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## MANUFACTURING COST MANAGEMENT IN MICROSOFT DYNAMICS NAV 5.0 – A CASE STUDY

**Abstract:** This article presents manufacturing costs management functionality in the ERP system Microsoft Dynamics NAV 5.0. The application supports consumption, complete tracking of component and finished product costs and manufacturing capacities, posting analysis and entering into the general ledger. During the implementation, numerous new functionalities and algorithms have been developed to streamline cost management, including standard and average costs update routines, as well as forecasting cost of future use of production resources.

**Keywords:** costs management, manufacturing costs, Microsoft Dynamics NAV 5.0.

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### 1. Overview

The difference between manufacturing and distribution companies is that distributors sell products as previously purchased, while manufacturers processed purchased goods into something different.

At manufacturing companies, productivity becomes one of the most important parameters (Klir 1976).

Productivity is measured as (Klir 1976):

$$P = Y / X \quad (1)$$

where:

$Y$  – turnover,

$X$  – costs.

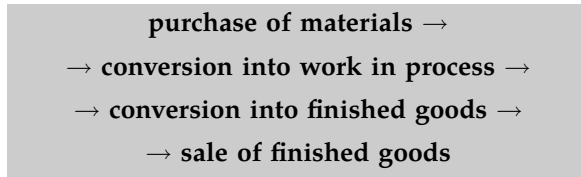
Equation (1) shows that the lower the costs, the higher the productivity is. High productivity increases a company's profit and reduces prices of finished goods (Klir 1976).

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The manufacturing process can be presented schematically as follows (Bojarski 2003):



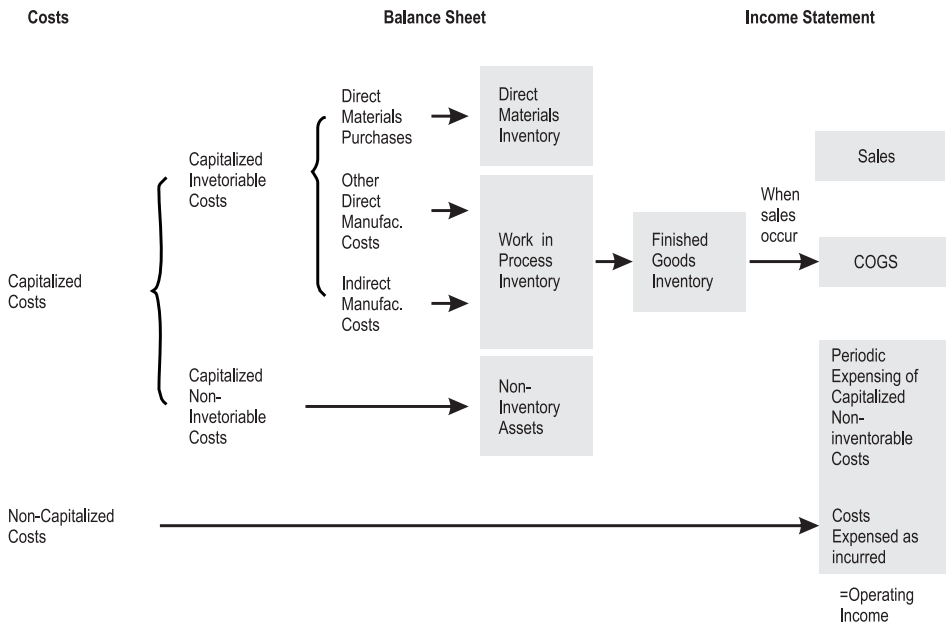
The cost of products sold by a manufacturing company may be expressed as follows (Microsoft Corporation 2005):

$$C = K_b + C_m - E_i \tag{2}$$

where:

- $K_b$  – beginning finished goods inventory,
- $C_m$  – cost manufactured goods,
- $E_i$  – final finished goods inventory,
- $C$  – cost of products sold.

The cost relationship for manufacturing companies is presented in Figure 1 (Microsoft Corporation 2005):



**Fig. 1. Costs relationships**  
Source: (Microsoft Corporation 2005)

There are three types of inventory: raw materials, work-in-process (in progress) and finished goods inventory. Manufacturing costs are assigned to these types of inventory.

These costs are (Microsoft Corporation 2005):

- direct material cost – acquisition cost of materials including freight charges, custom duties, etc.,
- direct manufacturing labour cost – compensation to all manufacturing labour, including operator wages, benefits, etc.,
- indirect manufacturing labour cost – cost that is a part of the object cost, but cannot be traced individually to the object; it includes: electricity, indirect materials, supplies, taxes, etc.

All these costs form inventoriable capitalised costs and are assigned to raw materials, work in process and finished goods until they are sold. These costs include assets costs that facilitate manufacturing process and usually their amortisation becomes a part of indirect manufacturing costs.

There are two main viewpoints on the treatment to fixed manufacturing costs:

- absorption costing, where fixed manufacturing costs are added to finished goods,
- direct costing, where direct cost only is equal to product cost and fixed costs are treated as term expenses.

## **2. Case study overview**

Company X is a real company, a UK leader in glove production, with the 2007 annual turnover of about GBP 60m. It offers a wide range of gloves for different use across three business sectors: industrial, consumer and medical ones. As one of the company's main product range is sold to the British government, the company has to follow very strict pricing rules. To provide accurate price management, a very precise cost supervision was required. Although Navision is billed as a full enterprise management system, the company's prime concern was the impact that Navision might have on the costing side of the operation.

In terms of technology, every Navision deployment is always composed of two elements: system setup and development. Navision has its own pre-build development environment C/SIDE (Client/Server Integrated Development Environment) and almost all source code is available for MS Navision Partners. These features render Navision a very flexible application which can be customised on a case-by-case basis.

Company X required a very special system for cost management and tracing. Consequently, numerous innovations must have been done. This new approach related to manufacturing only is presented in this article.

### 3. Standard cost

Companies choose to value their inventory according to a combination of the following bases (Microsoft Corporation 2005):

- acquisition cost,
- standard cost,
- net realisable value,
- replacement cost.

Most of manufacturing companies choose standard cost as their valuation base. Standard cost system – item unit cost is determined by historical and future projected costs. Standard cost per item is frozen until a decision is made to change it. It can differ from actual cost and a variance measured as a standard cost less actual one is calculated and analysed by the management.

Standard cost at Company X (Fig. 2) was introduced for both purchased and manufactured items. It prevents costs fluctuations in a long term.

01G02-0X075X500 GROUND T+0.05 W+0.2 1.2510/1.2 - Item Card	
Costing Method . . . . .	Standard
Cost is Adjusted . . . . .	<input type="checkbox"/>
Average Cost . . . . .	0.00
Standard Cost . . . . .	9.07
Unit Cost . . . . .	9.07
Overhead Rate . . . . .	0.00
Indirect Cost % . . . . .	0
Last Direct Cost . . . . .	9.07
Price/Profit Calculation . . . . .	Profit=Price-Cost
Profit % . . . . .	0.87432
Unit Price . . . . .	9.15
Gen. Prod. Posting Group . . . . .	FACTOR
VAT Prod. Posting Group . . . . .	STD
Inventory Posting Group . . . . .	FIN-FAC
Net Invoiced Qty. . . . .	0
Allow Invoice Disc. . . . .	<input checked="" type="checkbox"/>
Item Disc. Group . . . . .	
Sales Unit of Measure. . . . .	EACH

Fig. 2. Standard costing method in the item card

It is possible to set up some items to be valued based on standard cost and other with different posting methods, but manufacturing labour and capacity are always capitalised based on standard cost (Microsoft Corporation 2005). It does not have to apply subcontracting.

Standard cost for manufactured items is refreshed semi-annually, after a stock-taking. The calculation can be run in one of two ways:

- single level calculation,
- multilevel calculation.

In both methods, total item cost is equal to a sum of material, capacity and overhead costs. In the first method, all these three elements are calculated for the components of parent-item bill of material only (one level) and multi level cost is the total of costs of all the components from all levels.

Microsoft Dynamics NAV also provides a tool for mass updating standard cost. Standard cost worksheet supports reading a bunch of items and increasing or decreasing costs of all of them in one go. Update of purchased goods which are still on stock is done annually according to the inflation rate. This script must have been modified not to affect direct cost.

## 4. Production order costs

At Company X, all the processes start with purchasing materials. The value of purchased components forms a direct element of the total cost of a purchased item. The Navision system registers that cost in Value Entry table as a Direct Cost entry type. Additional acquisition costs, such as freight charges or duties, are added to that table as separate records with entry type equal to Indirect Cost.

Cost of Work in Process (WIP) is equal to components costs increased by the cost of work involved in the manufacturing. Depending on flushing method (backward flush, forward flush), the components consumption and capacity costs can be added at the beginning of the manufacturing process or at its end, while posting the last output operation. System creates two types of entries: item ledger entries, which are related to consumed (inventory decrease) and produced (inventory increase) items, and capacity ledger entries related to machine centres, operators and work centres. Value entries are created for both types: items and capacities.

At this stage, a production order is not invoiced. That means that costs of such process are not a part of inventory – these are known as expected cost. These costs become a part of inventory, once a production order status has been changed to “Finished” and the adjustment cost routine has been run. Posting date of the adjustment is the date of the sales invoice form the sale that the adjustment was associated with (Microsoft Corporation 2007b).

Company X has decided to change their production process, implementing one item per production order. Such approach simplifies cost analysis and reporting. After all the processes have been finished, a financial auditor can use numerous tools to trace and analyse them. Statistics are accessible from a production order card. The window shows comparison of standard and actual cost, expected cost, deviation and variance divided into cost of material, capacity, subcontracting and overhead.

In the Manufacturing – Costing menu, there are multiple reports supporting cost analysis in different ways. They include:

- Statistics (Fig. 3),
- Detailed Calculation,
- Compare List,
- Costs Shares (roll-up and single level),
- Transaction Details, etc.

	Standard Cost	Expected Cost	Actual Cost	Dev. %	Variance
Material Cost . . . . .	403.28	363.30	363.30	0	-39.98
Capacity Cost. . . . .	430.20	430.20	0.00	-100	-430.20
Subcontracted Cost . . . .	0.00	0.00	0.00	0	0.00
Capacity Overhead . . . .	0.00	0.00	0.00	0	0.00
Manufacturing Overhead . .	0.00	0.00	0.00	0	0.00
Total Cost . . . . .	833.48	793.50	363.30	-54	-470.18
Capacity Need . . . . .		15	0	-100	

Fig. 3. Production Order Statistics

In the production journal (Fig. 4), a standard cost of an output item is taken into account as a unit cost. It does not comply with Just-In-Time (JIT) analysis, although all information can be adjusted by overnight routine. To provide JIT analysis, a unit cost in the production journal must have been retrieved from a work centre card. To provide this, a brand new algorithm was invented to calculate accurate actual work and machine centres costs.

E...	Item No.	Operation...	T...	No.	Description	Consumpti...	Unit Cost	Amo
▶ C...	8934I				Granite 5 Delta linerx20 Sz 11	4	48.00	
O...	8934	10 W..	LABSIALKOD		Sialko prod labour for Delta		28.68	

Fig. 4. Production Journal

The algorithm calculates the cost of machine and work centres in real time, taking into account the following parameters:

- the most recent depreciation write-off per unit of measure which is an hour or day;
- wages of an operator, taken from a third-party payroll system;
- absence of an operator and his replacement, taken from a third-party payroll system;
- overtime for both an operator and a machine, taken from a third-party payroll system;
- future, planned maintenance, which enforces alternative routing and different costs;
- failure risk factors taking into account a frequency of former failures.

All of these factors with the exception of failure risk are quite simple to retrieve. Risk factor is a prognostic figure and is calculated based on the company's own algorithm applying statistical methods (Krawczyk 2001).

There are two types of risk factors taken into account:

- 1) Employee sickness prognosis, which is treated as season-type characteristics. This calculation is based on the Winters method.
- 2) Machine failure prognosis – after a statistical analysis it was approximated as a stationary characteristics. Likelihood of the failure is proportional to the length of a period of operation without damage. In this case, the very simple Roaming Average method has been used.

This invented algorithm is composed of two steps: the first step is based on the calculations referred to above (the Winters and Roaming Average methods). The second step is a "learning phase", where all figures calculated in previous terms are taken into account. Samples are stored in special tables. Every sample has two types of characteristics: real value and expected, prognostic value calculated by the algorithm. The average difference between the real and expected values is used in every new calculation. For example, work centre I/CLABEL (Tab. 1) is a labelling machine and its real damages are as follows:

**Table 1.** I/CLABEL sample

<b>Actual Value</b>	Jan 3 2004	Feb 15 2004	Apr 8 2004
<b>1st Calculation</b>	Jan 15 2004	Feb 20 2004	Apr 5 2004
<b>Difference</b>	12 days	5 days	-3 days

The second calculation reduces results for every sample according to the calculated differences. During next calculations, the average difference for every sample is taken into account:

$$D_i = Average (D_1, D_2, \dots, D_{i-1}) \tag{3}$$

where:

- D* – difference,
- i* – *i*-th calculation.

To reduce consumption time of the process, samples from the five most recent years are taken into consideration only. Users are allowed to update calculated figures according to their experience. No history of users' influence on calculation is stored. This algorithm provides calculation sufficiently accurate for estimating future changes in the costs.

This modification improves analysis and reporting, as well as reduces adjustment procedure time.

## 5. Subcontracting

In Navision, the subcontracting term describes outsourcing some or all of the production operations to third-party producers (Microsoft Corporation 2005). Subcontractors can be treated as company capacity (work centre) or a purchase. As a work centre, it is added to the produced item routing. In both cases the costs of these contracted services are added to the total cost of a production order and saved in the value entry table as a variance.

Company X decided not to treat their subcontractors as a work centre, but rather to treat their invoices as additional item charges. This additional fee is proportionally assigned to all processed items.

## 6. Average cost

Average cost is calculated for every item irrespective of the costing method. In actual cost environment, the average cost is used in relation to inventory decrease (the initial value in the FIFO and LIFO methods and the unit cost value in the Average Cost method) (Microsoft Corporation 2005), while in the standard cost environment it serves statistical purposes only.

Average cost is calculated according to the following rule:

- if totalled invoiced quantity is equal to zero, then average cost is equal to zero,
- otherwise, average cost is calculated as (4):

$$Avg. Cost = \frac{\sum Actual Cost}{\sum Invoiced Quantity} \quad (4)$$

In the first phase of the implementation, Company X recorded some discrepancies between the actual and average cost. Because of the rounding order assumed during the Stock Take, the inventory was not zeroed, but incorrectly reduced to almost zero and the invoiced quantity was equal to 0.000001. According to equation (4), the smaller the quantity the higher the average cost is. A new rounding tool was provided to fix the problem and avoid such situation in the future.

After the described modifications and system improvement, the difference between average and standard cost for every item is never greater than 0.5% in comparison with standard cost.

## 7. Traceability between G/L entries and value entries

Both expected and actual costs are posted to the General Ledger. The expected cost is posted during a certain transaction and the actual costs are reconciled by the script "Post Inventory Cost to G/L". A user can set up the system to automatically execute that posting or run it manually.

Navision posts the inventory costs in the following way (Microsoft Corporation 2007):

- Costs of the item ledger entries of the type Purchase are debited to the Inventory account in the balance sheet. The credit is posted to the following balancing accounts in the income statement:
  - for Value Entry of the “Direct debit” type, the “Direct Cost Applied” account is being used;
  - the “Overhead applied” account for values of the “Indirect cost” type;
  - the “Purchase Variant” account is being used for value entries of the “Variance” type.
- Costs of the item ledger entries of the “Sale” type are debited to the “Cost of Goods Sold” account and credited to the Inventory account.

Inventory account is set up per each combination of “Item Posting Group” and Location in “Inventory Posting Setup” window.

The three accounts related to purchase algorithm are set up in the “General Posting Setup” window for each combination of business and product groups.

Navision performs reconciliation between inventory entries and the general ledger by means of “Post Inventory Cost to G/L” batch job. This script posts the transactions basing on actual cost in the value entries. The program calculates the amounts to be posted by summing up the cost amounts in the value entries that are related to each item ledger entry.

## 8. Summary

The Microsoft Dynamics NAV 5.0 ERP system covers all areas of companies’ activities. In this article, manufacturing costing has been outlined only. NAV supports all known costing methods and their combinations. Costs can at every stage be posted to certain accounts in the General Ledger.

Since the system launch, Company X has been reporting excellent trading results. Its turnover was in 2007 by 50% higher then in 2006. Very precise and intuitive cost management functionality has enabled the company to save human resources time and perform more accurate pricing. Reporting time has been reduced by 80%.

During the implementation, several modifications and system improvements were introduced. New standard and average costs update routines assist the users in guaranteeing that their costs are always up-to-date and accurate. Projections of future costs calculation for resources, work and machine centres enables a user to correctly calculate expected costs and then compare them with the actual ones.

The article presents costing management supported by the Microsoft Dynamics NAV system. In Sections 3, 5, 6 and 7, the authors decided to briefly describe existing solutions to provide a costing functionality background. Section 4 describes their own, brand new solution invented by the authors. This new algorithm supports more accurate costs application and forecasting.

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