IMPLEMENTATION OF STOCK MANAGEMENT MODEL – CASE STUDY

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Abstract: Current inventory management concepts in both business practices and literature can be divided into two major themes. The first one optimizes transportation and warehousing activities within a single company, while the second one focuses also on collaboration with external partners, such as suppliers, clients, transportation companies and others. In the article, pursuant to literature review, a case study analysis of a company implementing a single entity inventory management model was undertaken. The aim of the article was to analyze benefits and weaknesses of single entity inventory management model together with its implementation. The results of such research, could be potentially valuable and applicable in business practices. The case study analysis showed considerable and quantifiable improvements resulting from aforementioned system implementation. More detailed analysis, revealed however, several weaknesses of a model. These weaknesses pave the way for the company to the further improvements and indicate a direction for potential future research.

Keywords: inventory, inventory management, case study.

1. Introduction

Although a question of how much inventory the company should keep has been thoroughly studied in recent decades, unambiguous answer has not yet been concluded. This is primarily because both excess inventory and out of stocks could be very costly to the company. Relph and Barrar pursuant to evaluation of 20-inventory profiles of companies in different sectors estimated that between 10 to 98 percent of stock values were overaged (Relph, and Barrar, 2003). In nearly the same time, another empirical studies revealed out of stock levels averaged 8 percent worldwide (Grun, and Corsten, 2006). Similar dichotomy of views is also presented in another research papers (Rajeev, 2008; Hoberg et al., 2017; Ayad, 2008).

Since both, researches and the companies find it challenging to optimize inventory levels this paper tends to analyze how companies approach in practice the issue of inventory management. The aim of the article is therefore to analyze benefits and weaknesses of a single

entity inventory management model together with its implementation. In the first phase of undertaken research the literature was reviewed. As the article is supposed to present practical implications to the business in the next step a company was selected to a case study research.

2. Review of stock management concepts

In general, inventory management literature can be divided into two major themes. The first one presents various inventory control models, which tend to focus on integration of traditional logistic decision such as warehousing, transportation and inventory management. The second theme is mainly focused on collaborative models (Williams, and Tokar, 2008). Both of aforementioned themes can be found in domestic and international papers.

The first group of themes comprise inventory control models, which are focused mainly on minimizing of two fundamental criteria: inventory levels and the number of orders. Additionally, another contemplated criteria include minimizing of such factors as an average size of inventory, expected supply lead time or expected size of missing inventory. These multi-criterial models can be divided further into deterministic ones, models with stochastic supply lead time or with stochastic demand in supply lead time, models with normal distribution demand in supply lead time, probabilistic models with a single purchase decision and probabilistic and dynamic models with multiple purchases (Jakowska-Suwalska et al., 2011). Michalski G. proposes several adjustments to above described classic models aimed to improve shareholders value, instead of accounting returns (Michalski, 2008). Krzyżaniak S. disclosed a model approach aimed to support companies with selection process of an optimal stock replenishment system. Basic criteria of that model are again quantity and frequency of orders (Krzyżaniak, 2017).

The issues of fast perishable goods management, subject to deterioration during warehousing were analyzed with application of generalized Wilson model for optimal lot sizing. Stated researches were based on assumption that the rate of deterioration depends non-linearly on the investment volume dedicated to reduction of goods deterioration (Filina-Dawidowicz, and Mykhaylo, 2016).

Kowalik M. and Baran J. applied Monte Carlo method in order to select the best inventory management model for a company from bathroom fittings and sanity industry. Monte Carlo simulations of various methods of inventory management were based on customer service level, stock rotation and inventory costs variables (Kowalik, and Baran, 2014).

Pursuant to literature review, it can be noticed however, logistic research is steadily evolving towards collaborative models theme (Basu, 2001; Attaran, M., Attaran S., 2007; Sari, 2008). In business practice, supply chain management is also becoming increasingly popular. Stated supply chain management concept places significant importance on customer

service, which can be achieved through coordination of operations across different business entities. Given, both themes focus on internal (within entity) coordination of logistic operations, the advantage of collaborative inventory management models over traditional ones is the additional focus on external operations. The most popular collaborative inventory management approaches are based on continuous replenishment planning (CRP), quick response (QR), efficient consumer response (ECR) and vendor managed inventory (VMI). Whereas these approaches are highly dependent on information sharing, their objective is to better match supply and demand, which should consequently, inter alia, optimized stock levels (Williams, and Tokar, 2008). These approaches, despite usually highly successful require considerable attention to be paid to various environmental and operational factors, which if ignored, might significantly reduce expected benefits (Sari, 2007).

Since collaboration is a complicated process it requires not only participation of manufacturer and distributor, but also of many other inter-dependent firms like carriers, wholesalers and logistic service providers. These entities are frequently important links in set ups of supply chain management enabling effective provision of high level services to the customers, while maintaining reasonably low inventory levels (Soosay, Hyland, 2015; Stefansson, 2006).

As initially indicated, the first theme of inventory management themes is primarily focused on trade-offs between warehousing, transportation and inventory management. These themes apply mostly analytical and simulation models. The second portion of themes is increasingly popular in literature within last years. That theme considers collaborative inventory management as most efficient in terms of inventory levels maintenance and customer service. Furthermore, according to Davis-Sramek B. and Fugate B. leading logistic visionaries consider this theme is the future of inventory management (Davis-Sramek, and Fugate, 2007).

3. Stock performance management model in HoReCa company

Analyzed in a case study company is a member of large international capital group (hereafter the Group), which produces and distributes professional equipment for HoReCa industry (i.e. Hotels, Restaurants, Catering). The clients of the Group are primarily restaurants, bars and hotels. Sales are usually being achieved through minor distributors. The Group comprise around 30 entities located all over the world. The majority of Group entities are distribution companies, several however, are production ones. Stated production companies are located in Central and Western Europe, Asia and North America. Production companies specialize in certain production areas like laundry, dishwashers, ovens, cooking, refrigeration and aluminum furniture. These companies are key suppliers of distribution

entities of the Group. Given remote location of production companies, relatively long delivery times with simultaneously short delivery times requested by some of the clients distribution entities must maintain certain stock levels as to buffer stochastic demand with supplies.

Historically stock management in the Group was subject to local management with only general indications from head office. Average inventory days exceeded 100 days, in some of entities being close to even 200 days.

A trigger to start a project in the Group was the need to improve financial liquidity. Since inventory was a considerable balance sheet position with significant potential of conversion to cash the Group decided to implement a new inventory management model in almost all entities. Among these entities was a Polish one, which was subject to a case study presented in the next sections.

3.1. Pre-implementation analysis, determinants and assumptions

The inventory of an analyzed company was initially divided, as disclosed in Figure 1, into 4 main categories:

- Merchandises – all these stocks are located in one warehouse in Poland and consists of around, on average, 500 positions.
- Spare parts – also located in one separate warehouse, comprising however around 10 thousand of different positions. Significant portion of spare parts had rotation as low as one unit per few years.
- Stock held at third parties. In order to increase sales revenue the company offered to its clients, based on their sales potential, stocks for showrooms. These stocks were placed at clients premises against goods dispatch note documents, which the clients signed. A few of these showrooms were displayed for several years, other showrooms had sound 1 or up 2 years rotations (i.e. after display period were sold with discount – from the company to the client and next to final customer).
- Obsolete stocks – although machines do not expire like foods or chemicals, changes in technology and fashion (design of machines) are key drivers of machines obsolescence. Obsolete machines pursuant to quality checks, can yet be sold, however usually with significant discounts. This category comprised also damaged and discontinued stocks.

As per Group instructions all merchandises were supposed to be classified further into three different but homogenous groups (see Figure 1). Each of these three groups should be addressed by different activates. These three groups were as follows:

- Full value stock, i.e. the group with the fastest rotation should be managed through purchasing model designed in Excel. The company was supposed to quickly reach targeted stock level via reasonably low purchases and fast rotation. New products despite lack of historical rotation were included within this group.

- Made to order – these are all stocks made/purchased for customized client orders and stock with low rotations. By low rotation were understood all stocks with sales levels lower than 6 units per year with sales for the last two consecutive years. Under the Group policy, the companies could have this stock only against orders and prepayment.
- Overstock – these were the excess of full value stocks over target rotation. As indicated above that group was supposed to disappear through reasonably low purchases and assumed fast rotations. Nonetheless, the companies were given the right to decided locally, if to give special discounts, as to boost achievement of targeted stock levels.

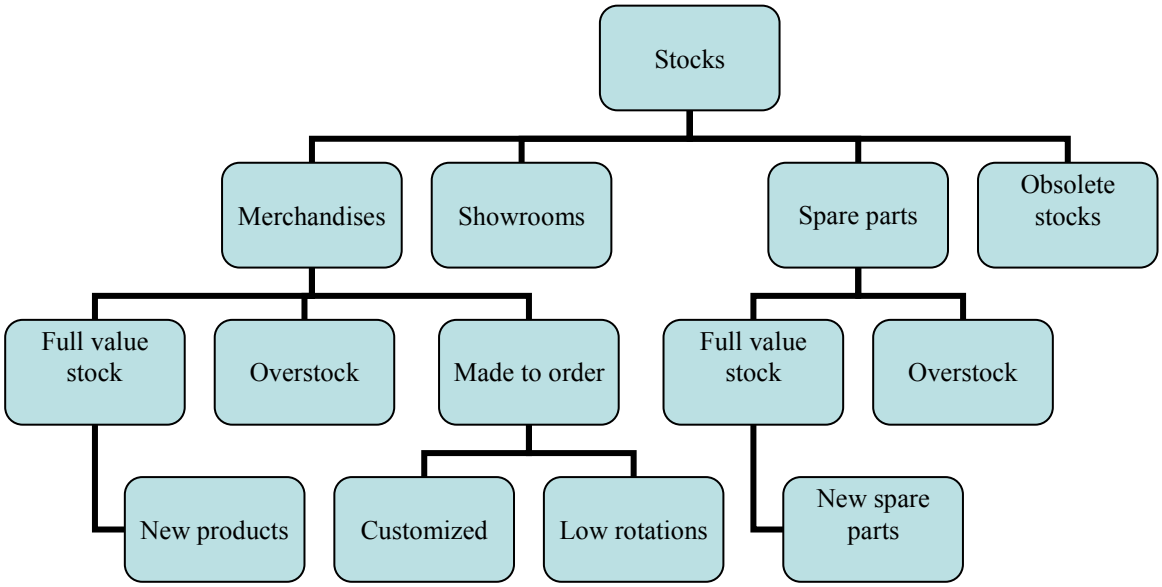

Figure 1. Inventory classification.

Spare parts were classified very much alike merchandises with different target rotation levels and with the absence of made to order spare parts.

In order to estimate stock reasonable levels the company analyzed delivery times from its suppliers (per product analysis) and client delivery expectations. This exercise was done through:

- Analysis of historical delivery times from certain (mostly related party) suppliers. Delivery times consisted of production times and transportation times. As a result of that the vast majority of delivery times were as high as 30 days. Some suppliers had 14 days delivery time, but two, frequently delayed deliveries up to 42 days.
- Next the company interviewed sales representatives and selected key clients. In case of full value stocks expected by the client delivery time most frequently varied from null to 14 days with some exceptions up to 30 days. In case of made to order stocks, for example all laundry products the clients accepted long delivery terms – 30/60 days. In case of spare parts expectation for deliveries were as low as few days.

Following above analysis and the principal of simplification of business processes the company reach a decision to set a 60 days rotation target for all full value stocks and a year for spare parts.

3.2. Stock purchasing model

Historically, the Group companies purchased stocks based on local decisions, which were in some extent subjective. Some companies purchased based on historical figures, others based on forecasts, nearly all companies purchased stocks with high buffers. Pursuant to new model implementation the purchases were supposed to be done as frequently as weekly and were expected to be done based on suggestions resulting from and Excel tool, as disclosed in Table 1 below (or in full in Table 4 in Appendix). Excel, although not an advanced ERP system is a tool frequently applied in companies in logistic management (Szczęśniak, Petryczko, 2016).

Table 1.
Extract from stock purchases Excel tool – full value stock

Product CODE	**Unit purchase cost**	**Sales in last 12 months**	**Stock available (in units)**	**Rotation (in days)**	**Rotation Target (in days)**	**Over stock (units)**	**Over stock value**
	A	F	I=G-H	J=I/F*365	K	O=(J-K)*F/365	P=A*O
12566321	6 747,50	8	5	228	60	4	24 864,08
12500212	7 205,00	12	7	213	60	5	36 222,40
12412321	9 697,00	15	1	24	60	-1	-14 213,41
20132254	2 762,00	7	7	365	60	6	16 155,81
20132255	6 750,00	6	8	487	60	7	47 342,47
20132278	2 738,80	12	2	61	60	0	75,04
50213421	5 359,00	15	3	73	60	1	2 863,03
		75	**33**	**161**	**60**	**21**	**113 309**

Note. Own study, based on data provided by the Company.

In general, purchase orders should be placed if "over stock value" is negative (see column "P"). Given purchases are being made on a weekly basis and the target of 60 days exceeds even delayed deliveries (up to 42 days) the model was supposed to decrease overstocks and prevent appearance of stock outs. Procurement manager, was given the right however to adjust results from the Excel in case of new products and if trends or other information suggested otherwise (Table 4 in appendix presents more information, for instance sales trends).

Purchasing activity was to be managed by procurement manager, the local executive management was to analyze the results on a monthly basis, based on two main reports. Both reports were simply lifted up from figures disclosed in Table 4 (appendix) using pivot table Excel function. The aim of the first report, as presented in Table 2, was to disclose overstocks and potential stock shortages by product groups.

Table 2.
Pivot table designed for monthly management reporting – by product

Product group	Sales Value in last 12 months	Total Stock value	Average Rotation	Over stock value	% over stock
Refrigeration	17 571 231	2 422 183	50	-466 239	-19%
Cooking	2 747 730	834 688	111	383 007	46%
Furniture	5 620 348	1 200 550	78	276 657	23%
Dishwashers	3 067 205	393 881	47	-110 317	-28%
Ovens	4 475 131	1 609 481	131	873 843	54%
Others	3 415 032	850 721	91	289 346	34%
Total	**36 896 677**	**7 311 504**	**72**	**1 246 297**	**17%**

Note. Own study, based on data provided by the Company.

The aim of the second report was to disclose overstocks and potential stock shortages by significant suppliers, see Table 3 below.

Table 3.
Pivot table designed for monthly management reporting – by supplier

Supplier	Sales Value in last 12 months	Total Stock value	Average Rotation	Over stock value	% over stock
Supplier 1	12 844 570	1 332 201	38	-779 236	-58%
Supplier 2	4 726 661	1 089 982	84	312 997	29%
Supplier 3	2 747 730	834 688	111	383 007	46%
Supplier 4	5 620 348	1 200 550	78	276 657	23%
Supplier 5	2 515 108	204 818	30	-208 624	-102%
Supplier 6	552 097	189 063	125	98 307	52%
Supplier 7	4 475 131	1 609 481	131	873 843	54%
Supplier 8	1 400 163	263 724	69	33 560	13%
Supplier 9	1 092 810	272 231	91	92 591	34%
Supplier 10	922 059	314 767	125	163 195	52%
Total	**36 896 677**	**7 311 504**	**72**	**1 246 297**	**17%**

Note. Own study, based on data provided by the Company.

Since the value of stock made to order should equal the value of orders, the company, under the Group rules, was not allowed to purchase any made to order stocks without prior reception of prepayment. Such prepayments should exceed at least 30% of customized or low rotating orders value.

Implementation of spare parts purchasing model was the most challenging task. This was primarily because of many positions disclosed in a ledger of spare parts (around 10 thousand indexes) with some of them sold once in a few years and short delivery time expectations by the clients. Too long delivery of spare parts to the final customer could result in a loss of a reputation, but to high level of stock of spare parts would mean freezing considerable funds with risk of future impairment of assets. Finally, the Group decided to set a target rotation level for spare parts of 1 year (i.e. if at least one unit of certain spare part was sold in each of 2 last consecutive years than the company could store such a spare parts locally). All other spare parts were to be stored globally and delivered once there is a demand for them. Such approach meant few days for delivery to the final client (including order or guarantee

processing). Hence, the company could purchase locally all spare parts with up to 1 year rotations, similarly based on the Excel tool, while all the other spare parts were to be delivered from global warehouses (within a week time).

3.3. Remaining stock categories management

All remaining stock categories, i.e. overstock, obsolete stocks (including damaged and discontinued), made to order stocks, showrooms were supposed to be nil. Such target was to be achieved through the following:

- overstocks – fast rotations and decrease of purchases should reduce overstock levels. None withstanding above management was allowed to give additional discounts as to reduce stock levels more quickly;
- obsolete and made to order stocks – the company was to analyze all these stocks, unit after unit and prepare a new price list with attractive to the clients discounts. That was not an easy task even for skilled experienced technical employees, who frequently had many doubts of which size discount to apply. Next, these lists were sent to the clients who could pick the products with reduced prices. The results of such action were not satisfactory and revealed all problems resulting from subjective pricing of the products. In the first step the clients purchased all valuable products with reduced prices. Nearly all obsolete, damaged and customized products left unsold. So the company discounted the prices and sent again new price lists to the clients. The result was not satisfactory again. Finally remaining products were moved to repairs department for spare parts in analyzed company or sent to related parties interested in certain spare parts. Majority of the Group companies approached this issue the same way. There were several exceptions however. The most successful technique, applied in another country was to divide the stock in a random way into several groups, next to value each group, set an extra but reasonable discount and make an offer to selected key customers, who could either buy in bulk or not to buy at all;
- showrooms – the company decided to quit showrooms policy and if the client was interested in having a display with machines than the company could sell him merchandises with higher discount and with deferred payment terms. The issue of historical showrooms became a considerable issue, since the majority of clients were not interested in purchases of machines which were already old and so in some cases huge discounts were applied.

3.3. Evaluation of system implementation

The overall new inventory management model implementation must be evaluated positively, as the Company managed to reduce stock levels by around 40 days in 6 months' time, while the problem of stock outs within stated 6 months had almost not appeared. The

reduction of inventory rotations improved the company's liquidity, reduced indebtedness, decreased total of assets and in such a way contributed to an increase of assets profitability, which is closely linked to the company's value, which eventually improved. Another important issue was reduction of risk, which again, in line with the decrease of inventories also declined.

The implementation of a system was not a simple roll-out of the Group policy as significant local aspects like client expectations were prior to model implementation considered and addressed. The new system was also subject to consultations with both local employees and the clients, which again most likely highly contributed to a successful system model implementation.

The Company was also given an Excel tool and a conceptual framework, which despite not advanced, was clearly understandable, well known, simple and straight forward. In a consequence, during the whole project implementation there were no feasibility barriers identified (nor IT nor human ones).

As for the weakness of analyzed model the followings should be noted:

- the model does not address properly purchases of new products,
- since a monthly seasonality was ignored the inventory might not be optimal during the year,
- there is some risk of stock outs resulting from monthly seasonality (if there is) left, which could materialize in case of deliveries from suppliers with the longest delivery days in a pick months,
- the model ignores trends, which can be noticed too late (i.e. after a year), as the model is based on sales from the last 12 months,
- the model ignores available warehousing space, which in case of quick growth of sales might limit purchases,
- spare parts management quality might not be of satisfactory in case of the clients with faster delivery expectations,
- the model does not comprise any inputs from outside the Company, ignoring competitors and any other external factors,
- furthermore, the model is based on historical sales figures and not forecast ones,
- cancellation of showrooms policy might in a long term affect sales revenues of the Company
- the model is subject to the whole set of all Excel – related problems, which among others include human errors in data transfers, mistakes in formula calculations and so forth,
- frequency of orders (once per week) is assumed to be constant, which perhaps could be variable as to optimize inventories better.

- the size of an order is subject to procurement manager decision, which in theory should lead to target rotations achievement, leaving some area for potential improvement
- the model ignores collaboration with suppliers. Given suppliers are related parties there should be no risk of information sharing and implementation on interconnected ERP system for the Group could lead to further significant savings and improvements in delivery times
- collaboration with clients was also ignored in contemplated model, which again could lead to further significant improvements.

4. Summary and conclusions

In due course of literature review two major inventory management themes were identified. The first one tends to optimize transportation, warehousing and inventory management within an entity. The second one focuses also on collaboration between all involved in supply chain management partners. Although the second model is likely to pave the way for future logistic, as for now both of aforementioned themes are present in up to date research papers and business practices.

Selected for the case study company decided to implement inventory management system described as the first theme. As indicated in a case study implementation of a system lead to significant improvements in financial area (liquidity and profitability improvements), reduction of inventory related risks, while preventing stock outs.

Despite the Company implemented a system designed in a head office due to local analysis comprising employees and clients interviews minor local adjustments to the global system allowed for effective system implementation.

Although as indicated, implementation of a system resulted in substantial benefits to the company the system is subject to several weaknesses. These weaknesses result primarily from lack of collaboration with external partners, assumptions resulting from historical and not future figures and the treatment of several variables as constant. Nonetheless, stated weaknesses indicate potential areas for further improvements to the Company.

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Appendix

Table 4.

Merchandise				(days)		Sales in units			STOCK									overstock	166 740,14
Product Group	CODE	Unit purchase cost	Supplier	Supplier's delivery time	Delivery time requested by the client	201X	201X+1	In last 12 months	Total stock (in units)	Gained orders (in units)	Stock available (in units)	Rotation (in days)	Rotation Target (in days)	Sales Value in 12 months	Total Stock value	Available stock value	Over stock (units)	Over stock value
		A		B	C	D	E	F	G	H	I=G-H	J=I/F*365	K	L=A*F	M=A*G	N=A*I	O=(J-K)*F/365	P=A*O
DISH	12566321	6 747,50	Supplier A	42	0	11	14	8	5	0	5	228	60	53 980	33 738	33 738	4	24 864,08
DISH	12500212	7 205,00	Supplier A	42	0	6	8	12	8	1	7	213	60	86 460	57 640	50 435	5	36 222,40
DISH	12412321	9 697,00	Supplier E	30	0	1	15	15	1	0	1	24	60	145 455	9 697	9 697	-1	-14 213,41
REFR	20132254	2 762,00	Supplier B	14	14	22	12	7	12	5	7	365	60	19 334	33 144	19 334	6	16 155,81
REFR	20132255	6 750,00	Supplier B	14	14	17	19	6	8	0	8	487	60	40 500	54 000	54 000	7	47 342,47
REFR	20132278	2 738,80	Supplier B	14	14	10	15	12	2	0	2	61	60	32 866	5 478	5 478	0	75,04
Ovens	50213421	5 359,00	Supplier C	30	14	3	8	15	3	0	3	73	60	80 385	16 077	16 077	1	2 863,03
Ovens	50213344	4 035,00	Supplier C	30	0	4	25	38	8	3	5	48	60	153 330	32 280	20 175	-1	-5 029,93
Ovens	50713001	5 044,68	Supplier D	30	14	0	19	42	14	2	12	104	60	211 877	70 626	60 536	5	25 707,14
FURN	30123492	3 360,00	Supplier B	14	14	9	15	21	4	0	4	70	60	70 560	13 440	13 440	1	1 841,10
FURN	30123498	490,60	Supplier B	14	14	3	9	16	5	0	5	114	60	7 850	2 453	2 453	2	1 162,65
FURN	30123492	3 360,00	Supplier B	14	14	9	22	13	2	0	2	56	60	43 680	6 720	6 720	0	-460,27
FURN	30123498	490,60	Supplier B	14	14	5	15	16	9	0	9	205	60	7 850	4 415	4 415	6	3 125,05
Others	60722891	3 961,24	Supplier G	14	0	9	7	7	4	1	3	156	60	27 729	15 845	11 884	2	7 325,58
Others	60344992	4 074,00	Supplier H	14	0	7	12	6	1	0	1	61	60	24 444	4 074	4 074	0	55,81
						116	**215**	**234**	**86**	**12**	**74**	**115**	**60**	**1 006 298**	**359 626**	**312 455**	**36**	**147 037**