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Procedia - Social and Behavioral Sciences 133 (2014) 180 – 188

Procedia
Social and Behavioral Sciences

ICTMS-2013

Developing ordering policy based on multiple inventory classification schemes

Manisha Ketkar[a]*, Omkarprasad S. Vaidya[b]

[a]*Symbiosis Institute of International Business, Symbiosis International University, Hinjewadi, Pune, India 411057*
[b]*Indian Institute of Management (IIM) Lucknow, Prabandh Nagar, Off Sitapur Road, Lucknow, India 226013*

Abstract

Various inventory related decisions are made in industry, specifically in the manufacturing sector. One of the most critical and crucial decisions is development of ordering policies. Usually the ordering policy decisions are made based on a classification scheme (like ABC Analysis). This paper attempts to look at the problems of inventory control, specifically the ordering policy from a broader perspective for input materials like raw / packing materials and/or components. Here we consider multiple classification schemes in order to enable the decision maker to make a conscious and holistic decision. These schemes are assigned proper weights, considering the organizational vision and mission. The proposed approach is formulated in its simplest form by using a multi-criteria decision making (MCDM) technique called Simple Additive Weighting (SAW) method. In this paper, we explain the developed methodology along with an illustration. We propose the approach or methodology with no specific industry in mind, and hope this will help practicing manager, working in any business vertical.

Keywords: Inventory classification, Inventory control and ordering policies, Multi-criteria decision making technique (MCDM), Simple Additive Weighting (SAW) method.

* Corresponding author. Tel.: +91-20-22934316
E-mail address: manisha11.ketkar@gmail.com

doi:10.1016/j.sbspro.2014.04.183

1. Introduction

Organizations would like to maintain a sufficient level of inventory for various reasons. The rationale for maintaining inventory include the need to manage sudden variation in supply and demand, exploit the economies of scale, manage variation in price change, among many others. The study by Pong, C. and Mitchell, F., (2012) indicated a positive association of financial performance with improvement in inventory. But at the same time they emphasised that it also depends on the successful implementation of inventory control initiatives like Just in Time (JIT), World class manufacturing, IT solutions like Enterprise Resource Planning (ERP), etc.

Managing inventory is a complex and tedious task as there are large number and variety of inventory present in an organization. The type of inventories include the raw material inventory, finished goods inventory, in process inventory, in transit or pipeline inventory and many more. Researchers and practicing managers have classified the inventory into various categories to facilitate ease in inventory related decisions. Various types of classifications used for different purposes include Selective inventory control – Always Better Control (ABC), Vital – essential – Desirable (VED), Fast – Slow - Non-moving (FSN), High – Medium - Low (HML), Scarce – Difficult - Easy (SDE) etc. Inventory decisions are mainly related to the time and quantity of reorder, and cost of inventory, which amongst other things help decide the ordering policy. In this paper, we present an approach for inventory control with special emphasis on ordering policies by comprehensively classifying the input materials (raw, packing materials and components) based on the various inventory schemes. An Illustration is also explained. A similar approach can be followed for other types of inventories.

2. Related research

Generally companies have numerous Stock Keeping Units (SKUs) and this number grows with the growth of the businesses. It is not feasible to control them item-wise. Traditionally ABC classification is used for grouping the items for inventory control. But it has been generally recognized that the traditional ABC analysis may not be able to provide a good classification of inventory items in practice as pointed out by Partovi, F. Y., and Anandarajan, M. (2002). There are many instances when other criteria like criticality, availability, pace of consumption, etc. become imperative in deciding the importance of an inventory item. The ABC approach to classification of items for inventory control incorporates only the monetary value of usage and no other factors. Hence it is not an entirely effective classification system. Multi-criteria inventory classification problems have been studied by some researchers. Torabi, S., et al. (2012), applied Data Envelopment Analysis (DEA) model for ABC classification incorporating quantitative and qualitative criteria. Chen, J. (2011) exercised peer estimated approach for multiple criteria ABC classification.

There has been research focusing on inventory classification problems proposing various methods of classification. However, very little attention has been paid to the area of linking the same to inventory control policy, Mohammaditabar D., et al. (2012). While in their work, the authors integrated inventory classification with cost effective inventory control policy. Kumar, K., (2008) proposed an innovative inventory control technique called Multiple Basis Approach to Selective Inventory Control (MBASIC) for the classification and control of drugs in a hospital. Some other examples where researchers considered inventory control are: Gupta, R., et al. (2007) suggested ABC and VED matrix for monitoring and controlling drug inventory in an Armed Forces Medical Services (AFMS). Devnani, M. et al. (2010), employed a combination of ABC and VED analysis to evolve a meaningful control over materials supplies of the pharmacy store of a tertiary care teaching, research and referral care institute and identified the categories of materials requiring stringent management control. Chu, C., et al. (2008) suggested inventory control policies based on ABC–FC (Fuzzy Classification) approach. They incorporated manager's experience, knowledge, and judgment along with ABC classification. It is illustrated with data of the Keelung Port. Bacchetti, A., et al., (2012 – Article in press) designed a hierarchical multi-criteria classification method to facilitate forecasting, inventory management and differentiation of planning choices for after-sale spare parts. It is empirically validated through an extensive case study of the household appliance industry.

There are very few papers studying the ordering policies. Mohamadghasemi, A. and Hadi-Vencheh, A., (2011) developed a model of multi-criteria ABC classification by drawing fuzzy rules. They determined policies for B class items. To fill up the research gap, we have suggested a very comprehensive approach to establish the importance of input materials (raw / packaging materials / components) by considering different inventory classification schemes in line with the organizational goal. The model is then applied to determine the material ordering and control policies. This will enable an organization to achieve its objectives at optimum cost.

In general, complex computational tools or procedures are needed for multi-criteria ABC classification, Chu C. (2008). For multiple criteria inventory classification, researchers have used various statistical approaches like Analytical Hierarchy process (AHP), cluster analysis, Artificial Neutral Network (ANN), etc. which are very complex and hence not practical, Mohammaditabar D., et al. (2012). We have proposed an approach which is formulated in its simplest form for using a multi criteria decision making (MCDM) technique called SAW (Simple Additive Weighting) method. Because it is an easy approach people in industry may find easy to implement and will not need complex technical tools which will enable its wider usage. Modarres M. and Sadi-nezhad S. (2005) proposed that SAW is the most popular method of classical Multiple Attribute Decision Making (MADM) due to simplicity and practicality.

We found that SAW has been used for various applications but for inventory classification. Chou, S., et al. (2008), used fuzzy SAW for solving facility location problem. Afshari, A., et al. (2010), explained the detailed process of SAW. They used this method for personnel selection in a Telecommunication sector of Iran. Hadi-Vencheh, A. and Mohamadghasemi, A., (2011), used SAW for aggregating item scores under different criteria while they used fuzzy AHP DEA for inventory control to determine suitable ordering policy. It is demonstrated with case study of a factory having two production lines viz. a soft drink and biscuit manufacturing. We have however used SAW for categorizing materials using multiple inventory classification methods keeping in mind the organizational goals to determine optimal ordering policies.

This paper is organised as follows. In the next section, we explain briefly the various inventory classification schemes. Next, we illustrate an approach to assign universal classification number for each of the material, along with the proposed algorithm. Conclusions are finally presented.

3. Inventory Classification Schemes

Every inventory classification scheme has its strong and weak points. If we consider only one or a combination of two methods, it may ignore few important aspects. We have therefore suggested to use a combination of 4 -5 applicable methods to get more realistic solution.

We have used four inventory classification schemes in our study viz. ABC, HML, FSN and SDE. Brief description of each of these is given in annexure I. The practicing manager may consider relevant classification schemes according to the need.

4. The approach

In this section we present an approach for classifying the materials, based on various inventory classification schemes. Although, many schemes can be considered, here we select a few relevant indicative classification schemes for input materials.

Initially, the classification schemes are assigned appropriate weight, based on their applicability or suitability with the vision and mission of the organization. A formal or informal meeting of senior officials and inventory managers may be necessary in order to arrive at such evaluation scores. This approach uses SAW technique, and the corresponding weights assigned are called as classification weights. We designate these weights as cw_j, where j is the considered classification scheme. As an illustration, one such rating is presented in Table 1. In this illustrative example, we consider that the organization is equally inclined to work towards the three goals viz. a. low cost, b. improved customer satisfaction and c. innovation. We assume equal weights to these goals. That means, the weight value for each of these goals is 0.33.

Once goals and their importance are established, we need to translate these into the classification schemes. A commonly used MCDM tool called simple additive weighting (SAW) is used for this purpose. As mentioned earlier, these weights called as classification weights cw_j are evaluated as shown in Table 1. Since there are four classification schemes considered here the value of j will be from 1 to 4.

In the next stage of the analysis, we look at the materials classified. Here, we presume that the material classification has already been carried out according to the individual classification schemes. The Table 2 provides such classification list for more than 40 materials under consideration. The data considered here is hypothetical in nature and for illustrative purpose only

Table 1: Assigning weight to the classification schemes

Goals \ Method	Weight	ABC	HML	SDE	FSN
Low cost	0.33	3	4	2	1
Improved customer satisfaction	0.33	4	1	4	1
Innovation	0.33	2	2	4	2
Classification weights (cw_j)		3	2.31	3.33	1.33

Table 2: Given material classification under each scheme

	Classified Under the Scheme			
Material Name	ABC	HML	SDE	FSN
LOM144NKO	A	L	D	S
KNS283LOM	C	H	E	N
RTW752LOM	B	H	E	S
CFT232RTW	C	H	E	F
BHI136NKO	A	H	E	N
USP973LOM	C	L	E	N
AWQ547LOM	B	L	E	S
LOM330BHI	B	M	D	N
USP263XDR	C	L	D	N
RTW534NXY	C	L	E	N
NOL690NOL	B	L	E	N
BHI496AWQ	C	M	E	N
BHI983USP	B	L	E	S
XDR827MLP	C	M	E	N
NOL999KNS	C	L	E	S
NKO786CFT	C	L	E	S
NXY798NOL	B	L	E	S
MLP468CFT	C	L	E	S
XDR570RTW	C	L	S	N
NXY767KNS	A	M	D	N
LOM782KNS	C	L	S	F
MLP820NKO	C	L	D	N
NKO762AWQ	C	M	E	S
NKO200USP	A	L	S	F
KNS661NXY	C	M	E	N
NXY997BHI	C	M	E	F
LOM386VGU	C	L	D	S
VGU604RTW	C	L	D	F
NOL592XDR	C	L	D	N
USP215NOL	C	L	D	F
VGU659MLP	B	L	E	N

CFT727MLP	C	H	E	F
MLP989BHI	C	L	E	S
RTW742ZSE	B	L	E	N
ZSE393NXY	C	L	E	N
BHI367BHI	B	L	E	N
KNS501ZSE	C	L	E	N
AWQ222NXY	C	M	S	N
ZSE914MLP	C	M	E	N
NXY697VGU	C	L	E	N
MLP872USP	B	M	S	N
NKO826NKO	C	L	D	N

In order to quantify the classification under each scheme, we assign a numeric value. For instance, the most important material under classification scheme ABC is “A”. Hence A is assigned a value of 3, B a value of 2 and C a value of 1. These assigned values are called as Classification Values, cv_i and are assigned to each material i. The classification values for the classification scheme considered are indicated in Table 3.

Table 3: Classification values to the different schemes

Schemes				
ABC	HML	SED	FSN	Classification Value
A	H	S	F	3
B	M	E	S	2
C	L	D	N	1

Table 4 provides the list of materials assigned with classification value

	Classified Under the Scheme			
Material Name	ABC	HML	SDE	FSN
LOM144NKO	3	1	2	2
KNS283LOM	1	3	1	1
RTW752LOM	2	3	1	2
CFT232RTW	1	3	1	3
BHI136NKO	3	3	1	1
USP973LOM	1	1	1	1
AWQ547LOM	2	1	1	2
LOM330BHI	2	2	2	1
USP263XDR	1	1	2	1
RTW534NXY	1	1	1	1
NOL690NOL	2	1	1	1
BHI496AWQ	1	2	1	1
BHI983USP	2	1	1	2
XDR827MLP	1	2	1	1
NOL999KNS	1	1	1	2

NKO786CFT	1	1	1	2
NXY798NOL	2	1	1	2
MLP468CFT	1	1	1	2
XDR570RTW	1	1	3	1
NXY767KNS	3	2	2	1
LOM782KNS	1	1	3	3
MLP820NKO	1	1	2	1
NKO762AWQ	1	2	1	2
NKO200USP	3	1	3	3
KNS661NXY	1	2	1	1
NXY997BHI	1	2	1	3
LOM386VGU	1	1	2	2
VGU604RTW	1	1	2	3
NOL592XDR	1	1	2	1
USP215NOL	1	1	2	3
VGU659MLP	2	1	1	1
CFT727MLP	1	3	1	3
MLP989BHI	1	1	1	2
RTW742ZSE	2	1	1	1
ZSE393NXY	1	1	1	1
BHI367BHI	2	1	1	1
KNS501ZSE	1	1	1	1
AWQ222NXY	1	2	3	1
ZSE914MLP	1	2	1	1
NXY697VGU	1	1	1	1
MLP872USP	2	2	3	1
NKO826NKO	1	1	2	1

Table 4: Assigning each material a classification value

Once the classification value is assigned to each of the material, we then compute a Classification Number cn_i for each material i, as the product of classification weight and classification value.

Eqn 1

$$cn_i = \sum_{j=1}^{4} (cw_j \ x \ cv_i)$$

Table 5 shows the materials arranged in the descending order of the classification number.

One may realise that value of classification number, cn_i will lie between 9.97 to 29.91. We propose to classify the materials into five groups, for the reason explained later. The range of each group for the illustration under consideration is as shown in Table 6

The analyst may now realize that there is presently no material that belongs to Group 1, material with serial number 1 and 2 belong to Group 2, material with serial number 3 through 9 belong to Group 3, material with serial number 10 to 20 belong to Group 4 and other materials with serial number 21 to 42 belong to Group 5.

In this approach, each material is analysed by various methods using weightages based on different aspects of materials, say consumption value, unit price, procurement difficulties, movement from stores, etc. Such analysis would suggest use of different inventory control policies than classical methods which can be seen from table 5 columns ABC and Group No.

Table 5: Computing the classification number

Sr. No	Material Name	Classified Under the Scheme ABC	HML	SDE	FSN	*cn*	Group No. as defined in table 6
	cw_j	3	2.31	3.33	1.33		
1	NKO200USP	3	1	3	3	25.29	2
2	MLP872USP	2	2	3	1	21.94	2
3	NXY767KNS	3	2	2	1	21.61	3
4	LOM144NKO	3	1	2	2	20.63	3
5	BHI136NKO	3	3	1	1	20.59	3
6	LOM782KNS	1	1	3	3	19.29	3
7	AWQ222NXY	1	2	3	1	18.94	3
8	RTW752LOM	2	3	1	2	18.92	3
9	LOM330BHI	2	2	2	1	18.61	3
10	CFT232RTW	1	3	1	3	17.25	4
11	CFT727MLP	1	3	1	3	17.25	4
12	XDR570RTW	1	1	3	1	16.63	4
13	VGU604RTW	1	1	2	3	15.96	4
14	USP215NOL	1	1	2	3	15.96	4
15	NXY997BHI	1	2	1	3	14.94	4
16	LOM386VGU	1	1	2	2	14.63	4
17	KNS283LOM	1	3	1	1	14.59	4
18	AWQ547LOM	2	1	1	2	14.30	4
19	BHI983USP	2	1	1	2	14.30	4
20	NXY798NOL	2	1	1	2	14.30	4
21	NKO762AWQ	1	2	1	2	13.61	5
22	USP263XDR	1	1	2	1	13.30	5
23	MLP820NKO	1	1	2	1	13.30	5
24	NOL592XDR	1	1	2	1	13.30	5
25	NKO826NKO	1	1	2	1	13.30	5
26	NOL690NOL	2	1	1	1	12.97	5
27	VGU659MLP	2	1	1	1	12.97	5
28	RTW742ZSE	2	1	1	1	12.97	5
29	BHI367BHI	2	1	1	1	12.97	5
30	BHI496AWQ	1	2	1	1	12.28	5

31	XDR827MLP	1	2	1	1	12.28	5
32	KNS661NXY	1	2	1	1	12.28	5
33	ZSE914MLP	1	2	1	1	12.28	5
34	NOL999KNS	1	1	1	2	11.30	5
35	NKO786CFT	1	1	1	2	11.30	5
36	MLP468CFT	1	1	1	2	11.30	5
37	MLP989BHI	1	1	1	2	11.30	5
38	USP973LOM	1	1	1	1	9.97	5
39	RTW534NXY	1	1	1	1	9.97	5
40	ZSE393NXY	1	1	1	1	9.97	5
41	KNS501ZSE	1	1	1	1	9.97	5
42	NXY697VGU	1	1	1	1	9.97	5

Table 6: Range of cn_i values

Range of cn_i values	Group
9.97 to 13.958	Group 5
13.958 to 17.946	Group 4
17.946 to 21.934	Group 3
21.934 to 25.922	Group 2
25.922 to 29.91	Group 1

The practicing manager may use the group classification of the material for developing an ordering policy. Materials in Group 1, are highly important and must have a very strict ordering policy like having a very close look on the economic order quantity policy. The Group 2 materials may require a moderately strict ordering policy, which may be somewhere between ordering policy for Group 1 and Group 3. Materials under Group 3 may require moderate ordering policies. Here, lot for lot ordering policy appears to be good. Group 4 materials may require moderately loose ordering policy, which may be somewhere between ordering policy for Group 3 and Group 5. Group 5 materials may follow a loose ordering policy.

This model gives a holistic view for building up ordering policies by providing categorisation of materials into multiple groups depending on various important aspects linked with organizational goals. This will give the proper focus to the manager's initiatives resulting in optimised efforts.

These classification numbers can also be used for taking various inventory related decisions like physical verification policy, establishing relationship with the suppliers, identifying supplier control policies, etc.

The limitation of this approach is that this model is quite subjective in nature. It considers individual opinion of the managers in assigning weights to organization goals and inventory policies with respect to organisation goals. This model envisages periodic review of categorization of each material under multiple inventory classification methods which would be tedious and time consuming.

5. Conclusions

The proposed heuristic is eloquent to comprehend. It is aimed to consider a holistic view. The framework aims to establish the importance of each material in tune with organizational goals and also considers different inventory classification schemes. Our approach will serve as a beginning to the systematic approach for classification and hence the ordering policy practices. Our model, being simple as it uses SAW technique, will help any practicing manager to quickly and effectively analyse and evaluate materials on the shop floor and/or in a factory and design an effective ordering policy. This method being easy, we envisage higher utilization. One can also realize the variation in the policies as a result of this approach vis-a-vis the classical approach. This will help derive financial benefits to the organization.

The proposed system can be used to develop the inventory control policies applicable for input materials (like raw / packing / components). A similar type of an approach can be used for various other material types like finished goods, stores and spares, etc. Depending on the need of the organization, a software application for inventory control may also be developed. It will ease and speed up the decision making process. Further, to its application, this technique can also be used to identify key suppliers based on the value, cost and other important aspects of classification, that are in tune with the organisational aims. This model is not developed by considering any specific industry in mind. A similar approach may also be developed, not only for various types of the materials in the industry, but also for various business verticals viz. health care, food processing and some service industries.

We have used arithmetical progression for the weightages in the example above, there is a scope to evaluate if the outcome differs if geometric or harmonic weightages are considered. We have assumed each material being supplied by one supplier, the impact on the ordering policy can be evaluated if one material is supplied by multiple suppliers or one supplier supplying multiple materials.

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Annexure I – Inventory classification schemes

The ABC Classification scheme: This classification is also known as ‘separating vital few from trivial many’. Here we develop a material list based on consumption value for a period (usually annual) in the descending order. Generally the materials listed in the top 70-75% of the consumption value are presumed to be in category ‘A’. The materials listed next 10-15% of the consumption value are presumed to be in Category ‘B’ and the remainder are presumed to be in category ‘C’.

The HML Classification scheme: This classification is similar to ABC, except that the annual consumption is not considered here. The classification is based on the pre-decided unit value of the material as High, Medium or Low.

The SDE Classification scheme: This classification is usually based on the availability of the materials. Materials with longer lead time, special material required for the manufacturing process, imported material belong to category ‘S’ (Scarce). The material which is generally available, with a less potential to go ‘out of stock’, acceptable or moderate lead times, are considered in category ‘D’ (Difficult) whereas the material with shorter lead times, and ready availability, are considered in category ‘E’ (Easy).

The FSN Classification scheme: The basic theme of classifying into this category is to understand the frequency and quantity of replenishment. Here, we typically look at the material from its consumption perspective. Consumption of a fixed quantity of material is studied. If consumed at a faster pace (say, within a week) the material is classified as Fast moving or ‘F’. If the material is consumed at a moderate pace (say, from one week to 3 months), it is classified as Slow moving or ‘S’, and if a material is in store for a longer duration, (say more than 3 months) it is called as Non moving or ‘N’.