STUDY ON THE NEED TO USE SEVERAL UNITS OF MEASUREMENT FOR A PRODUCT IN THE COMPANY'S INVENTORY MANAGEMENT

Horia DEMIAN
Management Marketing Department, Faculty of Economics University of Oradea, Oradea, Romania
horia_demian@yahoo.com

Abstract*: This paper is a case study on the need to use several units of measurement for a product in inventory management system. Following this case study, it was agreed on the form of parameterization of the units of measurement and the cases that this parameterization covers. The conversion of the stock from one unit of measurement to another can be done by means of a conversion factor between the specific units of measurement of a product. The existence of this conversion factor leads to conversion errors depending on the number of decimals with which it is defined. Using multiple units of measurement for one product does not solve all the problems, but it does help to simplify certain operations that are performed at the management level.*

Keywords: *measurement unit; products; inventory management*

JEL Classification: L86

1. Introduction

In the inventory's management of a company, the calculation of product stocks is done according to a unit of measurement, which we will call the main unit of measurement.
"A **unit of measurement** is a definite magnitude of a quantity, defined and adopted by convention or by law, that is used as a standard for measurement of the same kind of quantity." (International vocabulary of metrology — Basic and , 2022)
There are situations in practice in which we want the stocks of products expressed in another unit of measurement, which we will call a secondary unit of measurement. The conversion to a secondary unit of measurement is done by means of a conversion factor. This conversion factor applied to the storable quantity expressed in the main unit of measurement, converts the stock to the secondary unit of measure.
An Oracle article also mentioned some cases when for some products more than one measurement unit is needed. (Dual Units of Measure, 2022)

Purposes of the Study and Research Methods

This paper will present a case study. During this research we analyzed the practical situation within a company regarding the need to use several units of measurement in which to express certain reports or even the quantities sold on invoices.

The following objectives have been defined for the IT solution
• Converting stocks for certain products and expressing them in a secondary unit of measurement
• Conversion of stocks according to a unit of measurement defined by the supplier
• Conversion of stocks according to a unit of measurement negotiated with the customer
Discussions were also held with the users of the IT solution, which led to the appearance of some concept changes during the implementation.

Requirements analysis and concept realization

At the level of a company there is a product catalog, which contains all the products you work with inside the company. Here we discuss raw materials, consumables, packaging, finished products, goods, etc. For each product you can define certain characteristics such as an internal code, a name, an interpretation from an accounting point of view as well as a unit of measurement. The decision regarding the placement of the main unit of measurement at company level has as motivation the achievement of an easy centralization of the information regarding the situation of stocks at company level. It is often necessary to see if the request received from a customer can be satisfied from another store than the one to which the request arrived. Each store has its own product management.

Converting stocks for certain products and expressing them in a secondary unit of measurement

The first requirement to express the stock of products in a different unit of measurement than the main unit of measurement implies that for each product another unit of measurement can be defined. The existence of several units of measurement for a product has implications, because at this moment it is necessary to establish the main unit of measurement, the one in which the stocks will be expressed at the level of all the company's management. In our research we have identified products for which more than two units of measurement are needed, which are used inside the company. As it is not possible to establish a maximum number of units for these products to work with and will work in the future, it was necessary to provide for the existence of several units of measurement, so that the user can always intervene and - define new units of measurement, their number being unlimited. The existence of several units of measurement also implies the existence of a conversion ratio between them. A possibility to define these conversion ratios would be achieved by the existence of a conversion matrix, so that we know exactly the conversion from one unit of measurement to another.
Let's take the following example: We have a product whose main unit of measurement is the linear meter, and which has a width of 1 meter and for which we need 3 units of measurement: linear meter, square meter and kilogram.

Conversion		1	1	1
		Linear Meter	Kilogram	Square Meter
1	Linear Meter	1	0.5	1
1	Kilogram	2	1	2
1	Square Meter	1	0.5	1

How would we interpret the data in this matrix?
1 linear meter = 0.5 Kilograms
1 kilogram = 2 linear meters
1 square meter = 1 linear meter for a product with a width of 1
1 linear meter = 1 square meter for a product with a width of 1

The main drawback of this method is that the conversion matrix has a variable number of lines and columns in this organization. In the situation presented above, it can be noted that certain conversion factors are repeated. We ask ourselves the problem that of these conversion factors to keep only one and to interpret the data by reading from left to right or from right to left Elimination of this shortcoming can be achieved with a transposition into a tabular structure as follows, with the elimination of the transposition in the same unit of measurement:

	First measurement unit	Second measurement unit	
1	Linear Meter	Kilogram	0.5
1	Linear Meter	Square Meter	1
1	Kilogram	Linear Meter	2
1	Kilogram	Square Meter	2
1	Square Meter	Linear Meter	1
1	Square Meter	Kilogram	0.5

How data should be interpreted?
1 linear meter = 0.5 kilogram
1 linear meter = 1 square meter

It can be seen that the entire matrix with variable number of columns and lines could be correctly transposed into a table with a fixed number of columns, which implies a static structure of the table regardless of the number of units of measurement defined for a product.
We'll take the next example. We have a product for which we have the following properties: variable length, fixed width of 0.6 and a weight of 0.15 kg for 1 linear meter with a width of 0.6 m. We aim to represent this data through the conversion table.

	First measurement unit	Second measurement unit	
1	Linear Meter	Kilogram	0.15
1	Linear Meter	Square meter	0.6
1	Kilogram	Linear Meter	100/15 = **6.(6) = 6.6666**
1	Kilogram	Square meter	6.6666*.6 = **39.9996**
1	Metru Square meter	Linear Meter	1.6666

1	Square meter	Kilogram	0.24999

In such a situation we have a problem with the representation of these numbers, because keeping the conversion factors in the form of numbers produces errors of specifications, as can be seen in the upper table where we have an accuracy of 4 decimal places. In order to compact the number of recordings we will be able to organize the table with two conversion factors, one for the reading from left to right and another for reading from right to left

First measurement unit	Second measurement unit		
Linear Meter	Kilogram	0.15	6.6666
Linear Meter	Square meter	0.6	1.6666
Kilogram	Square meter	**39.9996**	**0.24999**

The interpretation of the information in the sheets would be the following, if we look at the first line 1 linear meter = 0.15 Kilograms and 1 kilogram = 6.6666 linear meters We intend to achieve the compaction of the information by keeping a single conversion factor, so that for all the units of measurement we will relate with a conversion factor to the main unit of measurement. In order to organize the information in this form we would have the information presented as follows:

Measurement unit	
Linear meter	1
Square meter	1.6666
Kilogram	**6.6666**

The interpretation of the data in this table would be done as follows:
1 square meter = 1.6666 linear meters
1 kilogram = 6.6666 linear meters
And if we want to convert from linear meters to square meters then we will say that
1 linear meter = 1/1.6666 = 0.6000 square meters
1 linear meter – 1/6.6666 = 0.15000 kilograms

We will interpret as the main unit of measurement the unit of measurement next to which the number 1 is placed. When we are talking about a catalog of products with thousands of items, we would like the stock situation to be displayed simultaneously in the main unit of measurement and a secondary unit of measurement. In order to achieve the automatic conversion in the secondary unit of measurement, it is necessary to mark one of the secondary units as a reporting unit of measurement, so that the user will not have to establish each time he accesses the stock situation which is the secondary unit of measurement in which it is desired to report the stock of products. In order to signal it, a new column was introduced through which the secondary unit of measurement of reporting will be specified.

2.1. Conversion of stocks according to a unit of measurement defined by the supplier

Because the transfer of documents is made between the supplier and the customer, often the unit of measure specified next to a product on the supplier's invoice is different from the main unit of measure used in its own management. There are even situations in which the unit of measurement used by the supplier for a product does not even exist between the units of measurement specific to that product defined in the customer's computer system. The operator of that invoice will have to calculate a conversion factor and transpose the invoice to the supplier according to the products and units of measurement defined for them in the computer system.
The use of a different unit of measurement for inventory records also involves a conversion of the purchase price of that product according to the same conversion factor. Let's take the following situation as an example. A customer will buy juices from a supplier. Because the supplier is a wholesale supplier, the unit of measurement it uses is the box. One box contains 6 bottles. Because the customer is a grocery store where these juices are sold by the piece, it is necessary to perform a conversion between the two units of measurement, so that the reception of the products will be done in the unit of measure Piece, where the product stock will be calculated at the customer. Since the value is calculated by multiplying the quantity by the price, we notice that the two values are not always identical, as can be seen in the following figure.

	Prouct	Measurement unit	Quantity	Price	Value	VAT	VAT Value
1	juices	Box	2	16	32	9%	2.88
					Total		34.88
	Produsul	Measurement unit	Cantitate	Price	Value	VAT	VAT Value
1	juices	Piece	12	2.66	31.92	9%	2.87
					Total		34.79
				Variance	0.08	Variance	0.01

Since the value of the two invoices must be identical, this problem can be solved by introducing differences of values without VAT and a difference of values for VAT. The two differences can be kept at the invoice line level or at the document level, only their total values can be kept.
Let's take a drink from a bar as an example. The sale of a whiskey to the customer is done in 50 ml portions. The purchased product is packaged in several types of bottles of 750 ml, 1000 ml, etc. How can we proceed in such a situation, because the invoice received from the supplier will appear on the glass unit of measurement, and the purchase price will be specified for one bottle. On some invoices I bought 750ml bottles, on other invoices I bought 1000ml bottles.
In the absence of multiple units of measurement for a product, we will have to have three distinct products in the product catalog, a 750 ml whiskey product, a 1000 ml

whiskey product, and a 50 ml whiskey product (serving for sale to the customer). At the time of purchase it will be purchased on one of the two product codes of 750 or 1000 ml, followed by a conversion into portions.
The existence of several units of measurement associated with a product will allow us to use a single product code with three units of measure: 50 ml serving, 750 ml bottle, 1000ml bottle. Next to each unit of measurement we will have a conversion factor.

Measurement unit			
Portion 50 ml	1		
Bottle 750 ml	15	Yes	One bottle contains 14 portion
Bottle 1000ml	20		One bottle contains 20 portion

	Product	Measurement unit	Qua-ntity	Price	Value	Variance	VAT	VAT Value	Variance
1	Whiskey	Bottle 750 ml	1	70	70		19%	13.3	
	Whiskey	Portie 50 ml	15	4.66	69.9	0.01	19%	13.28	0.02

The stock will be able to be expressed in the main unit of measurement portion of 50 ml and in bottles of 750 ml, the secondary unit of measurement.

Product	Measurement unit	Stock	Secondary measurement unit	Secondary stock
Whiskey	Portion 50 ml	15	Bottle 750 ml	1

2.2. Conversion of stocks according to a unit of measurement negotiated with the customer

The commercial relations between the partners also involve the negotiation regarding the unit of measurement and the price at which the transaction will be concluded.
Let's take as an example a simpler case such as the sale of juices in two units of measure: glass and box. The stock at the management level can be kept in the bottle, but the price negotiated with the client will be defined as a low price.

	Product	M.U.	Quantity	Price	Value	Variance	VAT	VAT Value	
1	Juice	Bax	2	16	32		9%	2.88	
	Juice	Piece	12	2.66	31.92	0.08	9%	2.87	0.01
						Total		34.88	

The discharge is performed in the Piece unit of measurement, which means that 12 pieces have left the inventory's management. The calculation of the gross addition made involves the calculation of a difference between the sales price without taxes and the purchase price without taxes.
For example, fuel transactions are made in tons, even if they are sold to the final consumer in liters. One explanation would be the fact that the volume of the product

may undergo relatively larger changes during transport than the change in weight. Changing the volume leads to a change in density but not in weight. Another problem is in the field of agriculture the use of parameters that influence both the stock and the selling price, such as foreign body, moisture, gluten, etc

In situations where other parameters that influence the sale price in the contract occur, a conversion is first made from the quantity and parameters specified by the buyer and the quantity and parameters existing in management, following that after normalizing this quantity to sell the ready normalized quantity. This process involves an additional step before the actual sale and it is necessary to perform because it results in a document called analysis bulletin, which comes to certify the quality and parameters of the products sold.

Conclusion

The conversion of the stock from one unit of measurement to another can be done by means of a conversion factor between the specific units of measurement of a product. The existence of this conversion factor leads to conversion errors depending on the number of decimals with which it is defined.

The possibility to define several units of measurement for a product, has the effect of reducing the number of items that are used in the product catalog.

Using multiple units of measurement for one product does not solve all the problems, but it does help to simplify certain operations that are performed at the management level.

There are situations in the sale when in order to be able to make the sale at the parameters specified by the customer it is necessary to go through an intermediate step regarding the conversion of the products according to the parameters requested by the buyer. The existence of several units of measurement does not help us in this situation.

Bibliography:

1. *Dual Units of Measure*. (2022, 4 10). Preluat de pe Oracle: https://docs.oracle.com/en/cloud/saas/supply-chain-management/21d/faims/dual-units-of-measure.html#FAIMS4684478

2. International vocabulary of metrology — Basic and . (2022, 04 10). *Unit of measurement*. Preluat de pe wikipedia.org: https://en.wikipedia.org/wiki/Unit_of_measurement