Month	NL	BE
1	2000	1800
2	2100	1500
3	2000	1700
4	2200	1800
5	2600	1700
6	2300	1900
7	2400	1700
8	2400	1800
9	1800	1500
10	2100	1700
11	1800	1500
12	2100	1800

Table 4.1: Demand for Granbiket

Bill of material

In the case description of GrandBike we can find nine ChainScope items. Parts of these are the four raw materials: front wheel, back wheel, handle bar and frame. A painted frame is another item than the unpainted frame thus in ChainScope we also have the item "colored frame." The first assembly process where the wheels and frame are combined makes another ChainScope item which we name the "Frame and wheels." In the last real production step the handle bars and the frame with wheels are assemblied and the item Granbike is complete. After the completion of the Granbike we can identify two different ChainScope items namely a Granbike in the Dutch distribution center and a Granbike in the Belgium distribution center. This will lead to the bill of material structure showed in figure 4.1.

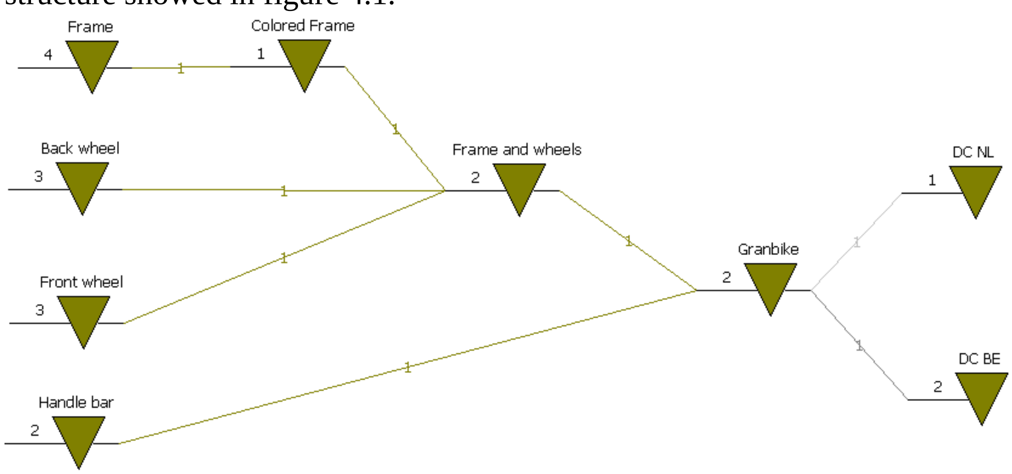


Figure 4.1: Bill of material GrandBike

Input Parameters

Grandbike can order every item once a week and thus the review period for every item is 1 week. Because of this review period and the smallest lead times of one week we will define one ChainScope period equal to one week. In ChainScope this will make 52 periods per year.
The selling prices of the Granbike is 143€ or 162€ and the total costs before transportation to one of the distribution centers is 110€. The transportation cost

to the Dutch DC is 5€ per bike en transportation to the Belgium DC is 10€ per bike. The sum of the raw material prices is 85€ for each bike and 5€ for the paint contractor. The cost of the first and second assembly step are 25€ and 10€ for each bike. This makes the total value of a bike in the Dutch DC 130€ and the value of a bike in the Belgium DC will be 135€.Combining this information with the stated selling prices the margins are 10% and 20%. The yield and lead times can all be found in the case description and in table 4.2.

Item no.	Rev. period	Lead time	Added value	Target stock	Release cost	Yield
Frame	1	4	40	50		1
Front wheel	1	3	15	50		1
Back wheel	1	3	20	50		1
Handle bar	1	2	10	50		1
Colored Frame	1	1	5	50		0,95
Frame and wheels	1	2	25	100		1
Granbike	1	2	10	100		1
DC NL	1	1	5	250		1
DC BE	1	2	10	200		1

Table 4.2: Item input parameters

In table 4.1 the demand of Granbikes in the Netherlands and Belgium are given per month. Based on this data we would have an average month demand of 2167 and 1733 bikes with a standard deviation of 235 and 161 bikes. More detailed data (not in this user manual included) shows us that the average demand is 500 and 400 bikes per week and the standard deviations are 71,95 and 123,99 bikes per week. This will lead to the item customer relation parameters as presented in table 4.3.

Item no.	ED	SD	Target ready rate	Target fill rate	Margin	Order lead time
DC NL	500	71,95	0,95	0,95	0,1	1
DC BE	400	123,99	0,90	0,95	0,2	2

Table 4.3: Item customer relation parameters

Evaluation

If one inserts the above presented input parameters and bill of material structure an evaluation with an interest rate of 30% per year will show the results of figure 4.2.

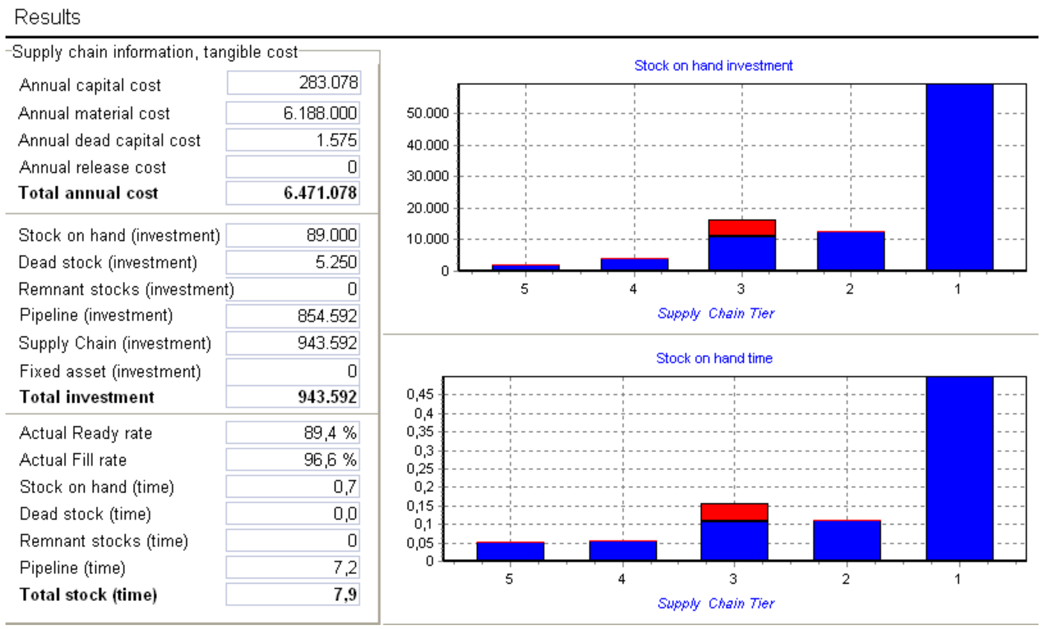


Figure 4.2: GrandBike evaluation results

4.2 Validating a project

What is validation?

Validation is the process of establishing documented evidence that provides a high degree of assurance that a product, service, or system accomplishes its intended requirements. It is sometimes said that validation ensures that 'you built the right thing' and verification ensures that 'you built it right'.

Business performances GrandBike

GrandBike knows the number of backordered bikes during the last year for each DC. In the Dutch DC there where 1015 backorders during the entire year. In the Belgium DC there were no peculiarities and the total number of backorders was 1465. The manager of the Belgium DC also told that every week the DC became empty on Thursday afternoon or Friday morning.
Based on the above stated case information we can conclude that the fill rate of the Dutch DC under normal conditions would be 96,10% ((500*52 – 1015)/(500*52)). Of the Dutch DC no information about the ready rate is known. For the Belgium DC the percentage of demand that was satisfied on time would be 92,96% ((52*400 – 1465)/(52*400)). Based on the not accurate information that in a five week workweek the DC is empty on the end of the week on the Thursday afternoon or Friday morning will give us an indication that the ready rate will be around the 80% (1 out of 5 days no stock in the DC.)

Evaluation

If one inserts the in section 4.1 presented input parameters and bill of material structure an evaluation with an interest rate of 30% per year will show the results of figure 4.2.
The information showed on the item customer output screen is presented in table

4.4 below.

Item no.	Actual ready rate	Actual fill rate	Capital	Average backlog	Allocated stock	EW
DC NL	0,97	1,00	32499,97	1,49	250	0
DC BE	0,80	0,93	27000,02	29,01	200	0

Figure 4.4: GrandBike evaluation results

Validation parameters

Based on the given business performance parameters and the evaluation output we will use the ready and fill rates as the validation parameters. A validation based on more parameters would be more accurate.
For the Belgium DC the measured fill rate of 92,96% matches almost perfect with the expected fill rate (93%) based on the model in ChainScope. The not accurate measured ready rate in the Belgium DC would be laying around the 80% based on the DC manager's experience. This also matches with the ChainScope outcome of 0,80 for the Belgium DC. Based on these results we can conclude that the model created in ChainScope is valid for the Belgium DC.
For the Dutch DC we only know the fill rate performance: 96,10%. The ChainScope evaluation expects a fill rate of 1 and an average backlog of 1,49. The outcomes of the ChainScope model are not valid due this difference so further research on the input parameters or measured performance is needed. Now we concluded that the model is not valid and it will not make sense to perform an optimization.

Adjustments

Due further research on the invalid results of the validation we found that there was a two week strike in the Duth DC. Due that strike all the demand for the two weeks could not be delivered on time. The total demand in the week before the demand and in the first week of the strike was 930 bikes. If there was no strike in the Dutch DC the total number of backorder would be 89. ChainScope evaluates the standard stochastic situation thus a situation without strikes. If there was no strike in the DC the fill rate would be around the 99,67% ((500*52 – 85)/(500*52)). The in ChainScope expected backlog in one year would be 77 (1,49*52) and the total number of backlog was 85. Based on the adjusted results one can conclude that the ChainScope model is also a valid representation of the GrandBike supply chain for the Dutch DC.

4.3 Optimize a project

Optimize the GrandBike project

Before one can make an optimization the validation of the created model in ChainScope is very important. In section 4.2 we proved that the created model for GrandBike in section 4.1 is valid. In this section we are going to optimize the supply chain of GrandBike.

Current performance

The current performance of GrandBike can be found in figure 4.2 and in the second column of table 4.5. The achieved and desired performances per customer can be found in table 4.4.

Item no.	Actual ready rate	Actual fill rate	Target ready rate	Target fill rate
DC NL	0,97	1,00	0,95	0,95
DC BE	0,80	0,93	0,90	0,95

Table 4.4: Achieved and desired service levels

In the above table one can see that for the Belgium DC GrandBike does not achieve the desired service levels. If ChainScope performs an optimization it will take the selected target service criteria as a constraint and shows an optimal situation where these criteria are met. Due this service constraint it could happen that in the optimization the total annual cost would be higher than in the evaluation of the current business situation. In the current business situation the service criteria would than be lower than the target service levels used for the optimization.
The third column shows the optimal situation if we want to achieve the same service levels than that GrandBikes achieves now.

Structure code	GrandBike	GrandBike	GrandBike
Scenario code	Granbike	Granbike Optimal (same service levels)	Granbike Optimal (desired service levels)
Service criterion		Fill rate	Fill rate
Design mode	Evaluate	Optimize	Optimize
Accounting data			
Periods/year	52	52	52
Interest rate/year	30%	30%	30%
Results			
Cost			
Annual capital cost	283.078	281.239	277.043
Annual material cost	6.188.000	6.188.000	6.188.000
Annual dead capital cost	1.575	0	0
Annual release cost	0	0	0
Total annual cost	6.471.078	6.469.239	6.465.043
Investment			
Stock on hand	89.000	82.871	68.885
Dead stock	5.250	0	0
Remnant stocks	0	0	0
Pipeline	854.592	854.592	854.592
Supply Chain	943.592	937.463	923.477

Fixed asset	0	0	0
Total Investment	943.592	937.463	923.477
Time			
Actual ready rate	89,40%	89,30%	75,60%
Actual fill rate	96,60%	96,60%	95,00%
Stock on hand	0,7	0,7	0,6
Dead stock	0	0	0
Remnant stocks	0	0	0
Pipeline	7,2	7,2	7,2
Total stock	7,9	7,9	7,8

Table 4.5: Results optimization

Optimization results

The outcomes of the optimization can be found in the last column of table 4.5. One can see that the total costs of the optimal situation are below the current situation and that the desired fill rate is achieved.
After the optimization one can find in the output screen the new optimal target stock levels (Stock #). For GrandBike these target stock levels are showed in table 4.6. With these target stock levels GrandBike can achieve the desired service levels and it will also save money in comparison with the current situation.

Item no.	Stock #
Front wheel	103,39
Back wheel	103,39
Handle bar	47,83
Frame	106,18
DC NL	67,02
DC BE	249,5
Granbike	80,28
Colored Frame	68,62
Frame and wheels	47,83

Table 4.6: Optimal target stock levels for GrandBike

4.4 Decision support

Decision description

The manager of GrandBike wonders if reducing or accessing the lead time of the transport to the Belgium DC would reduce the total costs. The lead time reduction of one week would cost 2€ extra and lead time accessing of one week would save 5€ on the added value of the item “Belgium DC.”
The price of the bike in Belgium can not be raised and thus the margin would in- or decrease due a lead time change. The price of one bike in Belgium is 162€ and 27€ is profit for GrandBike (20% margin). The lead time reduction would decrease the margin and the lead time accession would increase the margin. In table 4.7 an overview of this information is presented.

	Current situation	Lead time accession	Lead time reduction
Added value item "Belgium DC"	0	-5€	+2€
Margin	20%	24,62%	17,52%
Extra cost	0	- 104.000 €	+ 41.600 €

Table 4.7: GrandBike decision description

Based on the above presented information one would suggest that the lead time accession would be the best option. Lead time accession would increase the uncertainty and thus should increase the stock in the Belgium DC. With this information know one should perform an optimization for all the three scenarios to make the decision.

Results

In ChainScope one can build the three scenarios with the differences presented in table 4.7. An evaluation would not be fare because the target stocks would influence the result and the target stock was based on the current situation. With ChainScope, and thus the optimal situation known, it is plausible to compare the optimal situations for the scenarios. In table 4.8 the results of all these optimization are presented.

Scenario code	Current situation	Lead time accession optimal	Lead time reduction
Service criterion	Fill rate	Fill Rate	Fill Rate
Design mode	Optimize	Optimize	Optimize
Accounting data			
Periods/year	52	52	52
Interest rate/year	30%	30%	30%
Results			
Cost			
Annual capital cost	277.043	292.952	259.748
Annual material cost	6.188.000	6.084.000	6.229.600
Annual dead capital cost	0	0	0
Annual release cost	0	0	0
Total annual cost	**6.465.043**	**6.376.952**	**6.489.348**
Investment			
Stock on hand	68.885	72.913	62.834
Dead stock	0	0	0
Remnant stocks	0	0	0
Pipeline	854.592	903.592	802.992

Supply Chain	923.477	976.505	865.826
Fixed asset	0	0	0
Total Investment	923.477	976.505	865.826
Time			
Actual ready rate	75,60%	76,60%	73,70%
Actual fill rate	95,00%	95,00%	95,01%
Stock on hand	0,6	0,6	0,5
Dead stock	0	0	0
Remnant stocks	0	0	0
Pipeline	7,2	7,7	6,7
Total stock	7,8	8,3	7,2

Table 4.8: Scenario optimizations GrandBike

Conclusion

In table 4.9 the overall results with capital investment cost and margin change effects are presented. In this table one can see that lead time accession is the best scenario and that lead time reduction will lead to extra costs and these cost are more than the advantages

Scenario code	Granbike Optimal	Lead time accession	Lead time reduction
Extra costs	0	- 104.000 €	+ 41.600 €
Annual extra capital cost	0	+ 88 091 €	- 24 305 €
Result (cost change)	**0**	**- 15 909€**	**+ 17 295€**

Table 4.9: Overall results GrandBike scenarios optimization

Chapter 5

Definitions

This chapter is like the dictionary for ChainScope modeling, on the right side of each paper the terminology is presented and left the definition.	*This chapter*
Definition	***Terminology***
The value that is added to an item during the transformation process that creates the item.	*Added value*
	BOM quantity
	BOM structure

Index

Disclaimer

The ChainScope program enables the analysis of a supply chain or value network. Choosing an appropriate value network structure is part of the design process and requires a thorough understanding of the CODP concept and the definitions of the various input parameters. No liability is accepted for any consequence that results from using the ChainScope program or user manual.