Journal of Industrial Engineering and Management

doi:10.3926/jiem.2010.v3n3.p542-560 JIEM, 2010 – 3(3): 542-560 – Online ISSN: 2013-0953

Print ISSN: 2013-8423

Inventory management performance in machine tool SMEs: What factors do influence them?

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Received November 2009
Accepted September 2010

Abstract: Small and Medium Enterprises (SMEs) are one of the principal driving forces in the development of an economy because of its significant contribution in terms of number of enterprises, employment, output and exports in most developing as well as developed countries. But SMEs, particularly in developing countries like India, face constraints in key areas such as technology, finance, marketing and human resources. Moreover these SMEs have been exposed to intense competition since early 1990s because of globalization. However, globalization, the process of continuing integration of the countries in the world has opened up new opportunities for SMEs of developing countries to cater to wider international market which brings out the need for these SMEs to develop competitiveness for their survival as well as growth. It is observed from literature that pursuing appropriate IM practice is one of the ways of acquiring competitiveness among others, by effectively managing and minimizing inventory investment. Inventory management can therefore be one of the crucial determinants of competitiveness as well as operational performance of SMEs in inventory intensive manufacturing industries. The key issue is whether Indian SMEs pursue better IM practices with an intension to reduce their inventory cost and enhance their competitiveness. If so, what are the IM practices pursued by these enterprises? What are the factors which influence the inventory cost and IM performance of enterprises? These questions have been addressed in this study with reference to machine tool SMEs located in the city of Bangalore, India.

Keywords: inventory cost, machine tool, small and medium enterprises

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1 Introduction

Small and Medium Enterprises (SMEs) occupy a place of strategic importance in developing as well as developed countries owing to its considerable contribution to national income, employment, exports, and entrepreneurship development (Visvanathan & Kumar, 1999). The competition due to economic reforms and globalization has put more pressure on SMEs (Huin, 2004). Scully and Stanley (1994) argue that in order to survive in the competitive environment, SMEs must gear up themselves towards developing and sustaining a competitive advantage through high-quality, low cost products, with their limited resources. It is observed from literature that making use of appropriate Inventory Management (IM) practices is one of the ways to acquire competitiveness among others (Sprague & Walker, 1996). To survive in the competitive environment, SMEs must practice integrated IM and capacity utilization to achieve quality and cost reduction (Ricklavely, 1996).

Zeng and Hayya (1999) described the major functions of inventory as: (1) to support and provide necessary inputs for manufacturing; and (2) to protect companies against uncertainties that arise from such cases as discrepancy between demand and production, machine deterioration, and human errors, among others. They further argue that inventory cost (ordering and holding expenses) and inventory turnover (a measure of how effectively inventories are being managed) are very important in deciding the IM strategy of firms. IM has significance in an inventory intensive manufacturing industry, because effective IM will enable an enterprise to minimize inventory cost on the one hand and avoid the consequence of shortage of materials on the other. This assumes significance in the particular context of SMEs, because excess inventory and shortage of materials are often the two main problems found in SMEs regarding IM (Eloranta & Raisanen, 1988).

What are the factors that influence the inventory costs in SMEs? What are the factors that influence their ITRs? Is there any relationship between inventory cost and ITR? Apparently no study has attempted to answer these questions in the context of Indian SMEs. Therefore the objective of this paper is to bridge this gap in the context of machine tool SMEs in Bangalore. The paper is organized in five

doi:10.3926/jiem.2010.v3n3.p542-560 JIEM, 2010 – 3(3): 542-560 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

sections. Literature review is presented in section 2 and section 3 presents the objectives, scope and methodology. Section 4 comprises analysis of IM in SMEs followed by inferences and conclusions of the study explained in Section 5.

2 Inventory Management in SMEs: A review of literature

Many researchers have analyzed different IM practices and performance and these studies have amassed an enormous knowledge related to IM and operational performance of enterprises. Maria and Jones (2003) argue that implementation of IM practice involves providing high quality products at relatively less cost. Ballou, (2000) argues that inventory cost should be considered while taking inventory decisions. He found that inventory carrying costs typically range from 20% to 40% of inventory value. Palmer and Dean (2000) are of the opinion that selection of right IM practice is a must for a company's IM performance.

The linkages between IM and competitive advantages have been discussed by many authors in the context of large enterprises. Reducing throughput time by faster value addition to the materials clearly would lead to a competitive edge. This would lead to advantage on the inventory cost front also. Inventory costs are reduced as materials spend less time in the system. The importance of lead-time as a measure of inventory effectiveness has been mentioned by Rabinovich, Martin and Philip (2003). Ng, Partington and Sculli (1993) are of the opinion that long lead times and large usage fluctuation call for higher re-order stock levels and vice-versa.

Chandra and Grabis (2005) argue that a reduction in the inventory replenishment lead-time allows reducing safety stock and improving customer service. Wallin, Rugtusanatham and Rabinovitch (2006) also view lead-time as an important inventory element. Elorantha and Raisanen (1988) argue that one of the reasons for keeping large amount of inventory items has been related to customer service. Another reason is that smaller purchasing lots imply more work in purchasing department. However, Toelle and Tersine (1989) argue that excess inventory is an operational liability, because it uses valuable storage space, increases inventory costs. Raw material ordering frequency is identified as an important factor contributing to inventory cost. Frequent ordering in small quantity is considered as an important strategy. This is very relevant in the context of SMEs. This is because

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SMEs generally don't get the benefits of quantity discount. Their purchase requirement quantity of material is normally less to enable them to get these benefits.

A project to improve IM in a UK based SME found the importance of categorizing stock and setting ordering policies. A scheme developed for the above purpose found useful in optimizing inventory costs (Flores, Wang, & Burgess, 2003). The management of SME studied viewed the need for a more formal procedure to calculate its inventory policy parameters (maximum and minimum inventory level). In their own words, the growing investment in inventory combined with an increasing number of backorders and lost sales lead to lower profitability. Therefore it was decided to follow a more scientific approach than the currently used rules of thumb to establish inventory policy parameters with the objective of optimizing their inventory cost.

To exercise inventory planning and control, the understanding of the factors influencing IM is necessary. This will enable SMEs to select an appropriate IM practice in their enterprise. Though the role of IM practices of a firm, their inventory cost on order quantity and hence on inventory performance is well explained in theory, an empirical evaluation of the same is not done so far in the context of SMEs, particularly in developing countries. In this context, this study is an attempt to identify the factors influencing inventory cost and ITR with respect to the machine tool SMEs in Bangalore.

3 Objectives, scope and methodology

3.1 Objectives

1) To understand IM practices, inventory cost and related issues in SMEs.

2) To probe the factors that influence inventory cost and ITR in SMEs.

3.2 Scope and methodology of the study

The study is confined to machine tools industry in the city of Bangalore in India. Machine tools industry is rather the most important manufacturing industry concentrated in and around Bangalore (PIA, 2003). It is also considered an inventory intensive industry having formal or informal relationship with various

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large enterprises including Multi Nationals (MNCs) located in the city. The quality and cost of engineering products depends on the performance level of parent machine tools industry and their automation levels. The development of machine tool industry is therefore of paramount importance for a competitive and self-reliant industrial structure. Therefore, this sector is considered appropriate for our study.

As there is no systematic database of machine tool SMEs located in Bangalore, we decided to focus on a maximum number of 100 SMEs in this sector. From these SMEs we gathered data through a semi structured questionnaire having five sections on basic features, IM practices and performance, economic variables, production details, factors hindering/ facilitating IM. Respondents were asked to gauge the extent to which they agreed with the given statements regarding each question. Mostly items were formulated as short statements and respondents were asked to provide their views on a five point Likert scale. The data collection exercise was carried out by the author himself during September 2006 to February 2007. From a total of 100 SMEs covered, nine enterprises were eliminated due to incomplete information. The methodologies adopted for the data analysis are descriptive analysis, rank correlation and regression analysis.

4 Analysis of IM practices and IM performance in Indian SMEs

Since the machine tool SMEs are inventory-intensive in nature with a significant portion of their production cost involving material and inventory related cost, it is likely that the entrepreneurs recognize its due importance. It is with the above backdrop that understanding the present perception of SMEs about the importance of IM is appropriate. Out of 91 SMEs surveyed, all the SMEs explicitly stated that IM is very important for a firm's performance. This brings out that the level of awareness about the need and importance of IM practices is significantly high among the machine tool SMEs of Bangalore.

Given this, it is appropriate to look at these SMEs to ascertain how many of them follow IM practices and what kinds of IM practices do they pursue. Table 1 presents how many SMEs follow IM practices and how many do not, and what kind of IM practices are pursued. The table brings out that 22 SMEs did not pursue any IM practice at all. This brings out that there are some SMEs which consider IM

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practice important for firm performance but at the same time do not pursue any kind of IM practices. This is primarily due to lack of motivation on the part of the concerned entrepreneurs. This could also be because though they have an explicit feeling that IM is important, they have not explicitly realized its role either by looking at others' experience or by an explicit emphasis in Indian SME policies.

Sl. No	IM practice followed	Number of firms
1	No practice	22
2	Thumb rules	25
3	EOQ (Economic Order Quantity)	10
4	ABC (Always Better Control)	20
5	Computerized IM	4
6	Just-in Time (JIT) / Vendor Managed Inventory (VMI)	10
	Total	91

Table 1. "IM practices followed in SMEs".

Among various kinds of IM practices, the most significant one pursued by the maximum number of SMEs is that based on thumb rules: 25 of the 91 enterprises followed some informal practices based on thumb rules. The second most significant IM practice followed by SMEs is ABC (20 firms). About 10 SMEs follow EOQ whereas those SMEs which pursued computerized IM techniques are only four and about 10 of them followed JIT/VMI. VMI is defined as one of the supply chain strategies where the vendor or supplier is given the responsibility of managing the customer's stock based on the shared information between them (Klir & Yuan, 2003). All these bring out that modern IM practices are largely absent among SMEs, even in an inventory-intensive manufacturing industry.

An important aspect that might determine the kind of IM practice followed by an SME is the frequency of material purchase. In our sample we found that 12 SMEs purchased Raw Materials on a daily basis, 32 SMEs placed orders for Raw Material (RM) on a weekly basis and 23 of them on a fortnightly basis whereas 22 SMEs did it on a monthly basis. Only two SMEs purchased raw materials on a quarterly basis. Thus it is clear that majority of the machine tool SMEs resorted to raw material purchase ranging from a daily basis to a monthly basis. This is quite understandable given the limited financial capability of SMEs. However, it is important to understand why the raw material purchasing frequencies vary from daily basis to monthly basis.

How frequently an SME would resort to raw material purchase might depend upon the kind of IM practice adopted by it. Therefore, it is necessary to understand how

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does the raw material ordering frequencies of SMEs vary vis-à-vis the kind of IM practices pursued by them. Table 2 shows such a distribution. It appears that those SMEs which did not pursue any kind of IM practice resorted to less frequent raw material ordering. Whereas those SMEs which adopted computerized IM/JIT/VMI resorted to more frequent raw material ordering.

IM Practice	RM Ordering Frequency					
	Daily	Weekly	Fortnightly	Monthly	Quarterly	Total
No Practice	1	5	10	6	0	22
Thumb Rules	3	5	7	10	0	25
EOQ	2	3	3	2	0	10
ABC	2	11	3	2	2	20
Computerized IM	0	4	0	0	0	4
JIT/ VMI	4	4	0	2	0	10
Total	12	32	23	22	2	91

Table 2. “IM Practices and Raw Material Ordering Frequency”.

To further ascertain whether there is any statistically significant relationship between the two variables, we carried out rank correlation analysis: raw material ordering frequencies were ranked from one to five as follows: Quarterly (5), Monthly (4), Fortnightly (3), Weekly (2) and Daily (1). IM practices are ranked from one to six as follows: No practice (6), Thumb rules (5), EOQ (4), ABC (3), Computerized IM (2), and JIT/VMI (1). The rank correlation analysis brought out that there is a statistically significant positive correlation (0.343) between raw material ordering frequencies and IM practices.

The need for raw material purchase will also be realized based on stock verification exercise done by these enterprises. Our survey results indicate that only four SMEs did stock verification on a daily basis. Another eight did it on a fortnightly basis and 25 SMEs did stock verification on a monthly basis. Whereas the remaining 54 enterprises did stock verification quarterly or only once a year. Thus the frequency of stock verification exercise is also important for raw material purchase on the one hand and IM practices and IM cost on the other. Table 3 shows stock verification details. It appears that those SMEs which did not pursue any kind of IM practice resorted to less frequent stock verification. Whereas those SMEs which adopted computerized IM/JIT/VMI resorted to more frequent stock verification.

To further ascertain whether there is any statistically significant relationship between the two variables, we carried out rank correlation analysis: stock verification frequencies were ranked from one to five as follows: Yearly (5),

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Quarterly (4), Monthly (3), Fortnightly (2), and Daily (1). IM practices are ranked from one to six as in the previous case. The rank correlation analysis brought out that there is a statistically significant positive correlation (0.480) between stock verification frequencies and IM practices.

IM Practice	Stock Verification Frequency					
	Daily	Fortnightly	Monthly	Quarterly	Yearly	Total
No Practice	0	1	3	7	11	22
Thumb Rule	2	0	3	10	10	25
EOQ	0	0	7	1	2	10
ABC	0	0	10	5	5	20
Computerized IM	1	1	1	1	0	4
JIT/VMI	1	6	1	1	1	10
Total	4	8	25	25	29	91

Table 3. “IM Practice and Stock Verification Frequency”.

An important determinant of IM practice pursued by SMEs can be their size itself. The larger the size of an SME greater might be the scope for the adoption of more sophisticated IM practice and vice versa (Vergin, 1998). The size of a SME can be measured either in terms of number of employees or in terms of investment. The study indicates that SMEs irrespective of size do not have sophisticated IM practices. To further ascertain whether there is any statistically significant relationship between size of investment/ number of employees and IM practices we carried out correlation analysis which indicates that there is no statistically significant correlation between the two variables.

This made us wonder whether the type of production has any relationship with the IM practice pursued by a SME. Table 4 presents such a distribution. It gives some indication that those SMEs which follow job shop/batch production processes either do not have any IM practice or follow thumb rule/EOQ/ABC based IM practice. On the other hand those SMEs which have mass production/flow shop production processes adopt computerized IM/ JIT/VMI practices. The correlation analysis brought out that there is a statistically significant positive (0.825) correlation between the two implying that production process has a significant relationship with the kind of IM practice that SMEs would adopt. This is understandable because production types such as mass production and flow shop production require more frequent stock verification and raw material purchases and are compatible with better inventory practices. Whereas job shop/ batch production systems do not call for either frequent stock verification or frequent raw material purchase and can be managed even without any IM practice.

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Type of IM Practice	Type of Production				
	Job shop	Batch Production	Mass Production	Flow Shop	Total
No Practice	10	12	0	0	22
Thumb Rules	15	9	1	0	25
EOQ	3	5	2	0	10
ABC	10	2	2	6	20
Computerized IM	0	0	1	3	4
JIT/ VMI	0	0	4	6	10
Total	38	28	10	15	91

Table 4. “Type of production and IM practices”.

Given all these, it is appropriate to know whether inventory cost per sales has any relationship with either IM practices or raw material purchase or stock verification frequency. To ascertain the relationship between the number of raw material ordering frequencies and inventory cost per sales, we did a rank correlation analysis. Inventory cost per sales is defined as the ratio between the yearly inventory cost and the annual sales, expressed as a percentage. The inventory costs are ranked from one to five to cover the ranges of 0 -5 %, >5 – 10%, >10 – 15%, >15 – 20% and above 20% respectively. Similarly raw material ordering frequencies is numbered from one to five ranging from daily (5), weekly (4), fortnightly (3), monthly (2) and quarterly (1). The statistically significant negative correlation between the two variables implies that if the number of raw material ordering frequency is more inventory cost per sale is likely to be less.

To further understand what kind of relationship exists between the stock verification frequency and inventory cost per sales, we did rank correlation analysis between number of frequencies of stock verification and inventory cost per sales. The inventory costs are ranked from one to five as in the previous case. The number of frequencies of stock verification are ranked one to five to represent the frequencies of stock verification ranging from annual (1), quarterly (2), monthly (3), fortnightly (4), daily (5). The results (Table 6) clearly show that there is a statistically negative correlation between the number of frequencies of stock verification and inventory cost per sale. This indicates that those SMEs which verify their stocks on a daily basis have less inventory cost per sales compared to others which do stock verifications on a monthly, quarterly, semi- annually and annual

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basis. Those SMEs, which monitor their stocks on a day to day basis, are able to better understand their purchase requirements and place orders accordingly.

Since we have already seen positive correlation between IM practices and raw material ordering frequency and a negative correlation between raw material ordering frequency and inventory cost per sales, it is likely that there will be a negative correlation between IM practices and inventory cost per sales. The distribution of SMEs in terms of inventory cost per sales vis-à-vis IM practices is presented in Table 5.

	Inventory Cost per Sale					
IM Practices	0 - 5	>5 - 10	>10 – 15	>15 - 20	> 20	Total
No Practice	1	3	9	8	1	22
Thumb Rules	2	17	6	0	0	25
EOQ	4	3	3	0	0	10
ABC	5	12	0	3	0	20
Computerized IM	3	0	1	0	0	4
JIT/ VMI	3	7	0	0	0	10
Total	18	42	19	11	1	91

Table 5. “Inventory Practices and Inventory Cost per Sale”.

Variables	Correlation Coefficient
Raw Material Ordering Frequency and IM Practice	0.343**
Stock Verification Frequency and IM Practice	0.480**
Inventory Cost per Sales and IM Practice	-0.522**
Capital Investment and IM Practice	0.104
Labour and IM Practice	0.127
Inventory Cost per Sales and RM Ordering Frequency	-0.260*
Inventory Cost per Sales and Stock Verification Frequency	-0.297**
Inventory Cost per Sales and Production Type	-0.201

* Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Table 6. “Rank Correlation between Variables”.

From the above analysis we are able to identify factors such as raw material ordering frequency, stock verification frequency which influence the inventory cost per sales. To ascertain their joint influence we carried out a regression analysis where inventory cost per sales is the dependent variable and IM practices, raw material frequency and stock verification frequency are the explanatory variables. For IM practices we used two dummy variables- $dummy_{IM1}$ and $dummy_{IM2}$. $Dummy_{IM1}$ represented SMEs which pursued IM practices based on thumb rules, EOQ, ABC and $dummy_{IM2}$ represented SMEs which pursued modern IM practices such as computerized IM, JIT/VMI.

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To represent raw material purchase frequency we used a dummy variable D_{RF} where the dummy variable took the value of zero for monthly and quarterly purchases and one for daily, weekly, and fortnightly purchases. To represent stock verification frequency we used a dummy variable D_{SK} where the dummy variable took the value of zero for annually and semi-annually stock verification and one for daily, fortnightly, and monthly stock verifications. Similarly for the production type we used a dummy variable D_{PT} where the dummy variable took the value of zero for those SMEs which follow job shop/batch shop production and one for those follow mass production and flow shop production. Thus the regression equation is as follows: $INV_{c/s} = b_0 + b_1D_{IM1} + b_2D_{IM2} + b_3D_{RF} + b_4D_{SK} + b_5D_{PT,}$ Where b_0, b_1, b_2, b_3, b_4, b_5 are beta coefficients of the variables. The regression results are presented in Table 7.

SMEs →	Machine Tool
D_{1M1}	-0.622 (-5.914) [0.000]
D_{IM2}	-0.528 (-3.550) [0.001]
$D_{RM\ ORDERING\ FREQUENCY}$	-0.023 (-0.261) [0.795]
$D_{PRODUCTION\ TECHNOLOGY}$	-0.093 (-0.700) [0.486]
$D_{STOCK\ VERIFICATION\ FREQUENCY}$	0.044 (0.485) [0.629]
Constant	13.582 (12.923) [0.000]
Adjusted R^2	0.327
F	9.750 (0.000)
N	91

Values within the parentheses and square brackets are 't' values and significance level.

Table 7. "Regression Analysis of Inventory Cost per Sale with IM Type, RM Ordering Frequency, Production Type and Stock Verification Frequency (Dependent Variable: Inventory Cost per Sales)"

The model is statistically significant as the F-value is significant at 0% level. The model has a significant explanatory power as it explains almost 33% of the variations in inventory cost per sales as reflected by the adjusted R^2. Though the values of coefficients of all the variables are negative indicating their negative relationship with inventory cost per sales only the coefficients of two dummy variables of the IM practices are statistically significant. This brings out that those SMEs which pursue IM practices either based on thumb rules, EOQ, ABC or based on computerized IM, JIT/VMI will be able to realize or achieve lower inventory cost per sales compared to those SMEs which do not pursue any IM practice. This implies that adopting at least some kind of an IM practice is to the advantage of SMEs.

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The analytical description of IM practices of SMEs from various dimensions enabled us to understand the extent and diversity of IM practices pursued and its relationship to the inventory cost per sales of SMEs, among others. What is particularly important is that those SMEs which adopted a superior IM practice are able to achieve lower inventory cost per sales. It is with this backdrop that an understanding of ITR in SMEs has to be understood. ITR is defined as the ratio between the annual sales and the amount spent for materials required for production. The ITR is the most commonly used technique to study the IM performance of enterprises (Vergin, 1998; Rabinovich et al., 2003; Vastag & Whybark, 2005; Koumanakos, 2008; Rao & Rao, 2009). Zeng and Hayya (1999) used ITR in evaluating management effectiveness and observed that ITR is a good measure of IM effectiveness of enterprises.

Considering the above it is appropriate to understand the variance of ITR among SMEs of our study. The ITR ratios of SMEs are presented in Table 8. It is significant to note that 58 SMEs had an ITR up to five; 23 SMEs had an ITR in the range of above five to 10; hardly 10 SMEs had a ratio of more than 10. This indicates that by and large SMEs have lower ITRs implying that there is enough scope to improve their inventory performance.

No	ITR value	Number of firms
1	0 to 2.5	20
2	>2.5 to 5	38
3	>5 to 7.5	15
4	>7.5 to 10	8
5	Above 10	10
	Total	91

Table 8. “Distribution of ITRs of SMEs”.

If ITRs of SMEs vary, it is essential to understand whether and how do they vary with kinds of IM practices pursued, among others. The variance of ITR of SMEs between different IM practices is presented in Table 9. It is significant to observe that those SMEs which did not pursue any IM practice had a lower ITR whereas those SMEs which pursued sophisticated IM practices had higher ITRs. This underlines the importance of the necessity for SMEs to adopt better IM practices as that is likely to enable them to improve their ITRs. To further substantiate the relationship between ITRs and IM practices, we did rank correlation analysis. The IM practices are ranked from one to six as in the previous case. The ITRs are

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ranked from 0 – 2.5 (5), >2.5 – 5 (4), >5 – 7.5 (3), >7.5 – 10 (2), and > 10 (1). The statistically significant positive correlation between the two variables substantiates our inference that better the IM practice adopted by an SME, higher is its ITR.

	ITR					
IM Practices	0 – 2.5	>2.5 - 5	>5 – 7.5	>7.5 – 10	> 10	Total
No practice	17	3	1	1	0	22
Thumb rules	3	19	2	1	0	25
EOQ	0	3	4	2	1	10
ABC	0	8	5	4	3	20
Computerized IM	0	1	2	0	1	4
JIT/ VMI	0	4	1	0	5	10
Total	20	38	15	8	10	91

Table 9. "Inventory Practices and ITR".

Given the relationship between IM practice and ITR we are keen to understand how ITR varies with raw material ordering frequency. The relationship in terms of distribution of SMEs between raw material ordering frequencies and ITRs is presented in Table 10. It is understandable that those SMEs which resorted to less frequent raw material ordering had a lower ITR. On the other hand a significant proportion of those SMEs which resorted to more frequent raw material ordering particularly on a daily basis and on a weekly basis had ITRs ranging from 7.5 and above. Our correlation analysis further substantiated this positive relationship. The rank correlation coefficient was 0.401.

	RM Ordering Frequency					
ITR	Daily	Weekly	Fortnightly	Monthly	Quarterly	Total
0 – 2.5	2	8	8	2	0	20
> 2.5 – 5	4	11	11	12	0	38
> 5 – 7.5	0	6	1	8	0	15
> 7.5 – 10	2	2	2	0	2	8
> 10	4	5	1	0	0	10
Total	12	32	23	22	2	91

Table 10. "Raw Material Ordering Frequencies and ITR".

The next pertinent issue is whether ITR varies systematically between types of production of SMEs. Table 11 shows the distribution of SMEs in terms of types of production and ITRs. The table enables us to infer that those SMEs which have job shop production and batch production have lower ITRs whereas those which have mass production and flow shop production system have relatively high ITRs. Our rank correlation between types of production (job shop (1), batch production (2), mass production (3), flow shop (4)) and ITRs (0 - 2.5 (1), >2.5 - 5 (2), >5 – 7.5

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(3), >7.5 – 10 (4), >10 (5)) brought out that there is a statistically significant, though lower, positive correlation (0.294) between the two variables.

ITR	Type of Production				
	Job shop	Batch Production	Mass Production	Flow Shop	Total
0 – 2.5	12	8	0	0	20
> 2.5 – 5	17	13	3	5	38
> 5 – 7.5	3	7	0	5	15
> 7.5 – 10	5	0	3	0	8
>10	1	0	4	5	10
Total	38	28	10	15	91

Table 11. "Type of Production and ITR".

Given the above we are keen to understand whether the size of SMEs has anything to do with the ITRs. Our analysis between size of enterprises (measured in terms of capital and labour respectively) and ITRs brought out that size has nothing to do with ITRs. Considering the above analysis it is important to understand the relationship between ITR and inventory cost per sales. Other things remaining the same, there has to be a negative relationship between the two variables implying that those SMEs which have lower inventory cost per sales are likely to have higher ITRs and vice versa. Table 12 presents the distribution of SMEs in terms of inventory cost per sales on the one hand and in terms of ITRs on the other. The table indicates that SMEs having lower inventory cost per sales tend to have high ITRs. The high statistically significant negative correlation (-0.638) supports this inference.

ITR	Inventory cost per sales					
	0 - 5	>5 - 10	>10 - 15	>15 - 20	> 20	Total
0 – 2.5	1	6	7	6	0	20
> 2.5 – 5	4	25	9	0	0	38
> 5 – 7.5	2	6	1	5	1	15
> 7.5 – 10	3	3	2	0	0	8
> 10	8	2	0	0	0	10
Total	18	42	19	11	1	91

Table 12. "ITR and Inventory Cost per Sale".

Variables	**Correlation Coefficient**
ITR and IM Practice	0.692**
ITR and Capital Investment	0.076
ITR and Labour	0.123
ITR and Raw Material Ordering Frequency	0.401**
ITR and Production Type	0.294**
ITR and Inventory Cost per Sales	-0.638**

** Correlation is significant at the 0.01 level (2-tailed).

Table 13. "Rank Correlation between ITR and Other Factors".

Journal of Industrial Engineering and Management
doi:10.3926/jiem.2010.v3n3.p542-560 JIEM, 2010 – 3(3): 542-560 – Online ISSN: 2013-0953
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Given the above it is important to ascertain what factors determine the level of ITR in a SME. The possible factors could be (1) the sophistication of IM practice, (2) frequency of raw material ordering, (3) implementation level of modern manufacturing practices, and (4) inventory cost per sales. To ascertain whether these factors do really have an influence on ITR, we carried out a regression analysis as follows: ITR = $b_0 + b_1$ inc+ $b_2 D_{IM1} + b_3 D_{IM2} + b_4 D_{RF} + b_5 D_{PT,}$ Where ITR = Inventory Turnover Ratio, b_0, b_1, b_2, b_3, b_4, b_5 are beta coefficients of the variables, D_{IM1} and D_{IM2} are dummy variables for IM practices, D_{RF} is the dummy variable for raw material purchase frequency, D_{PT} is the dummy variable for the production type respectively as explained in the previous analysis.

The results are given in Table 14. The model is statistically significant and it explains almost 38% of the variation in ITR. But IM practices based on thumb rule, EOQ, and ABC do not make any difference compared to SMEs which do not follow any IM practices. However, SMEs which pursue modern IM practice such as computerized IM, JIT/VMI are able to achieve higher ITR as reflected in the positive coefficient of the variable (though it is significant only at the 20% level). In addition both raw material ordering frequencies and production types have statistically significant positive influence on ITR.

SMEs →	Machine Tool
$INV_{C/S}$	-0.371 (-3.556) [0.001]
D_{1M1}	-0.003 (-0.029) [0.977]
D_{IM2}	0.196 (1.279) [0.204]
D_{RF}	0.168 (2.002) [0.048]
D_{PT}	0.202 (1.597) [0.114]
Constant	6.092 (3.093) [0.003]
Adjusted R^2	0.377
F	11.871 (0.000)
N	91

Values within the parentheses and square brackets are 't' values and significance level

Table 14. "Regression Analysis of ITR with Inventory Cost per Sale, IM, Raw Material Ordering Frequency and Production Type (Dependent Variable: ITR)".

We are more particular about how IM practices and inventory cost per sales influence ITR. Therefore, we carried out a separate regression analysis as follows: ITR = $e_0 + e_1$ inc+ $e_2 D_{IM1} + e_3 D_{IM2}$, where $e_{0,}$ $e_{1,}$ $e_{2,}$ and e_3 are beta coefficients of the variables, D_{IM1} and D_{IM2} are dummy variables for sophistication of IM practices respectively. The results are presented in Table 15. The model is significant though the explanatory power has come down marginally. The dummy

Journal of Industrial Engineering and Management
doi:10.3926/jiem.2010.v3n3.p542-560 JIEM, 2010 – 3(3): 542-560 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

variable representing SMEs which pursue thumb rules, EOQ, ABC based IM practices is not statistically significant. But the dummy variable representing SMEs which pursue computerized IM, JIT, VMI practices is statistically significant indicating its positive influence on ITR. Inventory cost per sales has a statistically significant negative influence. The overall analysis above bring out clearly that adopting superior IM practices is likely to enable SMEs to achieve a reduction in their inventory cost per sales and an increase in their ITRs.

SMEs →	Machine Tool
$INV_{C/S}$	-0.389 (-3.636) [0.000]
D_{1M1}	0.019 (0.157) [0.876]
D_{IM2}	0.371 (3.108) [0.003]
Constant	7.772 (4.156) [0.000]
Adjusted R^2	0.341
F	16.547 (0.000)
N	91

Values within the parentheses and square brackets are 't' values and significance level

Table 15. "Regression Analysis of ITR with Inventory Cost per Sale and IM Practices (Dependent Variable: ITR)".

5 Inferences and conclusions

SMEs in inventory intensive manufacturing industries are likely to be aware of the need and importance of IM practices. Our study with reference to machine tools SMEs in Bangalore has indicated that these SMEs without exception are indeed aware of the importance of IM practices. However, when it comes to practice, almost one fourth of them did not pursue any kind of IM practice. This is primarily due to lack of motivation as well as lack of perception of immediate financial gains. Among the rest, 25 SMEs pursued IM practice based on thumb rules. Those who pursued EOQ/ABC accounted for about 30 whereas only 14 SMEs pursued modern IM practices such as computerized IM/ JIT/VMI. Thus modern IM practices are only confined to a minority even in the inventory intensive machine tools manufacturing industry. Our subsequent analysis brought out that those which pursued better IM practices also resorted to more frequent stock verification as well as raw material ordering.

Study brought out that two important dimensions of IM are inventory cost per sales and ITR. Those SMEs which could achieve better IM should be able to achieve lower inventory cost per sales as well as higher ITR. If that is so those SMEs which

doi:10.3926/jiem.2010.v3n3.p542-560 JIEM, 2010 – 3(3): 542-560 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

pursue modern inventory practices should be able to achieve lower inventory cost per sales and higher ITR. Our study brought out that this has indeed been the case in the context of machine tool SMEs. Our final analysis brought out clearly that better IM practices have a positive influence whereas inventory cost per sales has a negative influence on ITR. All these enable us to infer that it is appropriate to encourage SMEs to adopt better IM practices because that would enable them to achieve lower inventory cost per sales and higher ITRs.

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