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SUPPORT SYSTEMS FOR DECISION AND NEGOTIATION PROCESSES

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APPLICATION OF DSS IN INVENTORY MANAGEMENT

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Abstract: This paper explains development of the decision support system (DSS) for inventory management in the wholesale which is used in the firm "VELMOS" Mostar.

Keywords: DSS (Decision Support System),inventory management, decision maker.

1. Introduction

This paper presents specific approach in computer application for inventory management. Instead of making "universal" mathematics model, this approach starts with practical experiences in application of different methods for inventory management and with intuitive knowledge of real decision makers, which enable them that by themselves, in interactive work on computer find appropriate strategy and tactics for inventory management. DSS approach in developing computer support is chosen because of its main characteristic that offers support, rather than automation of human cognitive processes. It contributes, if not to solving, at least to continuous improvement and greater effectiveness in inventory management . Here are presented the main phases of development DSS for inventory management in the wholesale, intended for decision makers on the middle management level.

2. The main phases of a DSS application development process

During the application development of DSS for inventory management in the wholesale, the three main phases of a DSS development process have been obeyed (Young,1989) :

* phase I : preliminary assessment consisting of situation analysis and interface assessment and selection
* phase II: developing and assessing the base system (or first version of DSS)
* phase III: iterative development + usage + assessment.

2.1. Preliminary assessment - the first phase in developing DSS for inventory management

In the first phase of DSS development, all relevant information about real organization were gathered, providing a basis for assessing the applicability of DSS approach in the concrete case ,and for identifying which generic DSS components can appropriately be applied to the situation.

The starting point of analysis were goals which firm tried to gain through its work, such as: supply of different goods from specialized suppliers; storing and holding appropriate stocks to fulfilled prevailing and future demands, and future distribution (sale) of goods. On the basis of established goals, the major business processes were defined: supply, sale, finance and management.

In establishing and displaying the connections between major processes and organizational structure, and their connections with main classes of data in inventory management, BSP (Business System Planning) analysis was used. The basic conclusions from these analysis are: inventory management is related with management processes on the middle management level; ordering from suppliers is,also, related to processes of supply on middle management level; sale is related both to lower,commercial, and middle management level; financial aspect of inventory management is directly dependent upon entire financial flows in firm; while is inventory control related with processes of tracking inputs and outputs of the articles on the warehouse level.

BSP analysis has confirmed the need of development DSS for middle management level, which means that DSS in question is designed for broader sphere of users, not for an individual. It means variety in the levels of knowledge and experiences of users related with inventory management, about what the application development of DSS had to take care of. Table 1 gives the major list of methods, software tools and their purpose, used in development of concrete DSS. Two main approaches in application development of DSS are visible. The basic group of methods necessary for solving inventory management's problems has been programmed "from the ground" in a program language QuickBasic and presents a completely integrated part of DSS. The interfaces for users who are more familiar with statistical methods and/or modeling tools have been made according to standard software packages (STATGRAF and LOTUS). Such interface enables transfer of data from one DSS software component to another without manual reentry of data, which place this DSS in a class of "quasi-integrated" DSS tools.

Table 1

Methods	Software tools	Purpose
A-B-C analysis		classification of articles by relative importance
Trend analysis	programmed (QuickBasic) integrated part of DSS	defining type of trend
Exponential smoothing		selecting appropriate methods for demand forecast - answer to question about stock level
EOQ- Economic Order Quantity		answer to question when and how much ordered
Other statistical methods (Box-Jenkins, Winters,..)	STATGRAF-statistical software package	additional feature for users familiar with statistics methods and who want more sophisticated analysis and graphics displays
Modelling	LOTUS software package for modelling	additional feature for analysis "what ... if" questiones and possibility of tabelar and graphics displays

2.2. Developing/assessing the base system - the second phase

In the second phase of DSS development, identification of necessary data was made. In concrete case, it was taken over from yet developed E-R-A (Entity Relationship Attribute)model which was used in developing of computer support for the inventory control on the warehouse level. At the end of the paper, review of a major menus (displays) is given for better understanding of the basic structure and functions of concrete DSS. DSS development is now in the third, the last and successive phase, that is, in the phase of usage, assessment, further development, again assessment, development ....

2.3. Practical experiences in DSS usage

One among eight stock companies with wholesale as a main activity from "VELMOS" holding company, was chosen for assessing, usage and development of concrete DSS. Chosen stock company has only one profit unit (warehouse) , which is by annual turnover one of the leading in the whole firm (about 10% of total annual turnover). Cigarettes and different chemical product for household needs (detergents, cosmetics, etc.) make up the assortment of this profit unit with relatively "quick" turnover ratio (average 72 e.g. 5 days) and with about 4.000 articles.

On the exibit 1 is given the scheme with real DSS implementation architecture.

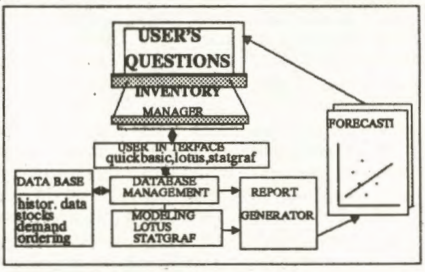
Two months after decision makers have used DSS, their main impressions could be grouped as in table 2.

The first real acceptance DSS was found in the processes of negotiations with suppliers.Now, users have in one place updated and easy accessible data about quantitative and value turnover with each supplier, about replenishment time, about delays, discounts and etc. (see menus at the end of paper).Analysis of ordering based on economic order quantity (EOQ) was, also, quickly accepted in determining when and how much to order. One of the possible ways of using DSS in analysis of ordering is given in the example 1.

Table 2

Advantages of DSS usage	Shortage
- better understanding of the inventory management problem - updating and easy accessibility (on the screen) of the data during negotiations with suppliers - easy and quickly testing of different variants - more real idea about capabilities and limitations of computer support -acceptance of the computer as a everyday tool for doing business more successfully	- english language as a base of user interface for a standard software packages (STATGRAF, LOTUS) - diversity (non standard) of user interface because of orientation to quasi-integrated DSS - user must know the theoretic base of the model (EOQ, forecasting etc.)

Exibit 1

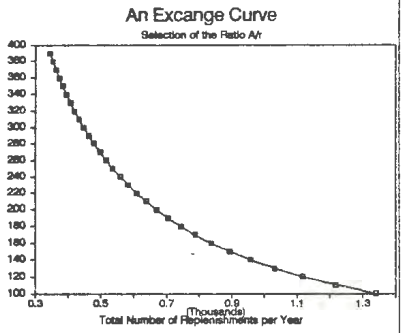


EXAMPLE 1

Decision maker was first made an exchange curve of relation between total average (cycle) stock (TCS) and total number of replenishment per year (Peterson,1979) - see exhibit 2 - in such a way that it takes boundaries from 100.000 to 500.000 dinars for the value of TCS (total TCS for all articles in this warehouse is about 1.300.000 dinars,and the articles from A group constitute about 30% of total value).At the beginning, the fixed costs (A) were estimated on 100 dinars.Decision maker made several variants :

TCS	TCR	Turnover ratio
200.000	134.065,79	111,50
250.000	107.252,63	89,20
300.000	89.377,19	74,33
350.000	76.609,02	63,71
400.000	67.032,90	55,75
450.000	59.584,80	49,56
500.000	53.626,32	44,60

Total cost of replenishment (TCR) vary in the range from 53.626,32 to 134.065,79 dinars, which means that "savings" can be as high as 60%. This range is "maneuver" space where decision maker try to makes such decision which should be on the best way to match the opposite goals: the more efficient customer service, the smaller stock level; the lower replenishment costs, the greater turnover ratio. It is difficult, here, to speak about some optimal strategy, because the final decision depends on immediate business conditions, both in the firm and in the environment. In the next table is given a review of the results chosen by the decision maker as the most appropriate in that moment.



Exibit 2

Data input :

100.00	fixed costs (A)
200.000.00	TCS (Total Cycle Stock)
0.34	carrying charge (r)
298.36	Ratio A/r
670.00	Number of replenishment

Art.No.	Article name	Demand	Var.cost	EOQ	TCR	Turnover ratio
13	Cigarette Ronhil	23.398	184	431,20	11.325,33	113,25
54	Matches	13.398	237	281,51	9.938,49	99,38
12	Cigarette Lord	19.909	145	429,36	9.273,88	92,74
30	Cigarette Drina	16.093	159	368,64	8.731,12	87,31
10	Cigarette Filter	13.387	184	312,54	8.566,50	85,66
20	Cigarett Croatia	7.161	183	229,21	6.248,35	62,48
7	Cigarett Partner	7.498	158	252,42	5.940,92	59,41
39	Cigarette Opatija	7.513	153	256,77	5.852,01	58,52
38	Cigarette Morava	5.372	143	224,58	4.783,97	47,84
36	Cigarette York	3.615	155	176,96	4.085,76	40,86
191	Detergent Mag 3/1	6.048	80	318,59	3.796,68	37,97
4	Cigarette Malboro	1.910	232	105,14	3.633,40	36,33
210	Detergent Fax 3/1	7.416	59	410,81	3.610,47	36,10

CALCULATED VALUES:

TCS : 300.000,00

N : 447,00

TCR : 89.377,19

Turnover ratio: 74,33

2.4. Conclusion

Everyday usage on a such a way developed DSS in solving concrete problems of inventory management, confirms that the achievement of benefits by usage of DSS depends not only on perfection of computer support. User interactive work on computer leads through learning to better understanding, and eventual modification of set goals and tasks, to better understanding of business processes and changes, which in turn leads to finding new ways of DSS usage and improving the work with environment.

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Review of a major menus/displays of DSS for inventory management

DSS

MAIN MENU

1.A-B-C analysis
2.Article's cardboard
3.Analysis of demand
4.Analysis of ordering
5.Modelling of ordering (LOTUS)
6.END of work

DSS

ANALYSIS OF DEMAND

1.Time series analysis

2.Transition to statistical tool (STATGRAF)

3.Return to MAIN MENU

ANALYSIS OF DEMAND

TIME SERIES ANALYSIS

Artical number: ____

Artical name

RESULTS:

Trend: _____(if exists)

Forecasting method:_____

CONTINUE : YES/NO

ANALYSIS OF ORDERING

ANALYSIS OF ORDERING

calculation of Economic order quantity

Artical name

Quantity demand *Demand x costs*

Replenishment time _____

Annual order.costs_____ Stockholding costs _____

Quantity discount_____ Date due _____

RESULTS :

Economic order quantity (EOQ)____Costs of EOQ____

Safety stocks _____Turnover ratio____

Article's cardboard

ORDERING

Artical number *Artical name*

Supplier's number *Supplier's name*

Turnover _____(QTY)/_____(din)

Replenishment time ___days EOQ_____

Order.qty _____ Date of last or._____

F3 - list of ordered / delivered

F4 - Conditions of payment

Article's cardboard - ordering

CONDITIONS OF PAYMENTS

Supplier's number *Supplier's name*

Contract No._____ Date of cont._____Deadline ____

Fixed payment days ____ Discount _____

Approved loan _____

Total input (QTY)_____Total output(QTY)_____

Total input(din)_____Total output(din)_____