

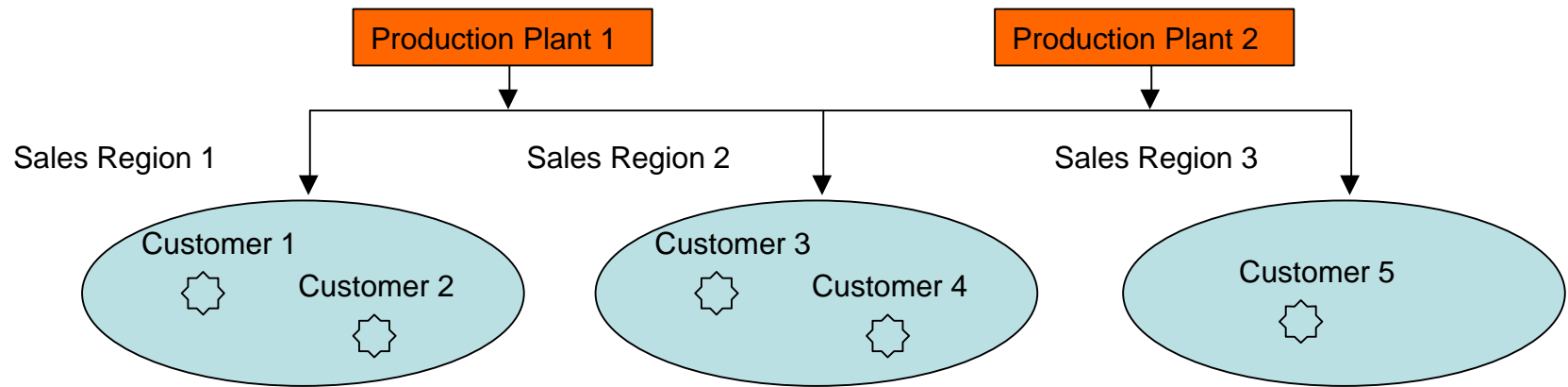
TriMatrix[®] Example: Supply Chain Management

Here is a simple example, how TriMatrix can
be used for Supply Chain Management

TriMatrix[®] Example: Supply Chain Management

Consider this:

- You have 2 production plants, 3 sales regions, and in these sales regions, 5 different customers:



- Your customers want to buy 3 different products, that can be produced at your production plants – and transported to them.
- For production, you need 2 different raw materials, that have to be purchased at your production plants.
- Both locations have two production lines, Line A and Line B, that produce the three products under slightly different conditions.

This example is rather simple – as it should be for demonstration purposes!

TriMatrix[®] Example:

Supply Chain Management,
Part I: Configuration

TriMatrix® Example: Supply Chain Management

This is how you would configure this example in TriMatrix®:

- You want 5 different **Operation Types**: Balance (which is a general name for “Stock”), purchase, production, transport, and sale.
- You want 2 different **Resource Types**: Bookkeeping (that cares for all the money involved, like income and costs) and products.
- You want 4 different **Location Types**: Production plants, production lines, sales regions, and customers. Generally spoken, a “location” is something that helps to distinguish things that should be kept apart, not only in a geographical sense.
- Finally, we want to configure the time dimension, for example in months. TriMatrix® calls this “**Time Periods**”; it is entirely up to you what you want to regard as a time period: months, weeks, years, or hours (or whatever). For our example, we choose to have 3 time periods (but the number of time periods you can have is virtually unlimited).

The following slides show you how this is done.

TriMatrix Configuration for Data Set: "Example Supply Chain"

Resources Types

	Long Text	Short	Set Zero	Loc Steps
0	Bookkeeping	Book	<input type="checkbox"/>	0
1	Products	Prod	<input checked="" type="checkbox"/>	1
*				

Resources Types: 1 / 2

Resources Units

	Resource Type	Long Text	Short	Rate
0	Bookkeeping	Euro	€	1
1	Products	Kilogramm	KG	0.001
1	Products	Ton	t	1
*				

Resources Units: 1 / 3

Locations Types

	Long Text	Short	Class
0	(undefined)	(undef)	Undefined Location
1	Plants	Plants	Balance Point
2	Lines	Lines	Secondary Location
3	Sales Regions	SoReg	Balance Point
4	Customers	Cust	Secondary Location
*			

Locations Types: 1 / 5

Time Periods

	Group	Code	Long Text	Short	Group 1	Group 2	Group 3	Group 4	Group 5
0	<input type="checkbox"/>	0	All Periods	All					
1	<input type="checkbox"/>	1	Period 1	1					
2	<input type="checkbox"/>	2	Period 2	2					
3	<input type="checkbox"/>	3	Period 3	3					
*									

Time Periods: 1 / 4

Operations Types

	Long Text	Short	Class	VType
0	Balances	Bal	Balance	<input type="checkbox"/>
1	Purchase	Pu	Push Operation	<input type="checkbox"/>
2	Production	Prd	Push Operation	<input type="checkbox"/>
3	Transport	Trp	PushPull Operation	<input type="checkbox"/>
4	Sale	Sa	Pull Operation	<input type="checkbox"/>
*				

Operations Types: 1 / 5

Operations Parm Types

	Operation Type	Long Text	Short	Resource Type	Val A	Fac
0	Balances	Inventory Cost	Inv Cost	0 Bookkeeping	<input checked="" type="checkbox"/>	1
1	Purchase	Purchase Cost	Pur Cost	0 Bookkeeping	<input checked="" type="checkbox"/>	1
2	Production	Production Cost	Prod Cost	0 Bookkeeping	<input checked="" type="checkbox"/>	1
3	Transport	Transport Cost	Trans Co	0 Bookkeeping	<input checked="" type="checkbox"/>	1
4	Sale	Sale Income	Sale Inc	0 Bookkeeping	<input checked="" type="checkbox"/>	1
*						

Operations Parm Types: 2 / 5

Operations Resource Types & Location Types

	Operation Type	Resource Type	Location Type	2nd Location Type
0	Balances	0 Bookkeeping	1 Plants	0 (undefined)
0	Balances	0 Bookkeeping	3 Sales Regions	0 (undefined)
0	Balances	1 Products	1 Plants	0 (undefined)
0	Balances	1 Products	3 Sales Regions	0 (undefined)
1	Purchase	1 Products	1 Plants	0 (undefined)
2	Production	1 Products	1 Plants	2 Lines
3	Transport	1 Products	1 Plants	3 Sales Regions
4	Sale	1 Products	3 Sales Regions	4 Customers
*				

Operations Resource Types & Location Types: 4 / 8

Settings & Info

From: To:

Info

Example Supply Chain

This is how the TriMatrix® Configuration screen would look like in our example; we go through this in detail on the following slides.

TriMatrix® Example: Supply Chain Management

TriMatrix Configuration for Data Set 'Example Supply Chain'

Resources Types					
	Δ	Long Text	Short	Set Zero	Loc Steps
▶	0	Bookkeeping	Book	<input type="checkbox"/>	0
	1	Products	Prod	<input checked="" type="checkbox"/>	1
*					

Resources Types: 1 / 2

Locations Types		Time Periods	
-----------------	--	--------------	--

This defines Resource Types “Bookkeeping” and “Products”.

Resources Units					
	Δ	Resource Type	Long Text	Short	Rate
▶	0	Bookkeeping	Euro	€	1
	1	Products	Kilogramm	KG	0.001
	1	Products	Ton	t	1
*					

Resources Units: 1 / 3

Time Periods							
Group	Code	Long Text	Short	Group 1	Group 2	Group 3	Group 4

This defines the units of measurement for resource types defined above. In our example, Bookkeeping (money) is always counted in Euro (€). In case you have different currencies, you can relate them by “Rate”.

Products might be measured in Tons or in Kilograms.

TriMatrix® Example: Supply Chain Management

The screenshot shows a software interface with two tables. The top table is titled 'Locations Types' and has columns for 'Long Text', 'Short', and 'Class'. It lists five entries: 0 (undefined), 1 Plants, 2 Lines, 3 Sales Regions, and 4 Customers. The bottom table is titled 'Operations Types' and has columns for 'Long Text', 'Short', 'Class', and 'VType'. The interface also shows 'Resources Types: 1 / 2' at the top and 'Locations Types: 1 / 5' at the bottom.

	Long Text	Short	Class
0	(undefined)	(undef)	Undefined Location
1	Plants	Plants	Balance Point
2	Lines	Lines	Secondary Location
3	Sales Regions	SaReg	Balance Point
4	Customers	Cust	Secondary Location

Long Text	Short	Class	VType
-----------	-------	-------	-------

These are the Location Types defined:

- “Plants”: where products can be produced.
- “Lines”: production lines at plants.
- “Sales Regions”: that’s where products are sold.
- “Customers”: similar to production lines at plants, customers represent a distinction within a sales region.
- There is a location type “(undefined)”; it acts as a placeholder for a location that is specified elsewhere or not at all.

Besides the “undefined” location type, all location types are classified as “Balance Point” (= primary location) or “Secondary Location”. More detail on this in part II below.

TriMatrix® Example: Supply Chain Management

The screenshot displays two tables from the TriMatrix software interface. The top table is titled "Time Periods" and has columns for Group, Code, Long Text, Short, Group 1, Group 2, Group 3, Group 4, and Group 5. The bottom table is titled "Operations Params Types" and has columns for Type, Operation Type, Long Text, Short, Resource Type, Val A, and Ear.

Resources Units: 1 / 3									
Time Periods									
	Group	Code	Long Text	Short	Group 1	Group 2	Group 3	Group 4	Group 5
▶	<input checked="" type="checkbox"/>	0	All Periods	All					
	<input type="checkbox"/>	1	Period 1	1					
	<input type="checkbox"/>	2	Period 2	2					
	<input type="checkbox"/>	3	Period 3	3					
▼	*								

Time Periods: 1 / 4

Operations Params Types						
Type	Operation Type	Long Text	Short	Resource Type	Val A	Ear

This is the definition of Time Periods:

- In our example, we said that we want to use 3 time periods = months.
- Additionally, a time period “0” is defined that represents “all time periods”. This can be used later on when certain information is true for all time periods – for example: a price that might not change over time.
- The fields “Group 1”, “Group 2” etc. can be used for much more distinctive groupings – for example, when you want to be able to say that a certain price should be valid for time periods 2 and 3, but not for time period 1. TriMatrix has a very distinguished concept of grouping, that will be referred to in more detail later on.

TriMatrix[®] Example: Supply Chain Management

The screenshot shows a software interface with a table titled 'Operations Types'. The table has columns for 'Long Text', 'Short', 'Class', and 'VType'. It lists five operation types: Balances, Purchase, Production, Transport, and Sale. Below this table is another section titled 'Operations Resource Types & Location Types' with columns for 'Operation Type', 'Resource Type', and 'Location Type'.

	Long Text	Short	Class	VType
0	Balances	Bal	Balance	<input type="checkbox"/>
1	Purchase	Pu	Push Operation	<input type="checkbox"/>
2	Production	Prd	Push Operation	<input type="checkbox"/>
3	Transport	Trp	PushPull Operation	<input type="checkbox"/>
4	Sale	Sa	Pull Operation	<input type="checkbox"/>
*				

Operation Type	Resource Type	Location Type
----------------	---------------	---------------

These are the Operation Types defined:

- “Balances”: where resources can be stored. Not only products, but, for example, money (bookkeeping) also has a “stock” in that sense.
- Purchase: where raw materials can be obtained.
- Production: where products are produced out of raw materials.
- Transport: where products are transported from production plants to sales regions.
- Sale: where products are sold to customers sitting in sales regions.

Besides Balances, operations either generate their leading resource (“Push”) or consume their leading resource (“Pull”) or do both, at different locations.

TriMatrix® Example: Supply Chain Management

Operations Types: 1 / 5

Operations Parms Types: 1 / 5

Operations Resource Types & Location Types

	Operation Type	Resource Type	Location Type	2nd Location Type
▶	0 Balances	0 Bookkeeping	1 Plants	0 (undefined)
	0 Balances	0 Bookkeeping	3 Sales Regions	0 (undefined)
	0 Balances	1 Products	1 Plants	0 (undefined)
	0 Balances	1 Products	3 Sales Regions	0 (undefined)
	1 Purchase	1 Products	1 Plants	0 (undefined)
	2 Production	1 Products	1 Plants	2 Lines
	3 Transport	1 Products	1 Plants	3 Sales Regions
	4 Sale	1 Products	3 Sales Regions	4 Customers

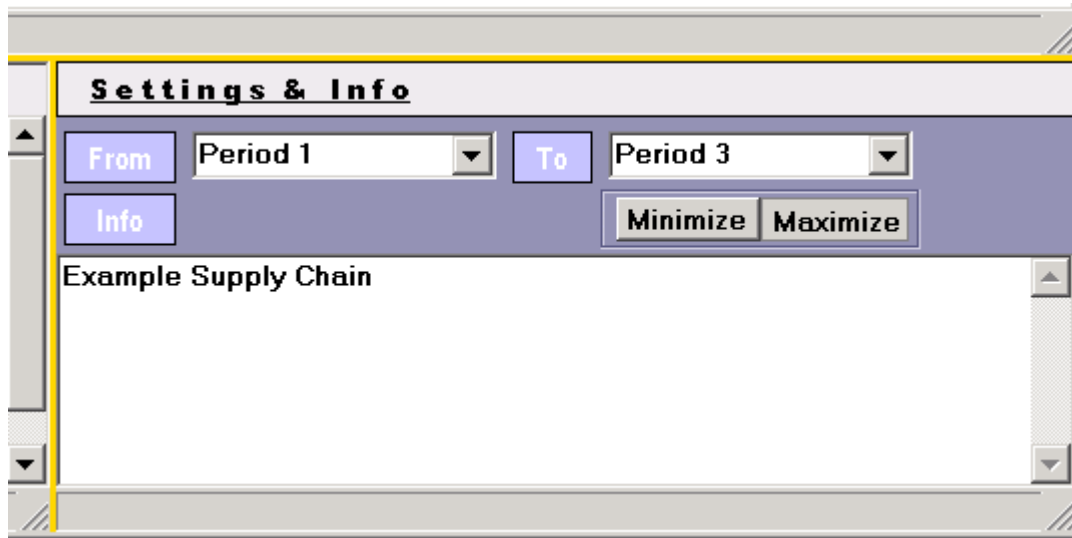
Operations Resource Types & Location Types: 1 / 8

These definitions actually “configure” the operation types defined:

- A “Balance” must be defined for all resource types at all locations types where such resources might appear.
- All other resource types refer to products only: Products (raw materials) are purchased, are produced from other products, are transported, and sold.
- All operations are related to locations: primary locations and (possibly) secondary locations. In the case of transport, the primary location represents the source, while the secondary location represents the destination.

Essentially, these definitions determine the objects that can be administered in a certain context; TriMatrix® must know what objects are allowed where.

TriMatrix® Example: Supply Chain Management



Finally, we want to tell TriMatrix®

- what time periods we want to optimize (there might be more than 3 defined, but we might only want to look at the first three)
- if we want to minimize or maximize the current problem.

In our example, we assume that we want to maximize sales income minus all costs.

The bottom area of the screen shot represented above can be used to provide a long descriptive text for the current optimization problem.

TriMatrix[®] Example: Supply Chain Management

This is essentially all you have to do in order to customize TriMatrix[®] for a Supply Chain Management problem that has the structure described above.

Please be aware that this customizing is independent of the actual size of the problem:

TriMatrix[®] has been successfully used for Supply Chain Management problems containing thousands of different products, many production plants, thousands of customers, where customization looks very similar to the one described above.

In order to bring the customized structure to actual life, you have to define the individual data – which will be done in part II, presented on the following slides.

TriMatrix[®] Example:

Supply Chain Management,
Part II: Data Input

TriMatrix® Example: Supply Chain Management

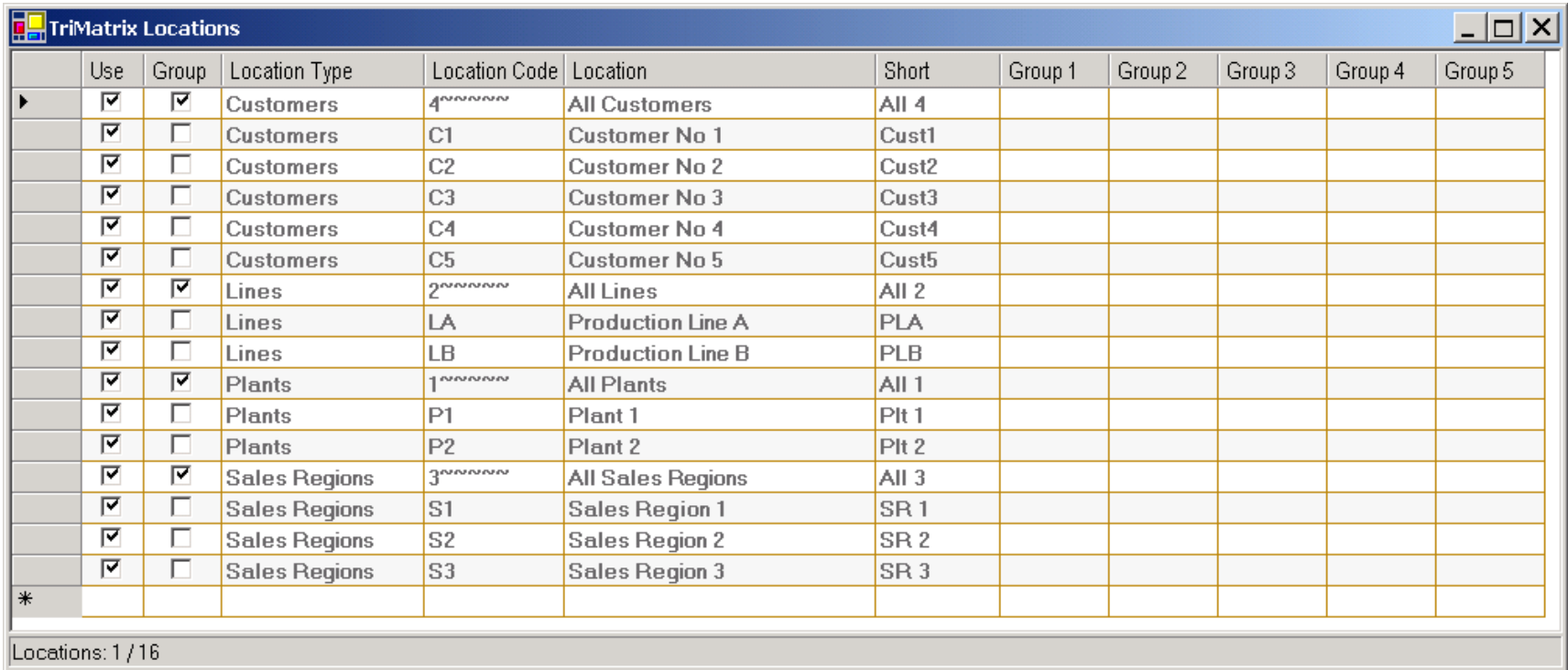
TriMatrix Resources												
	Use	Group	Resource Type	Resource Unit	Resource Code	Resource	Short	Group 1	Group 2	Group 3	Group 4	Group 5
▶	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Bookkeeping	Euro	0~~~~~	All Bookkeeping	All Book					
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Bookkeeping	Euro	0~Cost~~~~~	All Costs	All Costs	Cost				
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Bookkeeping	Euro	0~Income~~~~~	All Income	All Inc	Income				
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Bookkeeping	Euro	InvCost	Inventory Cost	InvCost	Cost				
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Bookkeeping	Euro	PrdCost	Production Cost	PrdCost	Cost				
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Bookkeeping	Euro	PurCost	Purchase Cost	PurCost	Cost				
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Bookkeeping	Euro	SallIncome	Sale Income	SallIncome	Income				
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Bookkeeping	Euro	TrpCost	Transport Cost	TrpCost	Cost				
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Products	Ton	1~~~~~	All Products	All Prod					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Products	Ton	Prod1	Product 1	Prod1					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Products	Ton	Prod2	Product 2	Prod2					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Products	Ton	Prod3	Product 3	Prod3					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Products	Ton	Raw1	Raw Material 1	Raw1					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Products	Kilogramm	Raw2	Raw Material 2	Raw2					
*												

Resources: 1 / 14

This is how Resources are defined in TriMatrix®:

- Every resource has a Resource Type and a Resource Unit (see “Configuration”).
- Resources are identified by some Code (which can be an external product code, for example) and a description (long and short).
- Resources can be grouped by 5 independent groupings; the first one is used in this example in order to classify the different cost items as “Cost” respectively “Income”.
- Entries whose “Group”-flag (2nd column) is marked “X” can be used in order to refer to individuals falling into that group.

TriMatrix® Example: Supply Chain Management



The screenshot shows a window titled "TriMatrix Locations" with a table containing 16 rows. The table has columns for Use, Group, Location Type, Location Code, Location, Short, and five Group columns (Group 1 to Group 5). The rows are grouped by Location Type: Customers (5 rows), Lines (3 rows), Plants (3 rows), and Sales Regions (5 rows). Each row has a "Use" checkbox and a "Group" checkbox. The "Use" checkboxes are checked for all rows. The "Group" checkboxes are checked for "All Customers", "All Lines", "All Plants", and "All Sales Regions". The "Location Code" column contains codes like "4~~~~~", "C1", "C2", "C3", "C4", "C5", "2~~~~~", "LA", "LB", "1~~~~~", "P1", "P2", "3~~~~~", "S1", "S2", "S3". The "Location" column contains descriptions like "All Customers", "Customer No 1", "Customer No 2", "Customer No 3", "Customer No 4", "Customer No 5", "All Lines", "Production Line A", "Production Line B", "All Plants", "Plant 1", "Plant 2", "All Sales Regions", "Sales Region 1", "Sales Region 2", "Sales Region 3". The "Short" column contains short descriptions like "All 4", "Cust1", "Cust2", "Cust3", "Cust4", "Cust5", "All 2", "PLA", "PLB", "All 1", "Plt 1", "Plt 2", "All 3", "SR 1", "SR 2", "SR 3". The last row is marked with an asterisk (*) in the "Use" column. At the bottom left of the window, it says "Locations: 1 / 16".

	Use	Group	Location Type	Location Code	Location	Short	Group 1	Group 2	Group 3	Group 4	Group 5
▶	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Customers	4~~~~~	All Customers	All 4					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Customers	C1	Customer No 1	Cust1					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Customers	C2	Customer No 2	Cust2					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Customers	C3	Customer No 3	Cust3					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Customers	C4	Customer No 4	Cust4					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Customers	C5	Customer No 5	Cust5					
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Lines	2~~~~~	All Lines	All 2					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Lines	LA	Production Line A	PLA					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Lines	LB	Production Line B	PLB					
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Plants	1~~~~~	All Plants	All 1					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Plants	P1	Plant 1	Plt 1					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Plants	P2	Plant 2	Plt 2					
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Sales Regions	3~~~~~	All Sales Regions	All 3					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sales Regions	S1	Sales Region 1	SR 1					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sales Regions	S2	Sales Region 2	SR 2					
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sales Regions	S3	Sales Region 3	SR 3					
*											

Locations: 1 / 16

This is how Locations are defined in TriMatrix®:

- Every location has a Location Type (see “Configuration”).
- Every location has a Code, a long and a short description, and 5 groupings.

Definitions of locations look very similar to those of resources. This is a general principle: TriMatrix® is based on the same structures throughout the system. When you’ve caught the basics, everything is clear very quickly!

TriMatrix® Example: Supply Chain Management

TriMatrix Operations: Sale														
Resource	Location	2nd Location	Version	All (A)	All (B)	1 (A)	1 (B)	2 (A)	2 (B)	3 (A)	3 (B)	4 (A)	4 (B)	
▶ Product 1	Sales Region 1	Customer No 1		100,00	0,00									
Product 1	Sales Region 1	Customer No 2		110,00	0,00									
Product 2	Sales Region 2	Customer No 3				105,00	0,00	110,00	0,00	115,00	0,00			
Product 2	Sales Region 3	Customer No 5						95,00	0,00					
Product 3	Sales Region 2	Customer No 4		120,00	0,00									
*														

<input checked="" type="checkbox"/> Ton	<input type="checkbox"/> Products	<input checked="" type="checkbox"/> Sales Regions	<input type="checkbox"/> Customers	B	C	Format (A): 1000 2	Format (B): 1000 2	<<	>>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Test	

Operations Bills					Operations Periods Bills				
Resource	Location	Period	Value		Resource	Location	Period	Value	
*									

Operations: 1 / 5 Operations Bills: 0 / 0

This is how sales operations can be defined in TriMatrix®:

- Every sale has a resource (Products 1 to 3), a primary location (sales region) and a secondary location (a customer)
- The numbers on the upper right represent the sales prices: Customer 1 pays 100 € for one unit (ton) of Product 1 in all time periods, while Customer 3 pays different prices in different months; Product 2 can be sold to Customer 5 in the second time period only.

If more than 4 time periods were defined, horizontal “Scroll”-buttons on the right can be used to shift to the next four time periods, and so on.

TriMatrix® Example: Supply Chain Management

TriMatrix Operations: Transport														
Resource	Location	2nd Location	Version	All (A)	All (B)	1 (A)	1 (B)	2 (A)	2 (B)	3 (A)	3 (B)	4 (A)	4 (B)	
All Products	Plant 1	Sales Region 1		10,00	0,00									
All Products	Plant 1	Sales Region 2		15,00	0,00									
All Products	Plant 1	Sales Region 3		18,00	0,00									
All Products	Plant 2	Sales Region 1		20,00	0,00									
All Products	Plant 2	Sales Region 2		10,00	0,00									
All Products	Plant 2	Sales Region 3		8,00	0,00									
*														

<input checked="" type="checkbox"/> Ton	<input type="checkbox"/> Products	<input checked="" type="checkbox"/> Plants	<input type="checkbox"/> Sales Regions	B	C	Format (A): 1000 2	Format (B): 1000 2	<<	>>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						Test

Operations Bills					Operations Periods Bills				
Resource	Location	Period	Value		Resource	Location	Period	Value	
*									

Operations: 1 / 6 Operations Bills: 0 / 0

This is how transport can be defined in TriMatrix®: You will notice that this looks very similar to the definition of sales operations:

- The primary “Location” represents the source, the “2nd Location” the destination of the transport.
- In this example, transport costs are not defined per single product, but for “All Products” in all time periods; this is how groupings can be used in TriMatrix®.

TriMatrix® Example: Supply Chain Management

TriMatrix Operations: Production

Resource	Location	2nd Location	Version	All (A)	All (B)	1 (A)	1 (B)	2 (A)	2 (B)	3 (A)	3 (B)	4 (A)	4 (B)
Product 1	Plant 1	Production Line A		25,00	0,00								
Product 1	Plant 1	Production Line B		26,00	0,00								
Product 1	Plant 2	Production Line A		26,50	0,00								
Product 1	Plant 2	Production Line B		27,00	0,00								
Product 2	Plant 1	Production Line A		23,00	0,00								
Product 2	Plant 1	Production Line B		22,50	0,00								
Product 2	Plant 2	Production Line A		22,00	0,00								
Product 2	Plant 2	Production Line B		21,00	0,00								
Product 3	Plant 1	Production Line A		26,00	0,00								
Product 3	Plant 2	Production Line A		25,00	0,00								
*													

Ton Products Plants Lines **B** **C** Format (A): 1000 2 Format (B): 1000 2 << >>
 Ton Products (undefined) Test

Operations Bills				
Resource	Location	Period	Value	
Raw Material 1	(undefined)	0	-1	
Raw Material 2	(undefined)	0	-50	
*				

Operations Periods Bills				
Resource	Location	Period	Value	

Operations: 1 / 10 Operations Bills: 1 / 2

This is production defined in TriMatrix®; again, the format is the same as for the previous operations, but there are additional entries at the bottom left:

- In order to produce 1 unit (ton) of Product 1 at Plant 1 on Production Line A, besides production costs of 25 €, additionally, 1 unit (ton) of Raw Material 1 and 50 units (Kilograms) of Raw Material 2 are consumed.
- “Bills” means: additional consumptions/generations of resources are activated by a certain operation; every line in the upper half has its own bill (only the bill for the first line is shown); in case bills are time related, they appear on the bottom right.

TriMatrix® Example: Supply Chain Management

TriMatrix Operations: Purchase

Resource	Location	2nd Location	Version	All (A)	All (B)	1 (A)	1 (B)	2 (A)	2 (B)	3 (A)	3 (B)	4 (A)	4 (B)
Raw Material 1	Plant 1	(undefined)				22,00	0,00	24,00	0,00	26,00	0,00		
Raw Material 1	Plant 2	(undefined)				24,00	0,00	25,00	0,00	24,00	0,00		
Raw Material 2	Plant 1	(undefined)				0,20	0,00	0,25	0,00	0,30	0,00		
Raw Material 2	Plant 2	(undefined)				0,15	0,00	0,25	0,00	0,10	0,00		

* [checkbox] Ton Products [checkbox] Plants [checkbox] (undefined) [B] [C] Format (A): 1000 2 Format (B): 1000 2 << >> Test

Operations Bills					Operations Periods Bills				
Resource	Location	Period	Value		Resource	Location	Period	Value	
*									

Operations: 1 / 4 Operations Bills: 0 / 0

This is purchase defined in TriMatrix®:

- Raw material 1 and raw material 2 can both be purchased at both plants.
- Purchase prices differ in different months, that's why they have been input in the time specific columns, not in the "All (A)" column.
- Remember that raw material 2 is measured in kilograms, not in tons: consequently, the price also has to be given per kilogram.

TriMatrix[®] Example: Supply Chain Management

Up to this point, this is what we have defined:

- The **Configuration** of the current example – with type information etc.
- The **Basic Objects** that TriMatrix[®] should deal with: **resources**, **locations**, and **time periods** (there are 3 kinds of basic objects – that’s why it’s called “**Tri**”-Matrix[®]).
- The **Actions** (= **operations**) that can be executed – associated with cost and price information.

Additionally, we have to define **Constraints** that restrict the possible actions to the limits that are set by reality:

- Your customers would not accept unlimited quantities of product; consequently, you have to define some sales volumes that you think are realistic.
- The sum of sales volumes that you expect your customers to buy might exceed given production capacities. Consequently, those capacities also have to be limited somehow.
- Finally, we have to tell TriMatrix[®] what it should optimize. In experts’ terms, this is called the **Objective Function** of the problem – that can be input as a constraint, as well.

TriMatrix® Example: Supply Chain Management

Resource	Location	2nd Location	Version	A	All Min	All Max	A	1 Min	1 Max	A	2 Min	2 Max	A	3 Min	3 Max	A	4 Min	4 Max
Product 1	Sales Region 1	Customer No 1		<input checked="" type="checkbox"/>			<input type="checkbox"/>		200	<input type="checkbox"/>		220	<input type="checkbox"/>		150	<input type="checkbox"/>		
Product 1	Sales Region 1	Customer No 2		<input checked="" type="checkbox"/>			<input type="checkbox"/>		150	<input type="checkbox"/>		120	<input type="checkbox"/>		150	<input type="checkbox"/>		
Product 2	Sales Region 2	Customer No 3		<input checked="" type="checkbox"/>			<input type="checkbox"/>		300	<input type="checkbox"/>		250	<input type="checkbox"/>		200	<input type="checkbox"/>		
Product 2	Sales Region 3	Customer No 5		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>			<input type="checkbox"/>		200	<input checked="" type="checkbox"/>			<input type="checkbox"/>		
Product 3	Sales Region 2	Customer No 4		<input checked="" type="checkbox"/>			<input type="checkbox"/>		100	<input type="checkbox"/>		200	<input type="checkbox"/>		300	<input checked="" type="checkbox"/>		

Bounds: 1/5

These are the constraints defined on sales operations:

- Product 1 can be sold to customer 1 up to 200 / 220 / 150 tons in each time period.
- The same product can be sold to customer 2 up to 150 / 120 / 150 tons in each time period.
- And so on.

In order to keep our example simple, constraints on sales volumes are defined as **maximum** only – which means that optimization can freely decide which customers to serve, according to given capacities and profits.

In a real life situation, such restrictions may be much more complicated – but nevertheless can be defined easily in TriMatrix®.

TriMatrix® Example: Supply Chain Management

Resource	Location	2nd Location	Version	A	All Min	All Max	A	1 Min	1 Max	A	2 Min	2 Max	A	3 Min	3 Max	A	4 Min	4 Max
All Products	Plant 1	All Lines		<input checked="" type="checkbox"/>			<input type="checkbox"/>		120	<input type="checkbox"/>		120	<input type="checkbox"/>		120	<input type="checkbox"/>		
All Products	Plant 2	All Lines		<input checked="" type="checkbox"/>			<input type="checkbox"/>		120	<input type="checkbox"/>		120	<input type="checkbox"/>		120	<input type="checkbox"/>		

Bounds Bills

Resource	Location	2nd Location	Version	Period	Operation Type	Factor
----------	----------	--------------	---------	--------	----------------	--------

These are the constraints defined on production operations:

- In every time period, each plant can only produce 120 tons in sum.
- By defining these constraints neither on individual products nor on specific production lines, but on “All Products” respectively “All Lines” instead, again, TriMatrix® grouping facilities come into place, allowing to define such constraint on the sum of all individuals concerned.

In a real-life situation, though, it might not be sufficient to define capacity as sum of volumes achieved; capacities on production lines might depend on individual products produced, for instance. TriMatrix® is capable of doing this – but again, the example should remain simple.

TriMatrix® Example: Supply Chain Management

The screenshot shows the TriMatrix software interface. The top window is titled 'TriMatrix: Bounds: Balances'. It contains a table with columns: Resource, Location, 2nd Location, Version, A, All Min, All Max, A, 1 Min, 1 Max, A, 2 Min, 2 Max, A, 3 Min, 3 Max, A, 4 Min, 4 Max. The first row is 'All Income' with Location 'All Sales Regions' and 2nd Location '(undefined)'. Below this is a control bar with checkboxes for 'Euro', 'Bookkeeping', 'Sales Regions', and '(undefined)', and buttons for '<<' and '>>'. Another control bar has checkboxes for 'Euro', 'Bookkeeping', 'Plants', and '(undefined)', and a 'Select Flags' section with radio buttons for 'Active Min', 'Min Run', and 'Switch'. Below this is a table titled 'Bounds Bills' with columns: Resource, Location, 2nd Location, Version, Period, Operation Type, Factor. It has two rows: 'All Costs' with Location 'All Plants' and Factor '-1', and 'All Costs' with Location 'All Sales Regions' and Factor '-1'. The bottom status bar shows 'Bounds: 1 / 1' and 'Bounds Bills: 1 / 2'.

Resource	Location	2nd Location	Version	A	All Min	All Max	A	1 Min	1 Max	A	2 Min	2 Max	A	3 Min	3 Max	A	4 Min	4 Max
All Income	All Sales Regions	(undefined)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Resource	Location	2nd Location	Version	Period	Operation Type	Factor
All Costs	All Plants	(undefined)		All Periods	Balances	-1
All Costs	All Sales Regions	(undefined)		All Periods	Balances	-1

This is the definition of the **Objective Function**:

- “All Income” is what we want to optimize (maximize).
- But from this income, “All costs” must be subtracted, the ones that are generated at plants (“All plants”) as well as the ones that might be generated at sales regions (there are none in our example so far).
- The subtraction of costs is expressed with a negative factor (bottom right), while the leading entry in the upper part of the form has a factor of +1 per default.

This allows the user to define by him- or herself specifically what should be optimized.

TriMatrix[®] Example: Supply Chain Management

And now you are ready to go!

All you have to do now is:

- Press the button “Optimize” in the TriMatrix[®] Main Menu.
- Look at the log file to monitor the progress of the optimization.
- When optimization has finished, reload the results and represent them in TriMatrix[®] reports.

The following slides show you how such reports might look like for our example.

TriMatrix[®] Example:

Supply Chain Management,
Part III: Reporting

TriMatrix® Example: Supply Chain Management

Production			Report TriMatrix				MATHESIS
Plant 1			Period 1	Period 2	Period 3	All Periods	
	Production Line A	Product 3		80	120	200	
	Production Line B	Product 1	120	40		160	
	Sum		120	120	120	360	
Plant 2			Period 1	Period 2	Period 3	All Periods	
	Production Line A	Product 3	100	120		220	
	Production Line B	Product 2	20		120	140	
	Sum		120	120	120	360	

This is the optimization result for production:

- You can see that capacity limits of 120 tons per plant and time period have exactly been matched.
- From the 10 production operations defined (see above), TriMatrix® chooses only to use 4; the obvious reason for this is different costs (production costs or costs generated by raw material purchase).


TriMatrix[®] Example: Supply Chain Management

Transport			Report TriMatrix				MATHESIS
Plant 1	Sales Region 1	Product 1	Period 1	Period 2	Period 3	All Periods	
	Sales Region 2	Product 3	120	40		160	
				80	120	200	
	Sum		120	120	120	360	
Plant 2	Sales Region 2	Product 2	Period 1	Period 2	Period 3	All Periods	
		Product 3	20		120	140	
			100	120		220	
	Sum		120	120	120	360	

This is the optimization result for transport:

- Transport volumes must exactly match production volumes, because in our example, no storage is defined.
- While Plant 1 serves two sales regions, Plant 2 delivers to Sales Region 2 only. Sales Region 3 (that also had some potential sales defined) doesn't get any product.


TriMatrix[®] Example: Supply Chain Management

Sale		Report TriMatrix					MATHESIS 
			Period 1	Period 2	Period 3	All Periods	
Sales Region 1	Customer No 2	Product 1	120	40		160	
	Sum		120	40		160	
			Period 1	Period 2	Period 3	All Periods	
Sales Region 2	Customer No 3	Product 2	20		120	140	
	Customer No 4	Product 3	100	200	120	420	
	Sum		120	200	240	560	

This is the optimization result for sale:

- In Sales Region 1, Customer No 2 gets all the product because of better sales prices, compared with Customer No 1.
- Customer No 4 pays the best prices, consequently, this customer always gets maximum volume, except for time period 3, where Customer No 3 is preferred because of better profit (lower production cost for Product 2 than for Product 3, see calculation on next slide).

TriMatrix® Example: Supply Chain Management

Raw Material Costs from Production			Report TriMatrix				MATHESIS 
Plant 1	Production Line A	Product 1	Period 1	Period 2	Period 3	Average	
		Product 2	32.00	36.50	41.00	36.50	
		Product 3	31.80	36.60	41.40	36.60	
	Production Line B	Product 1	26.20	28.90	31.60	28.90	
		Product 2	28.00	31.50	35.00	31.50	
		Product 2	27.80	31.60	35.40	31.60	
Plant 2	Production Line A	Product 1	Period 1	Period 2	Period 3	Average	
		Product 2	31.50	37.50	29.00	32.67	
		Product 3	30.60	37.50	27.60	31.90	
	Production Line B	Product 1	27.90	30.00	27.40	28.43	
		Product 1	28.50	32.50	27.00	29.33	
		Product 2	27.60	32.50	25.60	28.57	

This report helps you to understand the costs / profits that drive the result:

- The costs shown above result from raw materials used in production.
- For example, the first entry (32 € per ton) is calculated like this: Product 1 uses 1 ton of Raw Material 1 and 50 KG of Raw Material 2; costs for these are 22 € per ton respectively 0,20 € per KG in Period 1, which is $22 + 0,2 * 50 = 32$ € per ton.
- These costs plus production costs result in costs of $27,40 + 25 = 52,40$ € per ton for Product 3 at Plant 2 in Period 3 vs. $25,60 + 21 = 46,60$ € per ton for Product 2 at Plant 2 on Line B. Consequently, the second one gives a better profit.

TriMatrix[®] Example: Supply Chain Management

Report TriMatrix

MATHE S I S

Profits Plant 1			Period 1	Period 2	Period 3	Average
Customer No 1	Production Line A	Product 1	33.00	28.50	24.00	28.50
	Production Line B	Product 1	36.00	32.50	29.00	32.50
Customer No 2	Production Line A	Product 1	43.00	38.50	34.00	38.50
	Production Line B	Product 1	46.00	42.50	39.00	42.50
Customer No 3	Production Line A	Product 2	35.20	35.40	35.60	35.40
	Production Line B	Product 2	39.70	40.90	42.10	40.90
Customer No 4	Production Line A	Product 3	52.80	50.10	47.40	50.10
Customer No 5	Production Line A	Product 2		17.40		17.40
	Production Line B	Product 2		22.90		22.90

Profits Plant 2			Period 1	Period 2	Period 3	Average
Customer No 1	Production Line A	Product 1	22.00	16.00	24.50	20.83
	Production Line B	Product 1	24.50	20.50	26.00	23.67
Customer No 2	Production Line A	Product 1	32.00	26.00	34.50	30.83
	Production Line B	Product 1	34.50	30.50	36.00	33.67
Customer No 3	Production Line A	Product 2	42.40	40.50	55.40	46.10
	Production Line B	Product 2	46.40	46.50	58.40	50.43
Customer No 4	Production Line A	Product 3	57.10	55.00	57.60	56.57
Customer No 5	Production Line A	Product 2		27.50		27.50
	Production Line B	Product 2		33.50		33.50

This report shows a profitability analysis for customers, products, and production sources:

- The numbers represent sales prices minus all costs (transport, production, purchase)
- For example, the first entry with a profit of 33 € calculates like this (always per ton):
Customer No 1 pays 100 € for Product 1; transport cost from Plant 1 is 10 €;
production cost on Line A is 25 € and raw material cost is 32 € = $100 - 10 - 25 - 32 = 33$ €.
- Now you can easily check the decisions made by the optimizer!

TriMatrix[®] Example: Supply Chain Management

Summary:

- The simple example used in the slides should give you a brief idea on how TriMatrix[®] can be used in a real-life situation for Supply Chain Management.
- TriMatrix[®] can be used (and has successfully been used) for much more complicated situations – including for example:
 - Inventory management (with volume shifts over time periods)
 - Multi-step production processes
 - Minimum or fixed lot sizes in production and/or transport
 - Logistics with complicated routing scenarios
 - Volume dependent pricing
 - Restrictions depending on conditions.

In short: TriMatrix[®] is a multi-purpose optimizer that fits for practically any real-life situation you can think of – for it is based on a very general principle: All single operations that have to be executed during a business process have one thing in common: they generate and consume resources at certain locations in certain time periods. That’s how TriMatrix[®] “thinks” – anything more specific can be provided by data definitions, without any change to the system itself.