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Application of SWOT and Principal Component Analysis in a Textile Company - A Case Study

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Abstract—*Many companies are conducting a SWOT analysis as part of their strategic planning. This is the process to identify the strengths, weaknesses, opportunities and threats before proceeding to the formulation of their long and short term strategy. This article seeks to identify the SWOT variables to make better strategic planning through empirical study. After identifying thirty three SWOT variables, a rating type questionnaire have been made, and all the top management, managerial level and supervisory level (125 no) staff members were surveyed by interview method in a leading textile company in south India. Principal component analysis was used to reduce and group the SWOT variables. From this analysis nine non-significant variables are removed from the SWOT data set, and twenty four are found as significant for further analysis. After identifying twenty four SWOT variables, SWOT matrix was formed based the prioritized SWOT variables with four quadrants; maxi – mini (ST strategy), mini – mini (WT strategy), mini – maxi (WO strategy) and maxi-maxi (SO strategy). This will help the company to overcome the external threats and also to plan their short term and long term strategies.*

Keywords—*SWOT analysis, Textile, Strategic Planning, Principal Component Analysis, Case study*

I. INTRODUCTION TO SWOT ANALYSIS

Many companies are conducting a SWOT analysis as part of the strategic planning process to identify strengths, weaknesses, opportunities and threats before proceeding to the formulation of a strategy (Houben et al., 1999; Roth and Washburn, 1999). SWOT analysis, meaning the analysis of 'key' or 'critical' success factors, belongs to the highest ranked set of techniques of strategic analysis used by firms in empirical surveys (Glaister and Falshaw, 1999). Most of literatures are covering the strategic planning process; most approaches include a cyclic iteration of the following five elements. (i) Strategic planning process begins with a statement of the corporate mission and goals. (ii) Analysis of the organization's external competitive environment. (iii) Analysis of the organization's internal operating environment. (iv) Selection of focused organization strategies. (v) Implementation of the selected strategies. The last step also involves the design of the organizational structure and control systems necessary to implement the chosen strategy (Hax and Majluf, 1991). The focus of this article lies upon step 2 (external analysis) and step 3 (internal analysis). The main purpose of the external analysis is to identify opportunities and threats in the organization's operating environment, while the internal analysis seeks to count the organization's strengths and weaknesses.

1.1 AN OVERVIEW OF INDIAN TEXTILE INDUSTRY

The Indian Textile Industry has an overwhelming presence in the economic life of the country. Apart from providing one of the basic necessities of life, the textile industry also plays a pivotal role through its contribution to industrial output, employment generation, and the export earnings of the country. It contributes about 14 per cent to industrial production, 4 percent to the GDP, and 16.63 percent to the country's export earnings. It would provide direct employment to over 35 million people by 2010 to 2011 (Texmin 2005). The textile sector is the second largest provider of employment after agriculture. Thus, the growth and all round development of this industry has a direct bearing on the improvement of the economy of the nation. In India's current scenario, textile industry is facing more challenges (cotton and yarn price fluctuation, effluent treatment and discharge, customer expectation on high quality and disposal of solid waste) from all the areas of business. For facing these challenges, organization has to plan their effective long and short range strategy. Before starting the strategic planning, the organization has to identify their internal capabilities and their competitive environment. SWOT analysis is one of the self evaluating tools to measure the company internal capabilities and external competitive environment.

In this article the SWOT analysis of a leading textile company in south India is dealt. This company is having its entire value chain of textile process. Our research interest is the processing unit (dyeing, printing and finishing) of that company. Textile processing is the most critical link in the textile value chain (Figure 1) of any textile company. This article concentrates the textile processing unit's internal and external analysis (SWOT) for determining its short and long range strategy.

Figure 1: Textile industry value chain

1.2 INTRODUCTION TO PRINCIPAL COMPONENT ANALYSIS (PCA)

SWOT analysis can determine a perfect foundation for successful strategy formulation (Kajanus et al., 2004). However, SWOT analysis has weakness in the measurement and evaluation steps (Hill and Westbrook, 1994, Christianson, 2002). As planning processes are often complicated and difficult by numerous criteria, it may be that utilization of SWOT is insufficient to assess the appropriateness of decision alternatives based on these factors. Therefore, SWOT analysis alone cannot comprehensively assess the strategic decision-making process (Shrestha et al., 2004, Kurttlia et al 2000).

Principal component analysis (PCA) is a standard tool used in diverse fields from neuroscience to computer graphics - because it is a simple, non-parametric method for extracting relevant information from confusing data sets. With minimal effort PCA provides a method to reduce a complex data set to a lower dimension to reveal the sometimes hidden, simplified structures that often underlie it (Jonathan, 2009). It is one of the most widely used multivariate technique which involves a mathematical procedure that transforms a number of correlated variables into a lesser number of uncorrelated variables called principal components (Alberto, 2000). Even though the objective of PCA may be to reduce the number of variables of a dataset it retains most of the original variability in the data. The first principal component accounts for as much of the data variability as possible and succeeding components account for as much of the remaining variability as possible (Hair et al., 2006).

In this study an attempt is made to make use of principal component analysis (PCA) to overcome the drawbacks of SWOT analysis. PCA helps to reduce number of the SWOT variables. Based on the selected significant variables the SWOT matrix is formed.

The main objectives of this paper are,

- To identify the SWOT variables of the textile company.
- To find the significant SWOT variables.
- To form the SWOT matrix of the textile company.

This paper is organized as follows: The literature review of SWOT analysis in textile industry and principle component analysis is presented followed by the methodology used for the study with a case of a textile company is given. A step by step approach for forming SWOT matrix with the help of PCA is given Finally this article concludes with the SWOT matrix which will provide company's long and short range strategic planning.

II. LITERATURE REVIEW

The following are the review of literatures on SWOT analysis in the area of textile sector. Sandeep and Goswami, (2007), have applied SWOT analysis in Indian handmade carpets industry. That SWOT analysis confirmed that engaging handmade carpet work produces gainful employment resulting socio-economic growth. Ramesh (2006) applied SWOT analysis of garment industry and this paper analyzed the barriers in the garment exporters in district Salem, India. In this article SWOT analysis is used to determine the textile company's long and short range strategic planning through a systematic approach. Yuksel and Dagdeviren, (2007) have applied the strategic decision making (SWOT) for a textile company; this paper demonstrated the process for quantitative SWOT analysis. Hussain et al., (2009) have made a study to identify internal and external factors relevant to textile and clothing supply chain in Pakistan using SWOT analysis. These factors played an important role in the development of strategies which are useful for improving the competitiveness of the chain. Hussain et al., (2010) have focused to examine the potential of different strategies formulated by expert's guidance with focus on Pakistan's case. Rezaie et al., (2010) have made a novel systematic method to obtain the most proper organizational safety strategies in a textile company in Iran by utilizing SWOT concepts. After finding the SWOT factors 'DEMATEL' method was applied to find inter relations and casual diagram of factors for each four clusters separately.

Li Chuang, (2009) made a study on regional competitiveness evaluation of textile industry in China. The work adopted principal component analysis (PCA) method to calculate and rank the competitive level of textile industry of 31 provinces in China. Ludovic et al., (2007), made an objective evaluation method of seam pucker in textile samples for automated quality control. This method is based on 3D image analysis. PCA decreases the number of features in their 3D modeling of seam pucker. Safi et al., (2009) applied principal component analysis technique to K/S data to find an optimum linear concentration textile dyestuff color range. The results showed that an appropriate range of concentration can be recognized by the percent variation for the first eigenvector. In addition, the ratio of eigenvalues corresponding to the first eigenvector in both synthesized and commercial sample (standard) is described as a criterion for determination and control of relative color strength. Tina et al., (2009) focused on water quality classification of the textile waste water streams and evaluation of pollution. Data from the chemical characterization of the effluents were elaborated to identify a useful separation in potentially treatment for reuse. This was done with the aim of realizing a full scale characterization of effluents.

For handling the results different chemometric methods, namely, principal component analysis (PCA), cluster analysis (CA), and linear discriminant analysis (LDA) were used to find hidden information about textile waste water quality.

From the above review of literatures of SWOT analysis, none of the study had focused to determine the important SWOT variables. Since SWOT analysis will provide more number of variables some of which are really less significant. It is important to identify by analytical means the non-significant SWOT variables and to eliminate them from further analysis to make better strategic planning. From the review of PCA literatures, this tool has been applied various areas (Textile quality control, seam puckering, dyestuff comparison, textile waste water) of textile industry to handling the data reduction and analysis. In this article a methodology is proposed to reduce SWOT variable data with use of PCA for strategic planning.

III. METHODOLOGY

The proposed methodology is given in flow chat (Figure 2), which starts from SWOT variables identification, data collection from all the staff members of the company, followed by PCA analysis. PCA results in reducing and grouping of the SWOT variables. Based on the SWOT variables, the SWOT matrix is formed for strategy planning.

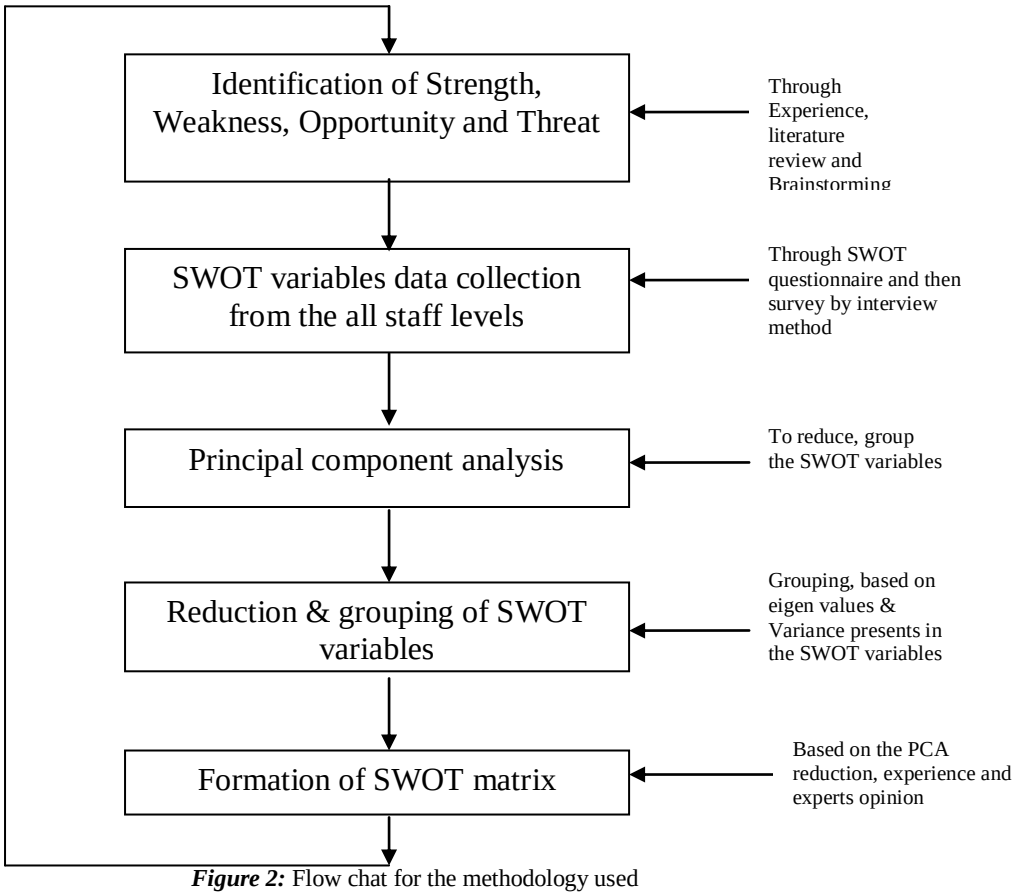

Figure 2: Flow chat for the methodology used

Table 1 shows the company's strength, weakness, opportunity and threat. The thirty three SWOT variables are identified based on the prior experience of the researcher and also with the help of brainstorming method. The same is made as rating type questionnaire. All the thirty three questionnaires are evaluated in qualitative nature. The questionnaires are surveyed by interview (Edward Bernroider., 2002, Koo et al., 2008 and Hannah Koo et al., 2011) through all the (125 no) staff members in top management, managerial level and supervisory level of the company (Gorsuch, 1983). They are asked to rate the variables on Likert 7 point scale (1-Extremely unimportant, 2-Quite unimportant, 3-Slightly unimportant, 4-Neither unimportant nor important, 5-Slightly important, 6-Quite important and 7-Extremely important).

Table 1: SWOT variables of the textile company

SWOT	SWOT Variables	Description
Strength	1. Mass production setup ($I1_s$)	High volume production capacity per unit time
	2. Cost conscious business ($I2_s$)	Product costing in all the aspects (Production cost, purchasing cost, market selling price and cost involved in the entire supply chain)

	3. Strong R & D for dyeing and finishing ($I3_s$)	Research and Development activities for new product development and existing product improvement
	4. Low labour cost ($I4_s$)	Low cost direct, contract and casual manpower
	5. Capital investment availability ($I5_s$)	Investment interests for new projects / developments
	6. Raw material supply ($I6_s$)	Trouble free supply of input materials for processing (Greige fabric)
	7. Supportive management ($I7_s$)	Support from the management for the managerial decision making
	8. High performance machineries ($I8_s$)	State of art high performance machinery for production
	9. Production of value added textiles ($I9_s$)	High value textiles (Flame retardant, acid and rain proof fabric) for revenue improvement
Weakness	1. Work environment ($I10_w$)	High temperature, heat, RH inside the production plant due to processing machines exhaust
	2. Textile engineering skills ($I11_w$)	Textile processing machine's electronics engineering maintenance skills
	3. Operatives fatigue ($I12_w$)	Tiredness of operatives due to movement of materials
	4. Effluent treatment capacities ($I13_w$)	Effluent treatment capacity per unit time is less compare to effluent generation from the production plant
	5. Availability of water ($I14_w$)	Disturbed water supply from Tamilnadu Water Supply And Drainage Board (TAWAD)
	6. Fragmented company ($I15_w$)	Different geographical location of value chain of the company
	7. Slow speed of sample development ($I16_w$)	Sample development time is high due to the information and trail sample transformation across the value chain of the company
	8. Cost of maintenance and spare parts ($I17_w$)	High cost of new spare parts and high cost of maintenance (Consumables and labour)
Opportunity	1. Market orders exports / locals ($O1_e$)	Huge volumes of orders from exports and local sectors
	2. Common effluent discharge facility ($O2_e$)	Effluent can be discharged to a common effluent treatment plant (CETP); CETP meets parameters given by TNPCB.
	3. Technical textile ($O3_e$)	Flame retardant, acid resistance, water repellant fabric production
	4. New developments in dyes, pigments and chemicals ($O4_e$)	New developments in dyestuff, pigments for colouring of textiles, also in chemicals for less effluent loads (TNPCB norms) and faster lead time of textile production
	5. Low cost dyes and chemicals ($O5_e$)	Low cost of dyes and chemicals available in due to the high competition in the dyestuff manufacturer
	6. Mass production capacity ($O6_e$)	Mass production capacity is available and unsed
Threat	1. Ecological product requirement ($T1_e$)	Textile certificates related to ecology (OEKO Tex Standard 100, GOTS and Reach)
	2. Availability fuel for steam generation ($T2_e$)	Imbalance demand and supply of wood fuel for processing of textile
	3. Product lead time ($T3_e$)	Time taken to produce a single unit of product output
	4. Market competition ($T4_e$)	Competition for market orders in south India
	5. Social awareness ($T5_e$)	Social and employee welfare
	6. Availability of electrical power ($T6_e$)	Imbalance demand and supply of electrical power for processing of textile
	7. High water consumption / effluent generation ($T7_e$)	High water consumption and effluent generation per unit of product
	8. Disposal of solid waste generated from effluent ($T8_e$)	Sludge waste as by product during the effluent treatment
	9. High inventory cost ($T9_e$)	Inventory cost goes high since number of dyes and chemicals availability for the wide range of textile coloures

		production
	10. Global quality standards of the textiles ($T10_e$)	High quality standard expected from international buyers (Example: M&S, TESCO and ENEL)

IV. RESULTS AND DISCUSSION

A reliability analysis was conducted before accessing the collected data. The Cronbach's α value is 0.73 [min value of α is 0.70, Nunnally, (1978)], this has proved the reliability of the survey instrument. Subsequently based on the top management, managerial level and supervisory level staff member responses, principal component analysis (PCA) is employed. The extraction of principal components is based on the eigen value more than 1. The Bartlett test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling were used to validate the use of PCA. The resulting components would help in grouping the SWOT variables. The Bartlett test of sphericity had returned a value of 765 and the Kaiser-Meyer-Olkin test of sphericity has a KMO index value of 0.509 (greater than 0.5, Hair et al., 2006). The significance value for the same (0.000) was less than 0.001, hence significant and validates the use of PCA. Then based on the received responses, PCA has been employed to extracted three components with eigenvalues > 1. Three components accounted for a total variance of 75.98%. This can be observed in Table 2 and the same be seen in the scree plot. Scree plot is a plot of eigenvalues against the number of factors in the order of extraction is shown in Figure 3. From the analysis nine SWOT variable's factor loadings were less than 0.5 (and, therefore not significant). Those nine variables were removed from the SWOT data set. Remaining twenty four variables are significant since the factor loadings were greater than 0.5 (Kannan et al., 2002). The three components extracted with eigenvalues more than 1, have been designated as threat factor, opportunity factor and internal factor (combination of strength and weakness) as seen in Table 2. It is desirable to reorient the factor solution so that the factor loadings matrix exhibits something close to simple structure such that the factors are easier to interpret. The factor solution is oriented through a process called rotation. In this case study varimax rotation – most popular orthogonal factor rotation method is used, which tries to achieve simple structure by focusing on the columns of the factor loading matrix and is given in Table 3 (Hair et al., 2006; Lattin et al., 2003). Communality which is the total amount of variance a variable shares with all other variables being considered. The communalities may be viewed as whether the variables meet acceptable levels of explanation. A small communality figure shows that the factors taken together do not account for the variable to an appreciable extent. On the contrary, large communality figure is an indication that much of the variable is accounted for by the factors. The communality value should be greater than 0.5 (Hair et al., 2006). All the selected twenty four communality values were greater than 0.5 and it is ready for further analysis.

Threat factor $T1_e$ through $T8_e$ has shown in Table 3. Earlier those variables were in the SWOT – Threats category in Table 1. Opportunity factor $O1_e$ through $O4_e$ has shown in Table 3. Earlier those variables were in the SWOT – Opportunity category in Table 1. Internal factor $I1_s$ through $I17_w$ has shown in Table 3. Earlier those variables are in the SWOT – Strength and Weakness category in Table 1.

Table 2: Total variance explained by the components

Components	**Extraction Sums of Squared Loadings**		
	Total	**Percentage of variance (%)**	**Cumulative percentage (%)**
1	8.544	35.599	35.599
2	5.983	24.928	55.527
3	4.908	20.449	75.976

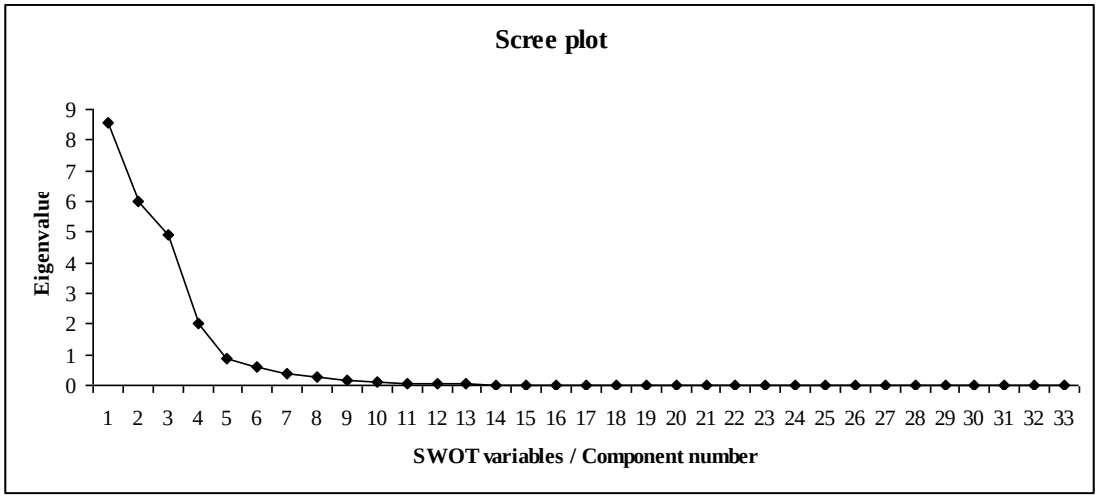

Figure 3: Scree plot of components

Table 3: Principal component analysis with verimax rotation

S. No	SWOT	Grouped PCA variable	PCA factor	Commun-alities	Rotated component matrix			Significance (Factor Loadings min 0.5)
					Component 1	Component 2	Component 3	
1	Strength	$I1_s$	Internal	0.882	0.048	-0.215	0.849	Significant
2	Strength	$I2_s$	Internal	0.794	0.500	-0.157	-0.160	Significant
3	Strength	$I3_s$	Internal	0.751	-0.038	-0.128	0.768	Significant
4	Strength	$I4_s$	Internal	0.930	-0.097	0.747	-0.043	Significant
5	Strength	$I5_s$	Internal	0.896	-0.067	0.046	0.926	Significant
6	Strength	$I6_s$	Internal	0.937	-0.123	0.631	-0.052	Significant
~~7~~	~~Strength~~	~~$I7_s$~~	~~Internal~~	~~0.630~~	~~-0.097~~	~~0.347~~	~~-0.043~~	~~Not significant~~
~~8~~	~~Strength~~	~~$I8_s$~~	~~Internal~~	~~0.696~~	~~-0.067~~	~~0.046~~	~~0.426~~	~~Not significant~~
~~9~~	~~Strength~~	~~$I9_w$~~	~~Internal~~	~~0.537~~	~~-0.123~~	~~0.431~~	~~-0.052~~	~~Not significant~~
10	Weakness	$I10_w$	Internal	0.743	0.101	-0.082	0.040	Significant
11	Weakness	$I11_w$	Internal	0.759	0.032	0.142	0.354	Significant
12	Weakness	$I12_w$	Internal	0.802	-0.203	-0.011	0.116	Significant
13	Weakness	$I13_w$	Internal	0.668	0.094	0.073	-0.198	Significant
14	Weakness	$I14_w$	Internal	0.593	0.033	-0.297	0.044	Significant
15	Weakness	$I15_w$	Internal	0.608	0.201	-0.084	0.006	Significant
~~16~~	~~Weakness~~	~~$I16_w$~~	~~Internal~~	~~0.693~~	~~0.033~~	~~-0.297~~	~~0.044~~	~~Not significant~~
~~17~~	~~Weakness~~	~~$I17_w$~~	~~Internal~~	~~0.508~~	~~0.201~~	~~-0.084~~	~~0.006~~	~~Not significant~~
18	Opportunity	$O1_e$	Opportunity	0.739	0.558	-0.206	-0.177	Significant
19	Opportunity	$O2_e$	Opportunity	0.938	-0.151	0.934	0.046	Significant
20	Opportunity	$O3_e$	Opportunity	0.807	0.596	-0.133	0.371	Significant
21	Opportunity	$O4_e$	Opportunity	0.943	-0.117	0.958	0.037	Significant
~~22~~	~~Opportunity~~	~~$O5_e$~~	~~Opportunity~~	~~0.707~~	~~-0.396~~	~~-0.133~~	~~0.371~~	~~Not significant~~
~~23~~	~~Opportunity~~	~~$O6_e$~~	~~Opportunity~~	~~0.743~~	~~-0.117~~	~~0.258~~	~~0.037~~	~~Not significant~~
24	Threat	$T1_e$	Threat	0.937	0.946	-0.078	0.026	Significant
25	Threat	$T2_e$	Threat	0.976	0.977	-0.138	0.020	Significant
26	Threat	$T3_e$	Threat	0.979	0.968	-0.179	-0.013	Significant
27	Threat	$T4_e$	Threat	0.929	0.933	0.003	0.091	Significant
28	Threat	$T5_e$	Threat	0.940	0.955	0.055	-0.040	Significant
29	Threat	$T6_e$	Threat	0.947	0.959	-0.131	-0.085	Significant
30	Threat	$T7_e$	Threat	0.967	0.969	-0.153	-0.060	Significant
31	Threat	$T8_e$	Threat	0.978	0.980	-0.149	-0.030	Significant
~~32~~	~~Threat~~	~~$T9_e$~~	~~Threat~~	~~0.867~~	~~0.469~~	~~-0.153~~	~~-0.060~~	~~Not significant~~
~~33~~	~~Threat~~	~~$I10_s$~~	~~Threat~~	~~0.878~~	~~0.480~~	~~-0.129~~	~~-0.030~~	~~Not significant~~

*~~Not significant variables are removed~~

V. SWOT MATRIX

The SWOT matrix matches the external factors with the internal factors. The positive impacts from favorable parameters (strengths and opportunities) were maximized and the negative influences from unfavorable parameters (weaknesses and threats) were minimized. Table 4 clearly shows the textile company's key internal and external strategy for business improvement. Internal strength and weakness variables, external opportunity and threat variables were also given in table 4 to plan the strategies. The results of the matching were listed in the four separate quadrants (i.e. Maxi - Maxi SO; Mini - Maxi WO; Maxi - Mini ST and Mini - Mini WT strategies). In maxi – maxi (SO strategy), favorable strength and opportunity variables have to be maximized; in mini – maxi (WO strategy), unfavorable weakness has to be minimized and favorable opportunity variables has to be maximized; in maxi – mini (ST strategy), favorable strength has to be maximized and unfavorable threat variables has to be minimized; in mini – mini (WT strategy), unfavorable weakness and threat variables have to be minimized. Here more attention has to be given to maxi – mini (ST strategy) and mini – mini (WT strategy) which involves threat factor, followed by mini – maxi (WO strategy) and maxi-maxi (SO strategy).

Table: 4 SWOT matrix of the textile company

SWOT	**Internal Strength**	**Internal weakness**
	1. Mass production setup ($I1_s$)	1. Work environment ($I10_w$)
	2. Cost conscious business ($I2_s$)	2. Textile engineering skills ($I11_w$)
	3. Strong R & D for dyeing and finishing ($I3_s$)	3. Operatives fatigue ($I12_w$)
	4. Low labour cost ($I4_s$)	4. Effluent treatment capacities ($I13_w$)
	5. Capital investment availability ($I5_s$)	5. Availability of water ($I14_w$)
	6. Raw material supply ($I6_s$)	6. Fragmented company ($I15_w$)
External Opportunity	**Maxi - Maxi (SO strategy)**	**Mini - Maxi (WO strategy)**
1. Market orders exports / locals ($O1_e$)	(SO_1) Production and ETP line balancing, can be achieved by changing product mix and production plan	(WO_1) Implementation of OHASAS and EMS
2. Common effluent discharge facility ($O2_e$)	(SO_2) Development of own retail market across the south India	
3. Technical textile ($O3_e$)	(SO_3) Production and ETP line balancing	
4. New developments in dyes, pigments and chemicals ($O4_e$)		
External Threat	**Maxi - Mini (ST strategy)**	**Mini - Mini (WT strategy)**
1. Ecological product requirement ($T1_e$)	(ST_1) Implement and optimize an innovative process (Colour Fast Finish - CFF) to reduce water, power, fuel and effluent load	(WT_1) Time and motion study and implementation
2. Availability fuel for steam generation ($T2_e$)	(ST_2) Capacity improvement of power generation by own generation or from 3rd party or from wind mills	(WT_2) Ergonomics study and implementation
3. Product lead time ($T3_e$)	(ST_3) Capacity improvement of steam generation by install new boiler units	(WT_3) Training and skill development campaign in production and services for production
4. Market competition ($T4_e$)	(ST_4) Production, lead time and quality improvement through TPM and TQM	(WT_4) Re locate and integration of the value chain of the company by considering the cost benefit
5. Social awareness ($T5_e$)	(ST_5) Implementation of SA 8000	
6. Availability of electrical power ($T6_e$)		
7. High water consumption / effluent generation ($T7_e$)		
8. Disposal of solid waste generated from effluent ($T8_e$)		

VI. CONCLUSIONS

This article has presented a quantitative SWOT analysis for a leading textile company in south India, aimed at helping the company management to formulate their long range and short range strategy. In the current competitive environment company's top management and managerial level people should know their internal strength, weakness and external opportunity, threats. Hence this study becomes more relevant to identify the SWOT analysis variables, so as to plan their strategy in a focused manner. This study helps them to concentrate the highly important SWOT variables rather than less important variables for their strategic planning. Also, this article brings the new dimension to the SWOT analysis to involve all the top management and managerial level staff members in building their strategy. This will bring the team members input from the strategic planning stage.

This work will help textile company's top management and operational managers to form their strategic planning process. This methodology removes the less influenced variables from SWOT analysis. The managers have to concentrate only the reduced significant variables for forming the strategies. So the effective strategic planning process is guarantied without any wastage of resources. In the future work, the management should focus on the quantifying the SWOT variables then ranking and implementation of these strategies. SWOT strategies (long and short term strategies) need to be implemented and based on the strategic importance.

VII. ACKNOWLEDGEMENT

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