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Abstract. This paper presents traceability of a product if we are using a stock management system which uses FIFO or LIFO discharging methods. In the first part there is a little presentation regarding the four types of inputs and outputs and the side effect to the system. In the second part I present an example of traceability.
Keywords: traceability, stock, management

In stock management systems, we need the calculation of the stock value for any product, at any particular moment in time. This means that we have to calculate the value of input and the value of the output based on FIFO or LIFO methods. Because we can have for a product a few inputs at different acquisition prices and quantity, and a few outputs, we need to create links between the outputs and inputs, to know for a specific output which is the specific inputs. This links are very important in traceability to find for a specific product, the raw materials which have participated.

1.Inputs and outputs registration

In any stock management systems inputs and outputs will be stored inside a database, in my case a relational database. We have four types of movements from suppliers and to customers: Acquisitions, Buy Back, Sales and Sales Back.

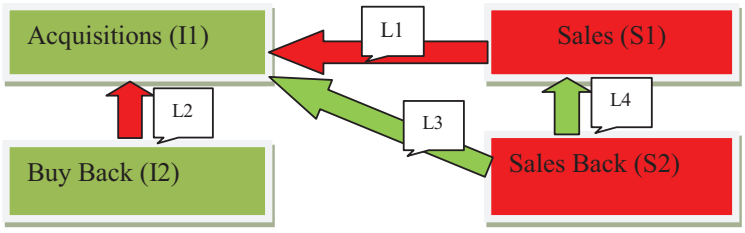

Figure 1. Schema of discharges inside a stock management unit

In figure 1, acquisitions are identified by I1 and means inputs to the system, sales are identified by S1 and means outputs from the system, buy back are identified by I2 and means returning of inputs, and sales back are identified by S2 meanings returning of outputs. Links between different types of inputs and outputs are identified by LN, where N is a number from 1 to 4.

Input and outputs					
ID	*Type*	*Quantity*	*Product*	*IDPrec*	*Discharged Quantity*
1	*I1*	*5*	*Product 1*		
2	*I1*	*5*	*Product 1*		
3	*S1*	*6*	*Product 1*	*1*	*5*
				2	*1*
4	*S2*	*-1*	*Product 1*	*3*	*1*
5	*I2*	*-1*	*Product 1*	*2*	

When we record an output of 6 items of Product 1, this items comes according to FIFO method, 5 item from input with ID=1 and 1 item from input with ID=2.
When we need products from one stock management unit in another stock management unit, we need to transfer the products from one to another. In figure 2 I present the schema for transferring products.

Figure 2. Schema for transferring products from one stock management unit to other

ID	*Type*	*Unit*	*Product*	*Quantity*	*idPrec*	*Discharged Quantity*	*Price*
1	*I1*	*First unit*	*Product 1*	*5*			*1*
2	*I1*	*First unit*	*Product 1*	*5*			*2*
3	*T1*	*First unit*	*Product 1*	*6*	*1*	*5*	*1*
					2	*1*	*2*
4	*I2*	*Second unit*	*Product 1*	*5*	*3*	*5*	*1*
5	*I2*	*Second unit*	*Product 1*	*1*	*3*	*1*	*2*

In the preceding example we have one input with ID=1 for 5 items and another input with ID=2 for another 5 items of the same product named **Product 1, in** the first stock management unit. Because we need 6 items of Product 1 in the second stock management unit, we need to transfer this quantity of Product 1. This transfer will discharge according to FIFO methods 5 items from input with ID=1 and 1 item from input with ID=2. Based on this transfer an input will be made in the second stock management unit. The value discharged from the first stock management unit is 5*1+2=7, and the value of input in the second stock management unit is 5*1+2=7. We can observe that this movements move not only the same quantity of product but also the same value.

Another situation is when we produce some goods. For goods production according to a receipt we have to consume one or many types of materials in different proportion. In figure 3 I will present the schema used for goods production.

Figure 3. Schema for goods production

ID	*Type*	*Product*	*Quantity*	*Discharged Quantity*	*IdPrec*	*IdNext*		*Price*
1	*I1*	*Material1*	*5*				*In*	*1*
2	*I1*	*Material1*	*6*					*2*
3	*I1*	*Material 2*	*5*				*In*	*3*
4	*C1*	*Material 1*	*2*	*2*	*1*	*6*	*Out*	*1*
5	*C1*	*Material 2*	*4*	*4*	*3*	*6*	*Out*	*3*
6	*I2*	*Product 1*	*2*				*In*	*7*

In this example we have an input of two different materials Material 1 and Material 2. For producing one product named Product 1, according to its receipt we will need 1 piece of Material 1 and two pieces of Material2. In our case for two items of Product 1, we have consumed 2 items of Material 1 and 4 items of Material 2. In this example because I used FIFO method for stock discharging, that two items of Material1 which I used in production, came from first input of Material 1 identified with ID=1. The four items of Material 2 came from first input of Material 2 identified with ID=3. This materials participated in production for Product 1 identified by ID=6.

The value of raw materials = 2(items of Material1) * 1(Price of Material 1) + 4(items of Material 2) * 3 (Price of Material 2) = 2+12 = 14.

Because we produce 2 items of Product 1, the value of raw materials will be divided by 2, to obtain the value of 1 item of Product1. This means that the value of 1 item of product 1 is 7.

2. Traceability

Traceability is the procedure which discover for a specific product, which are the raw materials and from where did they come. Also traceability can be the process which discover for a specific raw material which are the products which used that material, and where did they go.

The production process may include one or more technological phases, which may be inside one or more stock management unit, which means that our traceability can be like a graph in which inputs and outputs are represented like nodes, and the discharging links are represented like links between nodes. In this graph we can find all types of inputs and outputs.

One to many links problem.

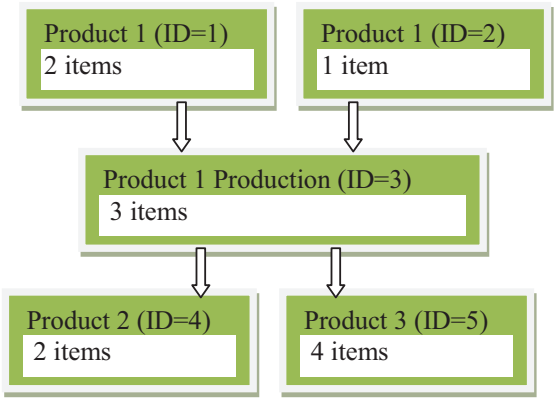

Figure 4. Breaking links problem

In figure 4, we have a production of 3 items of **Product 1**. We consume 2 items of **Product 2** and 4 items of **Product 3**. If we are interested to see the traceability for Product 1 (ID=2), we have to receive 1 item of Product 1 (ID=3), and 1/3*2 of **Product 2** (ID=4) and 1/3*4 of **Product 3** (ID=5). 1/3 means 0.(3) which cannot be represented by a computer with a finite number of decimal. To solve this problem we can apply n-1+1 method which means in our case that ID=2 uses 0.33 percent of ID=3 and ID=1 uses 1-0.33 which means 0.64 percent of ID=3. According to this procedure we have a side effect, the same type of products, in our case Product 1, can have different production cost. In our example we have a deviation of 0.005 percent for cost calculation.

Level problem

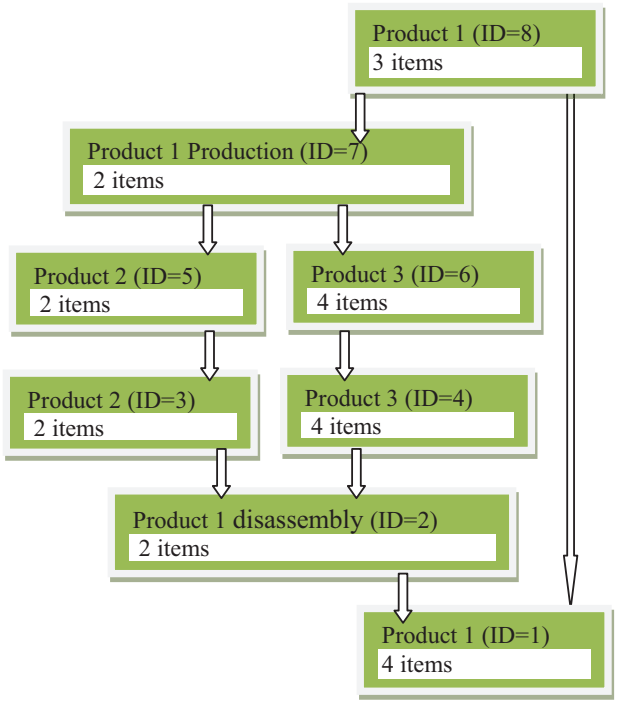

Figure 5. Level problem

In figure 5, is presented a possible situation, when at beginning (ID=1) I have 4 items of product 1. Because 2 of this items are not in the proper situation we need to disassembly, then to repair, and then to reassembly these products (ID=7). Also we send to a client 3 items of Product1 (ID=8), which came 2 from ID=7 (Level 2) and 1 from (ID=1) (Level 6). According to this example, one node can have links to nodes situated on different level. To calculate the percent of participation for each node first we have to put each nodes of the graph on level, to order them level by level and then to calculate the percent.

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2	37	0	0	stop	Gestiune Materii	3/2009	Intrare	47240.00 / 2498.10	.0000	TAV9T18
3	37	0	0	stop	Gestiune Materii	12/2008	Intrare	7230.00 / 308.78	.0000	LEGAV3(
4	37	0	0	stop	Gestiune Materii	2/2009	Intrare	504.00 / 26.10	.0000	FOLSCM.
5	37	0	0	stop	Gestiune Materii	4/2009	Intrare	1000.00 / 368.36	.0000	LEGCEAI
6	37	0	0	stop	Gestiune Materii	2/2009	Intrare	4900.00 / 271.02	.0000	CUT2M
7	37	0	0	stop	Gestiune Materii	3/2009	Intrare	1800.00 / 50.00	.0000	CUT2M
8	37	0	0	stop	Gestiune Materii	4/2009	Intrare	10000.00 / 4423.74	.0000	GOLF
9	37	0	0	stop	Gestiune Materii	3/2009	Intrare	1600000.00 / 68598.87	.0000	BAT
10	37	0	0	stop	Gestiune Materii	10/2008	Intrare	144.00 / 2.78	.0000	FOL.
11	37	0	0	stop	Gestiune Materii	8/2008	Intrare	2200000.00 / 1029.20	.0000	BAT1(
12	37	0	0	stop	Gestiune Materii	12/2008	Intrare	9520.00 / 741.35	.0000	LEGA
13	37	0	0	stop	Gestiune Materii	4/2009	Intrare	37790.00 / 5324.01	.0000	TAV9(
14	37	0	0	stop	Gestiune Materii	2/2008	Intrare	5360.00 / 21.48	.0000	LEGA'
15	37	0	0	stop	Gestiune Materii	5/2008	Intrare	144000.00 / 1962.99	.0000	ETC'
16	37	0	0	stop	Gestiune Materii	5/2009	Intrare	800000.00 / 770.87	.0000	BA
17	37	0	0	stop	Gestiune Materii	3/2009	Intrare	4500.00 / 1635.00	.0000	CUT.
18	37	0	0	stop	Gestiune Materii	4/2009	Intrare	4120.00 / 412.88	.0000	GOLF
19	37	0	0	stop	Gestiune Materii	4/2009	Intrare	1000.00 / 343.24	.0000	LEGCE.

Figure 6. Example of traceability

Conclusion

Traceability is very necessary in the food industry to identify for a batch of finished products, the source of raw materials.

One to many type of links can cause cost calculations errors.

The entire process of traceability needs to reorder nodes and links to be displayed correctly inside a table.

References

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