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A Study of Textile & Clothing Supply Chain in Pakistan

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Abstract
The expansion of textile and clothing production to Asian regions has both, increased competition and created a need for integration with the textile and clothing global supply chain. Strategies are being designed to improve competitiveness and responsiveness of the chains with increasing diversification of products.
This study examines the potential of different strategies formulated by experts with focus on Pakistan´s case, developed by brain storming sessions with external experts, composed from a chain´s internal-view and based on existing strengths and weaknesses in the chain using a SWOT analysis. The aim of this previous study was to identify internal and external factors relevant to textile and clothing supply chain in Pakistan. These factors played an important role in the development of strategies which are useful for improving the competitiveness of the chain.
In future it is our intention to formulate our decision structure based on external view of the chain and with more generalized criteria. This kind of structure produces the view which is usual in supply chain competitive scenarios. Here the criteria were viewed internally and the problem was formulated based on SWOT factors. Thus, using inputs from our previous work, "SWOT Analysis of Pakistan Textile Supply Chain", we evaluated the strategies developed for achieving competitiveness in textile and clothing supply chain in Pakistan and their potential effects using a process of prioritization following Saaty´s AHP. There can be innerdependencies and feedback within criteria, sub factors and alternatives which may have potential effects on the results. To study the effects of innerdependencies among factors we have used ANP and compared the results obtained by the two methods.
We have suggested the implementation of developed strategies simultaneously through different entities involved with the chain, as government agencies, academic and research institutes, industrial associations and entrepreneurs themselves.
Keywords: Competitiveness in textile and clothing supply chains, strategic planning, AHP, ANP, SWOT

1. Introduction

Supply chains are networks of activities linked virtually without necessarily any physical linkage. Every individual entity or group of entities in the chain manage their functions on their own and chain responds to meet the customer demand.
Textile and clothing supply chains are normally complex ones with a lot of individual activities which are scattered around the world. The skills and technology required for standard products are easy to adopt and this nature of the business has helped its dispersion worldwide.
The end of the quota regime has geared-up its manufacturing in Asian and Far East regions which are well suited to their low cost production because of lower wages and indigenous natural fibers. The phenomenon of this industrial shift towards low labor wage economies is discussed by Loo [1] and Bolisani and Scarso [2] .
The fashion segment of this chain is governed by the stronger players with large investments in the main markets. This segment comes under the high value products and is considered sensitive and responsive.
Sophisticated products like technical and functional textiles require advance technology for their development and testing. These are produced in countries which support this kind of advancement and have a strong base of specialty fibers. These standards help them to achieve better product reliability and endurance in environments for which these are produced.
The expansion of textile and clothing chain in the Asian region has increased competition and consequently the need for improving integration in the chain. Strategies are being designed to improve competitiveness and responsiveness of the chains with increasing diversification of products.
This study examines the potential of different strategies formulated by experts focusing on Pakistan´s case and is an extension of our previous study which was focused on analyzing the internal and external environment of the textile and clothing supply chain in Pakistan using SWOT analysis [3]. That study produced the status of individual entities involved in the existing chain. It was refined afterwards and is presented here as a SWOT

matrix in table 1. The internal and external factors for the Pakistan´s Textile & Clothing supply chain were identified which were utilized later when creating effective strategies for making the chain competitive.

Table 1: SWOT Matrix of Pakistan´s Textile & Clothing Supply Chain

	Internal Factors	
	Strengths	***Weaknesses***
	S1 - Indigenous cotton crop S2 - Low wages/labor costs S3 - Strong investment in textiles & made-ups S4 - Skills in ICT S5 - Skills in chemistry (for textile & clothing chemical industry)	W1 - Limited base of non cotton fibers W2 - Weak ginning sector W3 - Lower cotton yield (per acre) W4 - Low application & usage of ICT W5 - Non competitive behavior of entrepreneurs W6 - Skills (technical, marketing & management) W7 - Distance to (current) markets W8 - Underdeveloped logistics W9 - Weak market awareness (market´s dynamics, buyer´s needs, competitor´s strengths and weaknesses); because of weak ultimate-customer link W10 - Input´s costs and continuity W11 - Low Foreign Direct Investment (FDI)
External Factors	***Opportunities***	***SO Strategy***	***WO Strategy***
	O1 - Technical Textile O2 - Value added products (fashion, children clothing & home textiles) O3 - Closed proximity to future potential markets O4 - Government support for R&D O5 - Dyes & chemical manufacturing O6 - Machine manufacturing O7 - Logistic link for Far East to European and Middle East Markets	SO1 - Diversification of product range SO2 - Establishing industrial-parks with common facilities of design & development centers, ICT application centers, effluent treatment, etc SO3 - Applying export incentives SO4 - Establishing downstream links/facilities in competing regions (Turkey, Egypt, Bangladesh & Mexico…) SO5 - Improving domestic chemical industry	WO1 - Skill development programs WO2 - Expanding non cotton fibers base WO3 - Improving logistics WO4 - Developing effective linkage between industry, academia and R&D institutes WO5 - Developing domestic engineering industry
	Threats	***ST Strategy***	***WT Strategy***
	T1 - Political instability T2 - Regional competitors	ST1 - Development of markets access strategies ST2 - Establishing down-stream facilities in stable, near-to-market and competing regions	WT1 - Work in collaboration with competitors WT2 - Development and implementation of long-term and coordinated policies WT3 - Introduction of industry relief packages

SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. It is used in strategic planning for analyzing internal and external environment of a business. Some researchers believe that it has lost its value as they consider it a mere listing of factors without an in-depth view. Hill [4] suggests that this tool has passed its sell by date although he has commented in his paper that more value was possible in the results if the process would have been followed up more effectively. Some experts have tried to improve its usability as Kurtilla et al. [5] that used AHP in SWOT and others have even used it as it is and derived useful results like Dyson [6] .
In our case, we first used the SWOT analysis to develop the environment of the supply chain in study, status of individual identities present in the chain and finally derived strategies relevant to the competitiveness of the chain. These strategies were developed by brain storming sessions with external experts and focusing on a chain´s internal-view. This internal view of the chain helped in focusing on existing strengths and weaknesses in the chain for designing relevant strategies using the current SWOT matrix structure. Then, it was followed by a prioritization and evaluation process for these strategies using Saaty´s AHP.

2. What is AHP?

The analytical hierarchy process was introduced by Saaty in the 1970s and he describes it as follows [7]:

"The AHP is a general theory of measurement. It is used to derive priorities on absolute scales (invariant under the identity transformation) from both discrete and continuous paired comparisons in multi level hierarchic structure. These comparisons may be taken from actual measurement or from a fundamental scale that reflects the relative strengths of preferences and feelings. The AHP has a special concern with departure from consistency and the measurement of this departure and with dependence within and between the group of elements of its structure…."

Forman [8] preferred to describe it on the basis of its functions as structuring complexity, measuring on a ratio scale and synthesizing. He terms AHP simple, easy to understand, flexible and accurate with many applications ranging from the choice of an alternative or the prioritization of many to resource allocation, benchmarking, quality management, public policy, health care, and strategic planning. Using AHP structural methodology we have transformed our problem in a top to bottom hierarchy with goal at top and criteria and alternatives at the next levels; we have also measured the importance of criteria with respect to goal and alternatives with respect to criteria and tried to synthesize the SWOT criteria into alternative strategies.

We anticipate that these strategies will have positive effects on improving supply chain competitiveness; similar studies have already been presented by Yuksel [9] applied to strategic decision making for a textile company and by Koprulu [10] in a supplier selection model using a similar methodology also for a textile firm in Turkey. Farkasovsky [11] used AHP methodology for outsourcing decisions of firm´s application development function.

3. Problem structure

The problem was transformed into a hierarchical structure, as suggested by Saaty [12], for decision making with AHP. The goal "Determining Best Strategy" is placed on the top followed by the SWOT factors and sub-factors at intermediate levels and the alternative strategies at the lowest level. This type of integration of AHP framework with SWOT analysis is used by Kurtilla et al. [5] in his hybrid method for a case study on forest certification. Our model structure was constructed using the Web-HIPRE[1] and it is presented here in figure1.

The overall problem consists of the goal, "Determining Best Strategy" which is based on criteria of four factors: strengths, weaknesses, opportunities and threats. These factors are further added with sub factors of relevant importance to the chain and include five strengths, eleven weaknesses, seven opportunities and two threats. Linking the goal with the criteria, fifteen strategies are suggested which may have potential contributions in improving competitiveness in the case supply chain.

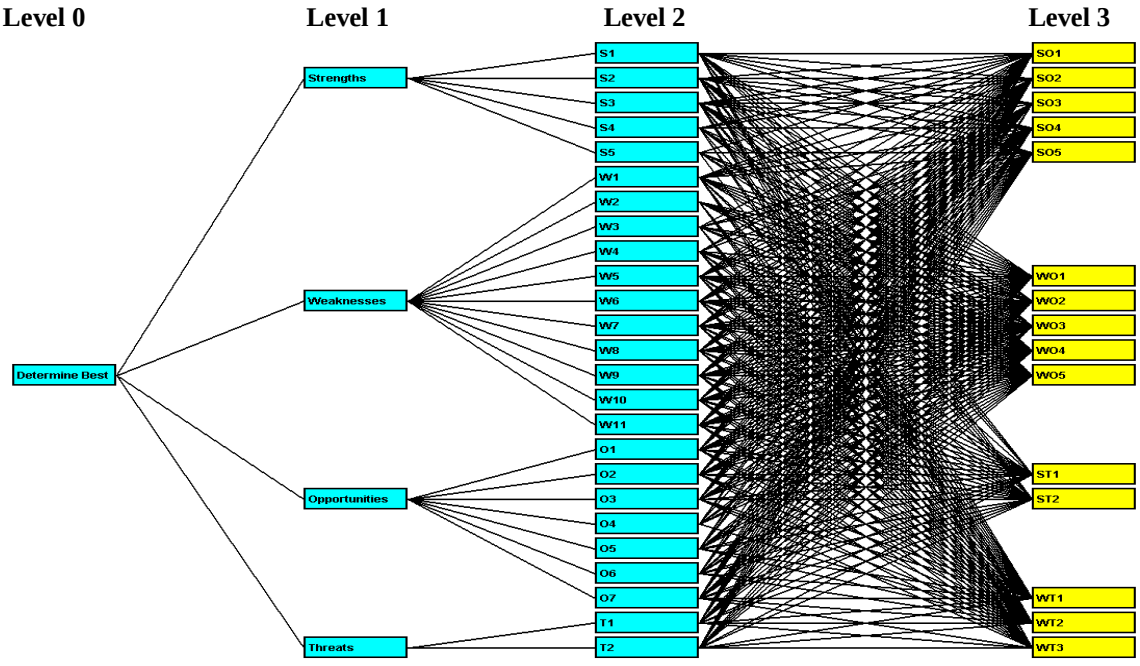


Figure 1: AHP Model for Determining the Best Strategy for Improving Competitiveness in Textile Supply Chain of Pakistan

The next step was to construct the set of pairwise comparison matrices introducing preferences between elements of the same level in achieving the criteria in the level immediately above them by using Saaty´s fundamental scale of absolute numbers which is presented at table 2.

[1] Web-HIPRE is an online decision support software developed at Helsinki University of Technology for problem structuring, multi criteria evaluation and prioritization (http://www.hipre.hut.fi/).

Table 2: Saaty´s fundamental scale of absolute numbers [12]

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity *i* has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with *i*	A logical assumption

The comparison matrix for the SWOT factors with respect to the goal was constructed first (see table 3).

Table 3: Pairwise comparison of SWOT factors in achieving the goal

Goal	Strengths	Weaknesses	Opportunities	Threats	Importance Degree of SWOT Factors
Strengths	1	$^1/_2$	$^1/_4$	2	0.141
Weaknesses	2	1	$^1/_3$	3	0.237
Opportunities	4	3	1	5	0.531
Threats	$^1/_2$	$^1/_3$	$^1/_5$	1	0.091

CR: 0,015073643

Then the pairwise comparison matrices for SWOT sub-factors local priorities were also constructed (see appendix A).Finally the comparison matrices for the alternative strategies with respect to each of the twenty five SWOT sub-factors were also constructed (see Appendix B for one example matrix). Saaty [12] has emphasized maintaining the consistency ratio below 0.1 when constructing the comparison matrices of orders larger than 5×5. This ratio is difficult to maintain in case of large size matrices and that is why we have initially applied this methodology of constructing comparison matrices in restrictive group of experts familiar to this process with the case supply chain.

4. Results

The priorities produced for the alternative strategies are shown in table 4.

Table 4: Results in text format

Goal	*SO1*	*SO2*	*SO3*	*SO4*	*SO5*	*WO1*	*WO2*	*WO3*	*WO4*	*WO5*	*ST1*	*ST2*	*WT1*	*WT2*	*WT3*
Strengths	0.011	0.010	0.003	0.011	0.008	0.018	0.011	0.006	0.023	0.003	0.010	0.010	0.006	0.007	0.002
Weaknesses	0.009	0.017	0.007	0.021	0.010	0.027	0.015	0.012	0.031	0.006	0.020	0.024	0.021	0.009	0.007
Opportunities	0.051	0.047	0.014	0.023	0.046	0.067	0.051	0.029	0.075	0.023	0.029	0.037	0.019	0.015	0.006
Threats	0.005	0.010	0.002	0.004	0.002	0.009	0.006	0.004	0.008	0.001	0.014	0.015	0.007	0.003	0.002
Overall	0.076	0.083	0.026	0.059	0.067	0.120	0.084	0.052	0.137	0.033	0.072	0.086	0.053	0.034	0.017
Ranking	6	5	14	9	8	2	4	11	1	13	7	3	10	12	15

These priorities are also presented in graphical format in figure 2.

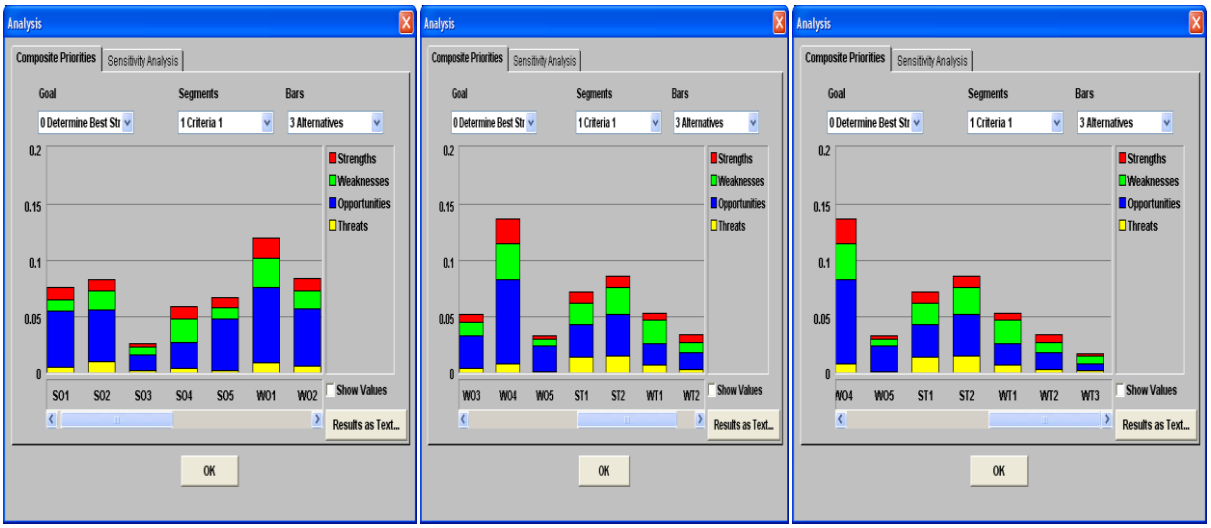


Figure 2: Results in graphical format

The prioritized strategies, obtained from the AHP analysis are placed into three groups with higher ranking strategies in first group and lower ones in the second and third groups respectively.

1st Group of Strategies:
Ranked 1st: WO4: Developing Effective Linkage between Industry, Academia and R&D Institutes
Ranked 2nd: WO1: Skill Development Programs
Ranked 3rd: ST2: Establishing Down Stream Facilities in Stable, Near to Market and Competing Regions
Ranked 4th: WO2: Expanding Non-cotton Fiber Base.

Overall score of this group of strategies/alternatives comes out to be 0.463. It is mainly focused to skill development and improving coordination between research institutes and different stakeholders in the chain. Keeping in view the targeted opportunities, down stream link of the chain (close to consumer) requires attention of both policy makers and enterprenuers. Decreasing this gap can improve the confidence of consumer in the supply chain, provide protection against threats and improve the responsiveness. This downstream focus will also help to increased usage of non-cotton fibers resulting in expansion of fiber base in country which will increase both product diversification and market share. Designing of policies towards expansion of fiber base will bring targeted results in this direction.

2nd Group of Strategies:
Ranked 5th: SO2: Establishing Industrial Parks with Common Facilities of Design & Development Centers, ICT Application Centers & Effluent Treatment Plants etc.
Ranked 6th: SO1: Diversification of Product Range
Ranked 7th: ST1: Development of Market Access Strategies
Ranked 8th: SO5: Improving Domestic Chemical Industry
Ranked 9th: SO4: Establishing Downstream Facilities in Competing Regions
Ranked 10th: WT1: Work in Close Collaboration with Competitors
Ranked 11th: WO3: Improving Logistics

Overall score of this group of strategies comes out to be 0.471. It is focused on developing a more dependable supply side with enhanced quality of products and services by improving internal infrastructure. It also addresses the need to enhance communication and collaboration with competitors. It trys to decrease the effects of threats by establishing market access. However dependence on these trade agreements may contribute to slowdown the natural process of improving competitiveness of the supply chain.

3rd Group of Strategies:
Ranked 12th: WT2: Development and Implementation of Long-term & Coordinated Policies Ranked 13th: WO5: Developing Domestic Engineering Industry
Ranked 14th: SO3: Applying Export Incentives
Ranked 15th: WT3: Introduction of Industry Relief Packages

The overall score of this group of strategies comes out to be 0.11. It tries to address gaps of policy, limited engineering base and providing the industry short term relief in the present scenario of political instability and energy shortfalls.

We made a sensitivity analysis of results (see Appendix C) that shows the effectiveness of strategies of the first group (WO4, WO1, ST2 and WO2) is sustained for different degrees of importance of factors like strengths, weaknesses, opportunities and threats. There is a consistent pattern of effectiveness in this group although ST1 and ST2 seem emerging important strategies when more weight is given to threats.

Three additional strategies (SO1, SO2 and SO5) seem emerging if more weight is given to opportunities, although this factor has already a highest importance in the overall criteria. These strategies collectively play an important role in expansion of product range/versatility which can show a potential attractiveness of additional market segments/share. The sensitivity analysis also shows that SO2 maintain its effectiveness with respect to others factors.

SO4 and ST1 seem to be potentially effective when analyzing with respect to weaknesses. These strategies are focused to improve the responsiveness of chain by establishing facilities in near-to-market and stable regions and increasing manufacturer confidence by developing market access.

Most interesting results are seen in sensitivity analysis with respect to threats where most important strategies seem to be losing effectiveness if current situation of political instability sustains and regional competition grows when limited choices of shifting facilities and developing market access remain the only choice.

5. Calculating the effects of innerdependencies of criteria on decision

After studying the hierarchical effects of decision elements on the alternatives, it is useful to study the effects of inner dependence in the elements of our decision. We have studied effects of inner dependence of criteria elements of our decision problem using Analytical Network Process (ANP).These are presented in this section.

Analytical Network Porcess is a generalization of AHP towards dependence and feedback. This was developed by Saaty like AHP and provides a framework to study dependence and feedback for different sources (elements) involved in decision making. There is no formal need to proceed in a hierarchical way like in AHP to describe the dependency but the decision structure is formulated in a network structure consisting of source, intermediate and sink clusters. These clusters are linked by arrows showing the kind of relations they possess like outer, inner dependence and/or feed back. The description of hierarchy, network and different kinds of dependences are shown in figure 3.

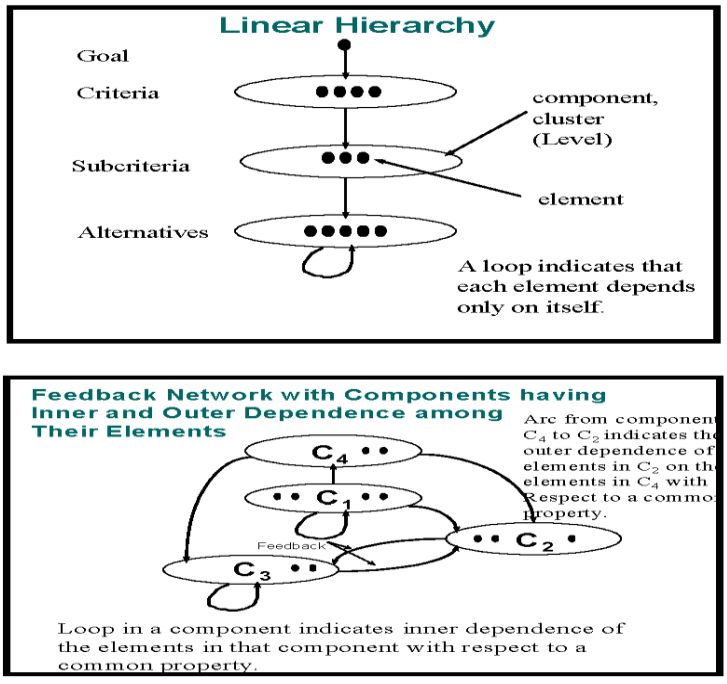


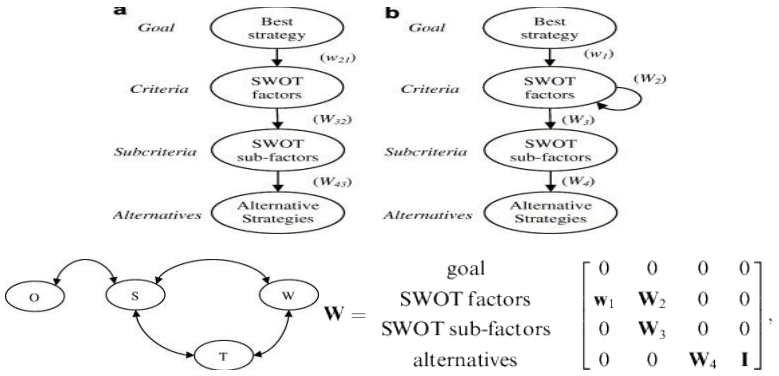
Figure 3:Composition of decision problems in hierarchical and network structures [12]

In decision making the use of ANP in many complex situations is proved useful where decision elements cannot produce actual value for the decision alternatives untill their inner dependencies and/or feedback are not taken

into account. Inner dependences represent relations between elements of the same cluster (level), outer dependences show relations between elements of different clusters (which in AHP, only travels in hierarchy or top to bottom) and feedback is used when dependence travels in reverse direction from other cluster towards itself.

5.1. Algorithm for calculating effects of innerdependence of criteria/factors in our decision problem

To calculate the effect of the inner dependence in SWOT factors, we have applied the ANP algorithm and inner-dependency model which was proposed by Yuksel [9] for his decisions involving similar criteria and decision environment. The model and corresponding supermatrix are shown in figure 4, parts a to d.



c.Innerdependence model for criteria **d.Supermatrix for the model**

Figure 4: Hierarchical composition of decision problem with innerdependence for criteria

The supermatrix consists of four levels of decision hierarchy (for goal, criteria, sub-criteria and alternatives). Innerdependence is introduced at criteria/factors level which is represented by W_2. The innerdependence flow in decision criteria/factors in this environment is shown in the dependence model in part c, figure 4.

Step 1:

Firstly the problem is formulated in a hierarchical composition as presented in figure 1.

Step 2:

Priorities are calculated for criteria with respect to goal without taking into account the inner dependencies at this stage and are represented by vector w_1 (shown in the last column of table 3).

Step 3:

To calculate the inner dependence in SWOT criteria/factors we have followed the model as presented in figure 4 (part c). The comparison matrices for these dependencies are presented in tables 5 through 7.

Table 5: Inner dependence with respect to strengths

Strengths	*Weaknesses*	*Opportunities*	*Threats*	*Importance Degree of SWOT Factors*
Weaknesses	1	1/4	2	0,211399711
Opportunities	4	1	4	0,655122655
Threats	1/2	1/4	1	0,133477633

CR: 0,014056333

Table 6: Inner dependence with respect weaknesses

Weaknesses	*Strengths*	*Threats*	*Importance Degree of SWOT Factors*
Strengths	1	4	0,8
Threats	1/4	1	0,2

Table 7: Inner dependence with respect to threats

Threats	*Strengths*	*Weaknesses*	*Importance Degree of SWOT Factors*
Strengths	1	1/4	0,2
Weaknesses	4	1	0,8

The comparison matrix (W_2) of inner dependences of SWOT factors is presented as follows.

$$W_2 = \begin{bmatrix} 1 & 0,8 & 1 & 0,2 \\ 0,211399711 & 1 & 0 & 0,8 \\ 0,655122655 & 0 & 1 & 0 \\ 0,133477633 & 0,2 & 0 & 1 \end{bmatrix}$$

Step 4:

Interdependent priorities of criteria/factors ($W_{factors}$) are calculated by multiplying w_1 and W_2.

$$W_{factors} = W_2 * w_1 = \begin{bmatrix} 1 & 0,8 & 1 & 0,2 \\ 0,2114 & 1 & 0 & 0,8 \\ 0,655123 & 0 & 1 & 0 \\ 0,133478 & 0,2 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 0,141 \\ 0,237 \\ 0,531 \\ 0,091 \end{bmatrix} = \begin{bmatrix} 0,8798 \\ 0,339607 \\ 0,623372 \\ 0,15722 \end{bmatrix}$$

Normalised values of these weights are presented as follows.

$$W_{factors} = \begin{bmatrix} 0,4399 \\ 0,165265 \\ 0,311686 \\ 0,07861 \end{bmatrix}$$

Step 5:

Comparison matrices for local priorities of subfactors with respect to criteria/factors are presented in Appendix A. These are shown in table 8 in column Local Priorities of subfactors and are used to create global priorities.

Step 6:

Local priorities of subfactors are converted into global priorities by multiplying these (W_3) with interdependent priorities of factors (criteria) $W_{factors}$. Global priorities of subfactors $w_{sub\text{-}factor(global)}$ are presented in table 8.

Table 8: Coversion of local priorities of subfactors into global priorities

SWOT Factors	*Interdependent Priorities of the Factors* ($W_{factors}$)	*SWOT Sub-factors*	*Local Priorities of the Sub-factors* (W_3)	*Global Priorities of Sub-factors* ($w_{sub\text{-}factor(global)}$)
Strengths	0,4399	S1	0,395	0,1737605
		S2	0,147	0,0646653
		S3	0,262	0,1152538
		S4	0,124	0,0545476
		S5	0,072	0,0316728
Weaknesses	0,16980368	W1	0,09	0,015282331
		W2	0,035	0,005943129
		W3	0,057	0,00967881
		W4	0,128	0,021734871
		W5	0,092	0,015621939
		W6	0,262	0,044488564
		W7	0,034	0,005773325
		W8	0,034	0,005773325
		W9	0,149	0,025300748
		W10	0,065	0,011037239
		W11	0,055	0,009339202
Opportunities	0,311686147	O1	0,27	0,08415526
		O2	0,292	0,091012355
		O3	0,076	0,023688147
		O4	0,158	0,049246411
		O5	0,106	0,033038732
		O6	0,059	0,018389483
		O7	0,04	0,012467446
Threats	0,078610173	T1	0,8	0,062888139
		T2	0,2	0,015722035

Step 7:
The priorities of alternatives with respect to each subfactor are developed in comparison matrices in Appendix B and these are included in matrix W_4.

$$W_4 = \begin{bmatrix}
.058 & .068 & .064 & .102 & .207 & .108 & 0 & .034 & .029 & .051 & .028 & .031 & .038 & .044 & .025 & .033 & .045 & .055 & .098 & .293 & .115 & 0 & .03 & .052 & .049 \\
.058 & .102 & .047 & .183 & 0 & .035 & 0 & 0 & .239 & .063 & .049 & .054 & .099 & .039 & .071 & .061 & .085 & .114 & .12 & .060 & .084 & .038 & .044 & .116 & .062 \\
.036 & .036 & .015 & 0 & 0 & .026 & 0 & 0 & 0 & .029 & .033 & .024 & .019 & .051 & .019 & .11 & .025 & .047 & .058 & 0 & 0 & 0 & .021 & .02 & .023 \\
.085 & .019 & .149 & .038 & 0 & .058 & 0 & .060 & .099 & .151 & .072 & .152 & .115 & .115 & .039 & .093 & .038 & .03 & .137 & 0 & .069 & .053 & .109 & .046 & .027 \\
.033 & .037 & .046 & 0 & .381 & .122 & 0 & .122 & 0 & .025 & .025 & .029 & .046 & .023 & .136 & .035 & .119 & .037 & .049 & .101 & .194 & .026 & .057 & .017 & .039 \\
.157 & .135 & .103 & .104 & .089 & .082 & .261 & .237 & .056 & .092 & .184 & .071 & .06 & .07 & .035 & .045 & .104 & .112 & .119 & .178 & .146 & .156 & .071 & .101 & .091 \\
.085 & .075 & .098 & 0 & .141 & .200 & .059 & .125 & 0 & .059 & .042 & .044 & .074 & .036 & .136 & .061 & .156 & .09 & .09 & .059 & .047 & .028 & .132 & .054 & .12 \\
.026 & .06 & .037 & .139 & 0 & .038 & .110 & 0 & .056 & .042 & .049 & .108 & .175 & .022 & .059 & .048 & .023 & .116 & .038 & 0 & .036 & 0 & .195 & .036 & .091 \\
.158 & .173 & .138 & .241 & .096 & .113 & .261 & .237 & .181 & .097 & .166 & .062 & .065 & .101 & .033 & .047 & .182 & .065 & .06 & .249 & .166 & .188 & .027 & .069 & .163 \\
.021 & .019 & .02 & .029 & .044 & .021 & .082 & .053 & .021 & .02 & .02 & .017 & .022 & .017 & .058 & .019 & .064 & .015 & .013 & .032 & .014 & .227 & .012 & .012 & .013 \\
.094 & .118 & .061 & 0 & 0 & .047 & 0 & 0 & .056 & .02 & .11 & .12 & .092 & .114 & .09 & .195 & .051 & .079 & .09 & 0 & .022 & .080 & .088 & .168 & .091 \\
.068 & .021 & .149 & .038 & 0 & .058 & 0 & 0 & .099 & .151 & .075 & .152 & .114 & .159 & .13 & .127 & .039 & .17 & .02 & 0 & .059 & .019 & .032 & .168 & .163 \\
.043 & .038 & .028 & .055 & .041 & .048 & .048 & .068 & .102 & .151 & .074 & .089 & .031 & .159 & .031 & .077 & .032 & .027 & .069 & 0 & .029 & .070 & .149 & .087 & .034 \\
.058 & .076 & .027 & .073 & 0 & .027 & .045 & .029 & .037 & .032 & .056 & .028 & .035 & .031 & .037 & .026 & .02 & .025 & .025 & .027 & .020 & .114 & .019 & .031 & .018 \\
.021 & .022 & .018 & 0 & 0 & .017 & .133 & .034 & .026 & .016 & .016 & .019 & .017 & .02 & .101 & .022 & .016 & .016 & .015 & 0 & 0 & 0 & .014 & .023 & .015
\end{bmatrix}$$

Step 8:
Finally the ultimate priorities of alternatives are established by multiplying the priorities of alternatives calculated with respect to sub-factors (W_4) and global priorities of sub-factors ($w_{sub\text{-}factor(global)}$).

$W_4 * w_{sub\text{-}factors\ (global)} =$

SO1	0,075
SO2	0,080
SO3	0,025
SO4	0,067
SO5	0,062
WO1	0,123
WO2	0,082
WO3	0,050
WO4	0,144
WO5	0,029
ST1	0,073
ST2	0,084
WT1	0,049
WT2	0,040
WT3	0,017

These results are also presented in the next section.

5.2. Result achieved from Web-HIPRE using innerdependent criteria values

The results which were achieved with innerdependencies in criteria are presented in table 9. It also includes the comparison to results with independent criteria.

Table 9: Result with innerdependent criteria and its comparison to result with independent criteria

Goal	*SO1*	*SO2*	*SO3*	*SO4*	*SO5*	*WO1*	*WO2*	*WO3*	*WO4*	*WO5*	*ST1*	*ST2*	*WT1*	*WT2*	*WT3*
Strengths	.034	.032	..10	.036	.026	.057	.036	.020	.071	.010	.031	.033	.018	.022	.007
Weaknesses	.007	.012	.005	.015	.007	.019	.011	.008	.022	.004	.014	.016	.015	.006	.005
Opportunities	.030	.028	.008	.014	.028	.040	.031	.017	.045	.014	.017	.022	.011	.009	.003
Threats	.004	.008	.002	.003	.002	.007	.005	.004	.007	.001	.011	.013	.006	.002	.002
Overall	.075	.080	.025	.067	.062	.123	.082	.050	.144	.029	.073	.084	.049	.040	.017
Ranking	**6**	**5**	**14**	**8**	**9**	**2**	**4**	**10**	**1**	**13**	**7**	**3**	**11**	**12**	**15**
Old Overall	.076	.083	.026	.059	.067	.120	.084	.052	.137	.033	.072	.086	.053	.034	.017
Old Ranking	**6**	**5**	**14**	**9**	**8**	**2**	**4**	**11**	**1**	**13**	**7**	**3**	**10**	**12**	**15**

6. Conclusion

The strategies developed for achieving competitiveness in textile and clothing supply chain in Pakistan and their importance in improving it is studied here. Although our study is mainly focused to textile and clothing supply chain, some of the strategies developed here are also found relevant for general business environment in the country as discussed by Schwab [13]. This report identifies the most problematic factors for these areas and include among others: Political/Government Stability, Inadequate Supply of Infrastructure, Inadequately Educated Work Force and Policy Instability. In the study referred above the score of responses weighted against these factors comes out to be 43.9 percent.

We have also studied the effects of innerdependencies of criteria elements on the prioritization of alternatives. We observed a little change in the overall score of alternatives but the ranking achieved by hierarchical composition of the decision problem remained valid.

There can be innerdependencies within subfactors and alternatives and some feedbacks which may bring valuable effects on the results which were achieved here. We intend to study these effects in the future and add an external view of our problem structure with more generalized criteria.

These strategies can be applied simultaneously by different sources involved in the chain as government agencies, academic and research institutes, industrial associations and individual industries. The prioritization and grouping of strategies presented in this study can be utilized for resource allocation, policy making and other strategic decisions related to the supply chain.

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Appendix A. Pairwise comparison matrices for SWOT sub-factors local priorities

Strengths	*S1*	*S2*	*S3*	*S4*	*S5*	*Local Weights*
S1	1	3	2	3	4	0.395
S2	1/3	1	1/2	1	3	0.147
S3	1/2	2	1	3	3	0.262
S4	1/3	1	1/3	1	2	0.124
S5	1/4	1/3	1/3	1/2	1	0.072

CR: 0,031666804

Weaknesses	*W1*	*W2*	*W3*	*W4*	*W5*	*W6*	*W7*	*W8*	*W9*	*W10*	*W11*	*Local Weights*
W1	1	3	2	1/2	1	1/5	3	3	1/3	2	2	0.090
W2	1/3	1	1/2	1/3	1/2	1/6	1	1	1/4	1/2	1/2	0.035
W3	1/2	2	1	1/2	1/2	1/5	2	2	1/3	1	1	0.057
W4	2	3	2	1	2	1/3	3	3	1	2	3	0.128
W5	1	2	2	1/2	1	1/3	3	3	1/2	2	2	0.092
W6	5	6	5	3	3	1	5	5	2	4	4	0.262
W7	1/3	1	1/2	1/3	1/3	1/5	1	1	1/4	1/2	1/2	0.034
W8	1/3	1	1/2	1/3	1/3	1/5	1	1	1/4	1/2	1/2	0.034
W9	3	4	3	1	2	1/2	4	4	1	2	2	0.149
W10	1/2	2	1	1/2	1/2	1/4	2	2	1/2	1	2	0.065
W11	1/2	2	1	1/3	1/2	1/4	2	2	1/2	1/2	1	0.055

CR: 0,018893363

Opportunities	*O1*	*O2*	*O3*	*O4*	*O5*	*O6*	*O7*	*Local Weights*
O1	1	1	4	2	3	4	5	0.270
O2	1	1	4	3	3	4	5	0.292
O3	1/4	1/4	1	1/2	1/2	2	2	0.076
O4	1/2	1/3	2	1	2	3	5	0.158
O5	1/3	1/3	2	1/2	1	2	3	0.106
O6	1/4	1/4	1/2	1/3	1/2	1	2	0.059
O7	1/5	1/5	1/2	1/5	1/3	1/2	1	0.040

CR: 0,021682706

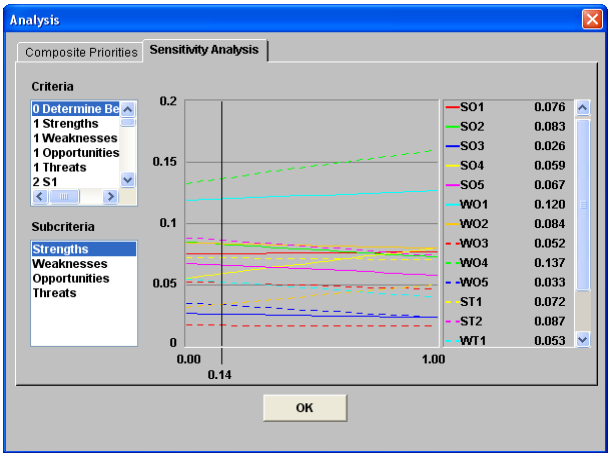
Threats	*T1*	*T2*	*Local Weights*
T1	1	4	0.8
T2	1/4	1	0.2

Appendix B. Example of one of the twenty five pairwise comparison matrices from alternatives priorities for strengths with respect to sub-factors

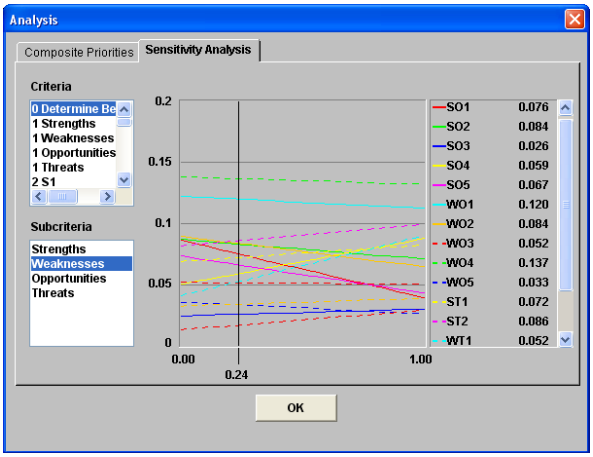
S1	*SO1*	*SO2*	*SO3*	*SO4*	*SO5*	*WO1*	*WO2*	*WO3*	*WO4*	*WO5*	*ST1*	*ST2*	*WT1*	*WT2*	*WT3*	*Local Weights*
SO1	1	2	2	1/2	3	1/3	1/2	3	1/3	3	1/2	1/2	2	1	3	0.058
SO2	2	1	2	1/2	2	1/3	1/2	3	1/3	3	1/2	1	2	1	3	0.058
SO3	1/2	1/2	1	1/3	1	1/4	1/3	2	1/4	3	1/3	1/2	1/2	1/2	3	0.036
SO4	2	2	3	1	3	1/3	1	4	1/3	4	1	1	2	2	3	0.085
SO5	1/3	1/2	1	1/3	1	1/4	1/2	2	1/4	2	1/3	1/2	1/2	1/2	3	0.033
WO1	3	3	4	3	4	1	3	5	1	4	2	2	4	3	2	0.157
WO2	2	2	3	1	2	1/3	1	3	1/3	3	1	2	2	2	5	0.085
WO3	1/3	1/3	1/2	1/4	1/2	1/5	1/3	1	1/5	2	1/2	1/3	1/2	1/3	3	0.026
WO4	3	3	4	3	4	1	3	5	1	5	2	2	4	3	2	0.158
WO5	1/3	1/3	1/3	1/4	1/2	1/4	1/3	1/2	1/5	1	1/4	1/3	1/3	1/3	5	0.021
ST1	2	2	3	1	3	1/2	1	2	1/2	4	1	2	3	2	1	0.094
ST2	2	1	2	1	2	1/2	1/2	3	1/2	3	1/2	1	2	1	4	0.068
WT1	1/2	1/2	2	1/2	2	1/4	1/2	2	1/4	3	1/3	1/2	1	1/2	3	0.043
WT2	1	1	2	1/2	2	1/3	1/2	3	1/3	3	1/2	1	2	1	3	0.058
WT3	1/3	1/3	1/3	1/3	1/2	1/5	1/3	1/2	1/5	1	1/4	1/3	1/3	1/3	1	0.021

CR: 0,041

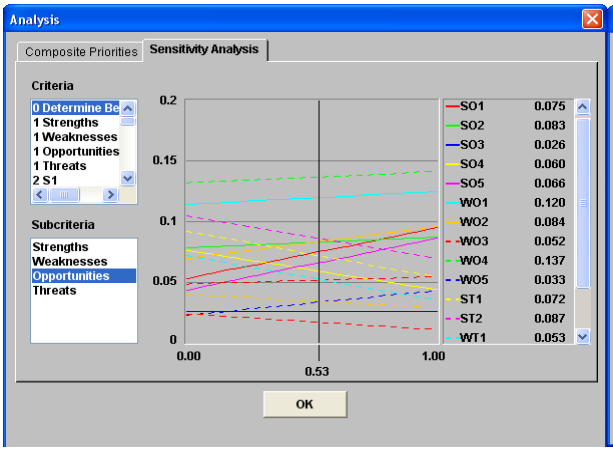
Appendix C. Sensitivity analysis of results



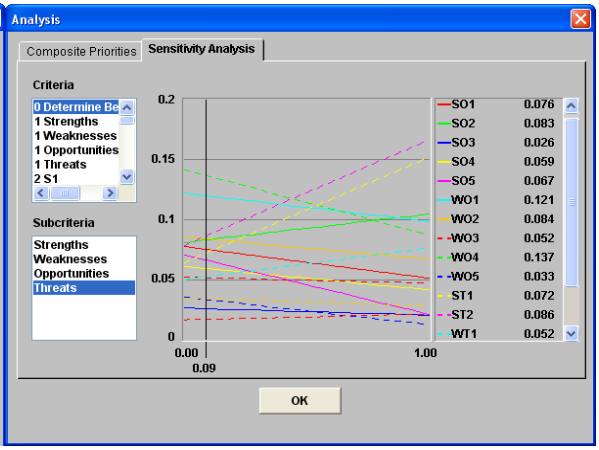
Sensitivity to Strenghts



Sensitivity to Weaknesses



Sensitivity to Opportunities



Sensitivity to Threats