Universidade do Minho
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Aga Deedar Hussain Pathan

Contributions for Improving Textile Supply Chain Management in Pakistan

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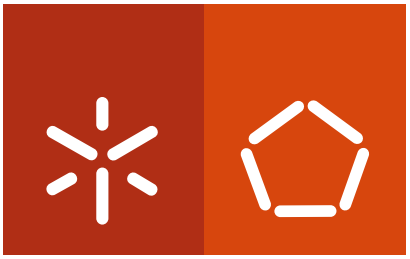

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Contributions for Improving Textile Supply Chain Management in Pakistan

Programa Doutoral em Engenharia Industrial e Sistemas

Trabalho efetuado sob a orientação do
Professor Doutor Manuel Carlos Figueiredo
e do
Professor Doutor Fernando Nunes Ferreira

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"Let us learn from the weavers who have the sensitive profession of joining;
They are always focused and never leave the disconnections unrepaired"
Shah Abdul latif Bhitai

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Braga, March 2013

Deedar Hussain

Contributions for Improving Textile Supply Chain Management in Pakistan

In the last decades, trade liberalization and communication innovations have increased the opportunities for retailers and brands to buy their products from producers worldwide. These are transformed into global sourcing companies, which outsource the production of goods they sell, to suppliers and producers worldwide through complex international networks or global supply chains. They control the supply chains (SCs) and determine price, quality levels, delivery times, and labour conditions for the suppliers and producers.

Under this transformation, the global textile and clothing SC activities are divided into high and low profit steps. Retailers and brands keep high profit steps such as innovation, marketing and retailing. Low profit steps, such as sourcing raw materials, production and assembly, finishing and packing, are outsourced to mid-chain suppliers and low-cost producers worldwide. This has created labour-intensive exports from low-cost locations especially Asia and Far East. The migration of textile and clothing industry has unlocked the potential of new markets including China, South Asia, Brazil and Middle East.

In the global restructuring of the textile and clothing, competitive capabilities including design, innovativeness and time-based performance emerged as the main factors of profitability. Now, the capabilities on quality, value-addition and customer service are utilized to maintain the overall strategic position of the SCs.

There are many textile and fashion brands which are manufactured now in India, Pakistan and Bangladesh. Pakistan is an important textile producer with proper resources, which are required for this industry including manufacturing setup, raw material availability and cheap labour. Meanwhile, it is producing standard products, directed to low profit markets. Many countries have successfully increased their export shares in textile and clothing after the elimination of the world quotas. Unfortunately, Pakistan was unable to increase its export share in its non-traditional markets like fashion clothing because of not developing relevant strategies and not upgrading its domestic textile and clothing industry. It is obvious

that the industry is not prepared for this scenario and it has difficulties in meeting short lead times and higher responsiveness which are expected now a day by most customers.

This research is focused on the textile and clothing SC system of Pakistan. The structure and the characteristics of the system were studied and the growth patterns were identified in the sectors, especially, for the activities in the cotton value chain which are in the formal setup. The informal setup is beyond the scope of this research. There is very low research at this scale for the supply chain system, which restricts the global view of the system and makes it difficult to adopt relevant strategic directions when working on the overall system improvement. Therefore, the intention was to identify the strategic environment of the system and the relevant strategic directions. The motivation behind this research is that the industry needs a proper restructuring to improve its overall competitiveness in the areas which can bring higher profits and for this a detailed study of the textile and clothing system was needed.

The strengths of this research are based on its multidimensional approach; strategic insight is produced on the overall system which is supported with tactical view of an advance supply chain. We believe this will provide a better understanding on the issues which are now faced in the global textile and clothing supply chains.

Contributos para uma melhor Gestão da Cadeia de Abastecimento Têxtil no Paquistão

Nas últimas décadas, a liberalização comercial e as inovações na área das comunicações têm aumentado as oportunidades para os grandes retalhistas e as grandes marcas se abastecerem em fornecedores e fabricantes de todo o mundo. Transformaram-se assim em empresas globais que subcontratam a produção dos bens que comercializam a fornecedores e produtores situados em qualquer parte do mundo através de complexas redes internacionais ou de cadeias de abastecimento globais. Desta forma, os grandes retalhistas e as grandes marcas controlam estas cadeias de abastecimento (CAs) e determinam os níveis de preço, qualidade, prazos de entrega e condições de trabalho para os fornecedores e produtores que fazem parte da CA.

Como resultado desta transformação, as atividades globais da cadeia de abastecimento têxtil e do vestuário estão divididas em operações de lucro elevado e operações de baixa rentabilidade. Retalhistas e marcas retém os processos de lucro elevado, tais como inovação, marketing e retalho. As operações de menor valor acrescentado, como o abastecimento de matérias-primas, a produção e montagem, o acabamento e embalagem, são subcontratadas a produtores de baixo custo em todo o mundo. Isso criou exportações intensivas de trabalho dos locais de baixo custo especialmente Ásia e Extremo Oriente. Esta migração da indústria têxtil e do vestuário tem desbloqueado potenciais novos mercados, incluindo a China, a Ásia do Sul, o Brasil e o Médio Oriente.

Na reestruturação global da indústria têxtil e de vestuário, capacidades competitivas como inovação, design e rapidez de resposta emergiram como os principais fatores de rentabilidade. Nos dias de hoje, a qualidade, a adição de valor e o serviço ao cliente são utilizados para manter a posição estratégica global das CAs

Existem muitas marcas de têxteis e vestuário que são fabricadas atualmente na Índia, Paquistão e Bangladesh. O Paquistão é um importante produtor têxtil, dispondo dos recursos necessários para esta indústria, nos quais se incluem instalações, tecnologia,

disponibilidade de matéria-prima e mão de obra barata. Apesar disso, tem produzido essencialmente produtos standard, de baixo valor acrescentado e dirigidos para sectores do mercado de menor rentabilidade. Muitos países aumentaram as suas quotas de exportação de produtos têxteis e de vestuário após a eliminação do regime de quotas. Infelizmente, o Paquistão não foi capaz de aumentar a sua quota de exportação nos seus mercados não tradicionais, como o do vestuário de moda, por falta de estratégias adequadas e de modernização da sua indústria têxtil e do vestuário. Tornou-se claro que a indústria não está preparada para este novo cenário tendo dificuldades em cumprir prazos de entrega curtos e em dar respostas rápidas exigidas pela maioria dos clientes hoje em dia.

Este trabalho centra-se na cadeia de abastecimento têxtil e do vestuário do Paquistão. Foram estudadas a estrutura e as características do sistema e os seus padrões de desenvolvimento sectoriais, em especial, para as actividades da cadeia de valor do algodão, que se encontram na configuração formal. A configuração informal está para além do âmbito desta pesquisa. Existem poucos estudos a essa escala para o sistema de cadeia de abastecimento, o que restringe a visão global do sistema e torna difícil a adopção de orientações estratégicas relevantes quando se trabalha na melhoria global do sistema. Assim, o objectivo foi identificar o ambiente estratégico do sistema e as decisões estratégicas mais relevantes. A motivação por trás desta pesquisa está no facto de a indústria precisar de uma reestruturação adequada para melhorar a sua competitividade global nas áreas que podem trazer maiores lucros e, para isso, um estudo detalhado do sector têxtil e do vestuário foi necessário.

Os pontos principais deste trabalho centram-se na sua abordagem multidimensional; É feita uma análise estratégica de todo o sistema, que é apoiada do ponto de vista táctico no estudo de uma cadeia de abastecimento moderna. Acreditamos que isso irá proporcionar um melhor entendimento sobre as questões que são enfrentadas atualmente, à escala global, pelas cadeias de abastecimento têxtil e do vestuário.

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List of Abbreviations

WTO	World Trade Organization
NAFTA	North American Free Trade Agreement
ASEAN	Association of Southeast Asian Nations
SAFTA	South Asian Free Trade Area
FATA	Federally Administered Tribal Areas
TCP	Trade Corporation of Pakistan
PCGA	Pakistan Cotton Ginning Association
APTMA	All Pakistan Textile Mills Association
CEC	Economic Committee of Cabinet
MFA	Multi Fibre Agreement
TCO	Textile Commissioner Organization
PCCC	Pakistan Central Cotton Committee
EPB	Export Promotion Bureau of Pakistan (Now known as TDAP)
TDAP	Trade Development Authority of Pakistan
PHMA	Pakistan Hosiery Manufacturers Association
TMA	Towel Manufacturers Association of Pakistan
PRGMEA	Pakistan Ready Made Garments Manufacturers and Exporters Association
ITMF	International Textile Manufacturers Federation

Chapter I	Introduction	Page

I.1. Global Textile and Clothing Supply Chain System

Over the past 25 years, trade liberalization and communication innovations have increased the opportunities for retailers and brands to buy their products from producers worldwide. According to studies, these retailers and brands have become "global sourcing companies", outsourcing the production of goods they sell to tiers of competing suppliers and producers through complex international networks, or global supply chains. Now, the supply chains (SCs) are driven by big brands and retailers that have tremendous power in determining price, quality, delivery, and labour conditions for suppliers and producers down the chain. The SC segments are divided into high and low profit steps. Retailers and brands keep high profit steps such as innovation, marketing and retailing. Low profit steps, such as sourcing raw materials, production and assembly, finishing and packing, are outsourced to mid-chain suppliers and low-cost producers worldwide. Thus global supply chains have created labour-intensive exports from low-cost locations especially Asian and Far East regions. The result is an enormous growth in the number of producers, increasing competition among the world's factories at the bottom of the chain. The phenomenon of the industrial shift to the low labour cost economies is discussed by Loo (2002) and Bolisani and Scarso (1996). As a result of this industrial shift in the last couple of decades, the major competing SCs in textile and clothing are now routed from countries like China, India, Pakistan, Turkey, Indonesia, Thailand and Vietnam and some others are emerging from Brazil and Bangladesh. The textiles and clothing sector generated, in 2007, flows of about 583.4 Billion $US, amounting to almost 4.2% of total world exports (WTO Statistics, 2007). The clothing sector, accounting for about 345.3 Billion $US, is particularly important to many developing countries where textiles are the main source of export revenue and manufacturing employment.

In such a situation, the suppliers in the global textile and clothing networks are adopting competitive strategies to improve their attractiveness to the global customers. The choice of competitive strategies depends on many factors, including geographical location of the suppliers, development status of the country´s infrastructure in which they operate, their capability in design and innovation, level of their advancement in the communication technologies and awareness to the needs and requirements of the end user. Based on these factors for example, the application and usage of the competitive strategies vary in the upward and downward segments of the textile and clothing chains because of the recent regionalization of these sectors. The generic nature of the products in the upward segments of the chain has made the choice of competitive options more specific, leaving cost, quality, service and reliability as some suitable

choices. These are the options which are favourable to adopt in the countries producing the generic products because of being far away from the main markets but being rich in raw materials and having cheap labour. On the other hand, the diverse nature of the customer segments and their needs have transformed the conventional, slow style changing and mass producers to modern, quick style changing and customized producers. They are technologically advanced and locate in regions of well-developed infrastructure having high speed transportation linkage to the important international markets. Tersine and Hummingbird (1995) discussed the strategic competitive options under different product environments of the companies which if merged to the current segmentation of the activities in the global context of textile and clothing manufacturing discussed by Teng and Jaramillo (2005), the situation which emerges is presented in Table 1 (Hussain et al. (2011b)).

Table 1: Segmentation of Global Textile and Clothing Supply Chain Network

	Segments	Competitive Options	Current State	Remarks
Upward Chain (Raw Materials to Fabric)	Producers: Asia (China, India, Pakistan, Turkey), S. America, Africa. Markets: N. America, Europe, Asia	Price/Cost, Quality, Delivery Time, Reliability, Service, Flexibility	Experiencing significant changes and new players are positioning themselves in new situation. Competition is fierce in gaining and maintaining position in markets when cost and delivery times are the critical options to maintain and control.	Maquiladoras initiated the transfer of these industries from North America to Central America and NAFTA accelerated this shift. Then the different events as revaluation of currency by Mexico, elimination of quotas and entrance of China into WTO regime, created a shift of textile and clothing manufacturing near to resource rich and low-cost locations.
Downward Chain (Clothing; Design and Development; Customer Link)	Markets: N. America Europe, Japan, Russia Emerging Markets: China, India, Brazil Producers: Asia, Europe, South America	Design, Services Differentiation with Shortest Possible Lead Times	Controlled by big brands and retailers (Wal-Mart, Zara, Gap, etc.)	Preferred geographical locations exists near main and emerging markets which support to compete on design and time

In the course of development, competitive capabilities including the design and innovation and the time-based performance of the supply chains have emerged as the main driving forces for the profitability of the companies involved in these saturated markets, specifically in fashion clothing sectors. Simultaneously, quality, value-addition and customer service help in developing the overall strategic position of the company in terms of its long term competitiveness and sustainability.

The success or failure when competing on the above factors depends on different parameters of the system. For example, the innovation and design mainly depend on the performance of the human skills. These capabilities have their strength in the product and market research. To develop these skills, experience and commitment in the system are needed. Better performance on time, quality, value-addition and customer service need a lot of investment in advanced technology, whereas the requirement to invest in human skill is lower in these scenarios.

As the textile and clothing companies are scattered around the world, they operate in very different environments and differ a lot in the level of their development. Therefore, the strengths and the level of maturity of the companies under the competitive factors are quite different in various regions of the world. In general, the process of historical development of the company and its environment govern the working culture of the organization. The success to develop specific strengths in the system depends mainly on the business culture. Therefore, companies should configure their SCs depending upon the historical development of the environment, available skills, other strengths and technological resources, which will ultimately affect the range of their product environment and types of services, offered to various customer segments. Most recently, when the companies collaborate internationally and integrate their operations to form a network of SC system, they produce a wide range of products and services for the global markets. This created a new and advanced demand and supply market where players collaborate with their suppliers and share market information and risks (Harland and Knight (2001); Hartley et al. (1997)).

There are many textile and fashion brands which are manufactured now in countries like Pakistan, India and Bangladesh. The fashion cycles of these brands are mainly once or twice per year, making it possible, to some extent, for the suppliers of these countries to respond to their lead times. However, world trends in textile and fashion business clearly indicate that the lead times are continuously reducing specially in the main markets of Europe and North America.

I.2. Position of the Textile and Clothing SC System of Pakistan in the World

Looking at the product environment of the textile and clothing industry of Pakistan, it can be observed that the country is producing narrow range of products and most of these are directed to the low profit segments of the international markets. The SC system mainly produces cotton-based standard products including coarse-to-medium fine cotton yarns and low-to-medium weight woven and knitted cloths (the fact which has its support in the export/production data in Chapter III). The manufacturers and producers, in the country, are accustomed to supply low cost products of good quality to the world markets. This was the main reason that the share of the country in the world exports in these sectors is stagnant after the phasing-out of the quota regime in 2005. On the other hand, many countries have successfully increased their shares of textile and/or clothing exports under the new scenario by working with other countries and devising mutual trade agreements like ASEAN economic trade zone and trade agreements of SAFTA and NAFTA. Unfortunately, Pakistan was not able to increase its share in its non-traditional markets because of not developing such strategies and not upgrading its domestic textile and clothing industry. Therefore, the weaknesses of the planning to improve the national industry and its integration to other important players should be the main factors behind the lower growth of the country's textile and clothing exports in comparison to other players in the world.

In the current business environment, focusing on the complete SCs with respect to planning and management is important in addition to focusing on the individual entities. Nowadays, many companies in the developed world rely on supply chain management (SCM) as a key competitive strategy. Large and small businesses alike have reported remarkable results, including dramatic reductions in the cycle time and costs and increase in their responsiveness on customers' inquiries. In this scenario, as the competing textile and clothing SC systems have developed their competitive strengths on design, delivery times and product diversification, SCM should be one of the key focuses of Pakistani textile industry to improve its performance and to attract the higher-end markets of fashion and clothing. It is obvious that the industry is not prepared for this scenario and it has difficulties in meeting short lead times or other time-based performance and higher responsiveness which are expected now a day by most customers in these sectors. Authors have defined the term SCM as follows.

SCM is the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purpose of improving the long-term performance of the individual companies and the supply chain as a whole (Mentzer et al (2001)).

SCM has been used to explain the planning and control of material and information flows as well as the logistics activities not only internally within a company but also externally between companies (Cooper et al. (1997) and Fisher (1997), cited by Chen and Paulraj (2004).

SCM is an interdisciplinary field that emphasizes cross-functional links and seeks to manage those links to enhance a company's competitive advantage. It involves forecasting, resource allocation, production planning, flow, process and inventory management, customer delivery, after-sales support and service, and a multitude of other activities and processes familiar and essential to business.

It is more relevant to observe the overall SC system and to evaluate its potential on main factors which can support the SCM activities and the orientation of the business networks in textile and clothing sectors in Pakistan. This approach is adopted in the development of the research.

Today, the fashion markets frequently create changing short-run orders causing a strong impact on the planning function which should be equipped with advance planning and decision making systems to facilitate quick response. Despite having latest computerized manufacturing machines, textile and clothing companies in Pakistan put less emphasis on such tools which can help fast decision making by demand forecasting, planning and control of production, inventory, etc. This behaviour results in higher costs of operations and late deliveries. Thus, even with state of the art machinery and access to capital, Pakistani textile and clothing industry is compelled to manufacture and export non-seasonal and low value textile products where high capital is required to manufacture at extremely low margins. Although, the main constraint in order to decrease the lead times for the main international markets of USA and Europe is the geographical location of the country, advance technologies can help to reduce this gap for specific customer segments. Anyway, the measures which can enhance the responsiveness of the country in the above markets will definitely enhance its strategic position in the emerging markets of China, India and Pakistan itself. Therefore, there is a need to address the factors on which the time-based performance of the system depends. These factors include poor logistics, limited use of advance technologies in planning and controls and low usage of advance information and communication in the SC system.

We will continue exploring the above factors in Chapters III and IV. In the following sections, we will discuss the objectives and the scope of the research.

I.3. Research Objectives and Questions

Many researchers have studied the competitive options in the supply and demand chain networks, including Tersine and Hummingbird (1995), Teng and Jaramillo (2005), Cox (2005) and Omera (2008).

Omera (2008) and Cox (2005) concluded that product design is a key factor in today's challenging markets for companies working in UK. In her case study, Omera (2008) described that with a strong product design background, companies in England have the support of geographical location and advance infrastructure which enhance their ability to reduce the time to market their products. In this way, the companies maintain their profitability even with the higher labour and material costs in the country.

We believe that improving the time-based performance in the textile and clothing supply chain system of Pakistan will increase its attractiveness in the higher-end markets of fashion and clothing. It will also decrease the overall cost as decreasing the flow time in the SC should lead to cost reductions. The factors, on which the competitiveness of the system can be based, include the research environment, skills on design, innovation and the diversification of fibres. At this stage, the expansion of the textile activities to the application areas of automotive, medical, construction and agriculture should also be focused. This will lead the product environment of the system to the advance industries of technical and functional textiles and will improve its technological and research dimensions.

Once the governing factors are in place, the time-based performance and the competitiveness can be improved significantly. Otherwise, the companies will try to improve their performance and the system will waste their efforts. Also, it will cost a lot to the individual companies to adopt such strategies on their own resources. This will ultimately result in the loss of their motivation to achieve competitiveness on the factors of strategic importance at higher costs. Therefore, it is logical to study the overall supply chain system of the country in order to analyse how the existing potential of the system can support the individual companies and supply chain networks to adopt the discussed competitive options. The study will also help to identify the strategic directions for the supply chain system of the country.

Therefore, keeping in view the overall supply chain system and its lead times or more generally the responsiveness on the market demands, the following research questions are evolved.

1. Which are the main characteristics of the textile and clothing supply chain system of Pakistan and how the linkages of the system can be improved to the main markets?

2. Which are the lead times in textile and clothing supply chains and how are these composed for Pakistan´s case? How these can be decreased without significantly increasing the cost?

In chapters III and IV, we will discuss the textile and clothing SCs in general, and then we will focus on the textile and clothing supply chain system of Pakistan in order to answer "Question 1". Our objectives are to develop the structure of the supply chain system and to identify its characteristics. The status of development for various sectors will also be presented and the strategic directions for the system will be formulated. This part of the study will conclude with the evaluation of the devised strategies. The competitive options which were discussed above will help to devise the essential strategies of the system in the current and the future scenarios of global textile and clothing markets.

In order to support the fresh insight on the developments in the international textile and clothing SC systems, a case study will be discussed in Chapter V. It was conducted in a textile and clothing SC chain in Portugal. The time performance of the SC chain on the customer orders was analysed in this study to develop the scenario of lead times in the advance textile and clothing SCs. The country has a strong background on the manufacturing activities in textile and clothing. Meanwhile, working inside the European markets also makes such a case study the most logical approach to reflect on the recent developments in these networks. The knowledge developed in this case study has a strong utility in the countries which are recently growing in these areas including Pakistan. This will also provide means to understand the strategic moves of the developed markets. Combining the production times of Portugal and transportation time of Pakistan will further help to answer the "Question 2" of the research.

In the next chapter, we have discussed the research methods and tools which helped to advance this research.

Chapter II	Literature Review & Research Design	Page

II.1. Literature Review

The activity of literature review was divided under two main themes which covered the areas of strategic planning in the textile and clothing SC systems and their configurations. Section II.1.1 covers the strategic planning process and section II.1.2 addresses the other part of the activity related to the configurations of the textile and clothing SCs.

II.1.1. Strategic Planning

Strategic planning, discussed in the planning theory is the process of fitting a match between the external opportunities and threats and the internal resources and capabilities of a firm. SWOT analysis is its simplest tool which identifies the SWOTs through internal and external appraisal and provides a basis for the planning process. Dyson (2004) related it to the contemporary planning methods of resource and competency-based planning.

Pickton and Sheila (1998) wrote:

> "Businesses seek survival, improvement and success. To fulfil such outcomes, management planning and decision making require information about business operations and circumstances which surround them; such information is the basis upon which business decisions may be made…
> So-called ´environmental scanning´ and ´environmental analysis´ (although many may use different terminology) are considered such a fundamental and basic part of the business planning process that the need to carry them out is accepted without question." (p. 102-103)

Hill and Westbrook (1997) associated the development and use of SWOT study in the works of business policy academics at Harvard Business School and other American business schools; they found the work of Kenneth Andrew (1971) as influential in popularizing the idea that strategic planning of a firm is creating a match between its external (threats and opportunities) and internal factors (strengths and weaknesses). However, Dyson (2004) connected the origins of SWOT analysis to the work of Learned et al. (1965).

In order to motivate a new strategic initiative, a variation of SWOT analysis was emerged as TOWS matrix which provided pairing of the factors like opportunities with strengths SO, WO, etc. (Dyson (2004)). The structure of a TOWS matrix is presented below.

Table 2: TOWS Matrix

	Strengths	Weaknesses
Opportunities	SO Strategy	WO Strategy
Threats	TS Strategy	WT Strategy

When discussing the value of SWOT analysis, it is rated as simple-to-perform and effective in performance. Hill and Westbrook (1997), Pickton and Sheila (1998), Valentin (2001) and Dyson (2004) are some of the authors who have appraised the SWOT analysis and Dyson (2004), Houben et al. (1999) and others applied it for their planning problems.

Some authors have casted their doubts for even considering it as an analytical tool including Hill and Westbrook (1997). Others have tried to supersede it with resource-based planning as Wenerfelt, 1984 and Grant, 1991, and with competence-based planning (Ulrich and Lake, 1990).

Criticizing the process of traditional, simple SWOT listing, Valentin (2001) wrote:

> …Rather than provide a sense of direction for delving deeply into strategic issues, conventional SWOT checklists seemingly beckon analysts to limit their work to judging offhandedly which listed items characterize a business and which do not. They are laden with catchall questions that lack coherent theoretical underpinnings, slight contextual complexities, prompt analysts to meander haphazardly from one issue to another, and leave in doubt how listed issues are to be examined. Consequently, traditional SWOT analyses often yield only shallow extemporaneous inventories that are as likely to detract from critical issues, themes, and thrusts as illuminate them.

Dyson (2004) considered the contemporary approaches of resource and competence-based planning as the development of the internal appraisal of SWOT rather than its replacement. In the same context, he considered the scenario based planning as a development of its external appraisal. In his general recommendations, Dyson (2004) assigned the SWOT as being a firm foundation for resource and competency-based planning and presented the enhanced version of TOWS matrix, based on the recent contemporary approaches. It is offered in the following figure.

Table 3: TOWS Matrix (Enhanced Version)

Scenario Driven ⬇	Strengths, Resources, Competencies	Weaknesses
Opportunities	SO Strategy	WO Strategy
Threats	TS Strategy	WT Strategy

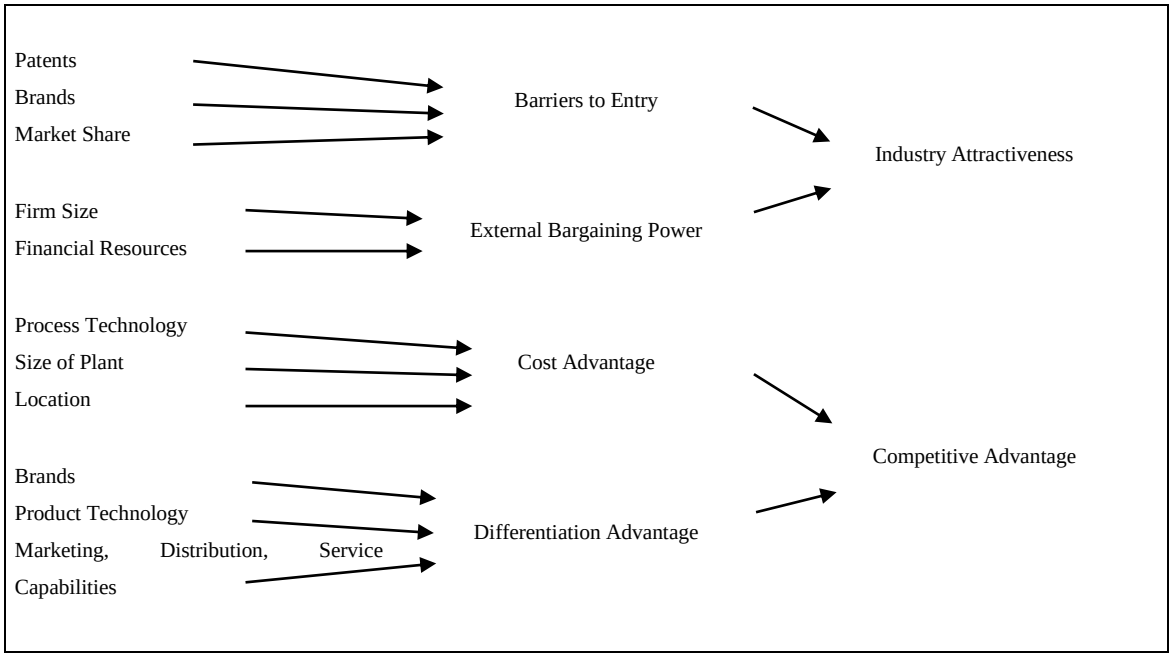
In the evolution of the strategic planning process, authors including Kotler (1991), Hill and Westbrook (1997), Pickton and Sheila (1998) and Valentine (2001) have advised additional measures to avoid the pitfalls of simple SWOT listings and improve its applicability as an analytical tool in the strategic planning.

Kotler (1991) advised the development of a Performance-Importance matrix for internal and external factors (referred by Pickton and Sheila, 1998). The description of such improvements in the SWOT analysis process can also be witnessed in the studies of Plamer and Hartley (1996), Wislon et al. (1992) and Johnson and Scholes (1993). Here, the Performance-Importance matrix includes the likely probability of occurrence and the impact of factors on the business and in this way it generates the prioritization of the factors establishing their relevant impact in the overall planning process. Based on this approach, Dyson (2004) calculated the score of SWOTs to prioritize the strategic directions under defensive and offensive dimensions.

Valentin (2001) discussed the resource and competition based description of the SWOT analysis which he based in the contemporary strategic management and marketing theory, especially the resource-based view of a firm presented by Wenerfelt (1984) and Grant (1991). It also draws from the Porter´s (1979, 1980) competitive paradigm and Brandenburger and Nalebuff´s (1995, 1996) value net.

From the resource-based view of a firm, Dyson (2004) developed the relationship of resources, capabilities and core competencies for the organizational competitiveness and attractiveness. It is conceptualized below.

Figure 1: Resource-Based Planning



On the basis of resource-based view of a firm, Valentin (2001) identified critical resources including both tangibles and intangibles which are presented below.

Table 4: Tangible and Intangible Resources

Resources	Examples
Financial	Cash and access to Financial Markets
Physical	Configuration of Facilities and Equipment, Raw Materials
Intellectual	Expertise, Formulas, and Discoveries
Legal	Patents, Trademarks, and Contracts (to protect intellectual capital)
Human	Employee´s Individual Expertise and Skills
Organizational	Culture, Customs, Shared Visions and Values, Routines and Working Relationships
Informational	Customer and Competitive Intelligence
Relational	Strategic Alliances, Relations with Customers, Vendors, and other Stakeholders (which often are affected by the bargaining power and switching costs)
Reputational	Brand Names (that reduce perceived risk or have symbolic value)

Dyson (2004) also discussed these factors but with a different classification as internal and external appraisal aspects. His internal aspects include personnel, facilities, locations, products, and services and external aspects include political, economic, social, technological and competitive.

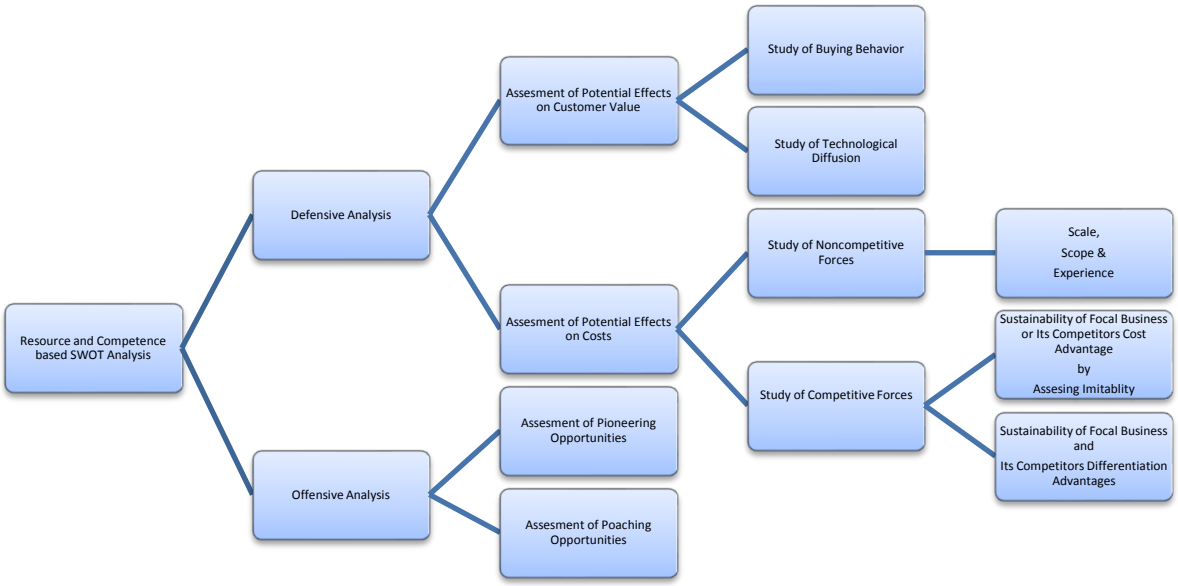
Valentin´s (2001) resource-based SWOT mainly analyses the defensive and offensive context for a firm by examining forces that affect its product´s Customer Value-Cost differential and competitive position from…

…a defensive perspective by identifying and assessing threats, conceiving counter measures, discovering weaknesses that exacerbate threats, and recognizing strengths that mitigate threats.

…an offensive vantage point by identifying promising expansion paths.

Detail of the Valentin´s (2001) method for the resource-based SWOT is conceptualized below.

Figure 2: Visualization of Valentin´s (2001) Resource and Competence Based SWOT Analysis



Valentin (2001) added that defensive analysis facilitates identifying and assessing threats, conceiving counter measures, discovering weaknesses that exacerbate threats, and recognizing strengths that mitigate threats. Similarly, offensive analysis facilitates identifying promising expansion paths.

Other criticism on SWOT is that it is a highly subjective process (Pickton and Sheila (1998)). To decrease its subjective aspect, they motivated to support it with more data and to carry out the activity in groups, involving people from all levels of the organizational hierarchy and functions. In this way, the subjective aspect of the process can be decreased but not completely eliminated. Probably, this can be further decreased by including the opinions of people who are not part of

the organization but have good understanding of the organizations products and services, namely its customers. Such an external view of the firm from customers can eliminate the subjective aspect of the conventional SWOT process which is mainly based on internal views.

The value of the SWOT is not only seen in its outputs but also in the very process of carrying it out (Pickton and Sheila (1998)).

The above discussion was mainly focused on the improvements in the methodology of performing the SWOT analysis in order to improve the overall strategic planning process. In reality such improvements address a very small area of the overall strategic planning process. It does not address for example, how to effectively expand the SWOT analysis towards more comprehensive strategic planning by improving the effectiveness of the linkage of SWOT analysis with the subsequent phases of the process. The subsequent phases of the processes include the design, evaluation and the implementation of the strategic plans. The SWOT analysis is mostly performed in the design phase of the strategic planning. It only holds the responsibility of carrying it out in the present period without providing an effective source for the future iterations of the strategic planning process. It does present (and thus preserve) the linkages of the factors in the strategy designing process. Those linkages are somehow kept in abstraction/intuition. On the more broad level, the SWOT analysis had a little effectiveness in the evaluation and implementation phases of the strategic planning before the hybridization of SWOT analysis with the decision methods was evolved. This is discussed in the following paragraphs.

Once the environmental analysis is conducted, setting the strategic direction becomes logical. In the research design section on the strategic planning II.2.1, we have provided an insight on the means to improve the visualization of the interface between strategic environment analysis and the strategy formulation process.

The work of Kurttila et al. (2000) presents a connection between environmental analysis (SWOT analysis) and the development and evaluation of the strategic plans in his hybrid method, Analytical Hierarchy Process (AHP) in SWOT. It combines the traditional SWOT analysis with a classical decision making method AHP, developed by Saaty (1980). This method provided the prioritization framework for the designed strategies on the basis of SWOT factors and sub-factors for their ultimate role in the selection or prioritization of the decision alternatives which were

developed as a result of the analysis of decision environment. AHP is a decision tool which takes into account the hierarchical relationship of the decision elements (including SWOT factors and sub-factors) and their effects on the decision alternatives. The methodology was also adopted, later in other studies including Stewart et al. (2002), Kajanus et al. (2004), Shrestha et al. (2004), Leskinen et al. (2006) and Masozera et al. (2006).

The hybrid method of Kurttila et al. (2000) provided the means to measure the hierarchical relationship of the decision elements i.e. SWOT factors and sub-factors and the strategy alternatives. The hierarchical effects are measured in a top-to-bottom hierarchy of decision levels. The dependence of the higher level decision elements on lower level elements is mainly measured in a top to bottom hierarchy where each element at top depends on the bottom element. It does not measure the effects of the inner dependence within clusters or feedback of lower levels. In real world problems the inner dependence in the elements of the same level exists and in some cases the lower level elements also affect the top level elements. As it is difficult to evaluate all these affects in single iteration of the analysis, experts measure them in iterations in order to observe them more rigorously and to separate their effects. Therefore, working on the same lines of Kurttila et al. (2000), Yuksel and Dagdeviren (2007) developed the hybrid method of ANP in SWOT for measuring the inner dependence of SWOT factors in the analysis for the strategic decision making. The base methods of AHP and ANP were developed by Saaty, discussion on these methods can be found in Saaty (1980), Saaty and Takizawa (1986), Saaty (1996), Foreman and Gass (2001), Saaty and Vergas (2006) and Saaty and Sodenkamp (2008).

These methods are explained in chapter IV, where we have applied these to the evaluation of the strategic plans of the textile and clothing SC system in Pakistan. Analysis of the internal and external environment for the textile and clothing SC system is also conducted, which helped to identify the position of the SC system in the global scenario and in designing strategic plans for its competitive functioning. These are covered in Chapters III and IV. Before that, we will discuss the design of the above analysis in section II.2.1.

II.1.2. Configuration of Supply Chains in Textile and Clothing

In the developed and developing countries, the configurations of modern day textile and clothing chains are very different as they work for different product environments. In the developed countries, the SCs which produce for the fashion segments for example are configured to respond

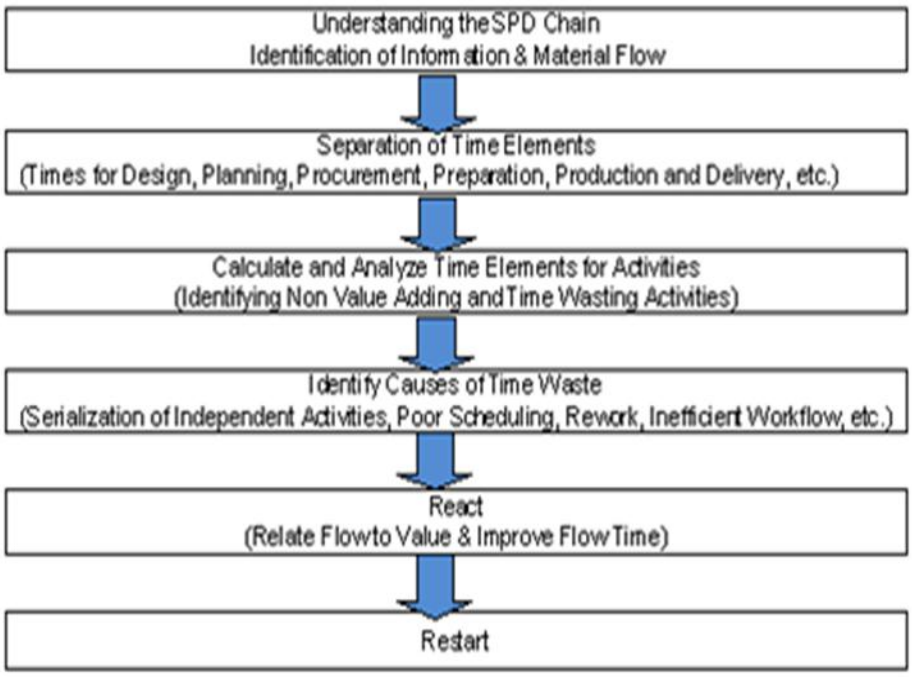
very fast to cope with the seasonal cycles and rapidly changing styles (Bruce and Daly (2011)). There are many other SC configurations in the textile and clothing networks under various product areas. These reflect to the developments which are taking place to maintain the competitiveness in these networks (Hussain et al. (2011b)). It will be insightful for the strategic moves of the textile and clothing industry in Pakistan to learn from these developments. In this perspective, this section and the resulting studies were performed to gain such an insight on the recent developments.

The time as a competitive option is not a very recent concept in the marketing strategies. It was discussed earlier by Alderson (1954) for example and later by Tersine and Hummingbird (1995). The application of time-based competitiveness is being observed more recently in many developed countries to maintain competitiveness in certain product segments of textile and clothing, especially in the high profit markets of fashion clothing and in some other product segments. Adopting this strategy looks more logical when other competitive options of cost, quality, design and service are being adopted by the SCs operating from newly developing countries (Hussain et al. (2011b)). In the time-based competitiveness, a priority is maintained for specific regions close to the main markets and/or logistically well-linked regions for the manufacturing of specific products. As an example, the main markets of Europe can be supplied more quickly for the seasonal items from the countries of East Europe and South Europe or countries of North Africa which are considered as low cost production locations, till now, compared to the countries of central Europe. Here, the countries of East and South Europe have a comparative advantage over countries of North Africa and other non-European countries, in term of higher development of logistics infrastructure which serve as main advantage for them in situations of quick response in fashion clothing and seasonal items. Therefore, it provides a control to keep certain share of textile and clothing manufacturing inside specific economic regions to support low technology and low skill employment for less educated and low skilled labour force. The textile and clothing activity also supports other objectives of the economic activity in these countries.

Tersine and Hummingbird (1995) provided insight on the time elements for various product environments including engineer-to-order, make-to-order, assemble-to-order and make-to-stock. Under these product environments, the time segments should be separated for activities of design/development, procurement, production and distribution for example. Therefore the allocation and control of these elements is associated with the product environment in which a

firm opts to operate. Another important aspect of the above product environments (-to-order and -to-stock) is that they provide decoupling points in the Supply-Production-Delivery (SPD) chain segments and allow them to behave with anticipative and reactive responses to the customer orders/requirements (Hoekstra and Romme (1991), refer to Fleischmann and Myer (2003)). Additionally, these decoupling points help to model SPD chains to fill the gaps of time, space, quantity, variety, information and quality which are always present in the supply, production and consumption sides (Tersine and Hummingbird (1995)). Thus the strategy to compete on time is based on identifying and findings the means to control and reduce the time elements in the SPD chain. The flow of such a study is conceptualized in figure below.

Figure 3: Flow of Study on Improving Time Performance of SCs



The process starts with the identification of the product environment and the configuration of the SPD chain. It follows the process to develop the models on order fulfilment and the identification of its time elements. The time elements are measured and analysed to identify the inefficient areas. The areas of time waste are improved and next iterations of the process analysis are initiated.

This was a view with a closer look on the SC configurations in response to adopting different strategies to compete. This discussion will be continued in Chapter V with facts from a real case

study, conducted in such a SC. We will also bring the helpful insight for the textile and clothing SC system in Pakistan, from the case study.

II.2. Research Design

At this stage, we can add that this research will proceed at two different levels including strategic and tactical dimensions. Question 1 will be covered in the strategic level by working on the strategic environment of the textile and clothing system in the country. Meanwhile, Question 2 is focused to provide insight on the tactical issues of an advance textile and clothing chain and will be covered through case study approach. Working at these levels, it will improve the visibility of the research design and the conduct of the research.

II.2.1. Strategic Issues

Here, Question 1 is termed as Study I to develop its process. The methodology for its conduct is discussed here. The study develops in various phases. It refers to the analysis of the strategic environment including potential markets, the structure and the characteristics of the system. It follows the designing of the relevant strategies for the system which will be evaluated for their importance in scenario of recent developments. Meanwhile, the adopted approach will help to bring the clear insight on the factors which are responsible for achieving the above objectives.

Study I: Which are the main characteristics of the textile and clothing supply chain system of Pakistan and how the linkages of the system can be improved to the main markets?

Two dimensions of the problem can be identified in this study including the analysis of the characteristics and structure of the system and the improvement of the linkages of the system to the main markets of textile, clothing and related areas.

The development of the system environment is the most difficult step in this study as no such effort was performed on the overall textile and clothing system of the country by the scientific community to serve as a starting point for this research. Further, the system is very broad and capturing its overall view is a complicated task. In general, it was required to develop the broader environment of the system in which various sectors of the industry operate and by which these are affected. The strategic environment was constructed from the analysis on the secondary data,

study reports of various government and private organizations which discussed the individual or more segments of the chain. These did not cover the broad environment of the system. The consultation and interviews of experts and managers, inside and outside the system, were also utilized to improve the findings of our research.

The second part of the study is focused on two types of issues; formulating the strategic directions for the system and the evaluation of their importance. With this dissection of the problem, the overall study was followed through the following steps.

1. To develop the strategic environment of the textile and clothing system of Pakistan based on its structure, characteristics and the potential markets
2. To formulate the strategic plans for the system on the basis of its potential and the identified markets
3. To evaluate the performance of the strategic plans in terms of their importance to achieve the overall objective of the improvement of the SC system

After the development of the structure and characteristics of the system, it was much easier to follow the other steps of designing the strategies and evaluating their performance. It is interesting to draw some insight on the implementation character of the devised strategies, which was also developed after performing the mentioned steps. These are discussed in Chapter IV.

The process of the strategic planning was embraced for the study, the discussion on its theory and the process was initiated in section II.1.1, which will continue here and in chapter III and IV.

The analysis of the strategic environment is based on the identification of the main factors which can affect its performance both from outside and from inside (within) the system. The outside factors are termed as external factors and they include opportunities and threats whereas the factors within the system are termed as internal factors and include strengths and weaknesses of the system. The main sources which were utilised to identify the SWOT factors for the system are secondary data, literature review and inputs of experts. During the analysis of the secondary data on the system, the development status of the sectors was also created, which took into account the growth of the factors responsible for the development of the sectors. The strength of this analysis has provided us the ability to develop a new tool called Planning-Link to synchronise the strategic environment with the strategy design process. This tool is discussed in Chapter IV.

The growth of the main factors identified the development status of sectors and the Planning-link provided the basis for devising the strategic directions for the system. Moreover, the inputs of the experts allowed us to refine our ideas on the strategic dimensions and the content of strategies. These strategic directions are intended to improve the competitiveness of the system by enhancing its responsiveness and capability in the directed markets.

The initial view of the system and its environment was formulated from the study of reports and discussion with various personnel in the SC; results were presented in the study by Hussain et al. (2009). Later, resources of secondary data were consulted to broaden the view of this study and the inputs of external experts were added to verify the findings. The overall findings are presented in Chapter III.

The devised strategies were evaluated with the process of strategic decision making, which was discussed in section II.1.1. At this stage, the evaluation is based on their importance in relation to identified markets and their implementability in relation to the time and resources. In these evaluations, the effects of the strategic factors of the system environment on the strategic directions were studied. This can be explained in terms of the strategic decision theory as the hierarchical dependence of the higher level decision elements (SWOT) on the lower level elements (Sub-SWOTs) and the inner dependence of factors. Further explanation is provided in Chapter IV.

Following four steps provide the best simplification of the strategic planning process discussed above and how it is covered in Chapters III to IV.

1. Resource-based SWOT analysis on the Textile and Clothing SC System of Pakistan
2. Formulating the Strategic Directions for the SC System
3. Evaluation of the Performance of the Strategic Plans
4. Evaluation of the Implementation Character of the Strategic Plans

The evaluation of the importance of the devised strategies was intended to provide their relevance in the scenario of current development status of the system and its potential to supply the identified markets. Meanwhile, the implementation character of the devised plans is evaluated to help the formulation of their implementation plans. Steps 3 and 4 address these areas and these are covered in chapter IV.

It can be explained further that the Steps 1 & 2 have high exploratory contents. The overall approach for developing the environment of the system is similar to the perspective of a critical realist (Saunders et al. (2007)). Meanwhile, we have analysed the system from the inputs of the internal and external experts, the study reports of various organizations, historical secondary data and the work of some authors. The sources utilised for the study are referred in detail in Chapter III.

II.2.2. Tactical Issues

Here, Question 2 is termed as Study II to develop its process. It covers the tactical issues including the configuration of a modern textile and clothing supply chain and analyses the time performance of the SC activities. The design of research is based on the methods available in the scientific literature, discussed in section II.1.2. It is explained below.

Study II: Which are the configuration and structure of a modern day Textile and Clothing SC and how the time components exist in the segments of the chain?

The study covers various aspects of a modern textile and clothing chain, including its product environment, supply chain configuration, order flow and the time based performance of various activities. The main focus is to analyse the time performance of the chain on the customer orders to develop insight on the importance of the time responsiveness in these supply chains. The study will bring important insight on the working of a textile and clothing supply chain in the developed countries and the implications of future environment for these supply chains which are operating in developing countries. To conduct the study, the steps identified in section II.1.2 are followed. Thus, it can be divided into the following parts.

1. Identification of the Product Environment
2. Study of the Characteristics of the Supply-Production-Delivery Functions
3. Modelling the Order Fulfilment Process and identify the Time Elements
4. Collection of data on time elements and time based performance of chain segments
5. Analysing the time performance of the order fulfilment and chain segments
6. Identifying the areas for improvement

The findings of the above parts can be extended to the textile and clothing SC system of Pakistan by including following parts into this study.

7. Generalize the results for similar supply chains like Pakistan
8. Collecting the data on transportation times from Pakistan to main T&C Markets
9. Developing the time based scenario in various product segments for Pakistan

The method of case study research is proposed which will support the exploratory nature of the study. To conduct the study two main strategies are proposed; to observe the functions and processes during the actual flow of specific orders through all the functions of the chain; to conduct detailed non-structured interviews and open-discussions with the managers of the functions in order to develop the integration of the chain activities and therefore to develop the linkage of those activities in the overall configuration of the value chain. The observation and the data collection process should adopt the role of an Observer-as-Participant in the fourfold categorization of Gill and Johnson (2002), cited by Saunders et al. (2007).

The findings will be triangulated from the structure of the information and management system. Later, the data will be collected on different types of order flows based on the order flow models to measure the time performance of the chain on order fulfilment and various activities in the chain. The areas for improvement will be discussed and recommendations will be formulated.

Due to limitation of resources and time, one such case study is conducted which will serve as purposive extreme (excellent) case (Patton (2002) and Peters and Waterman´s (1982), cited by Saunders et al. (2007)). The consideration of such a company as a sample case also lies in the fact that maintaining profitable manufacturing in textile and clothing products inside Europe is becoming more and more difficult as labour and material costs are increasing and the competition from the Asian countries is also soaring. Thus the companies which are continuing their manufacturing inside Europe operate under both severe competition and high costs of operation. They can survive only by developing their strengths in design, quick response and providing higher levels of value addition. The shorter transportation times to main markets provide an advantage to the companies to compete against the low cost Asian suppliers by shortening their lead times but the design and higher levels of value addition are never compromised. On the other hand an extreme (worst) case can provide an opportunity to compare the two systems and their competitive positions under the same or different product environments and customer segments.

Certainly, the time based performance should be different for both such systems as the adopted theory of the chain functioning is different for both such configurations. Such an opposite case for example can be chosen from the textile and clothing industry of Pakistan to further enhance the quality of results of this research to higher level. However, such a case study is placed in the future directions of this research due to limitations of time and resources. The findings of conducted case study are presented in Chapter V.

Portugal being closer to main markets of Europe possesses the advantage to offer quick response times to the main European markets. This advantage is supported with advance technologies, design and innovation capabilities (the fact which is obvious from the results of the case study). The configuration and structure of the Portuguese companies can provide a valuable insight for the tactical issues of the supply chains in Pakistan within the identified segments of textiles, woven clothing, home textile, terry towel etc.

The conclusions of the case study performed in a Portuguese textile and clothing company, are generalized for the textile and clothing system of Pakistan. Such generalization is reasonable as some segments of the supply chain system in Pakistan including textiles, woven clothing, home textile, terry towel, etc., are performing reasonably well in comparison to other systems. They seem to be at good level of development (the fact which has its support in the evaluation, performed in Chapter III) according to the export patterns of the country to the main markets of the world. Meanwhile, the Portuguese companies which had a similar level of development in the 1980s and 1990s present the future scenario for the textile and clothing companies of Pakistan. Therefore, they can provide valuable insight on the tactical issues of these supply chain segments.

The scenario of the time-based performance on the customer orders in the TC supply chain in Portugal can be utilized for the TC companies in Pakistan with similar configurations in order to see how they should respond in Pakistan by transforming the transportation/delivery times accordingly. Thus production times of companies inside Portugal with transportation/delivery times of Pakistan will present a new scenario of supply chain network in TC from Pakistan which will advise the system for new production and marketing strategies in future not only for the main markets of Europe and North America but also for the emerging markets of Asia like India, China and Pakistan. Structured surveys for the transportation times to main textile and clothing markets from Pakistan will help formulate such scenario. The delivery process for the export orders can further be divided into the transportation times inside country and off-shore shipping times,

which should present the potential of various locations in Pakistan to support various product segments. These areas are addressed in parts 7 to 9 above.

The scenario of lead time issues for Pakistan is initiated here by conducting surveys on the shipping times and inland transportation times in Pakistan. Parts 7 and 9 will extend these findings to provide a complete view on the issues of lead times for various markets for Pakistan.

Chapter III	Analysing the Strategic Environment of the T&C System in Pakistan	Page

III.1. Brief Historical View on the Textile and Clothing Sectors in the Region

The textile and clothing sectors in Pakistan have their origin in the historical production and usage of cotton and other natural fibres in the region. The use of manufactured fibres was started three decades back in early 1980s in the industry, to fulfil the demands of the export markets. In general, the diversity of the textile fibres used in these sectors of the country is low and the industry is dependent on low number of natural and manufactured fibres. This low range of fibres provides opportunity to specialize in certain areas and markets but offers constraints on the expansion of the product range of the sectors for the global markets of textile, clothing, related areas and advance textiles. This type of growth and expansion and the study of the important characteristics of these sectors in Pakistan are the main subject of discussion in this chapter.

The formal industrialization process in the country was started in late 1950s and was mainly focused on textile and clothing industry because of having an informal and cottage level industry in these areas. The regions of Pakistan, India, Bangladesh and Sri Lank had formal and informal sectors of cotton value chain because of the production of cotton fibre and its use in the clothing and furnishing. The cotton production also provided many benefits to other sectors including animal feed and production of vegetable oil, for example. During the de-regionalization of the Indian sub-continent into the boundaries of India and Pakistan in 1947, the existing region of Pakistan was producing almost 40% of the cotton of the overall Indian sub-continent (Gilham et al. (1995)). There was very limited number of textile manufacturing units in the formal or organised sector of the country (only two factories from the colonial heritage in the region (Ghayur and Zar (1993) cited by Siegmann (2005)). However, before the colonial era, the region was leading the world in the production of textile and clothing through its cottage industry in textile, clothing and furnishing. Later, it lost its competitiveness to England and other countries in Europe, where the process of industrialization was already started, which brought production efficiencies and competitiveness of the industry. Many other factors were also responsible for the shift of these areas from Indian sub-continent to Europe and England.

In its long history, Indus valley which now lies in the boundaries of Pakistan, holds the historical proofs of cotton production, yarn and fabric manufacturing, printing and dyeing dating back as early as 3000 BC. The artefacts found at “Mohenjo-Daro” which was once a flourishing town in Sindh, a region in Pakistan, tell the glorious history of the region in production and trade of textile and clothing in the world (Gilham et al (1995)). The Indus valley is situated on both the

sides of the river Indus (Sindhu) which is the very origin of the name "India" and starts in the north of the country in the mountains of Himalaya. The valley is one of the oldest regions on the globe and existed as an important trade route between South-Western India and other parts of the world. Arabs entered into India through this region and occupied it for many centuries. The Persians and the Afghans also attacked and destroyed it many times in order to take control of this important link in the Indian Ocean. The regions which are now part of Pakistan include Baluchistan, KP (Khyber Pakhtunkha), Sindh, Punjab, part of Kashmir and other autonomous regions of Gilgit-Baltistan and Federally Administered Areas (FATA).

Various regions of the country once existed as independent states with distinct language and rich and diverse culture which can bring a large diversification of design and styles in the clothing and furnishing products. However, the design areas are weak in most of the sectors, a fact which has the basis in our study in the following sections which identifies the current status of development of the value chain segments. The design and styles need attention to achieve competitiveness in the international and local markets through diversification and differentiation of the products and services.

After the separation from the Indian sub-continent, the country mainly focused on developing a strong industry in textile and clothing. Other sectors were developed later, including home textiles, towel, tents, canvas, etc. Many of these segments are competing well in the international markets except clothing which is not yet at a very competitive position. There are many reasons for the weak performance of clothing industry in the country. There are strong regional players like China and India, recently Bangladesh, and there is lack of effort inside the country to compete in these segments, a fact which will be further discussed in the following sections. On the other hand, the advantage of market access into the main clothing markets of the world for some of the regional competitors also increased the hardship for these sectors to compete on price in the global markets. For many countries, price is a competitive advantage which works well specially in textile and clothing areas (Loo (2002), Bolisani and Scarso (1996)). The factors for the success of the country in textile and related industries include cheap raw material, low wages and labour supply and a lot of incentives; these factors will also be discussed in detail in the following sections.

In neighbouring countries, India has a diversified base of natural and man-made fibres and has strong textile and clothing industry. Bangladesh does not produce cotton and imports the raw

material, yarn and/or fabric from India, Pakistan and China. Meanwhile, Bangladesh has developed a strong clothing sector. After phasing out of the quota regime of Multi-fibre Agreement (MFA), South Asian region including India, Pakistan and Bangladesh have evolved as strong players in the world for textile and clothing production and supply. The combined production of China and South Asian countries in textile, clothing and related areas stands around two-third of the world production. The cotton is still an important textile fibre and three top cotton producers in the world out of four are here in this region i.e. China (1st), India (2nd) and Pakistan (4th). These facts are discussed by Gilham et al. (1995), Altaf (2008), Bedi (2008), Vivian and Au (2008) and Bolisani and Scarso (1996).

III.2. Textile and Clothing Supply Chain System in Pakistan

The textile and clothing supply chain system in Pakistan includes the activities of cotton production, its ginning, production of manufactured fibres including polyester, viscose and acrylic, yarn manufacturing with ring spinning and rotor technologies, fabric manufacturing through weaving and knitting and the process industries including dyeing, printing and finishing to improve the fabric aesthetics. The fabric is converted into apparel and made-ups. There are other segments which support these activities including chemical industry, machines and tools manufacturing, logistics industry and the sectors of information and communication technologies. The main activities of the system and the supporting sectors are identified in Table 5.

Table 5: Textile and Clothing SC System of Pakistan

Common Functions, Technology and Skills	Supply Chain Entities
	Textile Fibre Production
	Cotton farming
	Ginning
	Others (Silk, Wool, ...)
	Man Made Fibres
	Yarn Manufacturing
	Ring Spinning
	Rotor Spinning
	Others (Air Jet, …)
	Fabric Manufacturing
	Weaving
	Knitting
	Others (Nonwoven, …)
	Fabric Coloration
	Dyeing

Common Functions, Technology and Skills	Supply Chain Entities
	Printing
	Fabric Finishing
	Conversion into Made-ups and Apparel
	Associated Industries
	ICT and Applications
	Machine Manufacturing
	Dyes and Chemical
	Marketing
	Research and Development
	Technology and Skills
	Logistics Infrastructure
	Rail Transportation
	Road Transportation
	Air Transportation
	Ports
	Storage Facilities
	Communication

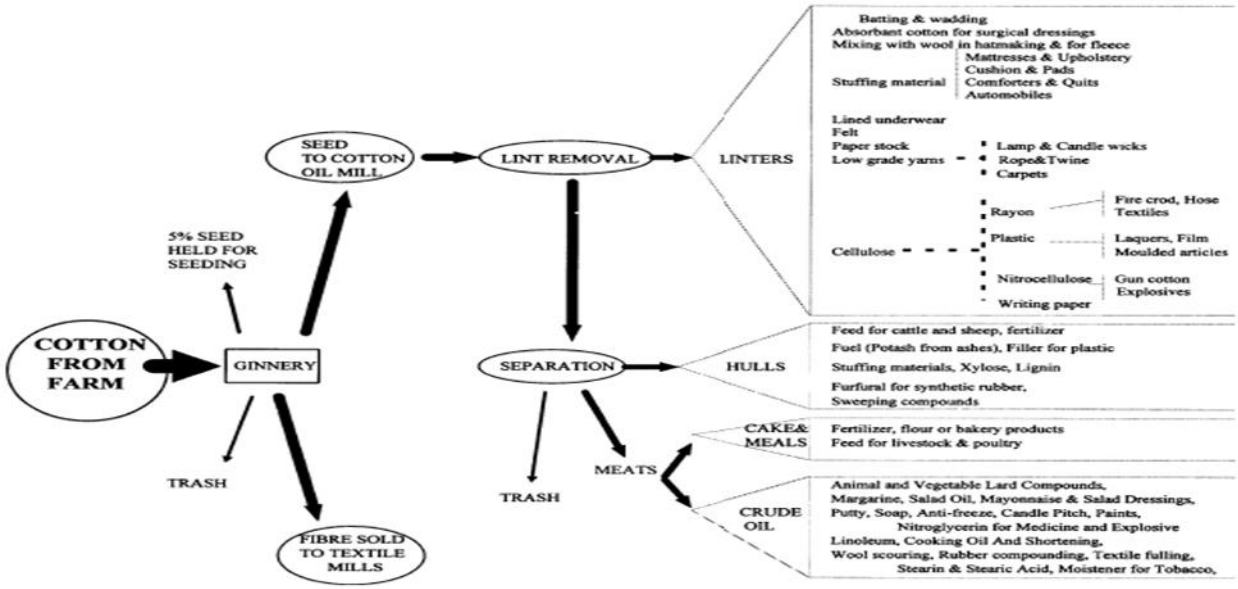
All the mentioned areas have different level of development. Similarly, the competitive position of the sectors is also at different levels in comparison to same sectors in the other countries of the region. It is important to analyse their potential in detail to identify the overall strategic position of the country in the global context of changing supply and demand patterns in textile, clothing and related areas. In the following sections, these activities are discussed individually and the secondary data for them is analysed. The objectives are to identify their development status and the main characteristics which can help to identify the areas for improvement to enhance the overall competitive position of the country.

III.2.1. Cotton Production

The authors including Gilham et al. (1995), Siegmann (2005), Salam (2008) and Altaf (2008) have discussed the cotton production sector of the country. They have developed an important insight on the sector and have identified that an extensive forward and backward linkage exists in the cotton chain of the country. This makes it important for the country´s economy and an imperative for the sustainable development of agriculture, food security (vegetable oil and animal feed) and poverty alleviation through employment generation. For example, around 85 per cent of the edible oil is produced from cottonseed, the cake produced during oil extraction process is used for stock-feed, 38 per cent of the industrial employment and two third of country's exports

are in the areas of textile and clothing (Gilham et al. (1995) and Siegmann (2005)). These linkages of cotton and its by-products to other industries are shown below.

Figure 4: By-products of Cotton as a Linkage to Other Industries



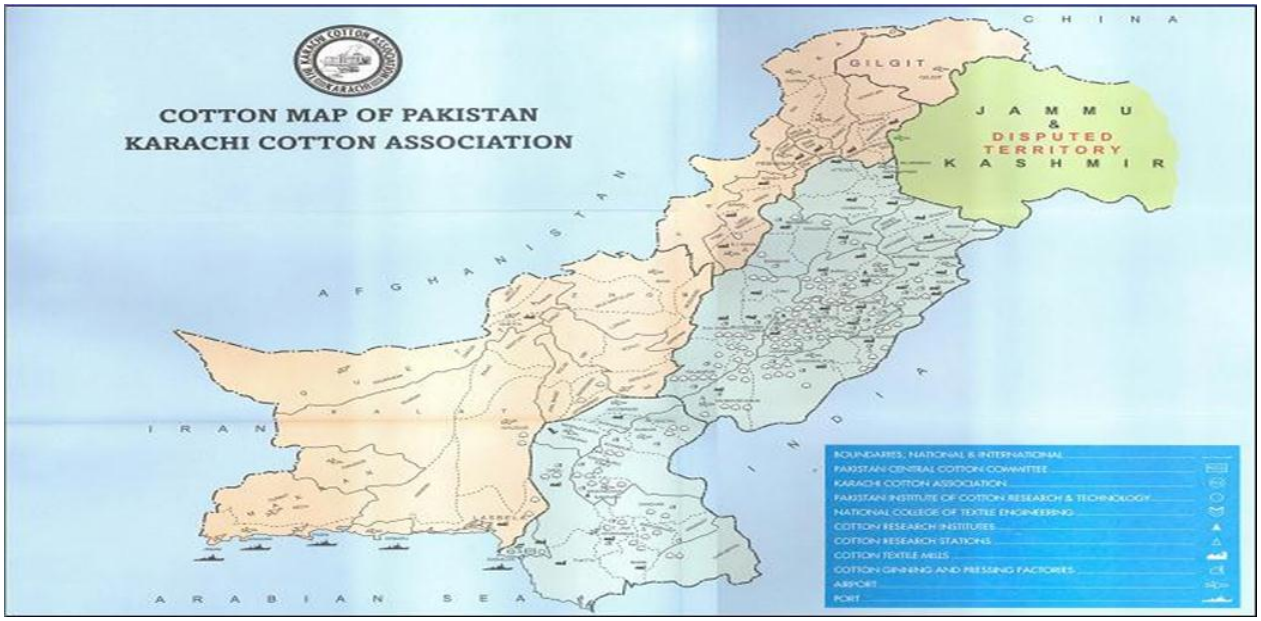
Salam (2008) and Altaf (2008) extended the insight from the production of cotton to the other segments which are downward in the supply chain system, including textile manufacturing and clothing production. Salam (2008) discussed the important features, basic characteristics, and the performance of cotton production; its marketing and price issues. Altaf (2008) on the other hand discussed the policy issues on cotton, the structure and the characteristics of the textile manufacturing and clothing segments.

In general, their findings are more focused on the segments of cotton production and yarn manufacturing, which are supported with much data but there is lack of data on the downward segments of fabric manufacturing and apparel, clothing and related areas. Also, the input industries and the support areas are also not discussed in detail in their studies. These lacking are mainly due to the non-availability of the relevant data. They have supported their study with the inputs of experts but that also is limited and mostly based on the inputs of internal chain experts. There is a strong need to study all the sectors of the textile and clothing system in the country which are expanding fast with more recent and relevant data. A detailed study on the system, supported with recent data, will provide means for proper planning and resource management in the long term scenario of developments. An attempt to fulfil these gaps was made in this study by including the relevant data for this analysis from secondary sources and extending the coverage

of sectors which are at the downside of the chain. The findings of the expert surveys conducted in the customer base will further enhance the quality and authenticity of the findings and bring new insight on the demand-side. The secondary data is available online; the resources which were utilized are referred at relevant places in the data tables and are also produced in the appendix of the chapter. These sources have helped to develop a more detailed and valid insight on the overall supply chain system of the country.

The production areas of cotton in the country are shown below.

Figure 5: Map of Country with Cotton Areas

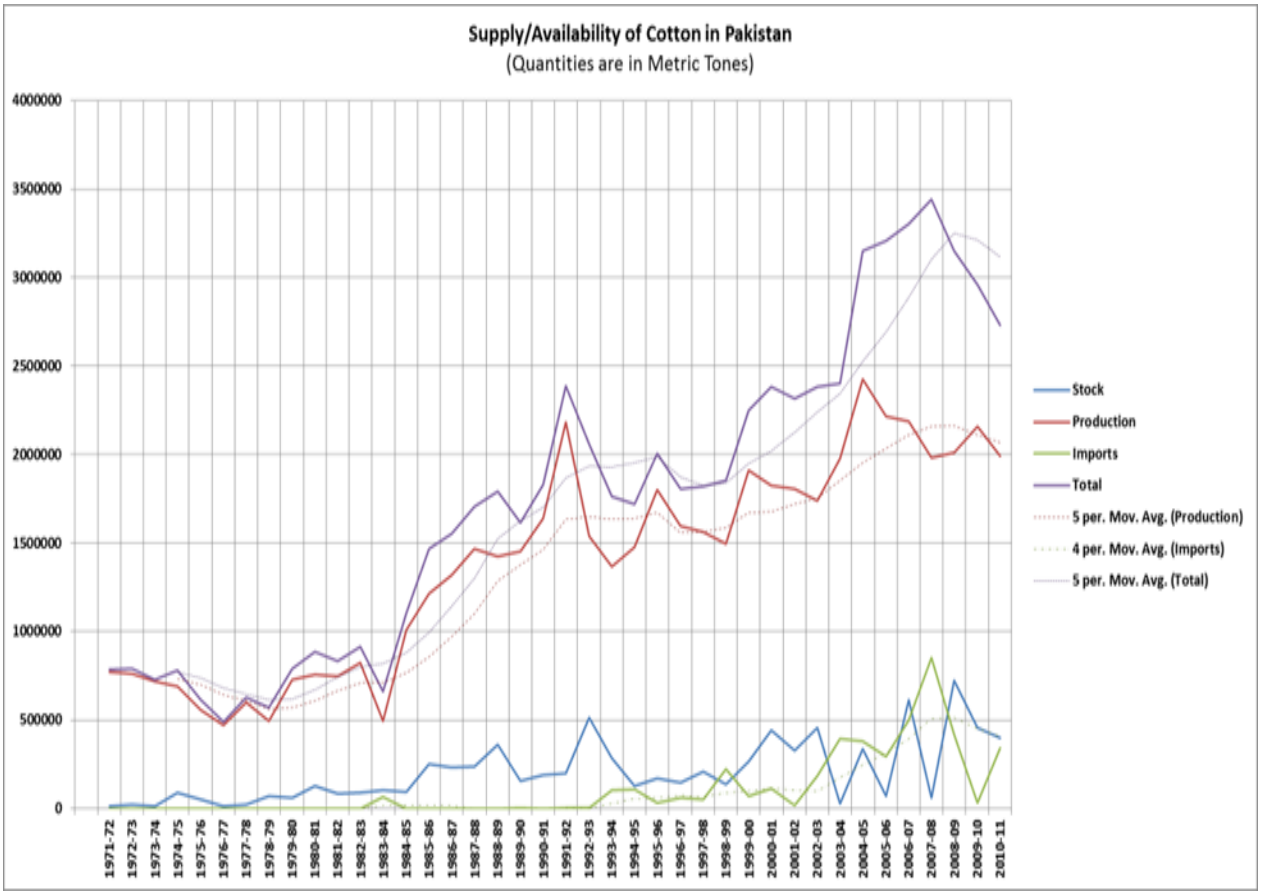


The main cotton production base of the country is in the south-eastern regions of Punjab and Sindh. Also, the formal industrial activities in textile and clothing are mainly in these regions. In other regions including KP (Khyber Pakhtunkha), Baluchistan and Kashmir (Pakistan), there is low industrial activity. Meanwhile, the informal sectors are located around the country to supply the local demand and there is no data and studies on these sectors. Therefore, the informal sectors of the industries in the country will not be discussed.

The figures on cotton supply, consumption and the trade are given at Table 6: Supply and Consumption of Cotton in Pakistan ‘000’ Kilograms (see Appendix III.A)

The historical growths on cotton production, consumption and trade are shown below.

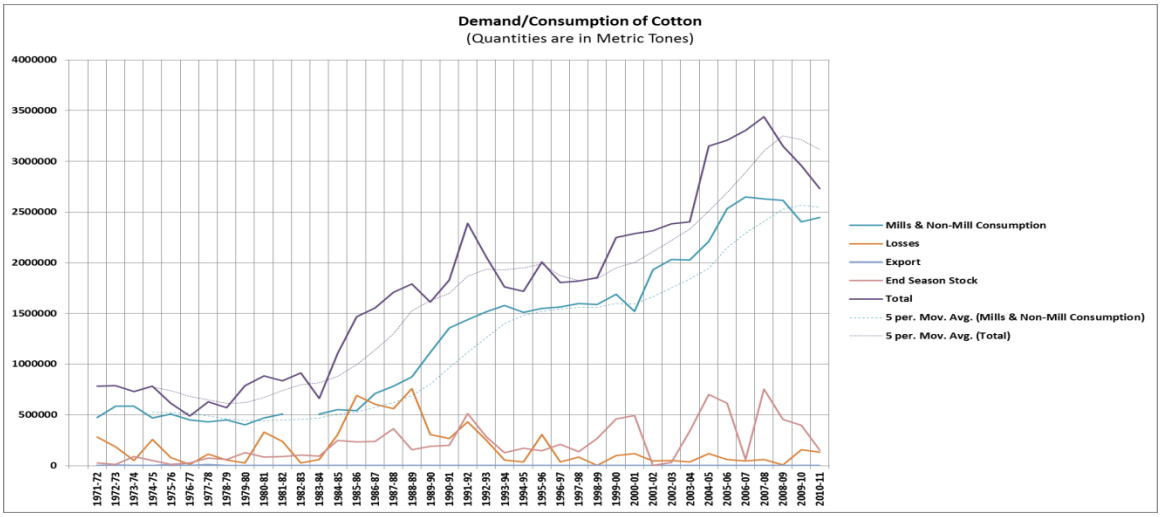
Figure 6: Supply of Cotton



The historical data on the cotton supply shows that the country produces large amount of cotton. It also imports finer and longer cotton fibres to supply the yarn manufacturing industry of fine yarns and subsequently fine (low weight in grams per square meter) fabrics.

There is a strong growth in the cotton production from the middle of 1980s to 1991. It followed a decline in the production due to severe weather and other reasons of virus and diseases. Later, there were various cycles of growth and decline but the trend of increasing production on the long horizon is quite visible. There is an important growth trend which is associated with the import of cotton during 2001 to 2007. The data does not identify the kind of cotton fibres imported but it can be added that this growth in the cotton import is related to the import of fine and long fibres. This fact will be supported with evidence in the following sections.

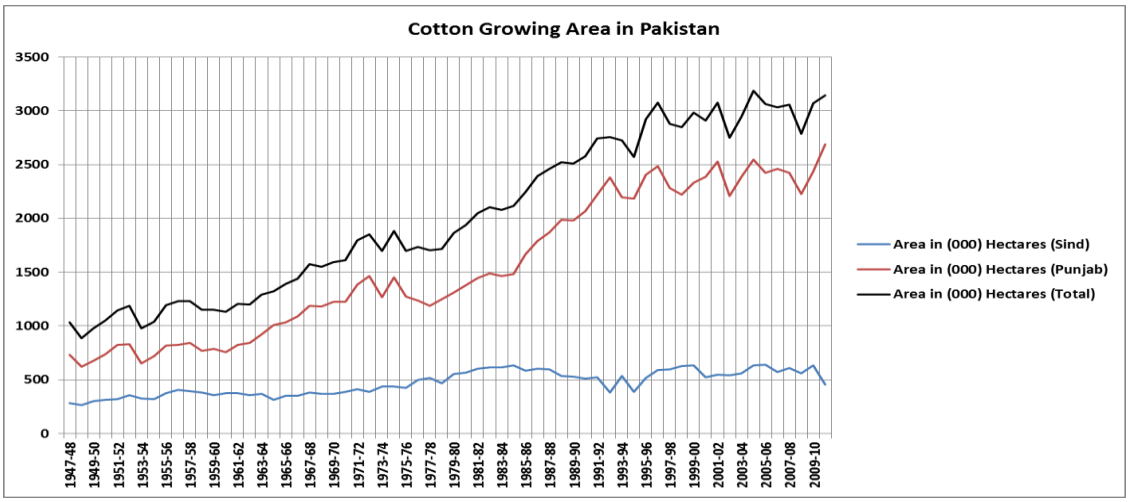
Figure 7: Demand of Cotton



The production growth stimulated the consumption of cotton inside the country which should be based on the increase of capacity of yarn manufacturing sectors since middle of 1980s. There is a strong growth in the consumption during 1988 to 1994 followed by some low growth and decrease in consumption. Again, the high growth started in 2001 and continued till 2006. The consumption trends follow the production growth and the capacity of yarn industry should also follow such growth patterns.

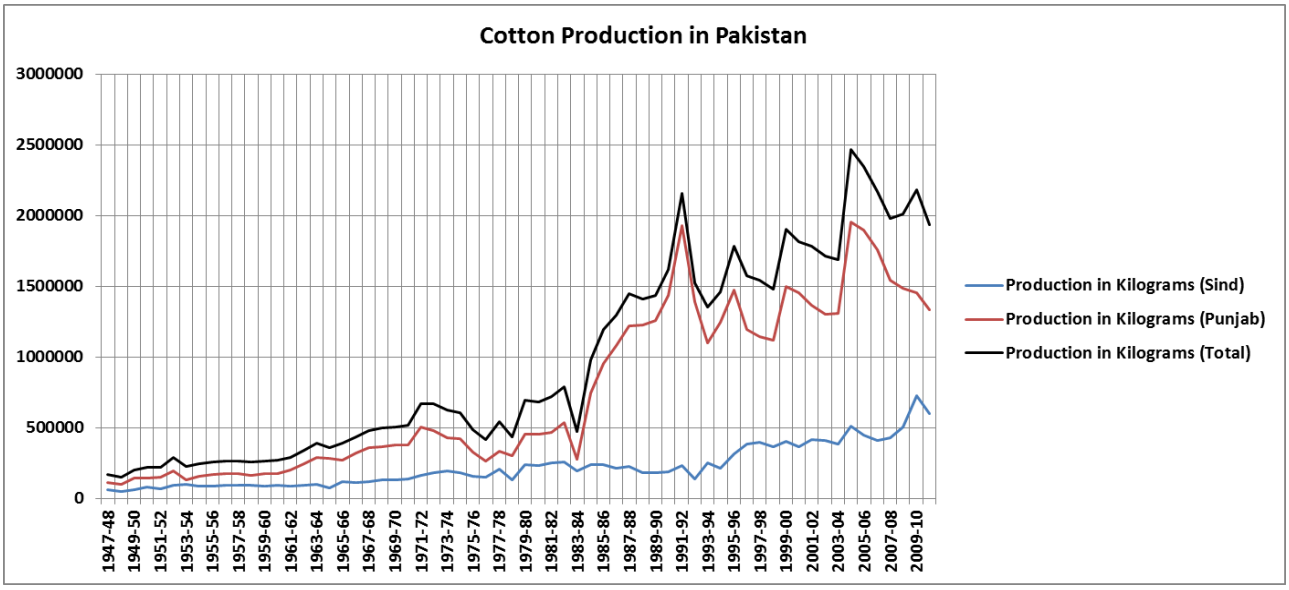
The characteristics of the cotton productivity are presented in Table 7: Cotton Production, Area and Per Hectare Yield (see Appendix III.A) and figure below.

Figure 8: Cotton Production Area



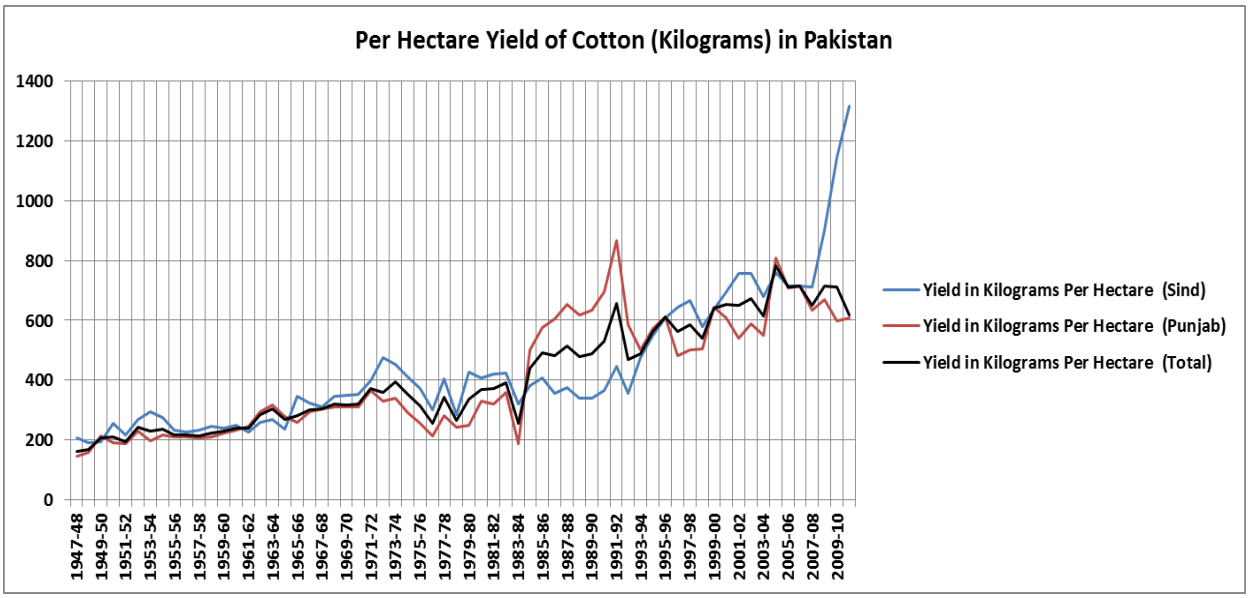
The area on cotton production was increased in the country in two long phases. The first phase was from 1950 to 1972 and the second phase was from 1980 to 1992. The increase in the cotton production area was mainly observed in the Punjab region while it was almost stagnant for the Sindh region.

Figure 9: Yearly Production Quantities of Cotton



The yearly cotton production figures present the same long term trend observed above. There is lot of variability in the yearly production quantities, which is discussed below.

Figure 10: Cotton Yield per Hectare



This increase of cotton yield per hectare is an important factor, which can be associated with the improvements in farming technology, practices of farming community and the development of improved varieties of cotton. The first phases of the nominal increase in yield are visible from 1966 to 1972 where the increase was higher in Sindh region. The second prominent increase is from 1984 to 1992 where the increase is much higher in the Punjab region. There is a sharp increase in the yield figures of Sindh after 1994 and also more recently. The yield in Punjab has a lot of fluctuations. The insight provided by other authors on cotton productivity will continue in the following paragraphs.

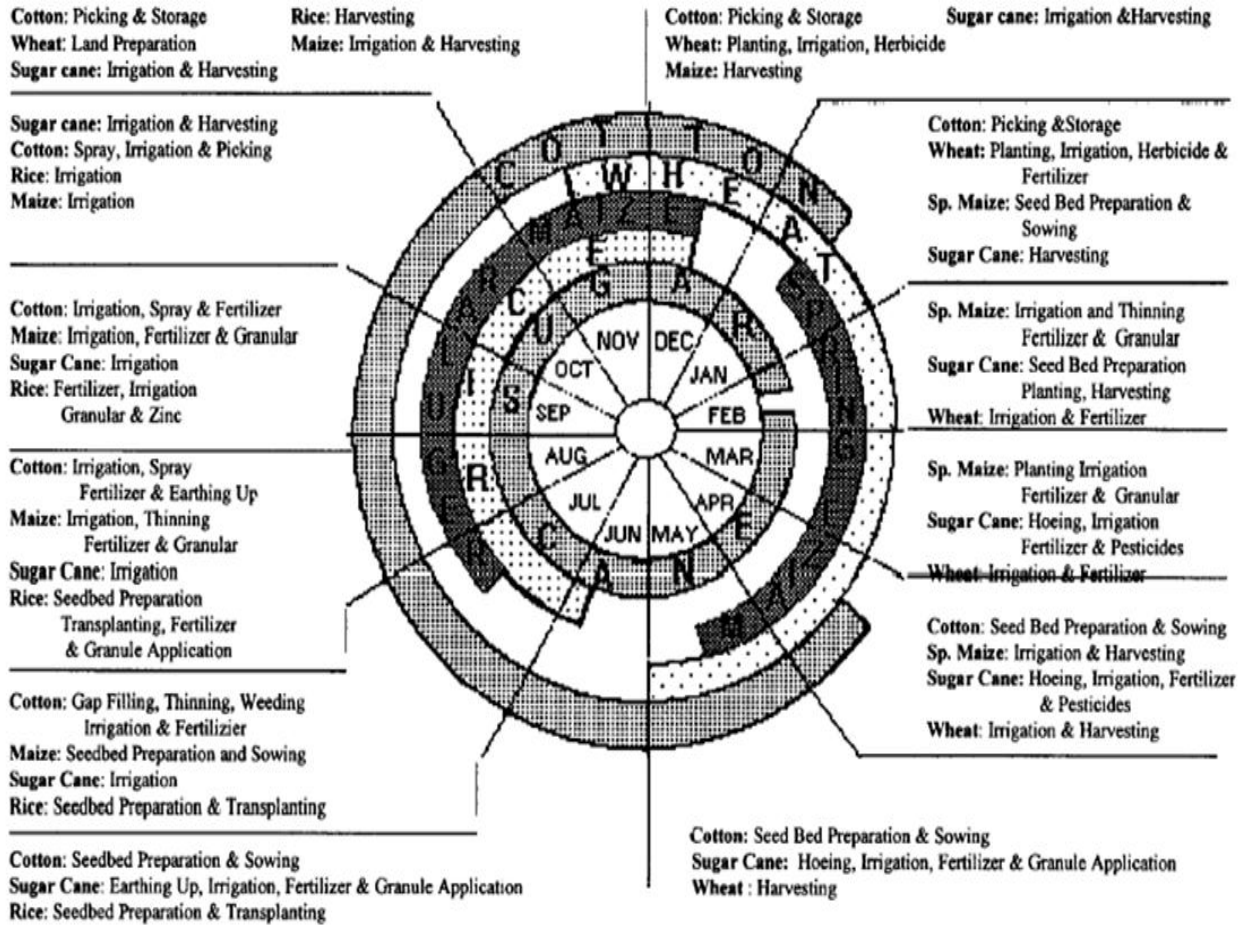
The figures show a lot of variation in the yearly production quantities of cotton, the area under cultivation and the yield per hectare in the country (Salam (2008)). The year-to-year changes in cotton production ranged from −29 per cent to 45 per cent in the period from 1991 to 2005, translating into a loss of 641,000 tons and a gain of 774,000 tons, respectively. These are staggering quantities with serious repercussions for farm revenues, capacity utilization of the ginning sector, supply of raw material to the industry, institutional infrastructure and logistic arrangements for handling and marketing the produce. A large proportion of the fluctuations in cotton production have its origins in the variations of cotton yield per hectare. The coefficient of variation of cotton yield, during that period, was 17.5 per cent, with year-to-year changes in yields ranging from −29 per cent to 35 per cent.

The variations in the area under cotton production also increase the variations of yearly quantities of cotton, increasing the uncertainty of cotton supplies and uncontrolled fluctuations of prices. Although, the coefficient of variation of cotton area is smaller (5.6 per cent) compared to cotton yield per hectare, where the annual fluctuations range between −10 per cent and 13 per cent. This, translate to a contraction of 322,000 hectares and to an expansion of 344,000 hectares, respectively.

The variations in production area can be related with the changing interests of farmers on the crops of high profitability and low risk. Cotton is highly vulnerable to viruses, disease and severe weather conditions; higher risks are associated with its production. Crop insurance does not exist in the country, which can provide some security against such risks and can improve the farmer´s confidence in growing cotton. The crops competing with cotton include wheat, rice, sugarcane and maize. They compete for labour and time management in various months of cotton growing seasons (Gilham et al. (1995), p. 167). It is difficult to comment on the amount of labour and

other resources required in different months. But, looking at the size of these crops, which are included in top ten world crops in size, the competition on resources is there; not only for the labour resources but also for the available area, water, fertilizers, pesticides etc. Thus the shifting of labour for different agricultural activities can sometimes become complicated especially in the scenario when the adoption of advance technologies of farming is scarce in the country. The following chart presents the crops growing periods and various activities required in the field (Gilham et al.). It reflects on the labour and other requirements in the agricultural activities happening during the same periods in various important months of the year. Due to low usage of automation in these activities there is lot of shifting of labour from activity-to-activity and from one area to other.

Figure 11: Agricultural Activities and the Crops Competition Scenario for Resources



The problems associated with the lower yield of cotton include inadequate plant protection measures keeping in view its susceptibility to number of insect pests and changes in weather conditions (Salam (2008)). He further identified that losses caused by insects and diseases to the crop in normal years are from 10 to 15% and in exceptional years, as high as 30 to 40%. This has

placed the production of cotton at higher risk, requiring high expenditure for pest control. This moves the farmers' choice of crops away from cotton, towards more easily manageable and low risk crops. Other factors which play a part in higher cost of cotton cultivation include substandard insecticides, aggressive marketing by pesticide companies and the limited knowledge of farming community for pest control methods and technology. These cause the inefficient usage of chemicals.

The variations in the per hectare yield are the result of many factors which include lack of advance farming practices, higher costs of inputs, vulnerability of cotton crop to weather, diseases and viruses etc. The variations in the overall cotton productions are the combined result of variations in area and yield.

To overcome the problems related to cotton production, Salam (2008) recommended the strengthening of the research base to develop the varieties of cotton, resistant to plant diseases and to adopt the practices to control insects. He also suggested the strengthening of the pest-scouting and the training of farmers for monitoring pest infestation to achieve efficient pest control and to introduce the weed control programs. He motivates to adopt a clear policy for developing the necessary institutional capacity and expertise to address and evaluate the emerging technological issues and to ascertain the risks involved in tackling the important issues like introduction of BT cotton. Salam (2008) and Gilham et al. (1995) have provided detailed insight on the measures which can further improve the cotton production in the country but discussing them will take us away from the scope of our project.

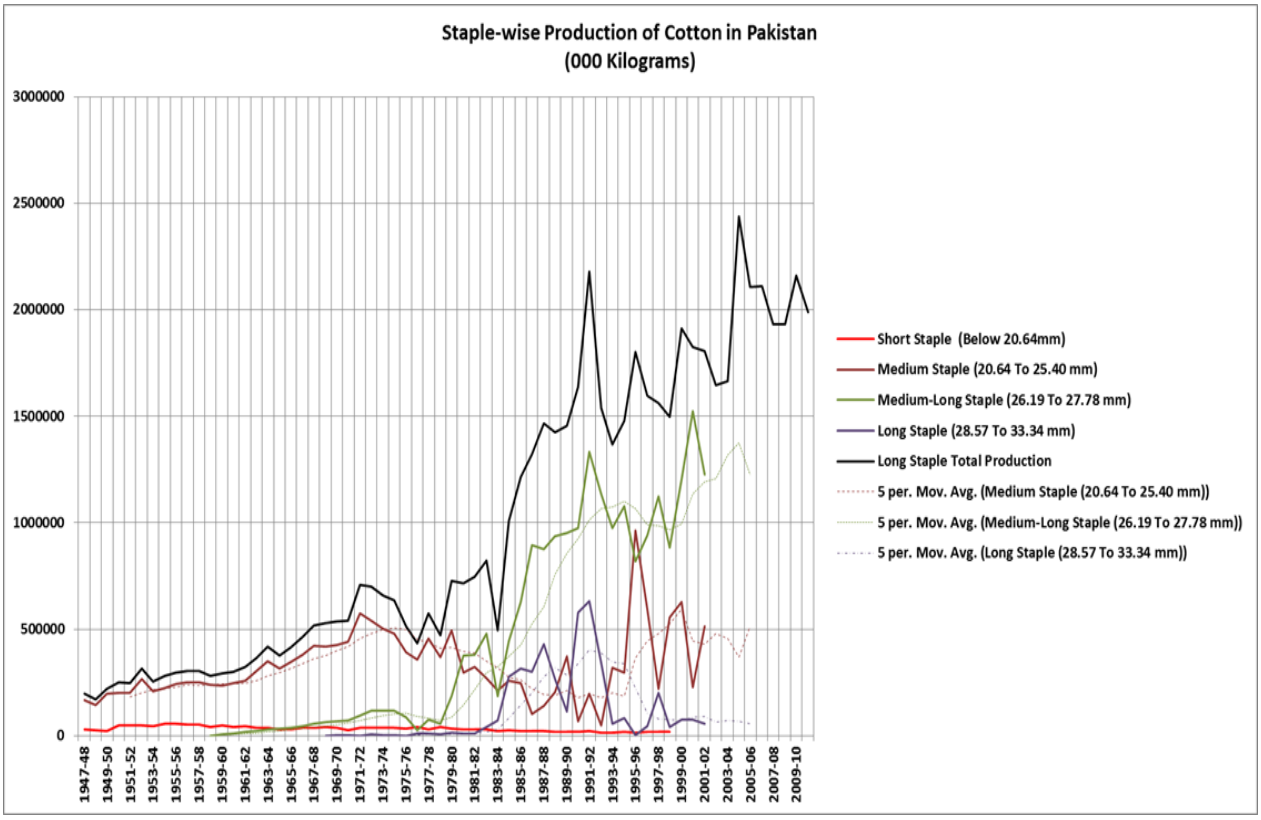
The prices of seed cotton have witnessed substantial inter and intra-year fluctuations in the country (Salam (2008)). Some of the reasons for these fluctuations have their origins in the international commodity markets, which are beyond the control of policy makers. There are causes of these fluctuations which are very much country specific which should be addressed. For example, cotton season in the country which spans from September to December (although, bulk of domestic trade in cotton is concentrated in November to January,) is now stretching from July to January/February and there is always lot of uncertainty surrounding the size of harvest and speculations on the prices of the product. There is a need to strengthen the institutional base and provide the framework for estimating the size of harvest to have a realistic and sound basis of the crop size. It is also important to have the support/reference price of cotton lint determined transparently in consultation with the stakeholders after the announcement of prices of seed

cotton rather than to leave it to the judgment of the Trading Corporation of Pakistan (TCP) (Salam (2008)). There is also a need for fine-tuning the implementation of a price stabilization program to save the farming community from the avoidable losses and machinations of unscrupulous trade.

The annual growth on the production cost of cotton, is higher than CPI (Salam (2008)), resulting in negative effects on the cotton profitability which also affects the farmers' choice on crops.

The figures on the type of fibres produced in the country are presented below. Table 8: Staple-wise Production of Cotton '000' Kilograms (see Appendix III.A) provides an overview of the material available for the production of various types of yarns including coarse to very delicate qualities or fine yarns.

Figure 12: Staple-wise Production of Cotton
'000' Kilograms

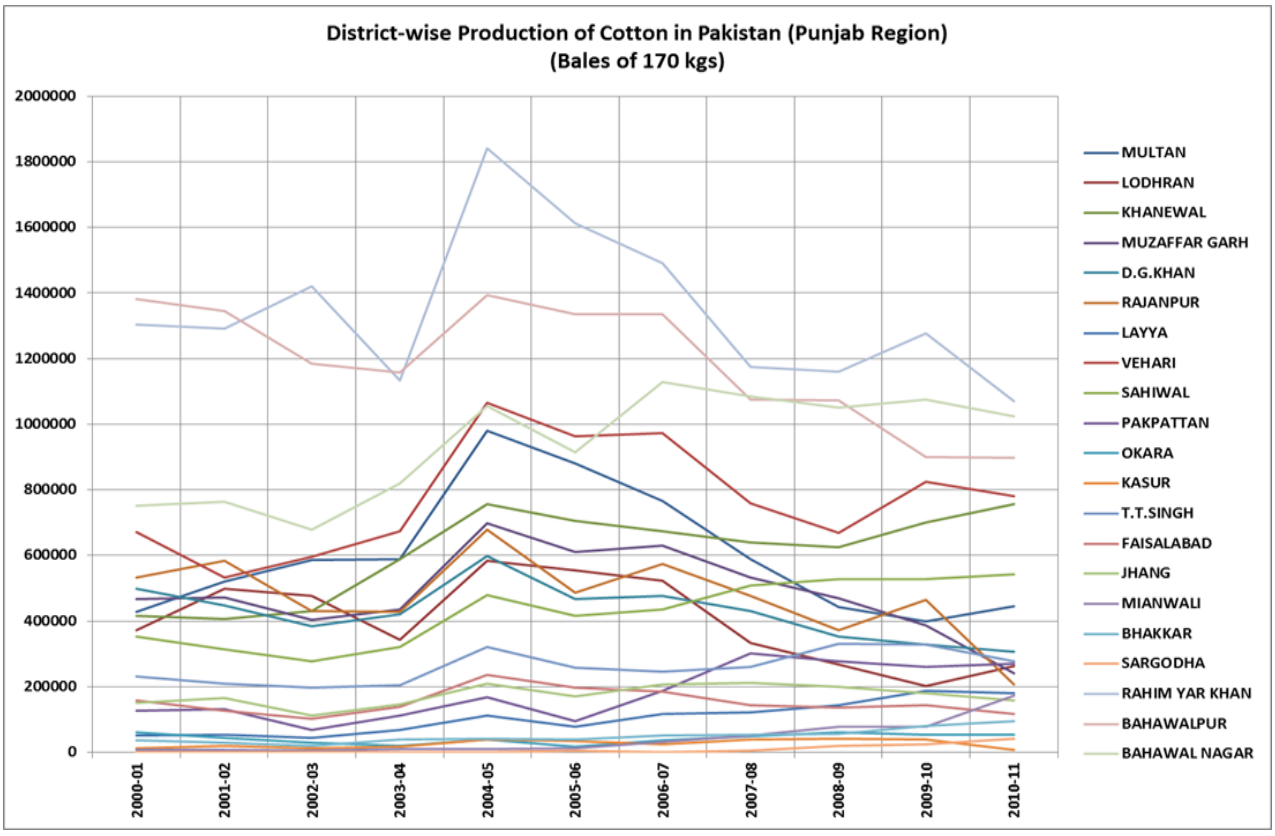


It can be observed that there is an increase in the production of long fibre cotton which supports higher value addition in yarn and fabric manufacturing. Although the data is not complete for the recent years, the trend is clearly visible. Further, the production of medium-long staple fibre has

crossed the production of medium staple length fibre. The long fibre production has also got some share in the overall production which should provide a saving in the import of costly raw material.

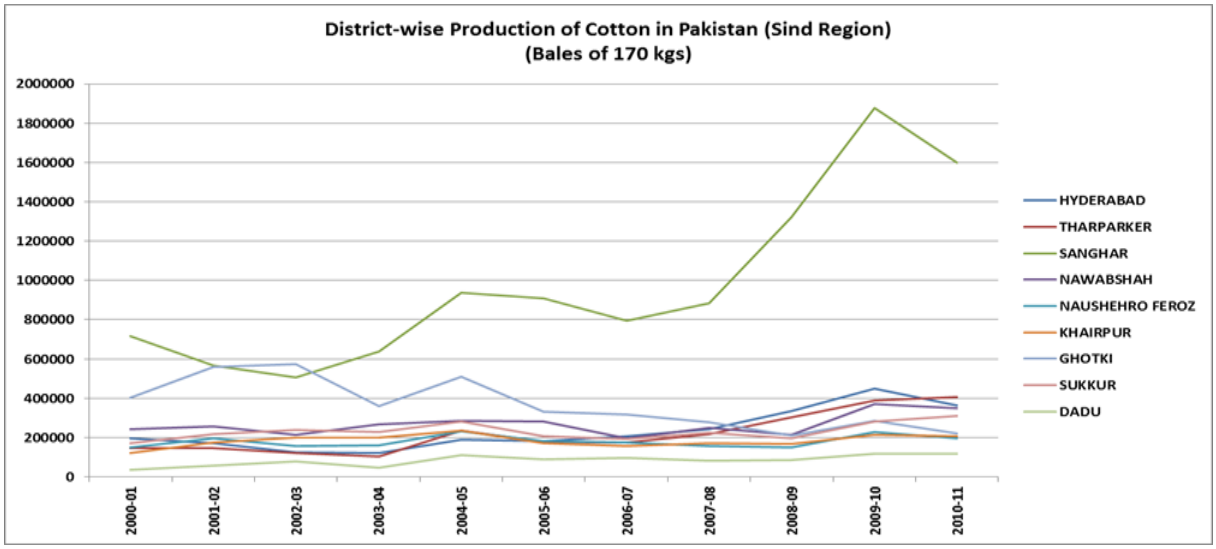
Table 9: District-wise Cotton Production Quantities (see Appendix III.A) presents the data on the cotton production districts, which will help in the later sections to evaluate the overall potential of these regions in textile and clothing and to develop the strategic directions of the system.

Figure 13: District-Wise Cotton Production in Punjab Region



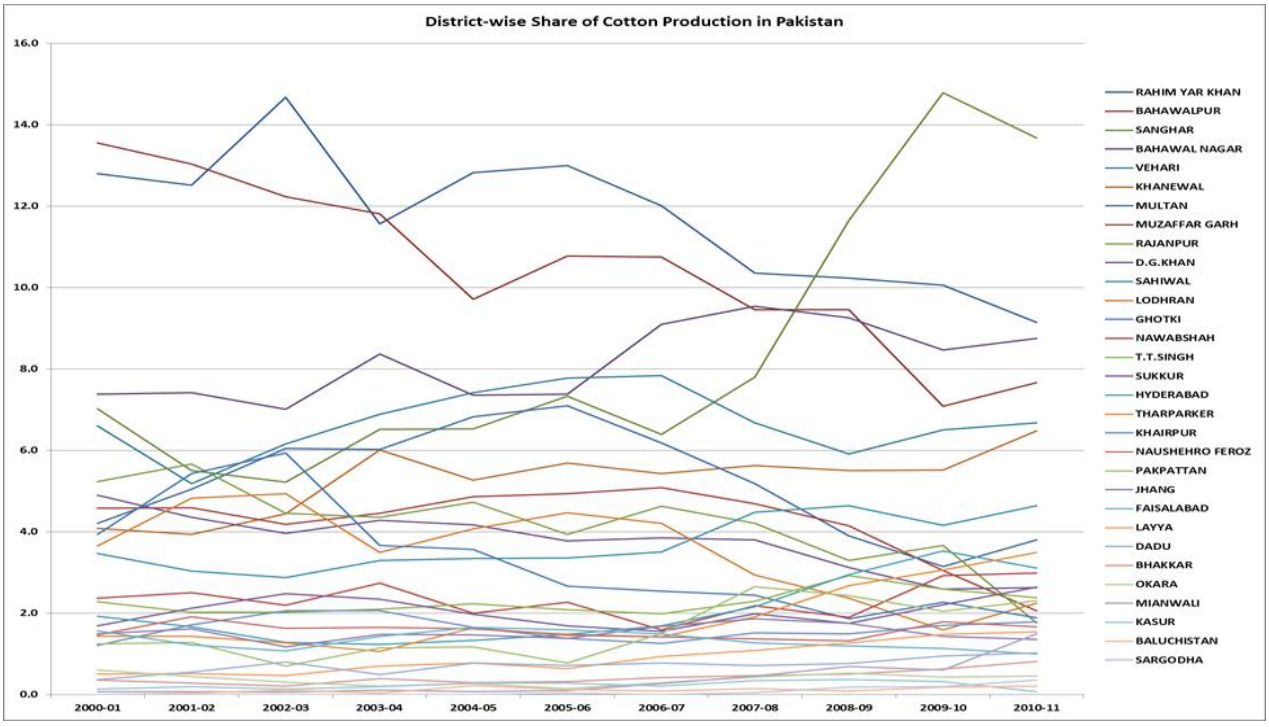
In Punjab, the high production districts are Rahim Yar Khan, Bahawal Nagar, Bahawalpur, Vehari, Khanewal, Sahiwal, Multan and Rajanpur, which have production higher than 300000 bales (of 170 kilograms). Most of the region is in south of Punjab and it is a main agriculture base of the region.

Figure 14: District-Wise Cotton Production in Sindh Region



Sanghar is the highest cotton producing district in Sindh and in overall Pakistan. Other important cotton producing districts in Sindh are Tharparker, Hyderabad, Nawabshah and Sukkur. Most of the cotton producing area exists in the north part of the province, Table 10: District-wise Cotton Production Share (see Appendix III.A).

Figure 15: District-wise Share of Cotton Production in Pakistan



Region-wise production figures are presented below.

Table 11: Province-wise Cotton Production Quantities

(Qty. in Bales of 170 kilogram)

Region	2000-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
Punjab	8008833	7959233	7457465	7664973	11296659	9849284	10090277	8831617	8353604	8458483	7904247
Sindh	2178553	2351233	2211061	2125957	3019986	2531605	2309926	2504908	2986025	4212752	3769801
Baluchistan	-	3779	9875	3596	30387	13900	10417	16400	9400	22033	24118
Pakistan	10187386	10314245	9678401	9794526	14347032	12394789	12410620	11352925	11349029	12693268	11698166
Source: PCGA (Data available at www.aptma.org.pk)											

There was a clear rise in the overall production of cotton in the country from year 2000 to 2005. Later, there was a decrease in the production quantities which was fluctuating a bit in last five years. In the long terms increasing trend continues. Major increase was observed in the production quantities of both Sindh and Punjab in year 2004-05 and then in Sindh in years 2009 to 2011. The share of Sindh region in the overall production has reached around two-third which was around 21 per cent in year 2000-01. This is a huge increase especially when the increase is mainly based on the improvement of yield per hectare.

The main cotton producing base of the country is in the centre of the country, i.e. north-east of Sindh and South-east of Punjab. This area in general is very strong in the agricultural activities.

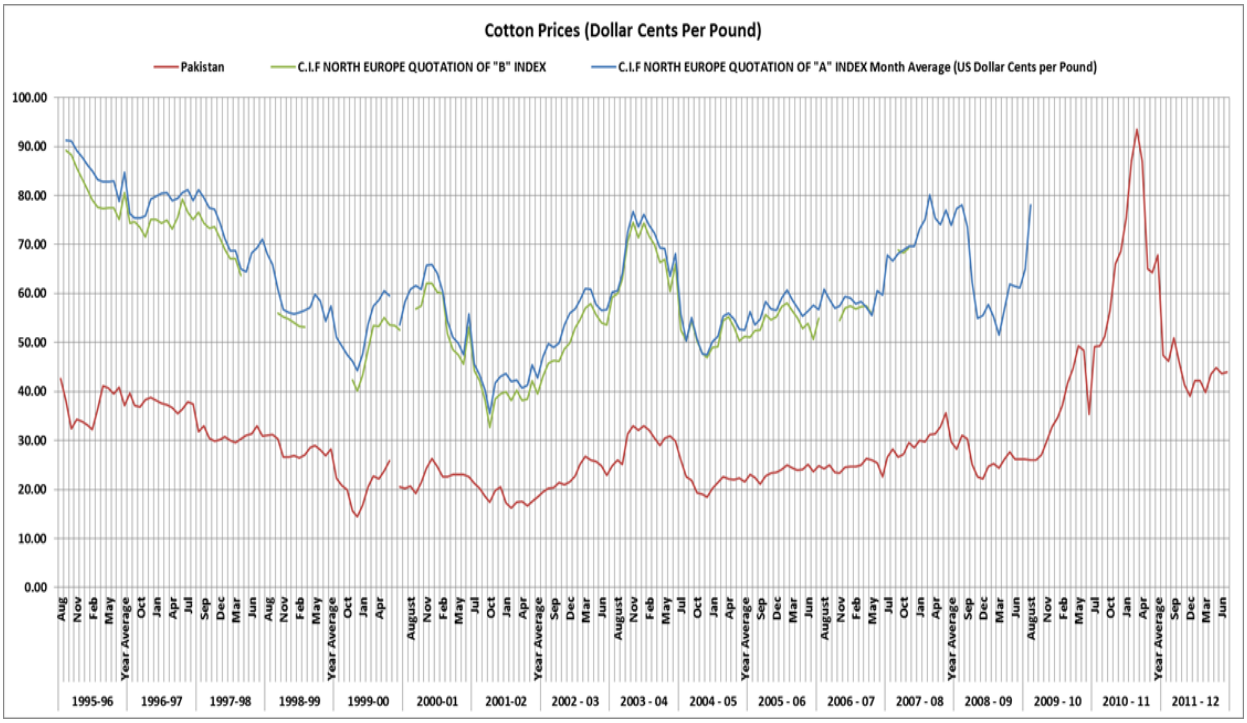
III.2.1.1. Policy Interventions on the Cotton Trade

It should be clear now that the share of cotton production in the economic activity has made it very important to direct the strategic and economic goals of the country. In order to develop an insight on the growth and problems of the textile and clothing sectors, it is important to take a close look on the history of policy interventions on cotton sectors.

It was mentioned above that the cotton production was an important crop in Indian subcontinent since last many centuries. After partition, the trade of cotton in Pakistan was open to the private sector in the period from 1947 to 1974. Then, the government intervened to take control of the economic activity in the country. This was based on the rationale that the producer was not getting their due economic share because of the poor performance of industry in the international markets and it was unable to transfer the economic benefit to the country (Altaf (2008)). As a result, the industry was nationalized in the middle of 1970s and Economic Committee of Cabinet (CEC) was formed to control the trade of cotton on government regulated prices. An export tax of around 30 to 35 per cent was imposed on cotton exports so that low cost raw material could be

supplied to the yarn industry. As a result of such moves, cotton producers were not able to get better prices of their product compared to prices in the international markets and they lost their motivation to improve the quality of cotton. The productivity was the only way out to compensate the losses, which was stagnant because of the constraints including low usage of technology at farming and low research in cotton production and varieties development. Therefore, no considerable improvements in cotton yield were achieved in these periods. It was also observed in the figures of the per hectare yield presented above. The comparison on the cotton prices inside the country and in the international markets is presented below.

Figure 16: Prices of Cotton in Pakistan and International Markets



It is clear that the local prices are quite low in comparison to international markets. The advantage of low price raw material is available to the domestic yarn industry to keep it profitable, contrary to its own commitment to compete with strong players. This price advantage was always there for the yarn industry. As a result, mal practices of keeping the high impurity contents in the raw and ginned cotton and keeping high moisture content in the stages of cotton cleaning arose to increase the profits at those stages. Thus inefficiencies crept into the system including lower raw material quality in the upward chain segments and lower productivity in the downward segments of the value chain. The SC was mainly composed of cotton production and yarn and fabric manufacturing in these times. For that reason, termination of the free market operations resulted in lower levels of competitions in domestic industry and it reduced the

competitiveness of the sectors. Later, the private sector was partly re-introduced in the cotton trade with its exports were subject to Minimum Export Price (MEP). During most of this period, the industry was involved in the under invoicing of raw material exports and over invoicing of machinery imports which hurt the industrialization process (Altaf (2008)). The practices to stop the mal practices were never successful due to the power of trade and industrial sectors which got political affiliations in different eras of industrial development. For example, until the mid of 1980s, it was required to get a permission to install an industrial unit in the country in the sectors of textile, cement, sugar etc. These permissions were utilized to gain political motives during those periods in many industrial sectors including the yarn industry. Many of the yarn and ginning industries in the country are examples of government supported economic activities. After 1980s, government reduced its playing with the industrial activities and private sector motivated again to participate in these activities.

The decade of 1990s observed free business activity although the main industrial potential was in the hands of old players. The yarn and fabric industries grew and the consumption of raw material too. The deficiencies in the supply system started to decrease in 1990s due to increased participation of the private sector. The consumption of raw material increased, export duty on cotton was removed and it was allowed to trade freely although the man-made fibre production in the country is still protected with duties on its import which lowers the competitiveness of the downstream sectors. When these developments were taking place, the textile and clothing system of the country had protection under the international quotas and there was some buffer to compensate for the deficiencies. In 1990s, many developing countries of the region started restructuring their textile and clothing chains like China and India and lately Bangladesh also joined the race to increase their share in world exports of textile and clothing. Due to the size of textile and clothing activity in these countries, they are mostly net exporters, which give them certain importance in the post-quota world of textile and clothing. Thus in the historical course of development, late 1990s till 2004 was a preparation period for the country to enter into post-quota period to retain and attract the added share in the textile and clothing trade which was not fully utilized as the textile and clothing exports are mostly stagnant.

Currently, China, India, Turkey, Pakistan, Bangladesh are the main competitors in the region and also main players in the world textile and clothing trade. China and India have a very strong vertical integration whereas Turkey and Bangladesh are somewhat dependent in terms of cotton production and textile manufacturing. Bangladesh is weak in its upward chain development. The

development of textile segments are more advance in Pakistan than its clothing sector but China and India are well developed in all segments. In the wake of increasing globalization and the abolition of the Multi-fibre Agreement (MFA), it was a necessity for the country to keep abreast of the policies of other countries in general and competing countries in particular as well as with the developments in the world commodity markets. It was required to strengthen the institutional framework and to develop the indigenous expertise to cater to the fast changing requirements and emerging situations (Salam (2008)) but it seems that improvements are not addressed.

The overall status of the cotton production is presented below.

Table 12: Characteristics and Status of the Cotton Farming

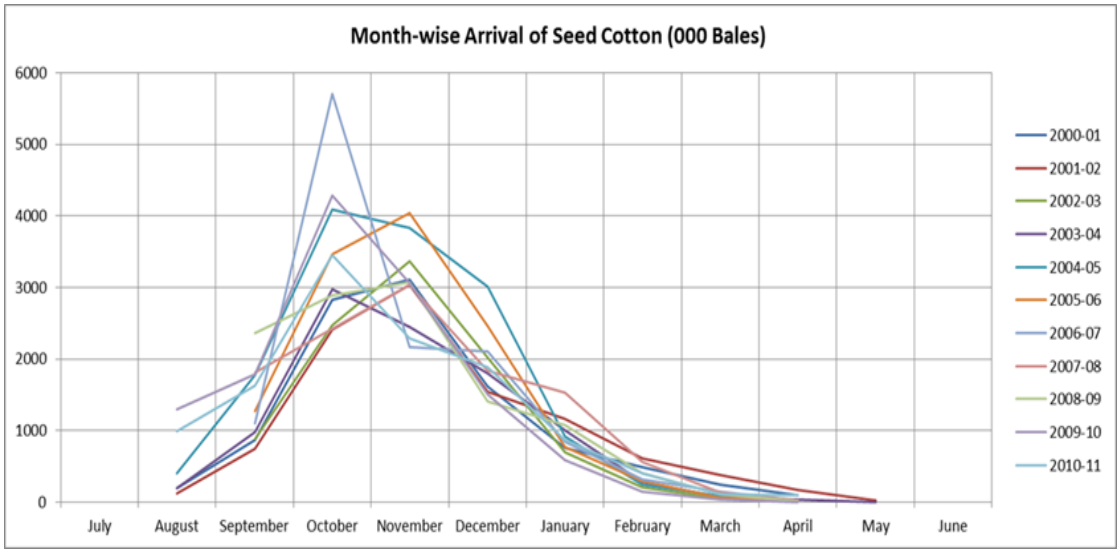
Segment	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Inputs Supply	Medium Strong-to-Strong	Availability of Labour, Medium High Skills of Farming, Weather Uncertainties, High Risk of Virus and Diseases, High Cost of Pesticides, Fertilisers etc. Non availability of Advance Farming Technology, Existence of Research on Cotton Varieties,
Farming Sector	Strong	High Expansion of the Cotton Production Activity in the Country, Low Advancement in Farming Technology, Growth of the Farming Area and Yield per Hectare, Variations in Production Area and Yield, Lot of Risks
Demand in National Markets	High	Growth of Ginning and Yarn Industry
Demand in International Markets	Average to High	Low Knowledge of Markets, Low Picking Quality, Low Use of Information Technology
Overall Cotton Farming Sector	Strong	
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong		

III.2.2. Ginning

In order to develop the insight on the ginning industry, the data on the cotton arrival periods in ginning factories, the quantity of cotton produced in various districts, and the location of the ginning factories is studied. This will help to discuss the requirements of the industry including labour required in various months and in various districts. It will also give an overview on the transportation requirement to carry the produce from field to the ginning factories.

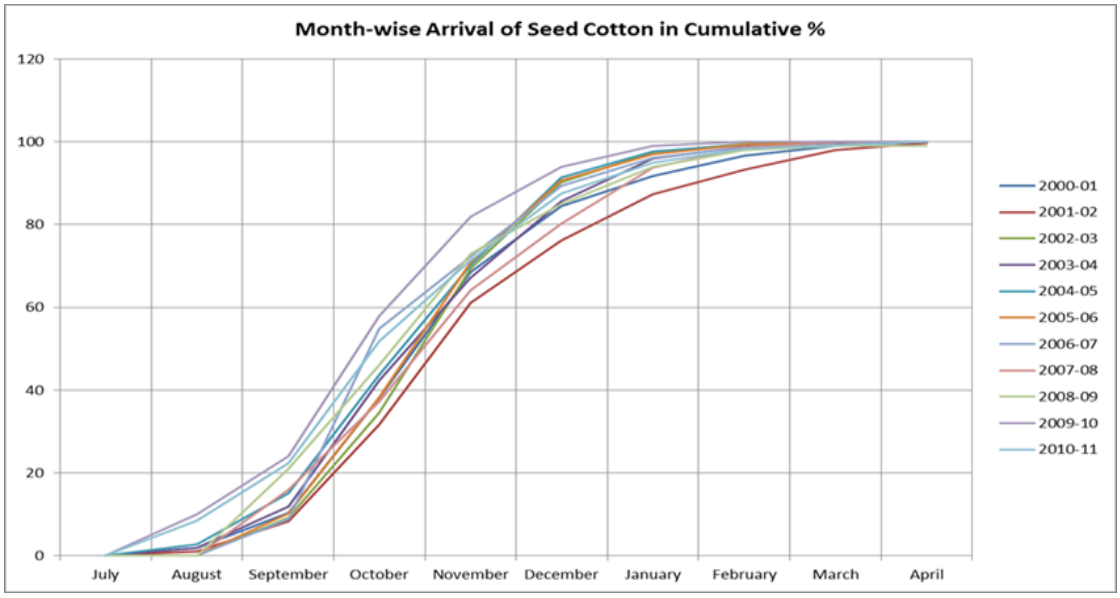
The cotton arrival in the ginning factories is presented in the next figures.

Figure 17: Month-wise Arrival of Seed Cotton in the Ginning Factories



Data Source: APTMA

Figure 18: Month-wise Arrival of Seed Cotton as Cumulative Share (%) in the Ginning Factories



Data Source: APTMA

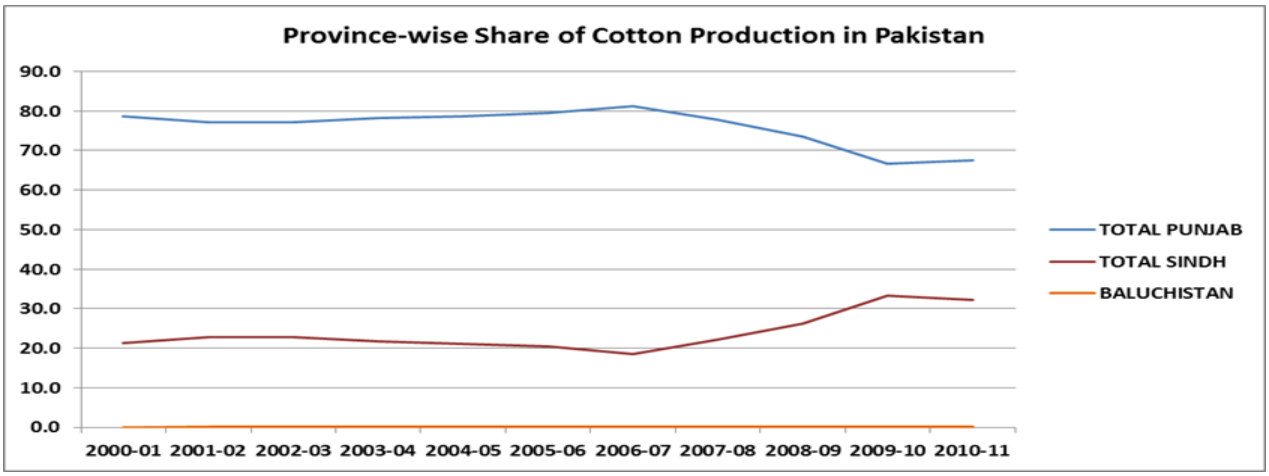
The ginning season in the country spreads over 100 to 120 days. The country has a ginning capacity of around 36 million bales where a bale weighs 170 kilogram (Altaf (2008)).

The share of provinces and districts on the production of cotton are presented below.

Table 13: Province-wise Cotton production Shares

Region	2000-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	Average
Punjab	78.6	77.2	77.1	78.3	78.7	79.5	81.3	77.8	73.6	66.6	67.6	76.0
Sindh	21.4	22.8	22.8	21.7	21.0	20.4	18.6	22.1	26.3	33.2	32.2	23.9
Baluchistan	0.0	0.0	0.1	0.0	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1
Pakistan	100	100	100	100	100	100	100	100	100	100	100	100
Source: PCGA (Data available at www.aptma.org.pk)												

Figure 19: Province-wise Cotton Production Share in Pakistan



The number of ginning factories in Pakistan has crossed twelve hundred (Altaf (2008)).

Table 14: Number of Ginning Factories in Pakistan

Number of Factories	< 1985	1999-2000	2005-06
	A Few Hundreds	1221	1223

The data collected from the website of Pakistan Cotton Ginning Association (PCGA), is studied here. It covers the location of the ginning industry in the country but unfortunately it does not provide detail on the technology and other characteristics of the industry. It also does not cover the full number of ginning factories, mentioned above but it covers almost half of that figure. We believe that these are in the formal sector while those not covered by this data can safely be counted in the informal sectors of the industry. The potential of cotton production and ginning for various districts is given in the next table.

Table 15: Overall Potential of Districts on Cotton Production and Ginning

Districts	Cotton Production in 2009-10 (Bales)	Cotton Production in 2010-11(Bales)	Share in Cotton Production Average of 2000-01 to 2010-2011	Number of Ginning Factories
Rahim Yar Khan	1277391	1069302	11.7	66
Bahawalpur	898882	896445	10.5	63
Sanghar	1877582	1599526	8.4	48
Bahawal Nagar	1074069	1024052	8.2	24
			38.8	201
Vehari	825489	781080	6.7	54
Khanewal	700524	757520	5.3	29
			50.8	284
Multan	399246	444899	5.2	44
Muzaffargarh	385673	241050	4.2	25
Rajanpur	464273	206182	4.2	28
			64.4	381
D.G. Khan	328361	306655	3.8	19
Sahiwal	528045	542366	3.7	24
Lodhran	200979	262732	3.5	19
Ghotki	287021	220324	3.3	16
			78.7	459
Nawabshah	371156	349168	2.3	20
Hyderabad	447974	362675	2.0	16
Pakpattan	259680	269620	1.6	16
Jhang	180709	158211	1.5	14
Mirpur Khas	N/A	N/A	N/A	13
Tharparkar	387560	407461	1.9	N/A
TT Singh	328837	278287	2.3	12
Total			88.4	550
Source: PCGA (Data available at www.pcga.pk and www.aptma.org.pk)				

In the above table, the cotton producing districts are categorised into five groups, based on their production potential and the number of ginning factories located there. The first group of four districts has the highest cotton and ginning potential; together they provide almost 40 per cent of the cotton production and have 34 per cent of the ginning factories. First and second group together make half of the total cotton production and half of the number of ginning factories. The first three groups together make around two-third of the overall cotton production and ginning. The maximum load on the availability of labour should be here in the districts of first three groups during the ginning season. It should be important to analyse the status and quality of other inputs required for these sectors and in these districts. They include for example, transportation, storage facilities, energy requirements, etc. Studying and comparing the data on yarn industry and its expansion in these and other districts will further explain the situation of the requirements.

The ginning process separates the cotton fibres from non-fibrous material. Some idea of the technology, utilized in the ginning industry can be established from the following data.

Table 16: Ginning Technology in Pakistan

Machine Type	No. of Installed Machines	Machine Capacity (bales per 8 hour shift)	Total Capacity (bales per day per shift)
80 Saw	229	12.5	2863
90 Saw	3500	18.5	59235
100 Saw	132	31.0	4092
Total	5488		12 Million bales
Source: Altaf, (2008)			

Most of the industry is based on the technology of saw-ginning. There is no data on the pre-ginning and post-ginning steps which can provide further explanation on the potential of the industry in terms of quality addition to the lint cotton. Meanwhile, our discussion with the industry experts identified that the use of post-ginning cleaning steps are rare in the industry. These stages add cost to the product and the yarn industry does not show willingness to pay for the higher quality of fibres. As a result, the ginning industry hesitates to improve the quality of the fibre in their process. Introduction of the cotton fibre industry to the international markets can resolve this issue and can bring strong motivation in the domestic industry to improve their quality and get higher prices. This will also bring quality benefits for the local yarn industry. Yarn manufacturing separate the non-fibrous material from the fibres rigorously in their preparation stages, which create other quality problems of increasing short fibres and the higher requirement of energy at this stage. The yarn industry has strong political strength and it is always in a position to demand concessions on energy and other issues from the government which will not improve the overall situation. It should be important to study the cost saving from the quality improvement in ginning compared to using severe cleaning in yarn manufacturing and also to study the effects on the quality of yarn produced in both cases. This will provide an insight on the policy issues in these segments.

There is a huge gap in the research at this point to reflect on the costs and on the other affects which the subsequent industries are observing because of the postponement of such cleaning till the preparation stages of yarn manufacturing. It is important to mention here that the ginning industry forms a compact package of cotton fibre called a bale, in order to ease the transportation and storing. Later, when the yarn manufacturer starts processing the fibres, he performs opening

processes which also reduces the impurity size and it can become more difficult to remove that impurity and more energy and costs should be required to separate these impurities.

Producing 100 bales of lint cotton (17200kg) requires around 52000kg of seed cotton with 33% ginning output. Remaining is seed cotton (averaging 32240 kg and around 62%) and trash (around 2560kg around 5%). On average, there is almost 7-8% foreign material found after ginning in Pakistan which is sometimes as high as 12% (Salam (2008)). Different sources of foreign matter in the cotton which is delivered to the yarn industry, include non-standard packing (fibres of jute, polypropylene, and pieces of polythene bag are common); uncovered transportation of fibres and its open storage in ginneries with unpaved floors (attracting tree leaves, dirt and dust). Other contaminants are human hairs, bird feathers, cotton twigs, unopened bolls, and leaves. The amount of foreign matter in cotton after ginning are around 2 to 3% in US, which can be seen as a benchmark and it identifies the room for improvement. It is interesting to comment that the cotton in US is mostly machine picked whereas it is hand-picked in Pakistan. The hand picked cotton should be cleaner than the machine picked; interestingly, it is contrary in this case. There is a need to convince the stakeholders to reduce this gap if the industry wants to decrease its energy consumption which is the only option in the current situation of huge energy shortfall.

The calculated losses in the downstream sectors due to cotton contamination were calculated by Textile Commissioner Organization (TCO), these are given below.

Table 17: Losses in the Textile Industry for Cotton Contamination in Year 2004-05

Product Category	Value (US $)
Cotton Yarn	55370
Cotton Fabric	104604
Ready-made Garments	61425
Knit-wear	99786
Bed-wear	321185
Towels	586999
Other Textile Products	1069394
Total	2298763

The calculation methods and the accuracy of data utilized for these figures are not clear, but they identify an increasing loss of dollar value in the subsequent processes. These losses point out that more and more effort is needed to remove or treat the contaminations present in the product as the processing stages go beyond the ginning stage. Thus any decrease in the amounts of

contamination at ginning will improve the quality of the products and reduce their processing cost.

Ginning productivity in developed countries has reached 60 bales per hour whereas in Pakistan and other developing countries, it is 10-12 bales per hour (Altaf (2008)). The factors which have kept the ginning process of the country unimproved and non-competitive at international level include the low automation, old technology, non-standard operations in ginning, lack of training on skills and on entrepreneurship and low research on the operations, process and technology. The strategy of giving low importance to the sector was adopted to provide low price raw material to the yarn industry and therefore, the ginning industry and the cotton production sectors were kept away from the international markets. The figures of price difference on the cotton in international and domestic markets have already shown evidence on such strategies. In the competitive textile and clothing supply and demand chains of today, the survival is for the efficient industries which can follow the market trends at fast pace and to retain competitive position. The global markets are more open now and there are lot of opportunities to trade in the international markets but the industry in the country has to learn how to compete without concessions otherwise shifting of industry is already a well-known phenomenon in these sectors.

The main requirements which are necessary at this stage in the ginning sectors include training and research facilities, technology up-gradation, standardizing the handling, transportation and storage practices of cotton in the processes of pre-ginning, post-ginning and ginning (Salam (2008) and Altaf (2008)). These measures will increase the quality of output and decrease the usage of energy at the subsequent stages of yarn and fabric manufacturing. Salam (2008) also recommended changing the marketing strategies of cotton from variety basis to quality based system which will improve the quality of cotton.

In general, the practices, methods, training and technology in the ginning sector need a substantial improvement. A good linkage of the domestic and international markets is also a need so that the benefits of handpicked cotton can be realized. It will also help to maintain the competitive edge of the country in the world markets in the yarn and fabric manufacturing sectors and it will improve the cotton production and farming. Thus, country can neutralize the risks and decrease losses in the economy caused by the incompetence or low development of some sectors.

The characteristics and status of ginning sector is given below.

Table 18: Characteristics and Status of the Ginning Sectors

Segment	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Supply of Cotton and Inputs	Strong	Supply of Cotton and Growth of Cotton Production
Ginning Industry	Medium Strong-to-Strong	Number of Ginning Units, Expansion of the Industry in the Country, Low Advancement in Technology in the Industry, Growth of the Industry, Availability of Labour, High Variations in Cotton Supply, Market Risks
Demand in National Markets	High	Growth of Yarn Industry
Demand in International Markets	Average to High	Low Quality, Low Knowledge of Markets, Low Use of Information Technology
Overall Ginning Sector	Medium Strong	
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong		

III.2.3. Other Fibres (Except Cotton)

The production and use of the manufactured fibres were started in the country in early 1980s. Since then, their share has increased in overall consumption of the textile fibres. In this category, main fibres are polyester and viscose which have high shares. Mostly, these are mixed with other fibres like polyester-with-cotton (PC) and polyester-with-viscose (PV). The year wise consumption and the growth of their share, in the industry, are given below.

Table 19: Consumption of Cotton and Manufactured Fibres and Their Share

Year	Consumption in "000" Kilograms			Growth in %		Share in %	
	Cotton	Manufactured Fibres	Total	Cotton	Manufactured Fibres	Cotton	Manufactured Fibres
1948	6876		6876			100	
1949	8731		8731	27		100	
1950	13664		13664	56		100	
1951	21871		21871	60		100	
1952	27119		27119	24		100	
1953	49421		49421	82		100	
1954	99018		99018	100		100	
1955	146299		146299	48		100	
1956	158436		158436	8		100	
1957	164503		164503	4		100	
1958	169756		169756	3		100	
1958-59	181440		181440	7		100	
1959-60	201184		201184	11		100	
1960-61	204484		204484	2		100	
1961-62	205330		205330	0		100	

Year	Consumption in "000" Kilograms			Growth in %		Share in %	
	Cotton	Manufactured Fibres	Total	Cotton	Manufactured Fibres	Cotton	Manufactured Fibres
1962-63	213224		213224	4		100	
1963-64	233540		233540	10		100	
1964-65	237402		237402	2		100	
1965-66	230669		230669	-3		100	
1966-67	243593		243593	6		100	
1967-68	271896		271896	12		100	
1968-69	296125		296125	9		100	
1969-70	334693		344693	13		100	
1970-71	360006		360006	8		100	
1971-72	407147		407147	13		100	
1972-73	463118		463118	14		100	
1973-74	475348		475348	3		100	
1974-75	420608		420608	-12		100	
1975-76	419735		419735	0		100	
1976-77	343194		343194	-18		100	
1977-78	355986		355986	4		100	
1978-79	387581		387581	9		100	
1979-80	428554		428554	11		100	
1980-81	407523	37088	444611	-5		92	8
1981-82	459459	4155	501009	13	12	92	8
1982-83	478716	37983	516699	4	-9	93	7
1983-84	457629	48829	506458	-4	29	90	10
1984-85	459394	52237	511631	0	7	90	10
1985-86	500065	58534	558599	9	12	90	10
1986-87	634886	62833	697719	27	7	90	10
1987-88	712456	67282	779738	12	7	91	9
1988-89	809978	69256	879234	14	3	92	8
1989-90	998447	71904	1070351	23	4	93	7
1990-91	1128978	8556	1214538	13	19	93	7
1991-92	1257399	105775	1363174	11	24	92	8
1992-93	1318892	125525	1444417	5	19	91	9
1993-94	1511610	182077	1693687	15	45	89	11
1994-95	1412732	192152	1604884	-7	6	88	12
1995-96	1509955	192691	1702646	7	0	89	11
1996-97	1444368	236692	1681060	-4	23	86	14
1997-98	1471169	318923	1790092	2	35	82	18
1998-99	1441923	407686	1849609	-2	28	78	22
1999-00	1566348	404008	1970356	9	-1	79	21
2000-01	1673280	405038	2078318	7	0	81	19
2001-02	1755669	409557	2165226	5	1	81	19
2002-03	1943197	449424	2392621	11	10	81	19
2003-04	1938678	468984	2407662	0	4	81	19
2004-05	2099380	488804	2588184	8	4	81	19
2005-06	2407560	525000	2932560	15	7	82	18
2006-07	2563510	580000	3143510	6	10	82	18

Year	Consumption in "000" Kilograms			Growth in %		Share in %	
	Cotton	Manufactured Fibres	Total	Cotton	Manufactured Fibres	Cotton	Manufactured Fibres
2007-08	2521170	638000	3159170	-2	10	80	20
2008-09	2519184	676464	3195648	-0.1	6	79	21
2009-10	2401840	970524	3372364	-4.7	43	71	29
2010-11	2444176	961551	3405727	1.8	-1	72	28
Source : TCO (Data available at www.aptma.org.pk)							

Figure 20: Cotton and Other Fibre Consumption in the Country

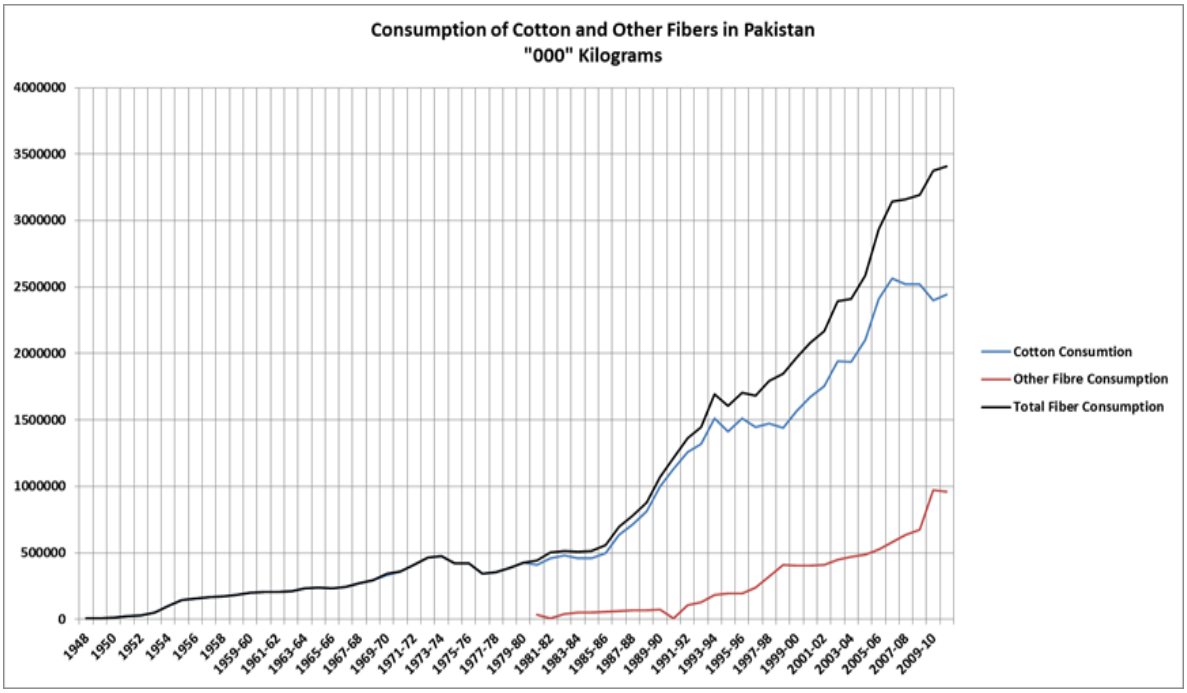


Table 20: Share of Various Fibres in Total Fibre Consumption

Period	Cotton	Other Fibres
Average 1948-80	100	0.0
Average 1980-90	91.3	8.7
Average 1990-95	90.4	9.6
1996-97	85.9	14.1
1997-98	82.2	17.8
1998-99	78.0	22.0
1999-00	79.5	20.5
2000-01	80.5	19.5
2001-02	81.1	18.9
2002-03	81.2	18.8
2003-04	80.5	19.5
2004-05	81.1	18.9
Source: TCO, Pakistan		

The manufactured fibres (polyester and viscose) have established their place in the supply chain system and it is only a matter of time and evolution which will ultimately improve the quality and competitiveness of these sectors. Meanwhile, exposing their production to international markets, will improve their performance more quickly. In general, the sourcing patterns of the textile and clothing supplies in the world, discussed earlier, identify the South Asian region with great potential and these sectors in the country should benefit from these opportunities both in the international and regional markets. The main strength of the manufactured fibre industry is that it is in an organised sector; strong research component will improve its competitiveness in the international markets. The use of elastic filaments as core spun has also increased in the country because of high demand in the international markets. Most of these fibres are imported in the country and their production can be focused for the future directions of the industry.

Other natural textile fibres except cotton include wool, silk and hair fibres (protein fibres); linen or flex (cellulose fibre). The production and use of these fibres are at different levels of growth. For example, wool fibre is produced and also imported in the related sectors but the quality and design versatility of the woollen products are low. As a result, the industry is mainly fulfilling the demand of the local markets. Silk is also produced and converted into textile and products but mostly in the unorganized or informal sectors. Serious effort is required to orient these sectors towards international markets. Linen fibre has a great potential in the country because of its aesthetic effects in the fabrics and also due to the weather conditions which make it suitable for wearing purpose in the region. Its usage is low because of less production of the fibre and also because of the higher dependence of the country on cotton which is available easily.

In general, the manufactured fibre sectors are improving but at low pace. The sectors of natural fibres, other than cotton are mostly in the informal sectors. It is needed to transform these into formal industrial activities. The characteristics and overall status of manufactured fibres and natural fibres, other than cotton are presented below.

Table 21: Characteristics and Status of the Manufactured Fibre Sectors

Segment	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Raw Material Supply	Medium Strong	Dependency on Imports
Manufactured Fibre Industry	Medium Strong	Discussion with Industry Personnel
Demand in National Markets	Average to High	Medium Quality and Rates, High Competition
Demand in International Markets	Average	Medium Quality and Rates, High Competition
Overall Manufactured Fibre Industry	Medium Strong	
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong		

III.2.4. Yarn Manufacturing

The yarn industry in the country is a strong and big supplier of world markets especially for the coarse and medium-fine yarn counts of cotton yarns and mixed fibres yarns. The growth of the sector was impressive and was based on the facts that it enjoyed strong political support, availability of cheap raw material and export quotas in the quota regime. After the demolition of the quota system, the industry struggled for some period and tried to improve and compete in the new scenario. The export data presented below, show that the yarn sector is performing well against its competitors. Meanwhile, the questions of how it is performing well or what incentives or benefits are supporting such an ability of the industry are interesting to discuss here. Some of these factors were discussed above, which were related to raw material and the discussion will continue on other such incentives here in this section.

The support for the yarn industry, include the bulk supply of low price cotton, the availability of manufactured fibres, low labour wages, labour availability, the historical developments in the textile and clothing sectors and the strong government support. Other attractions for the industry include the support of the international agencies for development and research and the global trends of the transfer of these manufacturing activities near to their resources. The developed world has adopted strategies to move towards the manufacturing of high value added goods and services in the technologically advanced areas like Nano-technology and bio-technology etc. Their economic interests are in the research for the advancement of technology, engineering, science, innovation, systems and other similar areas. As a result, the industrial activities in low value addition and high labour demand, including textile and clothing are encouraged to move in countries like China, India, Pakistan, Indonesia, Brazil and Bangladesh and South Africa etc. The trade in textile and clothing has globalised at all levels and sectors.

Such developments and the support from developed countries to those countries having some potential in textile and clothing have raised the industrial activity in the developing countries and the income level of their populations. The sectors of yarn and fabric manufacturing in Pakistan provide strong base for the other related industries too inside the country. These sectors are also supply inputs to other regional manufacturers of textile and clothing like Bangladesh, Sri Lanka and Indonesia.

Altaf (2008) was not convinced that the textile and clothing sectors of the country are at competitive position. He charges the industry and its economic behaviour as non-competitive as it had survived in protected markets with support of cheap cotton and strong government support. The non-competitive behaviour of the industry is connected to the very roots of its birth. The governments controlled the industrialization process by exercising the authority of permits for the industrial activity and used it as political bribes. The free market forces were not allowed to make decisions on the location of the industrial activity and support for entrepreneurs or financing of the activities were totally biased. Contrary to all these imperfections of the system, there was a strong economic growth in the country in 1960s which was based on the textile and clothing industry. We believe that the real effects of all these developments were actually seen at the end of 1980s where the true industrial growth in these areas is visible. Benefitting certain forces in the industrial process can be seen as demotivation for many others in the process of entrepreneurship and to lower the competing spirit of the industry which was unfair. These forces with strong political affiliations, who are now the political and bureaucratic elite, are driving the wheel of industry in the country.

Let us study and analyse the data related to the yarn industry to provide some insight on the characteristics of the yarn sectors in the country.

Table 22: Growth of Yarn Manufacturing Capacity (see Appendix III.A)

Figure 21: Number of Textile Units in Pakistan

Figure 22: Number of Spindles in the Yarn Manufacturing Industry

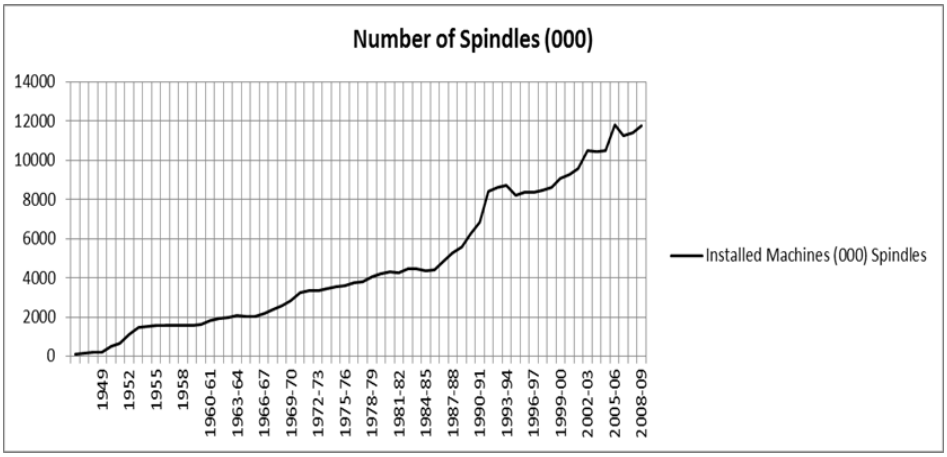
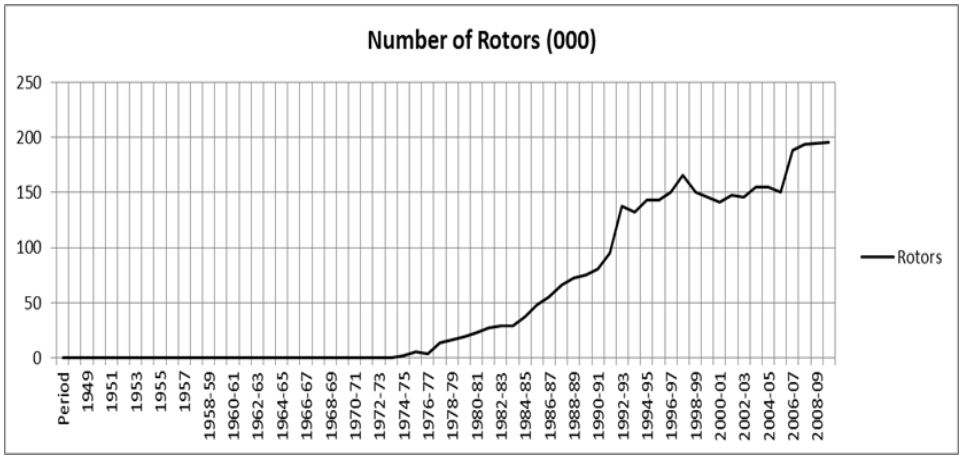


Figure 23: Number of Rotors in the Yarn Manufacturing Industry



It can be observed that the first phases of industrialization in the yarn sectors were introduced in 1950s and early 1960s with the ring spinning technology and the rotor technology was introduced in late 1970s. At start, the growth was high because of the availability of cotton in bulk and nonexistence of the industrial setup in the country. Later, there were various phases of slow and medium growth which were caused by the political instability and various experiments with the economy. The industrialization process started gaining thrust again in late 1980s and 1990s which continued at a regular pace. It can be observed that the last phases of the growth are more stable, although supported with the strong supplies of cotton which itself has various imperatives of growth. Such a relationship can be observed from the increasing cotton production trends which were discussed above (see Figure 12).

The strong growth of ring and rotor yarn manufacturing industry in the country in late 1980s is the reflection of the similar strong growth in cotton fibre production. By the end of the last

century, the cotton production and yarn manufacturing sectors were at strong positions to support other activities in the value chain.

The data on the capacity utilization in the yarn sector is presented in the next table.

Table 23: Capacity Utilization in the Yarn Industry

Year	Units	Installed Capacity (000)		Working Capacity (000)		Capacity Utilization %	
		Spindles	Rotors	Spindles	Rotors	Spindles	Rotors
1958-59	70	1581	0	1488	0		
1979-80	187	3781	16	2701	14	0.9*	0.59
1989-90	266	5271	72	4489	64	074†	0.83
1990-91	277	5568	75	4827	67	0.87	0.89
1995-96	503	8717	143	6548	80	0.73	0.56
1996-97	440	8230	143	6538	87	0.75	0.56
1997-98	442	8368	150	6631	80	0.79	0.61
1998-99	442	8392	166	6671	66	0.79	0.53
1999-00	443	8477	150	6825	66	0.79	0.40
2000-01	444	8601	146	6913	70	0.81	0.44
2001-02	450	9060	141	7440	66	0.80	0.48
2002-03	453	9260	148	7676	70	0.82	0.47
2003-04	456	9592	146	8009	66	0.83	0.47
2004-05	458	10485	155	8492	79	0.83	0.45

Source: Altaf, (2008); TCO

*Average capacity utilization for 1958-1979 (spindle and rotors)

†Average capacity utilization for 1980-1990 (spindles and rotors)

It can be observed that the capacity utilization in the ring spinning sectors was high, at around 83 per cent whereas much lower at around 50 per cent in the rotor sectors. The recent data is not available which can bring the fresh insight on the capacity utilization in the yarn industry. The higher capacity utilization in the ring spinning sectors can be associated with the higher demands and the trends of the domestics yarn consumption or the marketing focus of the country which is in the traditional tight-fabric constructions for the clothing and shirting areas. The denim industry and the terry sectors have expanded a lot in the last decades and the situation of capacity utilization in the rotor yarn manufacturing sectors should have increased. The factors of growth in the size of the cotton crop in the country and the higher demand of yarn in the neighbouring countries have boosted the overall yarn industry in Pakistan and the utilization of its capacity should also have positive effects in recent years.

The data on the capacity growth of yarn industry is taken to more detail and at regional level in the following figures.

Table 24: Province-wise Growth of Textile Manufacturing Capacity (see Appendix III.A)

Figure 24: Provinces-wise Number of Textile Units

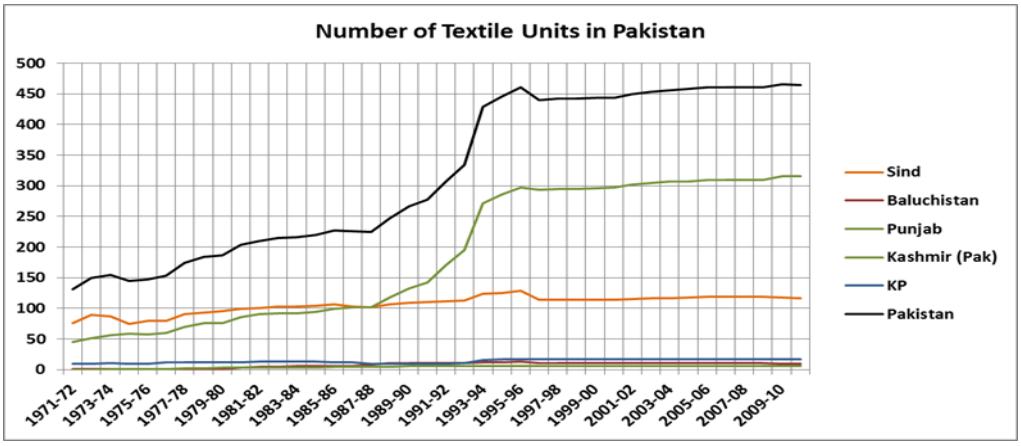


Figure 25: Province-wise Number of Spindles in the Yarn Industry

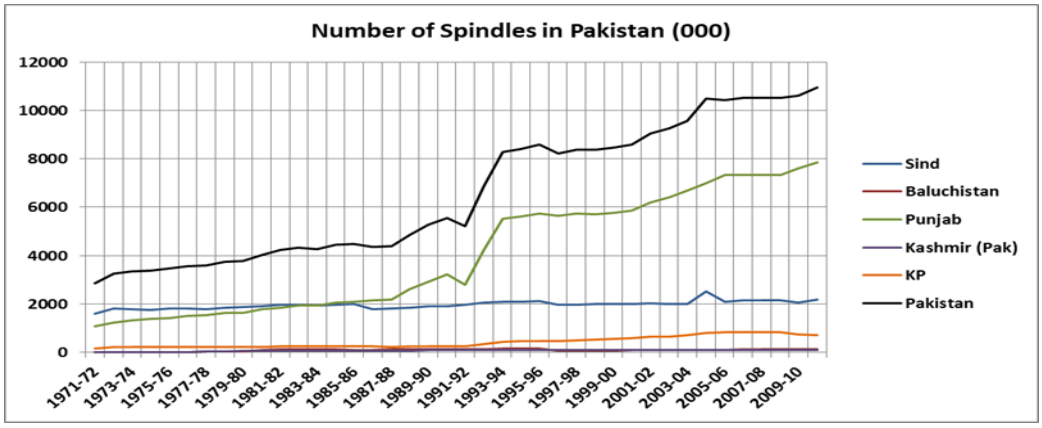
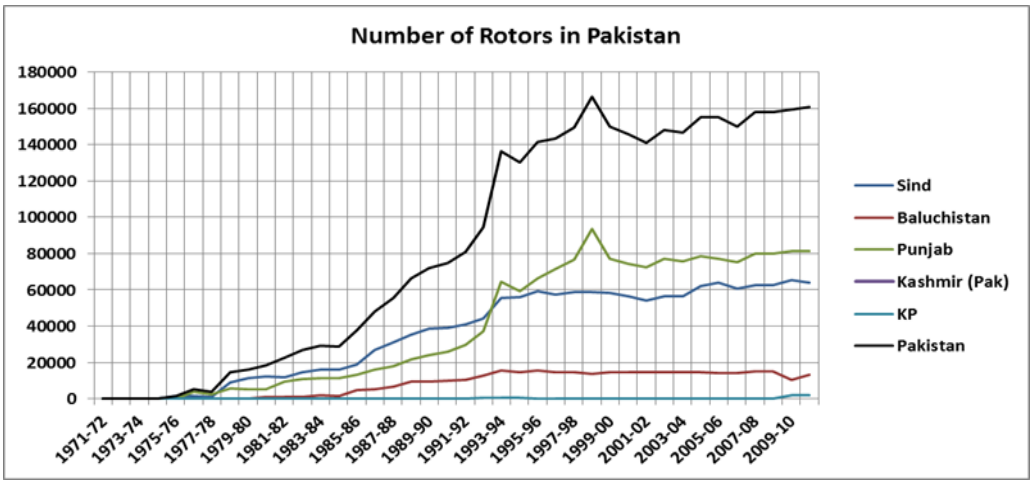


Figure 26: Province-wise Number of Rotors in the Yarn Industry



The formal industrial activity in textile manufacturing exists mainly in two regions, Sindh and Punjab. There is formal and informal industry in other regions including Baluchistan, KP and Kashmir but in low number. Meanwhile, as the cotton farming and production is mainly concentrated in Sindh and Punjab, most of the textile industry also exists in these regions. The growth in the yarn sector was mainly observed in the Punjab region and it was based on the increase in cotton production in decade of 1980s and later. Currently, the trends of higher growth in the production of cotton are being observed in the Sindh region, after the introduction of varieties of BT Cotton. As a result, similar growth in the yarn industry is due in this region too. Meanwhile, the developments in other regions of the country are not much clear and they have very low effect on the output of the yarn sectors.

During the period from 1990 to 2005, the production of yarn increased at an annual rate of 4.7 per cent, Altaf (2008). The yarn export share of the country in the world exports increased in period of 1970s to 1991-92, afterward it was eased and was declining till year 2004-05. The decrease in the export share of yarn was not because of less production but it was due to higher local demand which witnessed an increase in these periods. This identifies the trend of the increased value addition in the SC system.

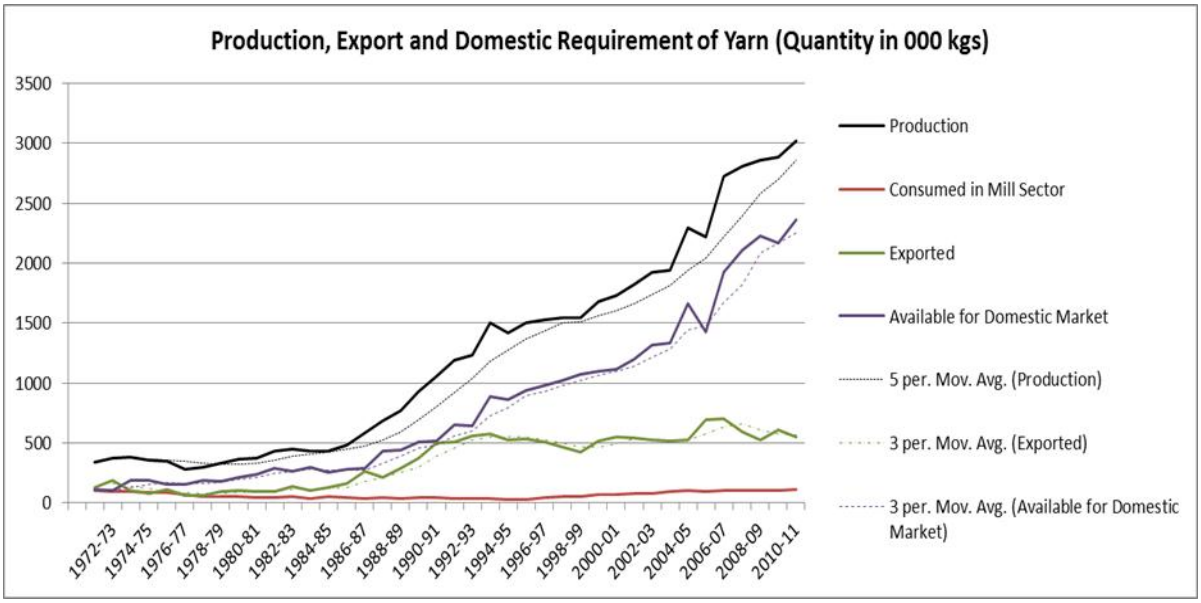
The data on the production, consumption and export of yarn is presented below.

Table 25: Production, Export and Domestic Requirement of Yarn (Quantity in '000' Kilograms)

Period	Production	Consumption (Mill Sector)		Available for Local Market		Export	
		Quantity	Share	Quantity	Share	Quantity	Share
1971-72	335.702	98.785	29.43	106.759	31.8	130.158	38.77
1972-73	376.122	89.88	23.9	101.838	27.08	184.404	49.03
1973-74	379.46	96.056	25.31	182.84	48.18	100.564	26.5
1974-75	351.2	88.103	25.09	184.732	52.6	78.365	22.31
1975-76	349.653	83.943	24.01	153.528	43.91	112.182	32.08
1976-77	282.64	65.452	23.16	152.894	54.09	64.294	22.75
1977-78	297.895	55.165	18.52	182.775	61.36	59.955	20.13
1978-79	327.796	51.215	15.62	178.652	54.5	97.929	29.87
1979-80	362.862	47.91	13.2	215.118	59.28	99.834	27.51
1980-81	374.947	43.277	11.54	236.438	63.06	95.232	25.4
1981-82	430.154	42.624	9.91	291.909	67.86	95.621	22.23
1982-83	448.43	50.563	11.28	263.767	58.82	134.1	29.9
1983-84	431.58	34.972	8.1	294.803	68.31	101.805	23.59
1984-85	431.731	53.546	12.4	252.33	58.45	125.855	29.15
1985-86	482.186	46.052	9.55	278.239	57.7	157.895	32.75
1986-87	586.371	36.41	6.21	290.293	49.51	259.668	44.28

Period	Production	Consumption (Mill Sector)		Available for Local Market		Export	
		Quantity	Share	Quantity	Share	Quantity	Share
1987-88	685.031	41.566	6.07	432.515	63.14	210.95	30.79
1988-89	767.434	38.172	4.97	437.309	56.98	291.953	38.04
1989-90	925.382	47.119	5.09	503.287	54.39	374.976	40.52
1990-91	1055.228	40.215	3.81	513.941	48.7	501.072	47.48
1991-92	1188.270	36.022	3.03	646.385	54.4	505.863	42.57
1992-93	1234.539	35.101	2.84	644.144	52.18	555.294	44.98
1993-94	1498.948	36.846	2.46	883.454	58.94	578.648	38.6
1994-95	1413.648	29.111	2.06	862.446	61.01	522.091	36.93
1995-96	1505.244	30.164	2	939.191	62.39	535.889	35.6
1996-97	1530.855	46.962	3.07	975.705	63.74	508.188	33.2
1997-98	1540.720	53.445	3.47	1025.356	66.55	461.919	29.98
1998-99	1547.632	55.947	3.62	1070.204	69.15	421.481	27.23
1999-00	1678.536	65.481	3.9	1100.084	65.54	512.971	30.56
2000-01	1729.129	68.275	3.95	1115.720	64.52	545.134	31.59
2001-02	1818.345	77.328	4.25	1201.517	66.08	539.5	29.67
2002-03	1924.936	79.435	4.13	1320.369	68.59	525.13	27.28
2003-04	1938.908	93.141	4.8	1331.487	68.67	514.279	26.52
2004-05	2290.340	105.362	4.6	1664.196	72.66	520.782	22.74
2005-06	2216.605	95.71	4.32	1429.403	64.49	691.492	31.2
2006-07	2727.566	104.423	3.83	1923.874	70.53	699.259	25.64
2007-08	2809.383	105.443	3.75	2109.004	75.07	594.936	21.18
2008-09	2862.411	106.416	3.72	2229.749	77.9	526.246	18.38
2009-10	2880.970	104.449	3.63	2164.108	75.12	612.413	21.26
2010-11	3016.972	108.79	3.61	2358.235	78.17	549.947	18.23
Source: PCCC							

Figure 27: Production, Export and Domestic Requirement of Yarn

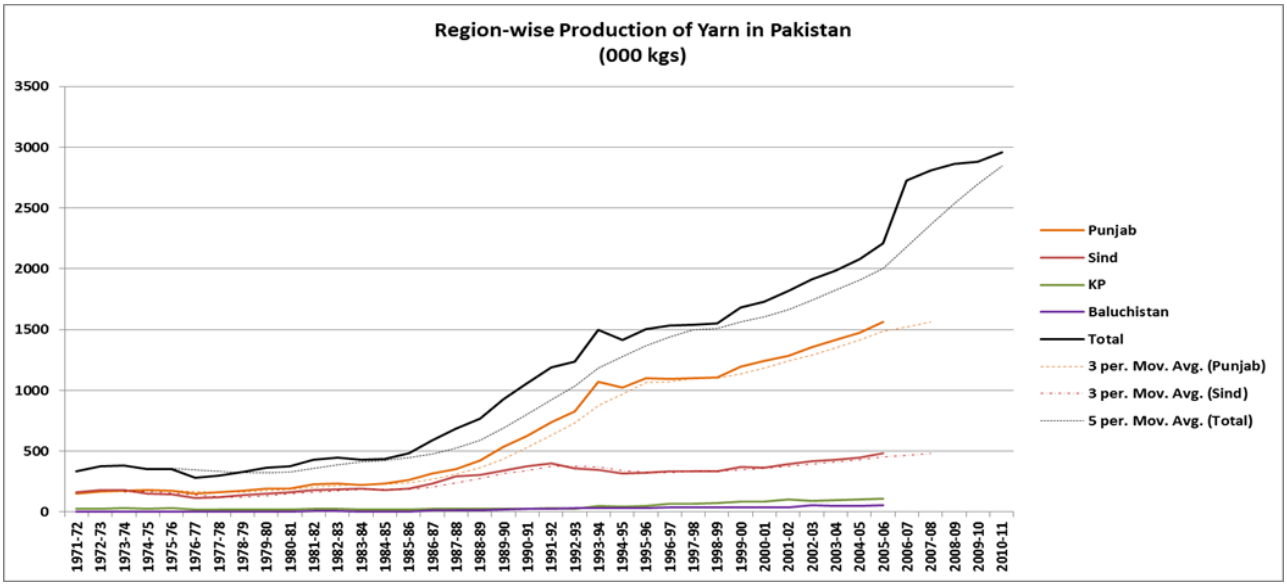


Let us observe the patterns of growth in yarn production, its consumption and export. The production was mostly flat in early 1970s to the middle of 1980s. The high growth of yarn production started at around 1985 and continued till 1995; it was followed by a steady growth period till the year 2005. Again, there is a high growth in the last five years from 2005 to 2010. It seems that the ending of the world quota restrictions have brought positive impact on the yarn industry where the local demand from the fabric, terry, sheeting and denim industries have driven the growth in the yarn sectors. The main factors which have supported these trends are the strong supply of cotton and the increase in the yarn manufacturing capacity. The export quantities were almost flat since early 1990s with some growth periods are visible in the last five years of the data. The trends in the mill sector consumption of yarn inside the country are not clear as there is no explanation on the sectors which are included in this category. The growth of yarn consumption in the mill sector is flat and raises our doubt on the quality of data. Our concerns have their basis in the export figures of terry and home textiles, discussed in section III.3.8, which have increased significantly and most of these sectors are in formal setup. Therefore the consumption of yarn in the mill sector should be higher and there should be a visible increasing trend of yarn consumption in this sector.

In the following figure, region-wise yarn production is presented.

Table 26: Province-wise Production of Yarn (see Appendix III.A)

Figure 28: Province-wise Production of Yarn



These figures also confirm the patterns of growth discussed above. Higher growth can be observed in Punjab region and similar trend is due in Sindh region from the recent rise in the cotton production. KP and Baluchistan have minor shares in the yarn production.

In the following table, the share of main yarn producers in the world is provided.

Table 27: World Production of Cotton Yarn

Year	Production (Million Metric Tons)								
	World	China		India		Pakistan		United States	
			%		%		%		%
1994	16.2	4.9	30.2	1.6	10.0	1.2	7.2	2.0	12.2
1995	16.7	4.5	32.5	1.8	11.0	1.2	7.3	2.0	12.1
1996	16.7	5.1	30.7	2.1	12.5	1.3	7.7	2.0	11.8
1997	15.6	5.6	35.9	2.3	14.4	1.2	8.0		0.1
1998	16.9	5.4	32.2	2.0	12.0	1.2	6.8	2.0	11.8
1999	17.7	5.7	32.0	2.2	12.2	1.6	9.1	1.9	10.8
2000	19.7	6.6	33.4	2.3	11.6	1.7	8.7	1.9	9.7
2001	19.7	7.0	35.3	2.2	11.2	1.8	9.0	1.6	8.0
2002	20.9	8.5	40.6	2.2	10.5	1.9	8.9	1.4	6.6
2003	22.1	9.8	44.5	2.1	9.4	2.0	8.9	1.2	5.6
2004	23.2	10.9	46.8	2.2	9.7	2.1	9.1	1.3	5.8
Source: Altaf, (2008); International Cotton Advisory Committee									

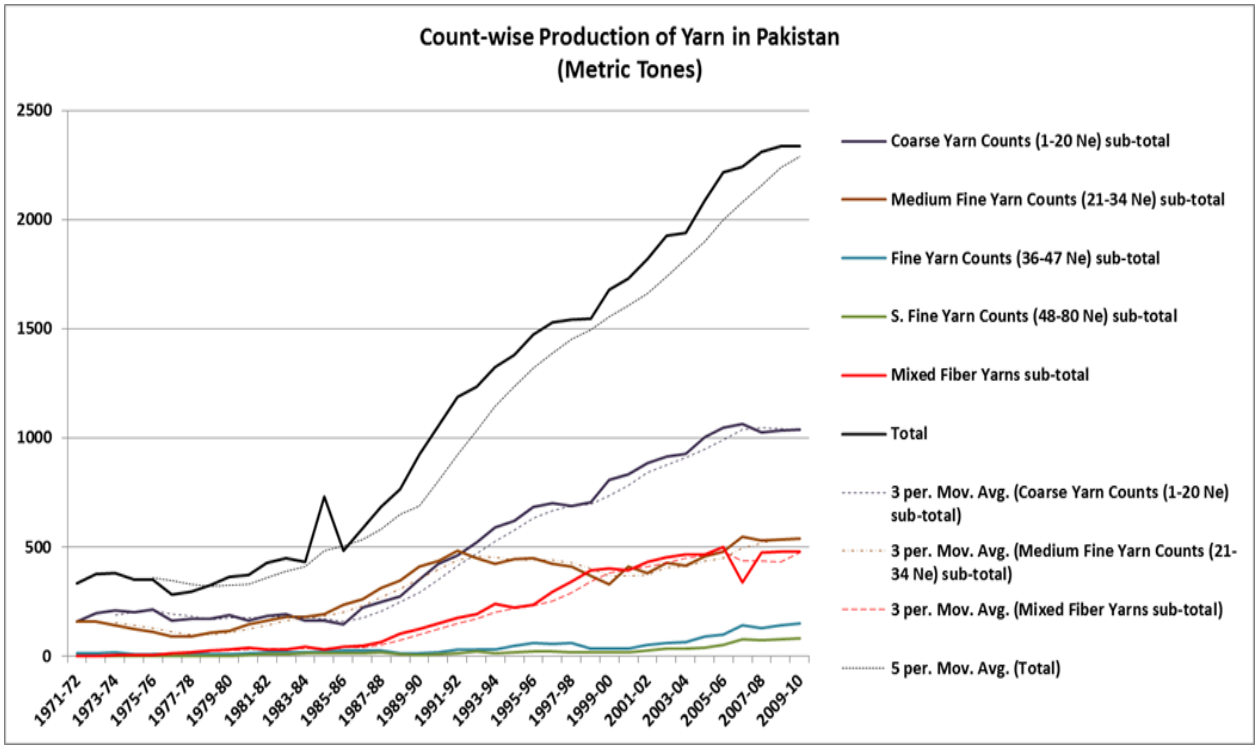
It shows that the country has increased its share in the world production of yarn from 7.2 per cent to 9.1 per cent in the period from 1994 to 2004. Both China and Pakistan have increased their production potential whereas the shares of US and India have decreased. The yarn industry in US should have contracted while in India, the reasons are not clear. Most probably, the production of yarn in India is stagnant and the overall growth of world production has decreased its global share. Overall, India has a very strong yarn industry. As the recent data is not present, our comments should be less representative on the current situation.

The growth of the production of various types of yarns is presented at Table 28 (see Appendix III.A).

The yarn industry is mostly producing the single yarn in the yarn Counts of Ne: 10, 12, 16, 20, 24, and 30. Other yarn Counts are also produced but in low quantities. For example, in year 2004-05, the production for the above six categories of Count was around 66 per cent of the total production; in year 2003-04 the share was 65.1 per cent of the total and so on. The finding that

the country mainly produces coarse cotton yarns has its basis in the supply of raw material which is suitable for these yarn Counts. The data on the types of cotton fibres, produced in the country confirms such an assumption. The process technology of the yarn industry is also adopted keeping in view the coarse yarn production potential of the country.

Figure 29: Count-wise Production of Yarn in Pakistan



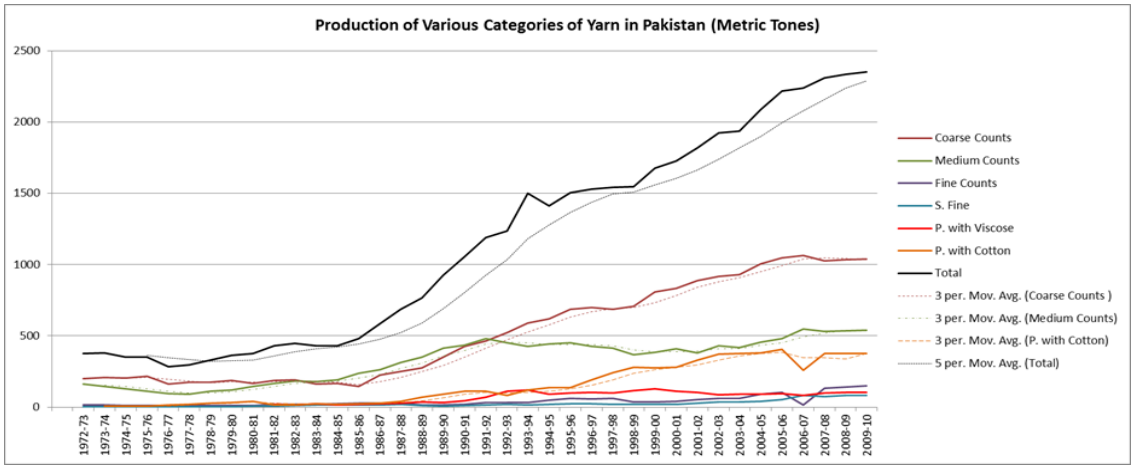
In the above figure, the coarse yarn production is the highest with steady growth. The production of mixed fibre yarns has crossed the production quantities of medium yarn counts. The production of medium yarn counts was stagnant for long period from early 1990s till 2005-06 and then there is some increase in the production. The production of fine and super fine yarns have very low share but a growth can be observed in the recent data. For the production of fine and super fine yarn counts, the country imports fine fibres and there is also an increase in the import of such fibres from North America and Egypt for example.

The data on the production of various yarn counts is categorized and presented in the next table.

Table 29: Production of Various Categories of Yarn (Metric Tons)

Period	Textile Mills	Coarse Counts	Medium Counts	Fine Counts	S. Fine	Waste	P. with Viscose	P. with Cotton	Total
1972-73	109	198.396	161.166	13.767	2.793	0			376.122
1973-74	118	209.12	143.512	16.848	3.491	2.125		4.364	379.46
1974-75	123	202.923	126.783	11.238	3.443	1.229		5.584	351.2
1975-76	116	215.7	113.253	11.364	3.811	770		4.755	349.653
1976-77	126	162.065	93.271	9.383	2.969	537		14.415	282.64
1977-78	136	172.232	91.479	10.408	3.037	841		19.897	297.894
1978-79	143	172.449	110.343	10.865	2.548	2.562		29.031	327.798
1979-80	149	187.405	118.84	11.651	3.669	8.08		33.217	362.862
1980-81	148	165.724	145.127	12.427	4.624	8.26		38.785	374.947
1981-82	157	185.632	165.888	18.128	8.359	19.362	18.032	14.753	430.154
1982-83	158	191.753	182.53	20.133	11.235	9.511	16.779	16.489	448.43
1983-84	161	163.334	179.538	19.789	15.545	9.372	22.441	21.561	431.58
1984-85	158	164.554	191.684	21.397	12.744	8.391	15.821	17.14	431.731
1985-86	160	146.867	238.126	28.498	15.544	7.909	20.359	24.883	482.186
1986-87	187	224.505	262.28	29.225	13.6	9.606	21.22	25.935	586.371
1987-88	197	249.72	311.559	29.272	17.088	10.189	26.881	40.322	685.031
1988-89	223	275.302	349	14.943	11.172	13.384	35.77	67.863	767.434
1989-90	266	351.262	412.149	16.31	7.739	14.21	32.771	90.941	925.382
1990-91	277	424.727	435.278	17.16	9.137	15.826	43.25	109.85	1055.288
1991-92	307	464.66	482.05	31.912	14.755	16.826	68.094	109.973	1188.270
1992-93	334	521.475	451.557	30.081	20.949	18.508	110.348	81.621	1234.539
1993-94	429	588.603	424.127	32.773	16.068	23.733	121.265	120.107	1498.948
1994-95	448	620.691	443.762	49.549	19.498	22.334	89.554	135.314	1413.648
1995-96	503	684.913	451.646	60.177	22.827	21.044	99.68	134.784	1505.244
1996-97	440	699.893	425.165	58.165	23.043	27.127	104.502	192.96	1530.855
1997-98	442	686.718	413.294	60.14	17.591	19.608	100.78	242.589	1540.720
1998-99	442	707.723	368.424	35.969	18.437	22.478	117.452	277.149	1547.632
1999-00	443	806.556	382.33	36.014	19.126	32.069	129.229	273.212	1678.536
2000-01	444	832.4	410.91	37.892	20.204	34.222	112.289	281.212	1729.129
2001-02	450	885.889	381.387	53.674	25.41	38.545	101.823	331.619	1818.347
2002-03	453	916.37	430.13	60.282	35.086	27.185	84.492	371.391	1924.936
2003-04	456	928.589	417.779	60.015	34.69	26.148	89.624	376.044	1938.889
2004-05	458	1003.636	457.543	91.754	38.006	27.483	90.833	378.032	2087.287
2005-06	461	1045.372	479.708	101.98	53.756	36.255	95.671	403.86	2216.602
2006-07	461	1064.584	547.45	14.543	80.605	66.706	81.082	259.176	2241.146
2007-08	461	1027.014	532.06	131.543	75.605	67	100.254	375.924	2309.400
2008-09	461	1033.014	535.06	142.115	80	67.028	102	376	2335.217
2009-10	439	1038.460	539.467	151.015	80.987	65.228	102	376	2353.157
N.A = Not Available									
Source: TCO									

Figure 30: Production of Various Categories of Yarn in Pakistan (Metric Tons)



The figure clarifies the share of manufactured fibres in the overall production. Polyester-with-cotton (PC) blend is at the third place in terms of quantity produced whereas polyester-with-viscose (PV) has also a good share with stable quantities. The quantities for the fine and super fine yarns are also growing.

The following tables present the yearly data on the share of different categories of yarn, produced in the country.

Table 30: Count-wise Production Shares of Yarn (see Appendix III.A)

Table 31: Share of Coarse and Medium Fine Yarns

Period	10s	12s	16s	20s	30s	Sub-Total
1971-80	16.4	3.4	9.1	23.2	6.9	59
1981-90	11.3	4.2	7.6	8.6	7.5	39.2
1990-91	11.3	1.7	10.0	16.5	8.7	48.2
1991-92	10.0	1.5	9.0	18.1	10.4	49
1992-93	9.1	1.6	9.7	21.4	10.8	52.6
1993-94	8.7	2.2	9.4	25.7	12.8	58.8
1994-95	8.4	2.0	10.1	27.2	14.3	62
1995-96	9.0	2.1	10.5	26.0	12.7	60.3
1996-97	9.6	2.4	10.8	25.5	12.4	60.7
1997-98	8.5	2.8	11.5	24.9	12.3	60
1998-99	9.3	3.1	13.3	26.9	12.8	65.4
1999-00	8.9	3.1	12.1	29.3	12.7	66.1
2000-01	7.6	3.2	12.9	29.1	12.8	65.6
2001-02	9.3	3.6	12.6	28.8	11.1	65.4
2002-03	9.1	4.4	10.9	25.6	11.6	61.6
2003-04	8.8	4.6	11.1	26.1	10.6	61.2
2004-05	9.7	4.7	10.2	25.0	11.3	60.9

The share of the coarse and medium fine yarns is more than half of the overall yarn production in the country. Their share crossed the two-third of the overall amount in the periods from 1998 to 2001. In latest figures, their share was decreasing most probably because of the increasing share of the fine counts.

Table 32: Share of Fine and Super Fine Yarns

Period	40s	47s	48s	60s	80s	Sub-Total
1971-80	2.2	0.2	0.2	0.6	0.2	3.4
1981-90	1.6	1.1	0.5	1.5	0.6	5.3
1990-91	0.7	0.1	0.2	0.8	0.1	1.9
1991-92	0.9	0.1	0.3	1.0	0.1	2.4
1992-93	1.0	0.1	0.4	1.2	0.4	3.1
1993-94	1.1	0.2	0.3	0.7	0.5	2.8
1994-95	2.0	0.2	0.2	0.5	1.0	3.9
1995-96	2.4	0.2	0.4	0.7	0.8	4.5
1996-97	2.0	0.2	0.4	0.5	1.0	4.1
1997-98	2.1	0.3	0.5	0.4	0.7	4
1998-99	1.6	0.3	0.5	0.5	0.7	3.6
1999-00	1.8	0.3	0.3	0.3	0.9	3.6
2000-01	1.9	0.3	0.4	0.3	0.9	3.8
2001-02	2.8	0.3	0.4	0.3	1.2	5
2002-03	2.6	0.5	0.7	0.6	1.1	5.5
2003-04	2.9	0.9	0.7	0.7	1.1	6.3
2004-05	3.7	0.9	0.6	0.6	1.2	7

The share of fine and super fine yarn counts was below five per cent of the overall yarn production. Meanwhile it crossed this limit in year 2001 and since then, their share is increasing. The production growth of fine presents evidence of the value addition in the yarn sector and also in the subsequent segments of the value chain. The products from fine counts offer higher profits and their demand is also associated with products which are in higher levels of quality standards. Although, the production of fine yarns also require finer fibres which are mostly imported to fulfil these needs.

Table 33: Share of Various Types of Cotton Fibre in the Overall Production

Period	Short (<20.64mm)	Medium (20.64-2540mm)	Medium Long (26.19-27.78mm)	Long (28.57-33.34mm)
1947-1970	13.6	82.5	7.4	0.4
1970-1980	6.2	77.5	15.3	1.0
1980-1990	2.7	26.4	55.4	15.5
1990-1991	1.0	4.1	59.5	35.4
1991-1992	1.0	9.0	61.1	29.0
1992-1993	1.0	3.1	73.8	22.2

Period	Short (<20.64mm)	Medium (20.64-2540mm)	Medium Long (26.19-27.78mm)	Long (28.57-33.34mm)
1993-1994	1.1	23.4	71.4	4.1
1994-1995	1.3	20.1	73.0	5.6
1995-1996	0.9	53.5	45.4	0.2
1996-1997	1.1	37.1	58.9	2.9
1997-1998	1.2	14.0	72.0	12.8
1998-1999	1.2	37.2	59.0	2.7
1999-2000	0.0	33.0	63.0	4.0
2000-2001	0.0	12.4	83.4	4.2
2001-2002	0.5	28.5	67.9	3.2
Source: PCCC				

In the data on fibre production, it seems that major fibre production interests were moved from long fibre production to medium and medium-long fibres in the period from 1980 to 1993. Since year 1999, slight opposite growth can be observed.

The strong demand from the local producers of heavy cloth, terry and home textiles should be the main motivation for the cotton producers to grow medium and medium-long fibres. Later, when the demand for light fabrics and yarns increased, the industry started importing the fine cotton from North America and Egypt. Part of the yarn manufacturing industry have shifted their production on fine counts and the country is emerging as an importer of fine and long fibre cotton (Pima, Giza and other such varieties). Such imports have increased in the recent years to fulfil the international demand.

The data on the yarn supplies in the world from different countries is presented in following table.

Table 34: Exports Data of Main Yarn Exporters

Region		1990	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06
World	Value	18.4	18.6	23.3	20.7	24.2	30.0	30.4	32.2	30.4	28.5	31.0	29.0	29.8	33.4	37.5	37.7	21.5
	Volume	5.3	4.1	5.2	5.6	6.2	7.2	7.9	10.4	13.7	9.1	10.5	10.2	10.8	10.8	11.5	11.3	6.5
	Price	3.5	4.5	4.4	3.7	3.9	4.2	3.9	3.1	2.2	3.1	2.9	2.8	2.7	3.1	3.3	3.3	3.3
Pakistan	Value	1.0	1.2	1.3	1.2		1.6	1.7	1.5	1.1	1.1	1.2	1.1	1.0	1.2	1.1	1.3	1.5
	Volume	0.4	0.5	0.6	0.6		0.5	0.6	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.5	0.6	0.7
	Price	2.2	2.4	2.2	2.0		3.1	2.8	2.7	2.4	2.2	2.1	1.9	1.7	2.2	2.3	2.1	2.1
China	Value			1.3	1.3	1.8	2.1	1.9	2.3	2.0	2.2	2.7	2.7	3.1	3.8	4.4	5.2	6.6
	Volume			0.4	0.5	0.5	0.6	0.5	0.7	0.6	0.6	0.7	0.8	1.1	1.3	1.4	1.7	2.2
	Price			3.2	2.9	3.4	3.8	3.8	3.6	3.5	3.5	3.8	3.4	2.9	3.0	3.1	3.1	3.0
Hong Kong, China	Value			1.9	1.9	2.3	2.8	3.1	3.2	2.9	2.6	3.0	3.1	3.2	3.6	3.9	3.5	3.6
	Volume			0.5	0.6	0.7	0.8	0.9	0.9	1.0	0.8	0.8	0.8	0.9	1.0	1.0	1.0	1.0
	Price			3.8	3.3	3.2	3.5	3.4	3.4	3.0	3.4	3.7	3.7	3.4	3.5	3.8	3.6	3.6

Region		1990	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06
United States	Value	1.3	1.3	1.2	1.0	1.2	1.5	1.7	1.9	1.9	1.9	2.1	1.7	1.7	1.9	2.1	2.1	2.5
	Volume	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.5	0.5	0.6	0.6	0.7	0.7
	Price	4.2	3.8	4.1	3.9	3.5	3.8	3.8	3.8	3.8	3.7	3.7	3.4	3.3	3.2	3.2	3.2	3.3
India	Value	0.4	0.5	0.6	0.7	1.1	1.3	1.8	2.0	1.4	1.6	2.0	1.6	1.8	1.9	1.9	2.3	
	Volume	0.1	0.2	0.2	0.3	0.4	0.4	0.6	0.7	0.4	0.7	0.9	0.7	0.9	0.8	0.8	0.9	
	Price	2.6	2.7	2.6	2.5	2.9	3.2	2.9	2.7	3.2	2.4	2.2	2.2	2.0	2.3	2.3	2.4	
South Korea	Value	0.9	1.0	1.0	0.9	1.1	1.3	1.5	1.8		1.4	1.6	1.3	1.4	1.6	1.6	1.5	1.4
	Volume	1.5	0.2	0.2	0.2	0.3	0.3	0.5	0.7		0.6	0.6	0.5	0.6	0.7	0.6	0.5	0.5
	Price	0.6	4.5	4.9	4.1	4.0	4.3	3.2	2.7		2.3	2.6	2.4	2.4	2.3	2.6	2.8	2.9
Value is in Billion US $, Volume in million tones and Price in $/kg																		
Source: Altaf, (2008); United Nations Comtrade Database																		

The above figures show that the India, Pakistan and South Korea are the low price suppliers of yarn. Except Hong Kong and South Korea, other countries have strong cotton production sectors which provide them competitive position to offer lower prices of yarns.

The characteristics and the overall status of the yarn sector are presented below.

Table 35: Characteristics and Status of the Yarn Sectors

Segment	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Cotton Supply	Strong	Supply of Cotton and Growth of Cotton Production
Manufactured Fibres Supply	Medium Strong	Presence of Manufactured Fibres in the Markets
Yarn Manufacturing Base	Strong	Number of Yarn Manufacturing Units, Expansion of the Industry in the Country, Introduction of Advance Manufacturing Technology, Growth of the Industry, Government Support, Low Cost Raw Material
Demand in National Markets	High	Growth of Fabric Industry, Yarn Rates
Demand in International Markets	Average to High	Design Versatility, High Competition, Low Use of Information Technology
Overall Yarn Sector	Strong	
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong		

III.2.5. Fabric Manufacturing

There are huge weaving and knitting sectors in the country both in the organised and unorganised set up. The unorganised sector is composed of small production units which lack development and proper structure. The manufacturing units are controlled and operated as a family or community business. The technology is local and the production is consumed in local market. Some of them work in the preparation process while others produce fabric and some others

perform marketing and other activities. Most of the units operate on conversion basis and charge for their services for performing some operation. In general, the sector functions in an extended network and different entities are strongly dependent on the performance of each other. The production and efficiency are low and the quality of the product is mostly inconsistent. The master workers transfer their skills to the next generations while the process of development is very slow for the development of higher skills, technology upgrading and entrepreneurship. On the other hand, the units which are shifted to the advance technology or the ones which adopted the new technology at their inception are at proper level of development. They are in the organised setup with higher production capacity and follow proper quality system. They have proper marketing functions which are linked to national and/or international markets and can better understand and fulfil the customer trends in these markets. Although, the linkage between the suppliers and international consumers is still at lower level of development, it is much higher than the unorganised sectors. That is why the areas of clothing and apparel are at low level of competitiveness in the international markets.

The organised sector exports most of its products to the international markets. If required, this sector hires the production capacity in the unorganised sectors in the situation of demand higher than their capacity. In these situations, they control the production and quality plans of the hired units. Thus with the help and support of organised sector, the informal sector also participates in the production activities intended for international markets. This helps them to adopt better practices and their transformation to the organised setup. In general, this transition is very slow in the country as it requires much capital and effort which are difficult to arrange for majority of such units. That is why; a huge unorganised sector still exists in the country. Meanwhile, there are also some benefits associated to the existence of this sector. For example, it creates labour for huge workforce who is uneducated and it can be difficult to provide work for them in other industrial activities of higher technology. The sector is more flexible in its production patterns and working environment and is efficient in creation of jobs at low wages. Further, it requires fewer resources to initiate economic activity and the industrial culture of these sectors is close to the social patterns of life in the society.

Some segments of this sector are focused in the product segments with cultural components of design and style. For example, some of the historical centres of textile design existed in the towns of Hala, Multan, Swat, Kamalia, Lahore, etc. and they are still the source of motivation in design and creativity. These can be considered as high value adding segments while the products are

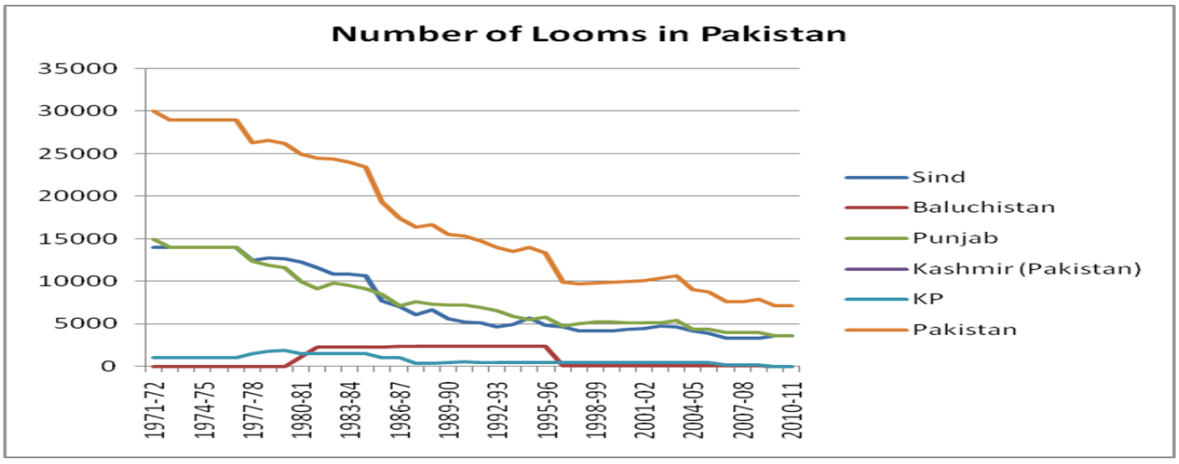
intended for specific customer segments. They have small setups and are specialised in producing for clothing and furnishing areas. Lack of technology and resources restrict them to the local markets. Very small portion of their products arrive in the international markets. This is the original potential of the regions inside the country on the design, which is yet not fully recognised but can provide the future driving force to the textile, clothing and furnishing sectors of the country. The fashion and design industry is trying to revive the cultural diversity in the design by developing design schools at these locations. These developments will be discussed in the later sections. This fact has support in the evaluation of the study programs, presented in section II.2.9.

In general, the existing structure of the fabric industry can produce for the traditional areas of clothing and furnishing sectors. Recently, the country is trying to introduce the non-traditional sectors of functional and technical textiles by establishing some research centres in these areas. The level of development in the industries where these products can be utilized, support such activity. The local industry can absorb the initial production before their acceptance in the international markets. These strategies will be discussed after studying the overall structure of the textile and clothing system, which will enable us to visualise the realization of these opportunities in more detail.

The secondary data available on the fabric industry is mostly focused on the formal and organised sectors in the country. Therefore, our discussion will be focused on these areas of the fabric industry.

The weaving industry has the production technology of shuttle and shuttle-less weaving including projectile, rapier, air jet and water jet machines. The shuttle weaving is old technology which still exists in the unorganised sectors of the industry. These machines are produced inside the country and provide low investment opportunity for establishing a fabric production unit. The sector is mainly concentrated at some locations including Faisalabad, Multan, Lahore, Gujranwala, Kamalia, Sialkot, Hala, Hyderabad and Karachi. The shuttle-less weaving technology was introduced in the country in early years of 1980s. It helped in improving the level of technology in the industry and to increase the production capacity of weaving units. Many units in the unorganised setup were upgraded and most of the newly established units were based on the advance technology. A huge decrease can be observed in the number of weaving machines in the yearly data presented below as a result of these developments.

Figure 31: Province-wise Number of Weaving Machines



Initially, there is a steady decrease in the number of weaving machines in the industry from year, 1977 to 1996 followed by a slight increase till year, 2004 and then again a slight decrease. The initial decline in the number of machines can be associated with two different factors including transfer of industry due to unfavourable conditions inside the country in 1970s and the shift to the advance technology in 1980s. The later decline is mostly because of the shift to the advance technology. The first factor brought negative effects on the industry and it was moved to other countries whereas the second factor has left positive effects by improving the level of technology.

This transformation also affected the other characteristics of the weaving industry including the size of the units, capital requirement, labour requirements and the overall structure of the industry. It has improved the skills on new technology. These developments are also improving the other industrial activities including the chemical industry related to textile and clothing, areas of information and communication technology, etc. The strength of these effects is high due to the higher participation in such activities and due to high economic dependence of the country on these areas. Further, these developments are improving the linkages of the industry to the international markets and as a result, closing the gaps of technology in many areas, associated to these sectors.

The main share of the fabric production comes from the weaving sector which is available for local and international markets. The investment required for a weaving unit is much higher in the organized sector with shuttle-less weaving technology whereas low capital is needed to install a power loom unit.

The development of the knitwear and hosiery industry was started in the decade of 1970s and it continued in the later periods. We will present the data on the expansion of the knitting industry inside the country in the later paragraphs. Here, we will continue with general characteristics of the industry. The knitting industry fulfils the local and international demands but most of the production is exported because the clothing trends in the country are more focused on the use of woven fabrics. The knitting industry is in the organized and unorganized setups. The organized sector has well developed structure and lot of composite knitting units exist in the industry. Their value chain is longer than the units in the unorganised sectors, including the production of fabric, dyeing, finishing and apparel making within intra-company setup. The unorganized sector is based on the less advance and cheaper technology which is produced inside the country or imported from China. Most of the units in the unorganised sector have single process stage in the value chain like fabric production or subsequent process of dyeing, finishing or apparel manufacturing.

The raw material requirement of the weaving and knitting industry is mostly fulfilled from the local yarn industry.

In the early years of the formal industry, fabrics of medium and low weight were produced because of the power loom technology utilised in those days. The power looms were capable of producing such fabric constructions. The new technology has increased the fabric style range. Now, the industry is not concentrated on the low weight and fine fabrics but it is producing the heavy fabrics; consequently the technologies of the processing and finishing of such fabrics are also adopted in the country. Since then, many segments are added into the fabric manufacturing base including heavy weight canvas fabrics and denim fabrics, for example. In last decades, the exports of the country in the heavy fabrics grew fast, which on the supply-side of the industry was supported with strong supplies of domestic cheap raw material. The demand of such fabric in the developed countries created a suitable environment for the growth of such sectors inside the country. When the industry started upgrading itself with new machinery and technology, the requirement for the skilled and educated labour was increased. Subsequently, the facilities for training and education in these areas also started emerging. The level of development of these areas can be rated low or medium because of low research component but naturally it will improve soon. At this stage, the country is moving towards knowledge and skill based industry with advance fabric manufacturing technology of shuttle-less looms (projectile, rapier, air-jet and water-jet) and skilled labour. The improvements in the process and operations are continued with

the introduction of the management systems and information technology, which will bring further improvements.

From another view, the weaving industry of the country can be divided into three levels: composite units, independent shuttles weaving units and the power loom sector or non-mill sector. Most of the composite units are vertically integrated. The vast non-mill or power loom sector produces around 90 per cent of the countries woven cloth (Altaf (2008)). The share of non-mill sector in the cloth production is higher but it started decreasing from the year 2002-03 and the mill sector has started growing its share. Although, the recent data is not available yet, but it can safely be stated these shares are changed because lot of investment was observed in the textile sector since 2002-03 period and level of technology is improved in the textile industry. There was already strong growth of around 5.6 per cent in the cloth production during the period from 1990 to 2005 due to the above developments in the industry.

The figures on the capacity of the weaving sector in the country are presented below.

Table 36: Installed and Working Capacities of the Weaving Sector

Year	Textile Units	Installed Capacity (000)	Working Capacity (000)	Capacity utilization %
1958-59	70	27	24	
1979-80	187	25	14	
Average 1958-79				0.85
1989-90	266	15	8	
Average 1980-90				0.53
1990-91	277	15	8	0.53
1991-92	307	14	8	0.53
1992-93	334	14	6	0.57
1993-94	471	14	6	0.43
1994-95	494	13	5	0.43
1995-96	503	10	5	0.38
1996-97	440	10	5	0.50
1997-98	442	10	4	0.50
1998-99	442	10	5	0.40
1999-00	443	10	4	0.50
2000-01	444	10	4	0.40
2001-02	450	10	5	0.40
2002-03	453	10	5	0.50
2003-04	456	10	4	0.50
2004-05	458	9	4	0.40
Source: Altaf, (2008); TCO				

The main trends include the decrease in the number of weaving machines in the country, which was discussed above. The figures related with the utilization of the available capacity are very low, which create our doubts in the authenticity of these figures. The data show a mere 40 to 50 per cent utilization of the available capacity which is much lower than the figures described by the industry personnel. The important aspect is that there is gap in capacity utilization which needs attention of various forces including industry and policy makers. The data presented below and more explanations in this direction can help to devise policies to improve the capacity utilization.

Table 37: Textile Manufacturing Industry in Various Districts of Pakistan

District	Spindles	Rotors	Air Jet Looms	Shuttle-less Looms	Other Looms	Employees
Kohat	144,610	1,000	46			3,620
Swabi	322,884	0	0			5,919
Total KP	519,838	1,000	46	0	0	10,930
Faisalabad	1326971	4008	724	374	148	29105
Kasur	1149405	1008	740	518	0	21580
Lahore	442960	4728	496	272	4	22388
Multan	443644	4880	732	180	0	11464
Muzaffargarh	471072	780	130	205	0	6173
Rawalpindi	188160	576	204	0	0	2505
Sheikhupura	669366	4000	240	794	0	11706
Total Punjab	6091050	30115	3622	2451	152	140623
Dadu	850563	17528	387	238	100	25919
Hyderabad	244932	0	0	0	0	5580
Karachi	458264	17348	463	1312	267	23074
Lasbelo	80216	5180	0	0	0	452
Sindh & Baluchistan	1655563	40056	850	1550	367	55375
Islamabad	59580	0	0	0	0	0
Total	8,326,031	71,171	4,518	4,001	519	206,928
Total Pakistan	10965000	160635				
Source: APTMA (Data available at www.aptma.org.pk)						

Table 38: Region-wise Textile Manufacturing Capacity (Part of Table 24)

PERIOD	Textile Units						Installed Spindles in "000"						Installed Rotors					Installed Looms					
	S	B	P	K	KP	Pak	S	B	P	K	KP	Pak	S	B	P	KP	Pak	S	B	P	K	KP	Pak
2010-11	116	9	316	6	17	464	2188	130	7841	94	712	10965	63892	13180	81538	2008	160635	3578	0	3592		0	7170
Source: TCO (Data available at www.aptma.org.pk) Abbreviations: S = Sindh, B = Baluchistan, P = Punjab (Pakistan), K = Kashmir (Pakistan), KP = Khaiber Pakhtunkha,																							

The above categorization will help to identify various needs and their availability at these locations and in providing the required inputs. We identified the districts with high potential to

discuss their structure and what requirements or inputs are needed there. Here, the high potential is meant to represent better capacity in one sector or growth of various sectors although with low potential in one single sector.

With high potential, there are two districts from KP; seven from Punjab; three from Sindh and one from Baluchistan. The districts of Lasbelo and Hyderabad can be placed at medium level but their proximity to Karachi and Kotri, the other major industrial sites improves their rating. On the whole, all seven districts of Punjab, Kohat from KP and Karachi and Dadu from Sindh have the highest potential in the textile manufacturing sectors of the country. It should be important to study the status of requirements which are needed at these locations including inputs of raw material and machinery or equipment, labour and the infrastructure. A general view of the development tells us that the Punjab and Sindh are developing better and more integrated infrastructure at locations of Faisalabad, Lahore, Multan, Sheikhupura, Karachi, Hyderabad and Dadu. The future activities of clothing, apparel, technical and functional textile will emerge here in the coming decade; the improvements are already started. The combined potential of Islamabad and Rawalpindi is also improving fast due to having the status of twin cities and Islamabad as being capital of the country.

It is important to remind that the above data is mainly focused to the organised sectors of the textile and clothing areas in the country and some of the unorganised sectors can bring more locations in picture. Also the above data do not cover fully the overall country; although it covers more than two-third of the overall figures in yarn and fabric manufacturing in the organised sectors.

The data on the cloth production and types; export quantities and export destinations is presented below.

Table 39: Fabric Production and Export (Million Square Meters)

Year	Production									Consumption			
	Gross	Mill Sector						Non-mill Sector		Domestic		Export	
		Quantity	Share as %	Cloth Types Produced				Production	Share as %	Quantity	Share as %	Quantity	Share as %
				Blended	Grey	Bleach	Dye/Printed						
1972-73	1191	589						603		673		518	
Average 1972-80			30.4	1.5	66.3	15.8	16.5		69.6		69.6		30.4
1980-81	1834	308						1526		1333		501	
Average 1980-90			13.5	14.7	55.1	11.2	18.9		86.5		66.8		33.2
1990-91	2854	293	10.3					2561	89.7	1797	63.0	1057	37.0
1991-92	3239	308	9.5					2931	90.5	2043	63.1	1196	36.9
1992-93	3360	325	9.7					3035	90.3	2232	66.4	1128	33.6
1993-94	3378	315	9.3					3063	90.7	2331	69.0	1047	31.0
1994-95	3101	322	10.4					2779	89.6	1940	62.6	1161	37.4
1995-96	3706	327	8.8					3379	91.2	2383	64.3	1323	35.7
Average 1990-95				19.3	54.2	5.1	21.4						
1996-97	3781	334	8.8	17.2	58.3	3.6	21.0	3448	91.2	2524	66.7	1257	33.3
1997-98	3914	340	8.7	16.6	60.6	3.8	19.0	3573	91.3	2642	67.5	1271	32.5
1998-99	4387	385	8.8	16.9	50.9	6.7	25.6	4002	91.2	3032	69.1	1355	30.9
1999-00	4987	437	8.8	13.9	60.3	2.5	23.3	4550	91.2	3412	68.4	1575	31.6
2000-01	5591	490	8.8	13.8	56.7	4.1	25.5	5101	91.2	3855	69.0	1736	31.0
2001-02	5826	568	9.8	13.6	55.8	3.2	27.4	5257	90.2	3868	66.4	1957	33.6
2002-03	5651	582	10.3	15.9	50.8	5.5	27.7	5068	89.7	3645	64.5	2005	35.5
2003-04	6833	683	10.0	14.9	48.6	6.4	30.1	6150	90.0	4420	64.7	2413	35.3
2004-05	6481	925	14.3	5.6	53.9	8.9	31.7	5556	85.7	3729	57.5	2752	42.5
Source: Altaf, (2008); TCO													

The data on the type of cloth produced in the mill sector is given in the following table.

Table 40: Quality-wise Share of Cloth Produced in the Organised Sector

Year	Cloth Quality and Share											
	Fine				Medium				Coarse			
	Grey	Bleach	Dyed/Printed	Gross	Grey	Bleach	Dyed/Printed	Gross	Grey	Bleach	Dyed/Printed	Gross
1997-98	36.5	1.8	4.0	42.3	10.8	2.1	13.1	26.0	27.3	0.6	3.8	31.7
1998-99	18.2	4.8	7.0	30.0	21.0	2.1	17.8	41.0	22.8	0.9	5.4	29.1
1999-00	17.4	0.6	2.0	19.9	33.1	2.5	20.8	56.4	18.3	0.3	5.0	23.7
2000-01	18.4	0.3	2.1	20.7	31.8	3.3	22.1	57.2	14.1	0.9	7.1	22.0
2001-02	22.5	0.2	1.9	24.6	27.1	3.0	24.3	54.4	14.6	0.7	5.7	21.0
2002-03	15.6	1.7	8.2	25.6	26.2	2.9	14.3	43.4	18.3	2.0	10.7	31.0
2003-04	15.9	1.2	9.8	27.8	23.5	3.1	14.5	41.1	17.8	2.3	11.0	31.2
Source: TCO Pakistan and Costistics												

In the categories of Fine and Coarse cloths, high share of cloth export was in the low value addition (mostly grey fabric) for the early years of the data. There is significant change in the later years to higher value addition (dyed and printed fabric), probably because of the fresh investment in these segments of the industry or better opportunities in the international markets. There was already better export share in the higher level of value addition in the product segments of medium weight fabrics. The development of the competitive apparel and clothing sectors will further improve the value addition in these areas in the coming years.

In the cloth production industry, the range of products is limited. Mostly standard products are produced to supply a wider market base thus keeping oneself at lower risk level. Most of the power loom sector is in sheeting and shuttle-less looms are producing shirting fabrics and twills (Altaf (2008)). The export destinations of the fabric produced are the main markets of the world as the following export figures identify. This can be considered as a confidence of the international markets in the fabric industry of the country. This will facilitate the expansion of the production and diversification of product range. There is a need to study the recent data to identify more recent situation in the export trends.

Table 41: Fabric Exports of Pakistan

Countries	2003-04	2004-05
United States	19.5	15.7
Turkey	6.9	7.7
Hong Kong, China	6.4	5.9
United Arab Emirates	3.7	5.2
Italy	4.9	5.0
Bangladesh	4.0	3.8
Spain	3.6	3.5
United Kingdom	4.8	3.6
Sri Lanka	2.5	2.9
China	3.1	2.8
Others	40.8	43.8
Source: Altaf, (2008); EPB		

In the following paragraphs we will discuss the characteristics of the Knitting industry in the country. Following facts are associated with the hosiery and knitwear industry in Pakistan, provide by the Association of Hosiery Manufacturers (PHMA).

The hosiery and knitwear industry of the country has around 3500 manufacturing units of all sizes including large, medium and small. The basis of such classification is not clear but it can be

added that the medium and large units can be placed in the organised sectors while others in the unorganised sector. Some portion of the small knitting units can also lie in the organised sector because of the low capital requirement compared to weaving sector. Overall, 85 per cent of the units are small; 10 per cent large and 5 per cent are rated as medium size units.

The industry is scattered around the country in the cities and towns which support the industrial activity. The data provided by PHMA on the location of this industry covers around 997 units, which are more than 35 per cent of the overall population. This should mainly composed of medium and large size units and part of the small unit category, which is in the organised sector. The sector provides employment to around 700000 skilled and unskilled labour and more than 300000 people earn from the associated cottage industries. A huge investment exists in the sector and the industry supplies large quantities of knitted fabric to the international markets. The share of the industry in the overall exports of the country stands at around 30 to 35 per cent. The main products include knitted fabrics, garments, bed sheets, socks, etc.

The summary on the location of the knitting industry in the country is presented below.

Table 42: Knitting and Hosiery Industry in Pakistan

District	Number of Factories
Karachi	419
Faisalabad	258
Sialkot	170
Lahore	150
Total	997
Source: PHMA (Data Available at www.phma.com)	

Most of the organised activity of the knitting industry is concentrated at five locations. These locations have better infrastructure and their input industry also support the industrial activities. Karachi alone has around half of the share in the organised sector and probably the share will surpass the half, if the figures of the unorganised sectors are added.

The main inputs for the weaving and knitting industry include raw material, labour, technology and design. Value addition can be achieved with the improvements of the design capability and the optimisation of the activities. These improvements will also enhance the competitiveness of the industry, which is evident from the developed textile and clothing industries of the Europe,

North America, etc. Some insight is provided on the structure and configuration of the textile and clothing supply chains of the advanced countries in the case study presented in Chapter 5.

Fatima and Ahmed (2005) stated that the status of the knitting sector in the country is at low maturity. They rated the potential of the sector poor, which we believe should be rated higher as the characteristics and growth of the factors identified. Therefore, this study suggests the following status of the weaving and knitting sectors of the country.

Table 43: Characteristics and Status of the Weaving and knitting Sectors

Segment	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Cotton Based Raw Material Supply	Strong	Supply of Cotton and Growth of Yarn Industry
Manufactured Fibres Based Raw Material Supply	Medium	Presence of Manufactured Fibres in the Markets
Fabric Manufacturing Base	Strong	Number of Fabric Manufacturing Units, Expansion of Industry in the Country, Introduction of Advance Manufacturing Technology, Growth of Industry
Demand in National Markets	Average	Low Development of the Demand Generating Factors
Demand in International Markets	Average	Low Design Versatility, High Competition, Low Use of Information Technology
Overall Fabric Sector	Medium Strong-to-Strong	
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong		

III.2.6. Dyeing, Printing and Finishing Sectors

There is no appropriate data available to study the characteristics of this sector. An initial view on this sector was developed and an attempt will be made to provide the insight developed from the discussion with the industry personnel. Some reflection on the status of the activities of this sector can be found in the data on other sectors. For example, the data presented on the fabric exports in the above section also presents some figures on this sector.

In past, domestics industry of dyeing, printing and finishing mostly fulfilled the local demand and grey fabric was exported to various countries for further processing. Therefore, the export was mainly in the grey and bleached fabrics refer to the production of the grey and bleached fabrics in the above section. In the periods of 1972 to 1980 and 1980 to 1990, the combined production of cloth in the categories of grey and bleached fabric was 82 and 66 per cent respectively whereas the share of dyed and/or printed cloth was 16.5 and 19 per cent. There was an improvement of around 2.5 per cent in the second period. More significant improvement is visible in the most

recent years where the share of dyed and printed cloth has reached at almost one-third of the total fabric produced in the country. It identifies improvement of value addition in these sectors.

The industry is passing through a modernization phase as discussed with various experts in and outside the country. It has improved its capability to cope with the changing needs of the international markets but the limited range of the products and blends have compelled it to focus on cotton products. Also, there is wide gap in the finishing industry of the country and the finishing industry of the advance countries. The research gap further widens the competitiveness of these industries on the global level where China and India and other regional competitors are doing well.

We will bring some more insight on these areas from our survey results which are being conducted in the international and domestic experts in the textile and clothing areas.

Table 44: Characteristics and Status of the Dyeing, Printing and Finishing Sectors

Segment	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Supply Side	Medium Strong	Bulk Supply of Fabric, Low Diversity in Design and Style, Supply of Other Inputs (Dyes, Chemicals) is Medium Strong, Low wage labour, Low Research
Dyeing/Printing and Finishing Industry	Strong	High Expansion of Industry in the Country, Low Number of Units with Advance Technology, Medium Growth of Industries,
Demand in National Markets	Average	Low Development of the Demand Generating Factors
Demand in International Markets	Average	Low Design Versatility, High Competition, Low Knowledge of Developed Markets Requirements on Quality, Design and Trends on Colour and Finishes, Low Use of Information Technology
Overall Dyeing, Printing and Finishing Sectors	Medium Strong-to-Strong	
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong		

III.2.7. Textile Made-up Sectors

The products which are produced under this sector include six categories namely, towels and cleaning cloths; bed wear and linens; blankets; curtains and furnishings; canvas products; and table linens. Major competitors in these area areas are China, Pakistan, India, Turkey and Portugal. The data on the share of these countries in the world exports is given in the following table.

Table 45: Export Figures of the Main Exporters in the Made-up Sector

Year	Exports in Billion US $										
	Total World	China		Pakistan		India		Turkey		Portugal	
		Amount	Share in %	Amount	Share in %	Amount	Share in %	Amount	Share in %	Amount	Share in %
2001	17.4	3.7	21.2	1.5	8.6	1.1	6.3	1.0	6.0	0.8	4.5
2002	19.1	4.4	22.9	1.8	9.2	1.3	6.6	1.2	6.5	0.8	4.1
2003	23.5	6.1	26.2	2.3	10.0	1.6	6.8	1.6	6.9	0.8	3.5
2004	26.4	7.7	29.3	2.3	8.9	1.8	6.8	1.8	7.0	0.8	3.2
2005	30.2	10.3	33.9	3.1	10.1	2.4	7.9	2.0	6.5	0.8	2.5
Source: Altaf, (2008); International Trade Statistics											

In these years, China, Pakistan and India have improved their share in these areas whereas the share of Turkey is stable and Portugal is losing its share in these areas. We believe that the strong supply side in China, Pakistan and India is the main force that helped them to improve their share in these market segments.

Towel industry in Pakistan is mostly in the organized sector consisting of around 325 units, out of which 250 are in the organized setup (Altaf (2008)). The technology in the unorganised sector is old and of low production whereas advance technology is adopted in the organised sectors. There are around 9000 terry machines in the country including 250 machines of advance technology. The figures on the advance terry machines are quite low and should not be recent. Probably, these are earlier than the years 2004-05 when the industry started upgrading its technology. Meanwhile, the export of the country in this area arose significantly in the last decade. The country has second highest share in the exports of towel and cleaning cloth after China which support the fact of the strong potential of the country in this area.

Table 46: World Towel and Cleaning Cloth Exports

Year	Exports in Million US $																
	Total World	China		Pakistan		Portugal		Turkey		Belgium		Germany		Brazil		Others	
		Amount	Share	Amount	Share	Amount	Share	Amount	Share	Amount	Share	Amount	Share	Amount	Share	Amount	Share
2002	3469	797	23.0	247	7.1	316	9.1	148	4.3	215	6.2	283	8.2	161	4.6	1302	37.5
2003	3752	865	23.1	321	8.6	302	8.0	172	4.6	217	5.8	278	7.4	168	4.5	1429	38.1
2004	5025	1900	37.8	305	6.1	284	5.7	251	5.0	238	4.7	260	5.2	181	3.6	1606	32.2
2005	4196	989	23.6	346	8.2	284	6.8	271	6.5	271	6.5	273	6.5	156	3.7	1606	38.3
2006	3838	913	23.8	375	9.8	265	6.9	251	6.5	251	6.5	213	5.5	156	4.1	1414	36.8
Source: Altaf, (2008); International Trade Statistics																	

Table 47: Towel and Cleaning Cloth Exports of Pakistan

Commodity	1999-00	2000-01	2004-05	2005-06
Cotton Gauze etc.				
Cotton Gauze Bleached	11.3	5.4	5.4	11.2
Towelling Cotton Bleached	30.1	4.1	4.1	30.4
Other Terry Towels Cotton	0.5	1.3	1.3	0.5
Other Linens of Cotton				
Towels Cotton Mill-Made	193.1	241.8	241.8	193.0
Towels Cotton Handloom	1.8	1.5	1.5	1.8
Toilet, Kitchen Linens Mill	12.0	12.1	12.1	12.0
Other Linens and Fibres				
Toilet, Kitchen Linens Flax	4.6	4.4	4.6	4.6
Cleaning Cloth				
Dish Cloth	10.2	11.0	11.0	10.0
Wash Cloth	65.2	82.4	82.4	65.2
Dusters	10.3	9.0	9.0	10.3
Bar Mops	40.2	39.1	39.0	40.2
Source: International Trade Statistics				

The sectors of towel and cleaning cloth are performing well against many competing countries and earning higher unit price with overall high export share. From the discussions with the industry personnel, the sector is trying to diversify the design and product characteristics. Meanwhile, it is investing in yarn dyeing machinery to improve the colour quality. To improve the aesthetics and the absorbance behaviour of the terry products it is improving the yarn characteristics like introduction of zero twist yarn etc. The process improvements are also initiated.

The expansion of the organized towel sector in the country was studied. It is summarised in the table below.

Table 48: Expansion of the Towel Industry in the Country

Location	Number of Units	Characteristics of the Industry in Different Regions of Pakistan
South Zone	158	The industry is mostly in the organized sectors and well established for domestic and international markets.
Karachi	158	
North Zone	27	The industry is mostly in the unorganized sector and is changing to the organized sector. Most of the unorganized sector is located in Faisalabad and Lahore.
Lahore	19	
Faisalabad	04	
Multan	03	
Gujranwala	01	
Total Units	185	
Data Source: TMA		

The towel industry is concentrated at low number of locations including Karachi which has more than 85 per cent of the terry units of the organised sector. Lahore follows with 10 per cent share of the organised units the rest of the units are located in Faisalabad, Multan and Gujranwala. The unorganized sector exists mainly in Faisalabad. In general, the industry is transforming itself into the organized sector more rapidly than the conventional power loom sector which still exists in a large size in the country.

The growth of the towel sector was exceptional which is clear from the export data of the country. The main factors behind the strong growth are the supply of short length fibres and the growth of the yarn manufacturing capacity in coarse yarns. The textile made-up sectors also grown because of their low dependence on design skills as the industry lacks in its design capabilities which confines it to standard products like terry, sheeting etc. The deficiency of skills on design and poor knowledge on the international fashion markets offer the main difficulty to enter into these areas.

The towel industries which are using advance technology and proper management systems and skilled labour are competing well at the international level. They participate in the international fairs to observe and present their design trends and they attract the demands from the international customers. They have better understanding on the requirements of international customers. Having expanded chains, they also offer complete services. They have better design skills and research functions, which work on the process and product development. The smaller units in the organized sector are doing well but they do not offer complete services. They produce terry towels and terry cloth in grey and sell to the other domestic and international customers. Towel in grey is mostly sold in local market where it is dyed and finished and then exported. The towel industries in the organised sector buy production capacities in the unorganised sector to meet the demands higher than their capacities. The unorganized towel sector in the country is at lower level of development in term of technology, skills, productivity and export potential. Meanwhile, the organised sector can be rated as medium strong in terms of the above factors.

The status for the organized towel sector of the country is given in the next table.

Table 49: Development Status of the Towel Sector

Terry Sector	Technology	Process	Product Quality	Design and Aesthetics	Marketing Functions
Organized	Advance	Well Organized	Very Good	Very Good	In big units it is well developed but in small units not so well developed and operates in low budget with occasional participation in international fairs.
Unorganized	Conventional	Low Organized	Good	Good	Poorly developed and has not participation in the international fairs. Mostly supply local demand or capacity is sold to big units
We focused on the organized sectors in order to identify the supply base for the international markets. The marketing and research areas of smaller units in the organized sector is weaker and need some kind of collective facilities at industrial sites, which can be easy to manage as most of the industry is located in some cities.					

The country has also performed well in the category of bed wear and linens. It has crossed the export figures of China in the bed wear area. The data on the exports of bed wear is given below.

Table 50: Bed Wear Exports

Million US Dollars

Years	1995		96		97		98		99		2000		01		02		03		04		05	
Country	Value	Share	Value	Share	Value	Share	Value	Share	Value	Share	Value	Share	Value	Share	Value	Share	Value	Share	Value	Share	Value	Share
China	658	23.9	597	21.2	708	23.4	603	19.1	696	21.3	786	21.8	819	21.8	825	20.3	988	19.9	1135	21.0	1847	27.1
Pakistan	376	13.7	469	16.6	487	16.1	567	18.0	681	20.9	745	20.7	831	22.2	1044	25.7	1380	27.8	1288	23.8	1926	28.2
Portugal	321	11.7	325	11.5	355	11.7	384	12.2	380	11.7	370	10.3	359	9.6	346	8.5	362	7.3	384	7.1	339	5.0
Turkey	117	4.2	131	4.6	174	5.7	210	6.7	214	6.6	233	6.5	251	6.7	289	7.1	409	8.2	499	9.2	549	8.1
U S	103	3.7	106	3.8	122	4.0	144	4.6	111	3.4	100	2.8	57	1.5	82	2.0	84	1.7	92	1.7	106	1.5
France	108	3.9	103	3.7	108	3.6	122	3.9	127	3.9	123	3.4	104	2.8	106	2.6	139	2.8	151	2.8	151	2.2
Mexico	85	3.1	115	4.1	121	4.0	133	4.2	77	2.4	69	1.9	52	1.4	62	1.5	54	1.1	63	1.2	72	1.1
Others	986	35.8	975	34.6	953	31.5	990	31.4	974	29.9	1175	32.6	1278	34.1	1309	32.2	1556	31.3	1790	33.1	1830	26.8
Total	2754		2821		3028		3153		3260		3600		3752		4062		4971		5401		6821	
Source: Altaf, (2008); International Trade Statistics																						

The data related to other product categories is not available here but the country has a well-developed sector for the production of canvas fabrics which is also strongly based on the supply of coarse yarns. Most of the canvas industry is in organized sector. The level of technology is low, which has supported the growth of the sector in the country.

Table 51: Characteristics and Status of the Textile Made-up Industry

Segment	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Supply Side	Strong	Bulk Supply of Heavy to Medium Weight Fabrics and Coarse to Fine Yarns, Supply of Other Inputs (Dyes, Chemicals) is Medium Strong, Low wage labour, Low Research,
Textile Made-up Industry	Strong	High Expansion of the Industry in the Country, Medium Number of Units with Advance Technology, High Growth of Number of Industries,
Demand in National Markets	Average High	Low Development of the Demand Generating Factors
Demand in International Markets	Average High	Low Design Versatility, Country is Competitive, Better Knowledge of Developed Markets Requirements on Quality, Design and Trends, Low Use of Information Technology
Overall Textile Made-up Industry	Strong	
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong		

III.2.8. Apparel and Clothing Sectors

It is well-recognised that the clothing and apparel are low capital intensive industries. Their technology is less complex, although the requirement of labour is high. These factors make these sectors ideal to start the process of industrialization in the less-developed countries. Many countries in Asia adopted such strategies including Pakistan, Bangladesh, Vietnam, Philippines, etc. They are successful in creating work opportunities for labour and initiating the process of industrialization. Now, they are at better level of industrial development and can supply the growing demands of global markets in clothing and associated areas. On the other hand, the developed countries are more dependent on advance technology in these areas and they have created more complex supply chains through technology advancement.

Many countries in Asia have increased their share in world clothing exports after the removal of quotas including China, India, Turkey and Bangladesh. Meanwhile, the exports of clothing and apparel sectors in Pakistan are stagnant. China and India have substantial potential in these sectors, which is supported by their diverse production and their potential to offer complete package. The suppliers in these countries have better knowledge on the trends in clothing and apparel around the world. The size of their industries is huge compared to other countries because of their large domestic markets. The world markets depend on their low cost supplies. The high end markets are more complex and their suppliers allocate higher resources and put more effort to fulfil the demands of their customers. These market segments are controlled by big brands and fashion chains, as discussed in Chapter I.

The data on the world apparel and clothing exports is given in the following table.

Table 52: World Clothing Exports

Year/ Country	World		China		India		Bangladesh		Pakistan	
	Billion US $	%	Billion US $	%	Billion US $	%	Billion US $	%	Billion US $	%
1996	162.6	100	25.0	15.4	4.2	2.6	2.2	1.4	1.9	1.2
1997	181.3	100	31.8	17.5	4.3	2.4	2.7	1.5	1.8	1.0
1998	180.8	100	30.0	16.6	4.8	2.6	3.8	2.1	1.8	1.0
1999	180.3	100	30.1	16.7	5.2	2.9	Not available	Not available	1.8	1.0
2000	193.9	100	36.1	18.6	6.2	3.2	4.2	2.1	2.1	1.1
2001	196.7	100	36.7	18.6	5.5	2.8	4.3	2.2	2.1	1.1
2002	190.8	100	41.3	21.6	6.0	3.2	3.9	2.1	2.2	1.2
2003	217.4	100	52.1	24.0	6.6	3.0	4.5	2.1	2.8	1.3
2004	233.8	100	61.9	26.5	6.6	2.8	4.4	1.9	3.0	1.3
Source: Altaf, (2008); International Trade Statistics										

Main potential of the clothing and apparel sectors of Pakistan are in the cotton products where the growth of the export is still low. The main causes for this low growth are the lack of skills in fashion and design and the lower level of knowledge on the requirements of international fashion. The sectors allocate very low resources on improving their education, skills and research on market trends. These facts have support in the study of the skill development and education programs in the country in these areas. The other factors which affect the linkages of these sectors to the international markets include the political instability and situation of law and order. These factors keep the international buyer away from the clothing and apparel producers of the country. Further, there is low institutional support for the entrepreneurship in the industrial activities.

The preferential status for some countries of the region including Bangladesh and Sri Lanka also affects the competitiveness of these sectors in the international markets. Low diversity of raw materials and less exposure to the world fashion markets collectively create constraint to supply to the high profit product segments. These factors identify the path, the industry was bound to follow in the post-scenario of quota elimination; the focus of the industry was diverted to home textiles, terry products, some areas of sports clothing and mostly standard products of cotton. The positive aspect is that the industry has not stopped growing and finding the directions which is encouraging in the above situation.

The developments on the political situation of the country are affected by the situation on its western borders. There are effects of the long isolation of the country from global technology and market trends and the fashion styles, etc. These are present on the clothing and apparel sectors of the country, especially the fashion segments. Under these affects, the clothing and apparel sector in the country tried to orient itself to the customer´s needs of the Middle-East markets; the evidence of this trend is visible in the export figures of the country. Thus the political scenario is actually diverting away the fashion and design segments towards new markets; whereas, the need is to diversify instead of diverting to specific markets. The rich cultural heritage can provide a strong base for new trends in fashion and design which is never focused in the strategic directions of the industry. Now, when the knowledge on the customers' needs in western-markets is poor, it will definitely take time and effort to cover this gap and to reorient the segments towards the dimensions of originality, versatility and diversification in terms of global demands. It will take time to expose the fashion society of Pakistan to global trends when the society itself feels offended to the western fashion.

The above factors are collectively responsible for the growth patterns of the industry which can be witnessed in the export data of the country´s fashion clothing and apparel sectors. It shows the higher dependence on the standard products of shirting, men´s clothing and clothing accessories. The export data in these areas is presented below.

Table 53: Clothing Exports of the World and Pakistan

Areas	2001	2002	2003	2004
World Exports (Million US $)	196.7	190.8	217.4	233.8
Men/boys Wear Woven	39.1	35.4	39.4	39.8
Women/girls Clothing Woven	42.2	39.5	44.2	47.1
Men/ boys Wear Knitted/Crocheted	10.0	9.5	10.9	11.6
Women/girls Wear Knitted/Crocheted	16.6	15.4	18.8	19.7
Articles of Clothing, NES	61.7	63.9	72.8	80.8
Clothing Accessories	12.4	12.7	14.3	16.1
Articles of Apparel and Clothing Accessories*	14.2	14.4	17.0	18.7
Exports from Pakistan (Million US $)	2.14	2.23	2.84	3.03
Men/boys Wear Woven	0.51	0.52	0.60	0.52
Women/girls Clothing Woven	0.14	0.17	0.21	0.19
Men/ boys Wear Knitted/Crocheted	0.54	0.51	0.70	0.75
Women/girls Wear Knitted/Crocheted	0.09	0.14	0.22	0.17
Articles of Clothing, NES	0.27	0.30	0.45	0.69
Clothing Accessories	0.18	0.27	0.27	0.28
Articles of Apparel and Clothing Accessories*	0.40	0.31	0.39	0.43

Areas	2001	2002	2003	2004
Exports of Pakistan as % of World				
Men/boys Wear Woven	1.32	1.48	1.52	1.30
Women/girls Clothing Woven	0.33	0.44	0.47	0.41
Men/ boys Wear Knitted/Crocheted	5.43	5.36	6.43	6.45
Women/girls Wear Knitted/Crocheted	0.54	0.93	1.14	0.86
Articles of Clothing, NES	0.44	0.47	0.61	0.85
Clothing Accessories	1.48	2.12	1.91	1.75
Articles of Apparel and Clothing Accessories*	2.79	2.14	2.33	2.28
Clothing Exports of Pakistan (% Distribution)				
Men/boys Wear Woven	24.1	23.5	21.1	17.1
Women/girls Clothing Woven	6.6	7.8	7.3	6.4
Men/ boys Wear Knitted/Crocheted	25.3	22.9	24.7	24.7
Women/girls Wear Knitted/Crocheted	4.2	6.4	7.6	5.6
Articles of Clothing, NES	12.6	13.6	15.7	22.7
Clothing Accessories	8.6	12.1	9.6	9.3
Articles of Apparel and Clothing Accessories*	18.6	13.8	13.9	14.1
Source: Altaf, (2008); International Trade Statistics NES= Not Elsewhere Specified *Other than textile fabrics; headgear of all materials				

The main export destination of the country for clothing and apparel are presented below.

Table 54: Main Export Markets for the Clothing Industry of Pakistan

Destination	Garments Export		Destination	Knit-wear Export	
	2003-04	2004-05		2003-04	2004-05
United States	33.8	34.6	United States	57.6	56.8
Germany	11.1	10.3	UK	10.7	9.4
UK	11.6	10.0	Germany	6.1	5.4
United Arab Emirates	6.7	9.5	Netherland	5.1	4.5
Saudi Arabia	5.2	5.5	Italy	3.1	4.1
France	5.1	4.7	France	2.7	2.9
Italy	4.4	4.5	Belgium	2.7	2.8
Spain	3.3	4.0	Spain	1.7	2.2
Netherland	5.2	3.8	United Arab Emirates	1.4	2.1
Belgium	3.3	3.3	Canada	2.4	2.0
Others	10.3	9.9	Others	6.4	7.9
Source: Altaf, (2008); EPB					

Historically, most of the clothing and apparel exports of the country were focused to limited number of markets including US, Germany and UK. The export of garments share is over 50 per cent for these markets. Whereas, the export share of knit-wear products is over 70 per cent to

these countries. The other export destinations include two destinations in Middle East, some countries in Central and South Europe. Almost 90 per cent of the export is concentrated to mostly ten countries. This export behaviour keeps the sector at risk whenever there will be some economic or similar problems in these markets, the export figures can be hurt. Although, working with low cost product profile will provide some protection to the industry on the cost of losing the higher profit markets. Expanding the export base needs lot of effort to improve the knowledge of the new markets and the clothing sectors and their marketing functions are not willing to provide this effort.

III.2.8.1. Characteristics of the Clothing and Apparel Sectors

According to the data figures in year 2000-01, the clothing sector consists of around 4500 industrial units (Altaf (2008)). Most of them are small in size; around 80 per cent can be rated as cottage industry. The number of sewing machines was 650000; of these 200000 are industrial machines and the rest are home-worker or domestic machines. In the period from 1972-73 to 2001-02, the production capacity of the clothing sector increased from 9.5 million pieces to 685 million pieces, which is a significant increase but most of the capacity is utilized to supply the local demand. The expansion of the formal sector is concentrated at some locations which support the requirement of labour and the other inputs for the industrial activity. The unorganised sector is dispersed around the country. The figures of labour employed in the industry is around 0.7 million.

For small and medium sized industries including clothing, it is hard to upgrade the technology and skills of workers for the changing needs of markets, especially when they have to import costly technology. The other issues include the high competition in the clothing sector and the market access to the main markets. The control of downward segments in these sectors by big brands and fashion chains further increase the difficulty of exporting to the main markets. These market forces have the potential to divert the production and manufacturing to locations of preference which can be difficult to overcome by the clothing sectors of countries like Pakistan, Bangladesh etc. due to their weak presence in the international marketing channels.

Let us have a look on the structure and characteristics of the apparel and clothing sectors of the country from the qualitative analysis of the data collected from the online resources of the Association of the Apparel Manufacturers and Exporters in Pakistan (PRGMEA). The objective

is to identify the potential of the clothing sector on the fashion products mainly, although it will also identify other areas which exist in these sectors.

We roughly assume that the 20 per cent of the population of clothing and apparel units in the country belong to the organised sector which creates a figure of around 900 units. This assumption is based on discussion with the industry experts. Further, some of these units should be at higher level of development and others at medium level of development. In general, we start from the assumption that the overall population of the organized sector is around 900 in the country. In the following paragraph, we will draw some insight on the product segmentation of the sector and we will also discuss its dispersion in the country. The study in the next section on the educational programs will provide support on the findings of this section.

The following summary is generated from the member directory of the PRGMEA which is presented in the appendix. The association is a representative body of the large population of the clothing units inside the country and we rely on their data.

The analysis is mainly on the qualitative characteristics of the clothing units and was performed on their names and location. We have tried to categorise the clothing units into various product segments from the symbolic components of their names. The categories are presented in the following table. The units are placed into specific group depending upon the components of their names. Then the quantitative summaries are developed to provide a general insight on the segmentation of the industries. We acknowledge that our data is weak and the analysis is also not very strong but it provides a basis for the development status of the industry which is supported from multi-dimensions. Further, this will provide basis for the future research of the subject area. This analysis represents one of the dimensions in the overall strategy to reflect upon these areas while the other dimensions included the support from input industries and the study of the export structure.

Table 55: Analysis Summary on Product Segments of Apparel, Clothing and Textile Made-ups

Location of the Industry							
District		Karachi	Lahore	Sialkot	Hyderabad	Total	Share in %
Total Units		260	116	168	02	5441	100
District Share in %		47.79	21.32	30.88	0.003		
Product Segments	Comments	Karachi	Lahore	Sialkot	Hyderabad	Total	Share
Fashion, Conceptual	We assume these units to be associated with fashion segments of clothing which are intended for domestic as well as international demand	22	19	01		42	7.72
Apparel, Garments	We assume these units having main component of standard garments and clothing, manufacturing produced for domestic and export demands	58	29	01	01	89	16.36
Home Textile, Safety Clothing, Terry	We assume these units with main component of trading in the segments of clothing and garments	06	02	02		10	1.84
Merchandising, Trading, Export, Sourcing, Buying,		23	19	14		56	10.2
Textile Manufacturing	We assume these units as capital intensive having some kind of manufacturing capacity and some of them may have clothing and garments components as strong complementary and others may just supplement their activities through garment and clothing	71	22	00		93	17.09
Generic Names and Components		69	22	72		163	29.96
Sportswear			03	78	01	82	15.07
Note: 1. Figures are based on the data collected from the online resources of PRGMEA. 3. The data for Faisalabad was not available, which has a strong textile manufacturing base.							

The above summary identify that the fashion segments are poorly represented in the industry with only 8 per cent of the 544 units of the organised sector belong to this product segments. This fact has some support in the study on the educational programs, which is discussed in the next section. There is low number of programs in the fashion and design areas although some increase is being observed more recently. The export structure has already confirmed such facts. There is a strong export potential in these areas for the country, based on the already existing potential of the textile manufacturing. This potential was never felt but some developments are now visible in the strategic trends of the industry and the outcome is due in the near future. The other areas which can support such activities at small scale include the growth of information technology and the development of skills in management and marketing which are also improving as the study in the next section has found.

The other poorly represented category is the Home Textile, Safety Clothing and Terry Fabric. The industry of safety clothing is not developed at large scale in the country; only fragmented industrial units are working in this area without proper direction. The figures represent a true picture of the growth of this area in the country. On the other hand, home textiles and terry industries are well developed and are recognized in the international markets as their export figures reflect. The terry sectors is better represented in our data analysis on the terry segments in the above section whereas the area of home textile is difficult to separate from the other product segments, at least in this qualitative analysis and on the basis of data which was available to us. In the above sections, the export structure identified that the products of the home textile sectors are also well placed in the international markets; this supports us to add that the home textile industry is also well developed in the country. We believe that their share is shifted in the categories of Textile Manufacturing and Generic Names which collectively occupy 47 per cent share in the above summary.

The product category of Standard Apparel and Garments and the activities of Trading etc. have better shares in industry which stood at 16% and 10% respectively. Again some portion from the categories in Generic and Textile Manufacturing can affect their share to increase. Especially, the share of Standard Apparel and Garment Manufacturing can increase significantly.

The interesting results are on the sportswear, the industrial activity which is mainly concentrated at a couple of locations in Karachi and Sialkot. The main reason behind such a concentration of the sectors at some location can be considered as the development of the sport equipment industry at these sites which may have provided some motivation for the industry of sports clothing at these locations. The other factors should include the low capital requirements and the industrial environment of these locations. It offers good example for the development of small scale industrial activity for other districts also from a low capital investment.

It is important to mention that the above data is not complete and most probably some regions are not covered well as the data is obtained from the member directory of PRGMEA, an association of garments and exporters. The membership for such associations is not mandatory. However, industries are normally obliged to become a member of such association which bring participation in the policy development on various issues at regional and country level. Normally, these associations have good representation of their sectors. The number of industrial units covered by the association’s member directory is large more than 50 per cent if we consider our

initial estimate of the size of formal sector being 900. It improves the confidence in the summary results. The findings are triangulated from various sources of data to improve their authenticity. The analysis provides insight on the general structure of product segments in the clothing and apparel industry in particular and their location in the country.

The structure and growth of individual segments can be studied in more detail according to the needs of specific research themes which are exposed in our research at various levels of this project. We are exploring the textile and clothing system for the answers of the research questions which are presented in our project; on parallel the research is also developing the overall research landscape of the textile and clothing system of Pakistan. It was not developed till now to provide a theoretical basis for such research. The characteristics of the regions are presented below on their textile and clothing potential.

Table 56: Characteristics of the Regions with Clothing and Apparel Sectors

Districts	Units	Product Segments	Strengths	Weaknesses	Opportunities
Karachi	260	Casual, Fashion, Executive, Wedding, Sports, etc.	Diverse manufacturing activity, large local demand, mature infrastructure for export potential, well organized sector, availability of high skills in fashion and clothing, higher use of ICT, availability of inputs for multiple types of products	Situation of Law and Order,	Population Size, Higher, Responsiveness can be achieved because of high quality of logistic linkage to inside country and rest of the world,
Lahore	116	Casual, Fashion, Executive, Wedding, Sports, etc.	Diverse manufacturing activity, large local demand, mature infrastructure for export potential, well organized sector, availability of high skills in fashion and clothing, higher use of ICT, availability of inputs	Lower responsiveness for international markets as compared to Karachi	Population Size,
Sialkot	168	Sports and Casual	Manufacturing activity is specialized in certain areas, availability of inputs, mature infrastructure for export potential	Lower responsiveness for international markets as compared to Karachi	Population Size,
Faisalabad	N/A	Casual, Executive, Sports, etc.	Manufacturing activity is specialized in certain areas, availability of inputs, mature infrastructure for export potential	Lower responsiveness for international markets as compared to Karachi	Population Size,
Hyderabad	02	Sports and	Availability of inputs, mature infrastructure for export potential		Population Size, Responsiveness can be achieved because of high quality of logistic linkage to inside country and Karachi port

Most of the clothing and apparel industries are concentrated at Karachi, Lahore, Sialkot and Faisalabad. These cities are active in the overall industrial activity, specifically in textile and

clothing and provide good overall environment for the clothing industry. It can be added that the data of Faisalabad is not available, which has in general a strong base in textile manufacturing.

The clothing and fashion industry of the country can be safely forecasted to raise a lot in the international markets in near future as many required capabilities are available and others are on their way of development. The need to initiate the trade agreements with neighbouring countries is yet missing in this picture which will also provide a boost to these industries.

The pace of expansion of clothing and fashion industry in the country can be increased by providing capital resources for the new entrepreneurs and providing the platform to the industry, which can improve the knowledge on the international fashion trends. The industry should organise fashion shows in addition to international fairs and exhibitions in these areas. The structure of the domestic garment industry, which is based on the tailor-master system of customized garments, is difficult to modify but providing a participation in the garment industry programs can convince them for a change in the structure of these segments also.

Important factors to improve the competitiveness of the apparel and clothing sectors were also identified by Altaf (2008). The evaluation was performed on the survey data collected from the leading garment manufacturers of the country and from the International Textile Manufacturers Federation (ITMF). Expanding the inputs base on such factors can bring more insight and authenticity to the results. We have extended the input base of experts on these issues, which will be presented in the later sections. Collectively, they will strengthen and improve the findings.

Table 57: Cross-country Evaluation for the Apparel Sectors

Important Aspects	Pakistan	India	China	Bangladesh	Sri Lanka
	Apparel Marketing Channels				
Respect for Contracts	1-2	4	4-5	3	4
Business Culture	2	3	4	3	4
Institutional Support	1-2	2-3	4	2	3
Strategic Alliances					
Joint Ventures	-	+	+	+	+
Technical Support	+	+	+	+	+
Expatriate Management	-	+	+	+	+
Value for Money					
Best Practice Mills	5	5	4	4	4-5
Average Mills	1-2	2-3	3	2-3	3
Labour Productivity					
Best Practice Mills	4	4	4	3-4	4-5

Important Aspects	Pakistan	India	China	Bangladesh	Sri Lanka
Average Mills	1-2	2	2-3	1	3
Labour Cost $/hour	0.55	0.60	0.65	0.45	0.52
	Apparel Human Resource				
Industry weaknesses					
Operator Skills	1-2	1-22	3	1	4
Market Management and Shop Floor	1-2	2-3	3-4	2	4
Management Organization	1-2	3	4	2-3	4
Education Training					
Primary	1-2	3	1-2	1	2
Secondary	1-2	3	1-2	1-2	3
Operator/vocational	1-2	2-3	2	1	2-3
Market Management and Shop Floor	1-2	2-3	2-3	1	3
University/College	-	+	+	+	+
	Apparel Bureaucracy and Infrastructure				
Bureaucracy: Perceived Performance					
Central Boards of Revenue	1-2	1	3	1-2	3
Export Promotion Bureaus	1-2	1	3	1-2	3
Customs	1-2	1-2	3	1	3
Banks	1-2	2	3	1	3
Infrastructure					
Road Paved as % of overall	54%	46%	N A	10%	95%
Railway	2-3	2-3	3	2	N A
Ports	2	2	3-4	1-2	3
Telecommunications	3	3	3-4	2	4
Source: Interviews with Leading Garment manufacturers; International Textile Manufacturers Federation (ITMF)					
Legend: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Very Good, - = Generally Negative, + = Generally Positive, N A = Not Available					

The level of development of the clothing and apparel sectors is presented below.

Table 58: Characteristics and Status of the Clothing and Apparel Sectors

Segment	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Supply Side	Very Strong	Bulk Supply of Cotton Fabrics, Medium Strong Supply of Other Inputs (Button, Zippers, etc.) and Higher Dependence on Imports, Low wage labour, Low Research, Low Design Versatility, Low Skills in Fashion and Designs
Clothing and Apparel Industry	Weak	High Expansion in the Unorganised Structure, Low Number of Units with Advance Technology, Weak Linkages with International Markets, Low Branding,
Demand in National Markets	Average	Low Development of the Demand Generating Factors
Demand in International Markets	Average to High	Low Design Versatility, Industry is Low Competitive, Low Knowledge of Developed Markets Requirements on Quality, Design and Trends, Low Use of Information Technology
Overall Clothing and Apparel Sectors	Weak-to-Medium Strong	
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong		

In the following sections, we will continue developing our insight on the other important areas which can improve the SC system.

III.2.9. Study Programs in Textile, Clothing and Related Areas

In order to develop a fresh insight on the skill development in textile, clothing and related areas, we have collected and analysed the study programs. We consulted various resources including people from academia and the internet resources to identify the study programs offered in the country under technology, engineering, and science and design fields. A summary is generated, which is presented below.

Table 59: Study Programs in Textile and Related Areas

District	Engineering			Science			Fashion and Design			Business		
	Bachelor	Masters	PhD	Bachelor	Masters	PhD	Bachelor	Masters	PhD	Bachelor	Masters	PhD
Karachi	1 (Comb.); 1(T); 1(P&P); 1(Chemical)	1 (Comb.); 1(EM)	By Research Work	1(T&D); 1(T); 1(TF); 1(TP); 1(T); 1(T); 1(TP Component); 1(FMM)	1(TP Component); 1(DMM)	By Research Work	1(TD); 1(TD); 1(FD); 1(TD); 1(FD); 1(TD); 1(FD)	1PGD(TD); 1PGD(AD); 1PGD(F); 1PGD(FD)	By Research Work	1(TMM); 1(AM); 1(FDM); 1(T)	1(T)	By Research Work
	05	02		08	02		07	04		04	01	
Jamshoro	1(Comb.)	1(Comb.)	By Research Work			By Research Work	1(TD); 1(TD)	1(TD)				By Research Work
	01	01					02	01				
Hala				1(TD)								
				01								
Sindh	06	03		09	02		09	05		04	01	
Faisalabad	1(TY); 1(TF); 1(TG); 1(T Pol.); 1(TP); 1(T)	1(T)	1(T) By Course Work	1(T)	1(F&T)	By Research Work	1(TD); 1(TD); 1(FD); 1(FD); 1(TD)			1(TMM); 1(TM); 1(AM)	1(T)	
	06	01	01	01	01		05			03	01	
Lahore			By Research Work	1(FMM); 1(FD); 1(TD); 1(TY); 1(TF); 1(TP); 1(A); 1(TT); 1(TTM)	1(TP); 1(TY); 1(TF); 1(TP); 1(A); 1(TM)	1(T) By Research Work	1(TD); 1(TD); 1(FD); 1(FD); 1(TD); 1(FD); 1(TD); 1(FD)	1(TD); 1(FD); 1(TD); 1(TD); 1(FD)	By Research Work			By Research Work
				09	06	01	08	05				

District	Engineering			Science			Fashion and Design			Business		
	Bachelor	Masters	PhD	Bachelor	Masters	PhD	Bachelor	Masters	PhD	Bachelor	Masters	PhD
Gujranwala				1 (TCM)								
				01								
Multan	1			1 (TD)								
	1			1								
Bahawalpur							1					
							1					
Sargodha							1					
							1					
Gujrat							1					
							01					
Punjab	07	01		12	07	01	16	05		03		
Islamabad			By Research Work	1 (FD)			1(FD); 1(TD)		By Research Work			By Research Work
				01			02					
Peshawar			By Research Work	1 (TD)		By Research Work	1(TD); 1(FD)	1				By Research Work
				01			02	01				
Quetta	1											
	01											
Pakistan	14	04	01(By Course Work)	23	09		29	11		07	01	

Abbreviations: Comb. = Areas of Yarn, Fabric and Processing are combined; T = Textile; P&P = Polymer and Processing; EM = Engineering Management; T&D = Textile and Design; TF = Textile Fabric; TP = Textile Processing; FMM = Fashion Marketing and Merchandizing; DMM = Design Marketing and Merchandizing; TD = Textile Design; FD = Fashion Design; PGD = Post Graduate Diploma; TMM = Textile Management and Marketing; AM = Apparel Management; FDM = Fashion Design Management; TY = Textile Yarns; TG = Textile Garments; T Pol. = Textile Polymers; F&T = Fibre and Textile; TM = Textile Marketing; TT = Technical Textile; TTM = Textile Technology and Management; TCM = Textile Clothing Management;

Note: It should be noted that the study programs in business area which are identified here, claim the direct relevance of the studies with the textile and related areas, although their claims are not verified here. In general, the study programs in business and management areas are rated good. These are available in the main cities of Karachi, Lahore, Islamabad, Faisalabad, Jamshoro, Sukkar, Quetta.

In the engineering field, fourteen programs were identified at undergraduate level while five programs were identified at postgraduate level. A couple of decades ago, there were only four to five undergraduate program in textile engineering, which identify some improvement. There are further thirty two programs for undergraduate and graduate studies in the textile and clothing science area. In this segment, the courses cover textile sciences and design components. Some of the programs are already recognised on their quality while the new programs need time to prove

their effectiveness. The old courses had low contents on advance technology; these are revised to introduce relevant contents and new technology inputs. The diversification of the study areas and the content improvement of courses are just initiated through the introduction of courses on fashion, design, technical textiles, and by the revision of course content. The effects and later iterations of the continuous improvement are due in future.

Various levels of studies now exist including certificate courses, graduate, masters and doctoral studies. The certificate and diploma courses are not covered well here but there exist many diploma and short courses especially in cities and towns including Karachi, Lahore, Faisalabad, Multan, Sialkot, Gujranwala, Hyderabad, etc. These courses fulfil the needs of continuous upgrading of the specific skills in addition to the development of basic skills. The regular programs offer higher skill development.

This summary on study programs is more recent and identifies some improvement on skill development in many areas. There is still a shortage of qualified workforce in the textile, clothing and related areas. Considering that many study programs were started in near past (in the last decade), the effects in the industry will be realized in coming years. We anticipate that the results of master level courses will bring better results in the intended directions. When the graduates of fashion and design areas will establish their effective career in the fashion industry, a lot of improvement is also expected in these sectors. The research components are still weak in these programs which can further improve many aspects of the industry. From the experience of the developed countries, it can be said that it takes lot of effort and resources to improve the quality and advancement of the textile and clothing sectors which are not allocated and/or utilized efficiently in developing countries.

The region-wise summary is presented below.

Table 60: Summary on Study Programs in Textile and Clothing

District	Engineering			Science			Fashion and Design		
	Bachelor	Masters	PhD	Bachelor	Masters	PhD	Bachelor	Masters	PhD
Karachi	05	02		08	02		07	04	
Jamshoro	01	01					02	01	
Hala				01					
Total Sindh	06	03		09	02		09	05	
Faisalabad	06	01	01	01	01		05		
Lahore				09	06	01	08	05	

District	Engineering			Science			Fashion and Design		
	Bachelor	Masters	PhD	Bachelor	Masters	PhD	Bachelor	Masters	PhD
Gujranwala				01					
Multan	01			01					
Bahawalpur							01		
Sargodha							01		
Gujrat							01		
Total Punjab	07	01		12	07	01	16	05	
Islamabad				01			02		
Peshawar				01			02	01	
Quetta	01								
Overall Total	14	04	01	23	09		29	11	

In general, following development status can be associated with the skill development in the textile, clothing and related areas.

Table 61: Development Status of Study Programs in Textile, Clothing and Related Areas

Engineering & Technology	Science	Design	Management & Business
Weak	Medium Strong	Weak-to-Medium Strong	Medium Strong (Weak Contents on the Textile and Clothing Areas)
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong			

III.2.10. Logistics

There is not enough literature on the logistic infrastructure of the country; we found only a few studies including one by Yusuf (accessed online in October, 2009). He has identified the following facts on the logistics facilities in the country.

The movement of freight is mainly performed with the trucking on the roads. These trucks are of low capacity and low power. The transportation costs are the lowest in the world but the service level is also very low. The average speed of trucks on road is 28 to 40 km per hour compared to 80 to 90 km per hour in Europe. The overloading is usual which adds to decrease the commercial running speeds of the trucks and increase the road deterioration pace. The rail accounts for less than 5 per cent of the freight traffic in the country, it does not offer quality service like on time delivery and package safety. The handling of ship-to-shore conditions have improved on the ports but the entry and handling charges are 5 to 9 times higher than other neighbouring ports in the region. The overall logistic infrastructure need improvement as it was developed long ago when the requirements and size of the industry were very different. Also the technology of logistics sources should be upgraded. The increase in the industrial and economic activity and growth of

population and the influx of millions of migrants from India, Afghanistan, Iran and other neighbouring countries have created a huge demand gap.

In general, a detailed study is required to address the gaps of research in the logistic areas in the country. Some improvements in the logistics infrastructure are being observed due to expansion of the logistic activity and participation from the private sectors in these areas which will bring positive effects in near future. There is a need to analyse industry specific requirements of logistics and to develop such services. We will present some findings on the structure of the lead time in textile and the requirement of some segments in these directions in Chapter V.

Following status can be related to the logistics facilities in the country.

Table 62: Level of Development for the Logistics Facilities in the Country

Storage Facilities	Rail Transportation	Road Transportation	Air Transport	Port and Sea Transportation	Communication Facilities
Weak	Weak	Weak-to-Medium Strong	Weak	Medium Strong	Strong
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong					

Communication facilities are improved due to high FDI in this sector in past. Road and Ports facilities are also at better level of development. The worse areas in term of development are rail transportation and storage facilities. They require huge resources which are not available inside the country and no interest is yet shown to attract foreign investment in these areas by the policy makers. The transportation by air is also at low development and no specific interest is visible in improving this area too. Without providing better logistics infrastructure, it will be difficult to maintain and gain competitiveness in the existing and new markets for the textile, clothing and many other industries which are highly dependent on them. These participate in improving the responsiveness of the producers to react on their customer demands.

III.3. Results and Discussion

In this chapter, we developed the overall insight on the textile and clothing SC system of Pakistan. The summary of the findings is presented and discussed below.

The main cotton producing base is in the centre of the country, i.e. north-east of Sindh and South-east of Punjab. This area in general is very strong in the agricultural activities.

Table 63: Districts with High Cotton Potential (Extracted from Table 15)

Districts	Cotton Production in 2009-10 (Bales)	Cotton Production in 2010-11(Bales)	Rank	Average Share in Cotton Production of 2000-01 to 2010-2011	Number of Ginning Factories in Formal Sector
Rahim Yar Khan	1277391	1069302	2	11.7	66
Bahawalpur	898882	896445	4	10.5	63
Sanghar	1877582	1599526	1	8.4	48
Bahawal Nagar	1074069	1024052	3	8.2	24
Overall				38.8	201
Vehari	825489	781080	5	6.7	54
Khanewal	700524	757520	6	5.3	29
Overall				50.8	284 (out of 596)

It should be important to study the status of inputs for cotton farming and ginning in these districts to start the process of improvements on logistics facilities, storage conditions, energy requirements and skills. These regions need proper training and research centres on cotton and ginning to improve and document their methods which can be applied in other regions too. It is important to develop the downstream sectors here to bring value addition close to the origins of resources.

Cotton farming has improved in recent years and also the cotton yield per hectare. The input costs are high in the scenario of high risks associated with the cotton farming, which affects the farmer's interests in cotton production. The quality of hand picked cotton is low which increases the process load in the subsequent operations. The markets are unstable with a lot of uncertainty and speculations which develops uncontrolled trading in the domestic markets. The ginning industry is vast but lacks advance technology and training. It also gives less importance to improve the quality of cotton. The cotton markets are less open to the international markets and there is low competitive behaviour in terms of quality.

The cotton production behaviour of the country in the last decade was discussed in section III.2.1. It was clearly observed that there was a rise in the overall production of cotton in the country from year 2000 to 2005, then there is some decrease in the production quantities and the total production was fluctuating a bit in last five years. In the long term, the increasing trend continues. Major increase was observed in the production quantities of both Sindh and Punjab in year 2004-05 and then mainly in Sindh in years 2009 to 2011. The share of Sindh region in the overall production has reached around two-third which was around 21 per cent in year 2000-01 (see

Table 11 and Table 12). This is an important rise especially when this was achieved with the improvement of the yield per hectare.

The manufactured fibre industry is developed mainly to supply the local demand and it has expanded fast in last two decades. The products and costs are less competitive due to their absence from the international markets. We did not find proper data to comment in detail on these sectors which require further study.

The yarn sectors are also dispersed mainly in two regions, Sindh and Punjab. These are well developed and have advance technology and lot of incentives from government. The yarn sectors have grown a lot in last decades because of strong cotton supplies and because of growth in neighbouring regions in fabric and clothing sectors. The major growth of yarn industry was observed in Punjab region due to higher cotton supplies and similar trend is due for Sindh region where cotton production has doubled in the last decade. The coarse and medium fine yarns are the main potentials of the sectors which support the huge textile made-up sectors of the country. There is some growth on the fine yarns due to increasing demand in the local industry on fine fabrics, which has increased the import of fine cotton fibres. There is a need to increase the value addition by adopting better marketing practices, developing high value customer segments and by improving the diversification of the product range of yarn sectors. Both, Pakistan and India are among the lowest price suppliers in the world in cotton yarn and there is need to increase the real profitability of these sectors.

The formal industrial activity of fabric manufacturing in the country is mainly composed of two sectors, weaving and knitting. The expansion of the fabric industry is wider than the yarn industry where the formal and informal sectors can be found in most of the regions of the country. The formal sectors produce for the export markets and the production of informal sectors is mainly consumed in local markets. Although, the formal sector sometimes utilise the capacity of informal sectors to produce for export markets. The formal sector is clustered at less number of locations; mainly in Sindh and Punjab. The expansion of the informal sectors is wider. The informal sectors help to provide employment to huge uneducated labour, which otherwise should be difficult to be employed in other industrial sectors with higher technological developments. The technology of the formal sectors has improved a lot in the last decades by moving towards the shuttles technology and the introduction of advance preparation technology and production systems. The automation of the processes is also improved which have improved the capacity of

the individual units. The product diversification is higher in informal sectors due to the input of cultural design aspects whereas, the product diversification is limited in the formal sectors of the industry. The formal sectors of both yarn and fabric industries have improved the skills of the labour on the advance technology and have also advanced the technology in the related areas.

The knitting sector has huge potential to supply the international markets, which is looking for the improvement of skills on design and production systems and the development of logistics and market channels to enter into the high profit markets of fashion clothing. The weaving and knitting sectors are the strong support of the textile made-up sectors which are competing well in the international markets.

The technology of dyeing, printing and finishing has improved in the last decade and many industries have imported advance technology to prepare them for producing for the international export markets. The research environment is improving in the dyeing and printing areas although it is poor in the finishing areas. We did not find proper data to comment in detail on these sectors which require further study.

The sectors of textile made-ups are working better in the global markets due to their low dependence on the design aspects. The strong textile manufacturing sectors support the competitive position of these sectors in the global markets. The towel sector is placed at second position in terms of global exports after China. It is improving fast in terms of production technology, product diversification and its linkage with the international markets. The country is placed at top in terms of global exports in the areas of bed wear and performing well against its competitors. The data was not available on the other sectors in the category of textile made-ups but it was identified in the discussions with the industry experts that the canvas sector is also well developed in the country. The status of the remaining sectors is not clear well, which needs further study.

The sectors of clothing and apparel are mostly producing standard products for the low profit markets due to their inability to compete in the markets of fashion clothing. Most of the sector is exporting on the strategy of low price. Slight change in the production behaviour is being observed by the SC experts as some local brands in fashion clothing are emerging which will bring further evolutions in the clothing and apparel sectors. It is too early to provide insight on future behaviour of the sectors or growth in these areas. Keeping in view the growth of the textile

manufacturing sectors in the country, there can be strong change in the export patterns of the country if required strengths are developed. The areas of research and marketing are still weak in clothing and apparel, which can increase the pace of this evolution. Advance production technologies and presence of international brands in the country will enhance this phenomenon. The political developments and the situation of law and order are keeping away the international buyers. It will take time to regain the confidence of international customers if the identified areas are improved. There are also the needs to develop the market access strategies and to develop regional trade agreements to improve the competitive position of the country. The summary analysis on the data collected on apparel, clothing and textile made-up sectors is presented at Table 55.

Fashion segments are poorly represented in the clothing sectors. The summary identifies low activity in home textile, terry and safety clothing which is not clear well. The sectors of bed wear and terry are well developed but the safety clothing sector is not well developed. Therefore, the figures in these areas need more clarification. We believe their share is added in the category of generic sectors, which has a large proportion in the above summary. The product categories of standard garments and sportswear have better share in the industrial activity; this fact has support also in the export data of the country. The trading activity also has higher share but the strengths of this sector cannot be identified in this analysis. This analysis needs proper inputs to produce better insight on these sectors.

Improvement was observed in the number of courses on the textile and clothing. The fields of engineering and technology are still at low development. Design fields are improved recently and the results will be observed in near future, especially in the clothing markets. The facilities of logistics are at low level of development and are the main constraint for the growth of regional trade in textile and clothing and the improvement on the responsiveness dimension. The status of educational programs and logistics were presented at Table 61 and Table 62.

There is a need to bring more insight on the areas of logistics and educational programs and to study the production systems, marketing strategies and the research environment in the country. There is also a need to identify the main factors which can improve the demand generation of the SC system in the high profit markets.

The broader insight on the textile and clothing SC system of the country is presented below.

Table 64: Overall Scenario of Characteristics and Development Status for the Textile and Clothing Sectors of the SC System (Formal Sectors)

Areas	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Cotton Farming		
Inputs Supply	Medium Strong-to-Strong	Availability of Labour, Medium High Skills of Farming, Weather Uncertainties, High Risk of Virus and Diseases, High Cost of Pesticides, Fertilisers etc. Non availability of Advance Farming Technology, Existence of Research on Cotton Varieties,
Farming Sector	Strong	High Expansion of the Cotton Production Activity in the Country, Low Advancement in Farming Technology, Growth of the Farming Area and Yield per Hectare, Variations in Production Area and Yield, Lot of Risks
Demand in National Markets	High	Growth of Ginning and Yarn Industry
Demand in International Markets	Average to High	Low Knowledge of Markets, Low Picking Quality, Low Use of Information Technology
Overall Cotton Farming Sector	Strong	
Ginning Sector		
Supply of Cotton and Inputs	Strong	Supply of Cotton and Growth of Cotton Production
Ginning Industry	Medium Strong-to-Strong	Number of Ginning Units, Expansion of the Industry in the Country, Low Advancement in Technology in the Industry, Growth of the Industry, Availability of Labour, High Variations in Cotton Supply, Market Risks
Demand in National Markets	High	Growth of Yarn Industry
Demand in International Markets	Average to High	Low Quality, Low Knowledge of Markets, Low Use of Information Technology
Overall Ginning Sector	Medium Strong	
Manufactured Fibre Sectors		
Raw Material Supply	Medium Strong	Dependency on Imports
Manufactured Fibre Industry	Medium Strong	Discussion with Industry Personnel
Demand in National Markets	Average to High	Medium Quality and Rates, High Competition
Demand in International Markets	Average	Medium Quality and Rates, High Competition
Overall Manufactured Fibre Industry	Medium Strong	
Yarn Sectors		
Cotton Supply	Strong	Supply of Cotton and Growth of Cotton Production
Manufactured Fibres Supply	Medium Strong	Presence of Manufactured Fibres in the Markets
Yarn Manufacturing Base	Strong	Number of Yarn Manufacturing Units, Expansion of the Industry in the Country, Introduction of Advance Manufacturing Technology, Growth of the Industry, Government Support, Low Cost Raw Material
Demand in National Markets	High	Growth of Fabric Industry, Yarn Rates
Demand in International	Average to High	Design Versatility, High Competition, Low Use of Information Technology

Areas	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Markets		
Overall Yarn Sector	Strong	
Weaving and knitting Sectors		
Cotton Based Raw Material Supply	Strong	Supply of Cotton and Growth of Yarn Industry
Manufactured Fibres Based Raw Material Supply	Medium	Presence of Manufactured Fibres in the Markets
Fabric Manufacturing Base	Strong	Number of Fabric Manufacturing Units, Expansion of Industry in the Country, Introduction of Advance Manufacturing Technology, Growth of Industry
Demand in National Markets	Average	Low Development of the Demand Generating Factors
Demand in International Markets	Average	Low Design Versatility, High Competition, Low Use of Information Technology
Overall Fabric Sector	Medium Strong-to-Strong	
Dyeing, Printing and Finishing Sectors		
Supply Side	Medium Strong	Bulk Supply of Fabric, Low Diversity in Design and Style, Supply of Other Inputs (Dyes, Chemicals) is Medium Strong, Low wage labour, Low Research
Dyeing/Printing and Finishing Industry	Strong	High Expansion of Industry in the Country, Low Number of Units with Advance Technology, Medium Growth of Industries,
Demand in National Markets	Average	Low Development of the Demand Generating Factors
Demand in International Markets	Average	Low Design Versatility, High Competition, Low Knowledge of Developed Markets Requirements on Quality, Design and Trends on Colour and Finishes, Low Use of Information Technology
Overall Dyeing, Printing and Finishing Sectors	Medium Strong-to-Strong	
Textile Made-up Industry		
Supply Side	Strong	Bulk Supply of Heavy to Medium Weight Fabrics and Coarse to Fine Yarns, Supply of Other Inputs (Dyes, Chemicals) is Medium Strong, Low wage labour, Low Research,
Textile Made-up Industry	Strong	High Expansion of the Industry in the Country, Medium Number of Units with Advance Technology, High Growth of Number of Industries,
Demand in National Markets	Average High	Low Development of the Demand Generating Factors
Demand in International Markets	Average High	Low Design Versatility, Country is Competitive, Better Knowledge of Developed Markets Requirements on Quality, Design and Trends, Low Use of Information Technology
Overall Textile Made-up Industry	Strong	
Clothing and Apparel Sectors		
Supply Side	Very Strong	Bulk Supply of Cotton Fabrics, Medium Strong Supply of Other Inputs (Button, Zippers, etc.) and Higher Dependence on Imports, Low wage labour, Low Research, Low Design Versatility, Low Skills in Fashion and Designs
Clothing and Apparel Industry	Weak	High Expansion in the Unorganised Structure, Low Number of Units with Advance Technology, Weak Linkages with International Markets, Low Branding,
Demand in National Markets	Average	Low Development of the Demand Generating Factors
Demand in International	Average to High	Low Design Versatility, Industry is Low Competitive, Low Knowledge of Developed Markets

Areas	Status of Development*	Factors Responsible for the Development of the Sector *(Development is the function of following variables.)
Markets		Requirements on Quality, Design and Trends, Low Use of Information Technology
Overall Clothing and Apparel Sectors	Weak-to-Medium Strong	
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong		

III.3.1. Development Status of the Supply Chain and Related Segments

The analysis and the discussion in the above sections supported the identification of the development status for each sector in the textile and clothing SC system of the country. This is presented in the following table.

Table 65: Development Status of Activities in the Textile and Clothing SC System of Pakistan

Development Status				Supply Chain Activities/ Infrastructure / Skill and Technology
		Weak		Fibre Production
Medium Strong	Medium Strong		Strong	Cotton farming
Weak	Weak		Medium Strong	Ginning
Weak	Weak		Weak	Other Natural Fibres (Jute, Silk, Wool, ...)
Weak-to-Medium Strong	Weak		Medium Strong	Manufactured Fibres
		Medium Strong		Yarn Manufacturing
Medium Strong-to-Strong	Medium Strong		Strong	Ring Spinning
Medium Strong-to-Strong	Medium Strong		Strong	Rotor (Open End)Spinning
Poor to Medium	Weak		N/A	Other Yarn Manufacturing (Air Jet, …)
		Medium Strong		Fabric Manufacturing
Medium Strong	Weak		Medium Strong	Weaving
Medium Strong-to-Strong	Weak		Strong	Knitting
Weak	Weak		N/A	Other Fabric Manufacturing (Braiding, Nonwoven, …)
		Medium Strong		Fabric Coloration
Medium Strong-to-Strong	Weak-to-Medium Strong		Medium Strong-to-Strong	Dyeing
Medium Strong-to-Strong	Weak-to-Medium Strong		Medium Strong-to-Strong	Printing
Medium Strong	Weak		Medium Strong	Fabric Finishing
Medium Strong	Weak	Poor to Medium	Weak-to-Medium Strong	Clothing
		Poor		Associated Industries
Medium Strong-to-Strong	Weak		Medium Strong	ICT and Applications
Weak	Weak		Weak	Machine Manufacturing

Development Status				Supply Chain Activities/ Infrastructure / Skill and Technology
Medium Strong	Weak-to-Medium Strong		Medium Strong	Dyes and Chemical Manufacturing
Weak-to-Medium Strong	Medium Strong			Marketing Function
Weak-to-Medium Strong				Research and Development
				Technology and Skills
				Logistic Infrastructure
			Weak	Rail Transportation
			Weak-to-Medium Strong	Road Transportation
			Weak	Air Transportation
			Medium Strong	Ports
			Weak	Storage Facilities
			Strong	Communication
Scale: 1 = Weak , 2 = Weak-to-Medium Strong, 3 = Medium Strong, 4 = Medium Strong-to-Strong, 5 = Strong				

III.3.2. Identification of SWOTs for the System

In the above analysis, the internal factors of the strategic environment, including Strength and Weakness were identified, which are presented below.

Table 66: Strengths and Weaknesses of the Textile and Clothing System in Pakistan

Internal Factors	
Strengths	Weaknesses
S1 - Indigenous Cotton S2 - Low Wages/Labour Costs S3 - Strong Investment in Textiles & Made-ups S4 - Skills in ICT S5 - Skills in Chemistry (for TC Chemical Industry)	W1 - Limited Base of Non-cotton Fibres W2 - Weak Ginning Sector W3 - Lower Cotton Yield (per acre) W4 - Low Usage of ICT in TC W5 - Non-competitive Behaviour of Entrepreneurs W6 - Low Skills (Technical, Marketing & Management) W7 - Distance to (current) Main Markets W8 - Underdeveloped Logistics W9 - Weak Market Awareness due to Weak Customer Link (including Market´s Dynamics, Buyer´s Needs, Competitor´s Strengths and Weaknesses) W10 - Input Cost and Continuity W11 - Low Foreign Direct Investment (FDI)

It can be added that, with a strong base in cotton and its products including fabrics, home textiles, canvas, knitted and others areas, it is natural and logical to focus on the value addition in these segments. This can be achieved by developing the research potential and focusing on the high profit markets including fashion clothing, children and men's wear, etc. These product segments already exist in the country, their improvement is required to enter into the global markets in

these areas. This will improve the export share in the future potential markets of China and India and certainly in Pakistan.

The factors which participated in improving the competitive position of the developed countries, in these product segments, are better infrastructure, design and innovation skills and strong marketing skills. Their engineering skills, machine manufacturing and chemical industry further helped them to advance the technological growth and to produce high value products faster than many developing countries. These areas are mostly at low level of development in Pakistan and are weaknesses of the system. In other aspect, these can be considered as future opportunity areas.

The main challenges for the SC system of the country are the political instability, market access in the main textile and clothing markets and the increasing costs and low availability of energy inputs. Some countries have shown high growth in the world export shares in clothing, like Bangladesh due to its tax free product access in the main markets. The economic environment is suffering from the political instability which is the main problem in developing the fashion sectors and attracting the international buyers for these products.

In general, China, India, Pakistan and Bangladesh have vast resources in low cost raw material, labour and textile and clothing infrastructure to provide the major share of world textile and clothing imports.

The external factors of the strategic environment are identified below.

Table 67: Opportunities and Threats for the Textile and Clothing System in Pakistan

External Factors	
Opportunities	Threats
O1 - Technical Textile O2 - Value added products (Fashion, Children & Home Textiles) O3 - 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	T1 - Political Instability T2 - Regional Competition
Note: Technical textiles are the textile products which are used for their functional properties and industrial usage. These are based on the specific properties and structures of their material which create their functional utility. On the other hand, textiles for clothing are less dependent on the functional properties of their raw material.	

Collectively, these can be transformed into a complete SWOT matrix of the system, produced in Table 68.

Table 68: SWOT Matrix for the Textile and Clothing SC System of Pakistan

Internal Factors	
Strengths	Weaknesses
S1 - Indigenous cotton crop S2 - Low wages/labour 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 fibres W2 - Weak ginning sector W3 - Lower cotton yield (per acre) W4 - Low application & usage of ICT W5 - Non-competitive behaviour 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	Threats
O1 - Technical Textile O2 - Value added products (fashion, children clothing & home textiles) O3 - 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	T1 - Political instability T2 - Regional competitors

III.4. Conclusion

The strategic environment of the textile and clothing SC system in Pakistan was analysed in this chapter. The main factors which are responsible for the growth were identified. These factors provided the basis for the identifying the development status of the SC segments. Textile manufacturing, textile made-ups and the cotton production sectors are the strongest in the system. At this stage of the development, the system is demanding to reorient the fashion clothing and apparel sectors which will bring higher value addition and more opportunities for the system. Logistics is an important area which needs attention to enhance the performance on the customer delivery process and to improve the customer service. There is a need to utilize the skills in information and communication technologies to improve the management and production

systems. Also, the marketing skills need improvement to enhance the capability to understand the needs of the international markets and to visualize the product segmentation. Improving these areas will bring many opportunities in the international markets including the emerging markets of South Asia and Middle East.

Positive developments are already being observed in the skill development programs. The number of study programs has increased in science, engineering and design fields for the textile, clothing and emerging areas. Meanwhile, these programs are being offered at limited number of locations like other developments in the country, which should be expanded.

There is very low interest in the non-traditional markets and advance textiles, which can bring new opportunities for the SC system. The growth of agricultural and the industrial base in the country offer strong motivation in these sectors. Some strategies are emerging from the government side in the areas of protective clothing, textiles for automobiles, textiles for construction and agriculture industry and medical textiles. There is a long way ahead to prove some success in these areas which strongly depend on the scientific research which is weak in the country. The raw material base of the country is a constraint for these areas in the current scenario, which also needs attention of the policy makers and the industrial community.

The expansion of the formal industry is very limited in various regions of the country, except Punjab. Such a concentrated growth of the sectors has imposed various types of pressures on such locations, including fast population growth and shortage of infrastructure. There is a need to expand the industrial base of the country to district level especially in Sindh and KP regions, which lack in such expansion of the industry. This will bring additional benefits to the economy of the country.

The findings of the study on the growth of the textile, clothing and related areas in different regions of the country, the development status of the sectors and the SWOT matrix on the SC system revealed the strategic environment of the SC system. These are the main inputs for the strategic planning process in the SC system. The categorization of the factors on the strategic dimensions, performed above, will help to formulate and to evaluate the strategic planning.

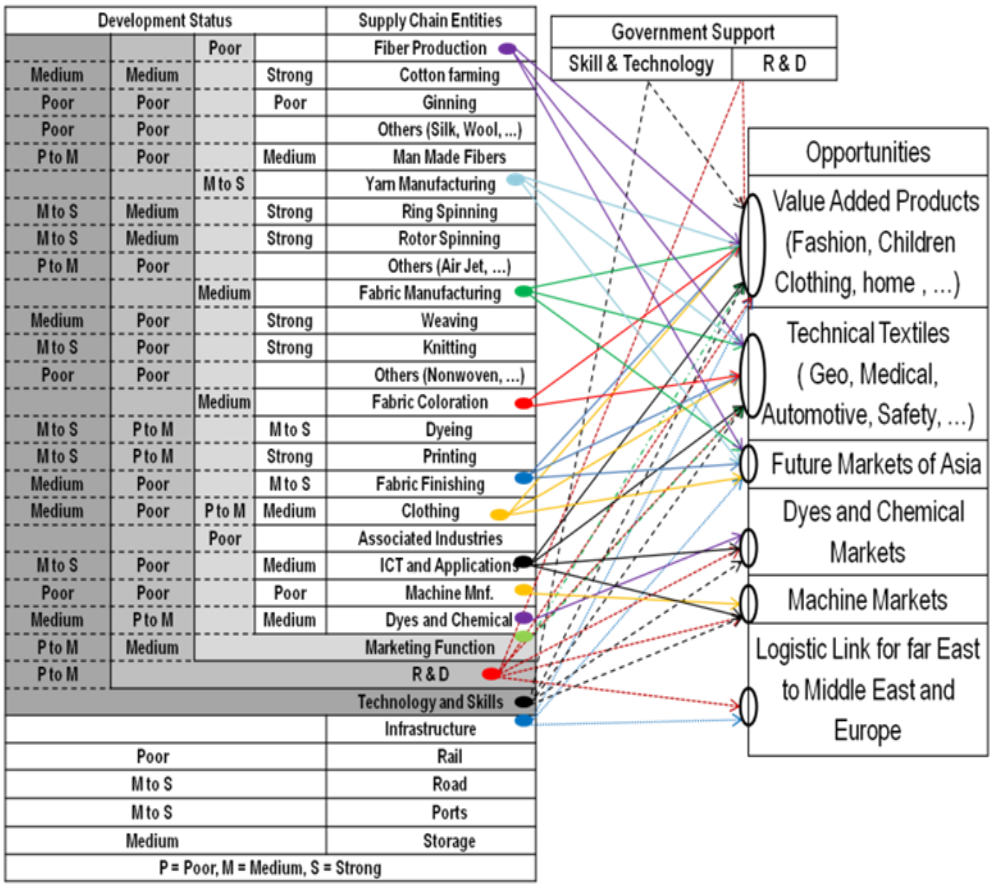
Chapter IV	Strategic Planning for the Textile and Clothing SC System in Pakistan	Page

In the last chapter, the characteristics and the structure of the textile and clothing supply chain system in Pakistan were studied. Important factors, their growth and the developments status of the SC activities were also identified (see Table 65 and Table 68). These will help to design strategies of the system. This will follow the evaluation of their importance for the SC system in the identified market sectors.

IV.1. Development of the Strategic Plans

The opportunities in the external environment provide the main motivation for the strategic directions of the system and their realization depends on the growth of internal factors and development status of the SC segments. This is a complex situation to visualize a large system and to link the internal strategic aspects of the system, i.e. factors and their growth to the external opportunities. To provide such visualization, a tool was introduced, which was termed as Planning-Link. This is a new tool, introduced in this research by Hussain et al. (2011a), presented in the next figure.

Figure 32: Planning-Link for the Strategic Planning Scenario of the TC System in Pakistan



It shows the relationship between various interfaces like the development-status of the SC segments and the opportunities for the system. It effectively identified the potential strategic directions and offered good visibility on the process and on the linkages of the interfaces to individuals, who were involved in the strategy formulation stage. Besides, it preserved the main aspects of the strategy formulation stage for the next iterations of the process and for the future revisions. The continuity aspects of planning and the policy are difficult to maintain in situations where the process is performed at long time horizons and involving different individuals/experts; offering both temporal and spatial variations. This tool also helps to achieve consistency in the present-to-future course of actions. Planning-Link and the evaluation on the strategic environment helped to devise the strategies and preserved the input-output scenario of the planning situation. It also facilitated the evaluation of the strategies. Strategies were devised and evaluated on the basis of their links with supply chain entities and the available or potential opportunities. A link gets higher priority in the process of prioritisation if it affects many outputs.

The above inputs of the strategy formulation process including SWOTs, the growth of the SC activities (Development Status) and their linkage to opportunities (Planning-Link) were discussed with the experts, resulting in the following strategies.

Table 69: Strategic Plans of the SC System

SO Strategies	WO Strategies
SO1 -Diversification of Product Range SO2 - Establishing Industrial-Parks (with Common Facilities of Design & Development, ICT Centres, Effluent Treatment, etc.) SO3 -Applying Export Incentives SO4 - Establishing Down-stream links/facilities in Competing Regions (Turkey, Egypt, Bangladesh, Mexico etc.) SO5 - Improving Domestic Chemical Industry	WO1 - Skill Development Programs WO2 - Expanding Non-cotton Fibre Base WO3 - Improving logistics WO4 - Developing Effective Linkage in Industry, Academia and R&D Centres WO5 - Developing Domestic Engineering Industry
ST Strategies	**WT Strategies**
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

These are grouped on the four dimensions of the SWOT framework of scanning the strategic environment. In this framework, the strengths of the system enable it to seize the available opportunities (SO-Dimension). They also reduce the effects of the threats on the system (ST-Dimension). The weaknesses react as an opposite force by impeding the system for the successful

realization of the opportunities (WO-Dimension) and increase the failure of the system against the threats (WT-Dimension). Further, the external threats are supported by the internal constraints. The system therefore struggles to maximize its strengths and minimize its weaknesses in response to improve its position. Keeping in view the above phenomenon, four sets of strategies were identified on the dimensions of Strengths-Opportunities (SO), Strengths-Threats (ST), Weaknesses-Opportunities (WO) and Weaknesses-Threats (WT). Again, in this process of strategy design, the strengths (for which different authors have utilized different terms like capabilities, etc.) are the main driving forces and the weaknesses are the main constraints in the system. These help and/or restrict the materialization of the opportunities. Our strategy formulation process was focused to improve the system so that its potential to materialize the maximum opportunities can be enhanced by improving the weak areas of the SC system. Simultaneously, the maximization of the opportunity materialization is directed in the traditional markets as well as in the non-traditional areas.

The available strengths (resources and capabilities) were considered first in order to devise the SO group of strategies. The focus is to transform the resources and capabilities of lower strength to higher level, which will help the system to seize the opportunities in the higher-end markets of the traditional segments for the SC system. Further, it is focused on improving the comparative advantage over competing systems in terms of system strengths. In this group, five strategies were devised for product diversification, infrastructure improvement, improvement of the domestic input industry and the linkages to the main markets. The SO group of strategies takes into account the short-to-medium term future environment. The WO group of strategies supports the SO strategies for its short-to-medium term goals. Simultaneously, it covers the long-term scenarios of growth in the international markets. Therefore, the characteristics and time dimensions of WO strategies are different than those of SO strategies; this will be further explored while evaluating their implementation characteristics. Five strategies were devised under the WO class. In their short time effects, they support the SO strategy dimensions by addressing the issues of skills and the linkages of the research entities. On the long terms, these focus on the wider issue of infrastructure and input areas like machine manufacturing and speciality fibre production; the areas which can assist the system into the emerging fields in the global markets. Here, the skills and the research linkages focus on the short-to-medium term opportunities whereas machine manufacturing and specialty fibre production focus on the future needs of the technical and functional textile industries. Finally, in order to neutralize the threats, the dimensions of strengths and weaknesses are considered by avoiding and/or overcoming on the

threats. Five strategies were devised under these two groups of ST and WT; two for the ST dimension and three for the WT. The characteristics of the devised strategies are summarized below.

Table 70: Characteristics of the Strategic Plans

Strategies	Characteristics
SO Strategies	
SO1 -Diversification of Product Range	Diversification
SO2 - Establishing Industrial-Parks (with Common Facilities of Design & Development, ICT Centres, Effluent Treatment, etc.)	Responsiveness
SO3 -Applying Export Incentives	Market Linkages
SO4 - Establishing Down-stream links/facilities in Competing Regions (Turkey, Egypt, Bangladesh, Mexico etc.)	Market Linkages, Responsiveness
SO5 - Improving Domestic Chemical Industry	Input Control
ST Strategies	
ST1 - Development of Markets Access Strategies	Market Linkages, Competitive Position
ST2 - Establishing Down-stream Facilities in Stable, Near-to-market and Competing Regions	Market Linkage, Responsiveness
WO Strategies	
WO1 - Skill Development Programs	Multiple Effects
WO2 - Expanding Non-cotton Fibre Base	Inputs Control, Diversification
WO3 - Improving logistics	Responsiveness
WO4 - Developing Effective Linkage in Industry, Academia and R&D Centres	Multiple Effects
WO5 - Developing Domestic Engineering Industry	Long Term Effects
WT Strategies	
WT1 - Work in Collaboration with Competitors	Differentiation, Diversification
WT2 - Development and Implementation of Long-term and Coordinated Policies	Multiple Effects: Long Term Vision & Policy Consistency
WT3 - Introduction of Industry Relief Packages	Short Term Relief

IV.2. Evaluation of the Strategic Plans

In this section, the evaluation of strategies is discussed. It was performed to develop their priorities considering the status of the activities in the SC system, strategic factors and focused opportunities. This will help to allocate the resources and manage the efforts in the required areas of strategic importance and to improve the competitiveness of the system.

It should also be helpful to identify the entities which can take part in the implementation of the plans. These may include, Ministry of Textile, Trade Development Authority, Council of Scientific and Industrial Research, Agency for Industrial Estate Development, Various Research Centres, Education Institutes, etc. It will also be necessary to identify and analyse the role of

these entities in the implementation phases. Our focus will be on the evaluation of the strategic plans and generating their priorities.

IV.2.1. Decision Methods of AHP and ANP in SWOT

Referring to the review of the scientific literature on the subject of strategic planning, performed in Chapter III, simple and valuable methods were identified. These provided means of analysis on the strategic environment and to visualize the linkages of factors in the system to design and evaluate the strategies. These include, the hybrid methods of AHP in SWOT and ANP in SWOT, developed by Kurttila et al. (2000) and Yuksel and Dagdeverin (2007), respectively. The methods have their basis in the Saaty's Analytical Hierarchy Process (AHP) and Analytical Network Process (ANP) which take into account the hierarchical and network effects of the decision situation (Forman and Gass (2001)).

These are applied by many authors in various situations of supply chain optimization. Korpela and Tuominen (1996) used AHP for the decision of warehouse site selection, Badri (1998) combined AHP with his goal programming (GP) model for global facility location, Kurtilla et al. (2000) used it with SWOT in his hybrid method for a case study on the forest certification, Korpela et al. (2002) integrated it with mixed integer programming (MIP) for production capacity allocation and supply chain design, Farkasovsky and Anna (2004) applied it for the outsourcing decisions of firm´s application development function and Yuksel and Dagdeviren (2007) utilized it in the strategic planning for a clothing firm.

AHP and ANP were developed by Saaty in the 1970s. These are defined as follows.

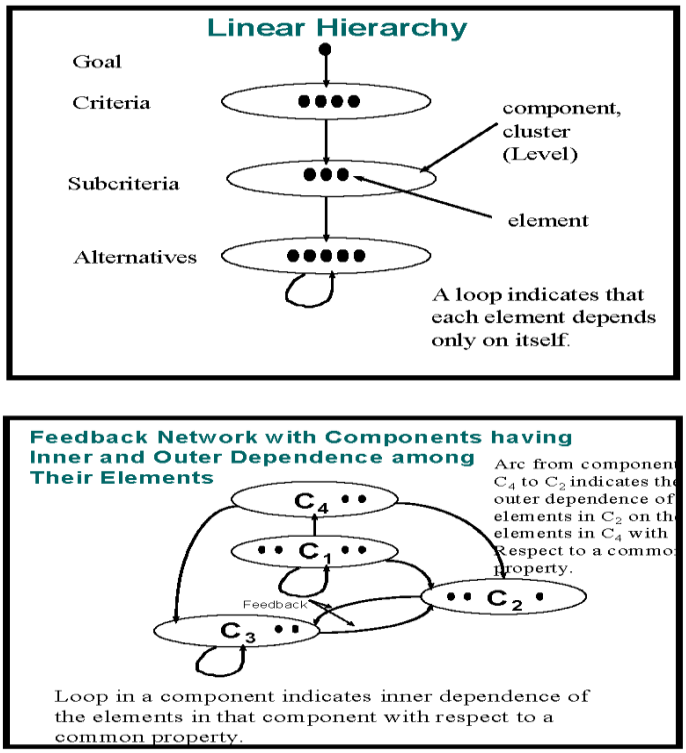
> The AHP is a general theory of measurement. It is used to derive priorities on absolute scales (invariant under the identity transformation) from both discrete and continuous paired comparisons in multi-level hierarchic structure. These comparisons may be taken from actual measurement or from a fundamental 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 groups of elements of its structure…In using the AHP or its generalization to feedback networks, the Analytical Network Process (ANP) to model a problem, one needs a hierarchic or a network structure to represent that problem, as well as pairwise comparisons to establish relations within the structure (Saaty and Vergas (2006)).

Forman and Gass (2001) described AHP on the basis of its functions; it provides the structuring of the complexity of decision problem, measuring on the ratio scale and to synthesize the

importance of alternatives. They rated AHP as simple, easy to understand, flexible and accurate. It provides an approach to select an alternative or to prioritize many, which have applications in the resources allocation, benchmarking, quality management, public policy, health care, and strategic planning.

ANP, which is a generalization of AHP towards dependence and feedback, provides a framework to study dependence and feedback for different sources (elements) part of the decision problem. The problem is constructed with clusters of a network namely source, intermediate and sink. These clusters are linked by arrows and identify the type of relationship exists between them like outer dependence, inner dependence and/or feedback (Saaty (1996), Saaty and Vergas (2006) and Saaty and Sodenkamp (2008)). The description of the hierarchy, network and various types of dependencies are shown and described in the following figure.

Figure 33: Hierarchical and Network Decision Structure



Inner dependence describes the effects of the elements on each other in the same cluster (level), outer dependence shows relations between elements of different clusters and feedback is used when the effects are present in the reverse direction from a cluster towards itself.

The application of the ANP is useful where the other methods cannot capture the proper formulation of the problem while considering the dependence and/or feedback of the decision elements. Yuksel and Dagdeverin (2007) presented the following steps to explain the application of ANP; it is based on the work of Chung et al. (2005), Meade and Sarkis (1999), Saaty (1980) and Saaty (1996).

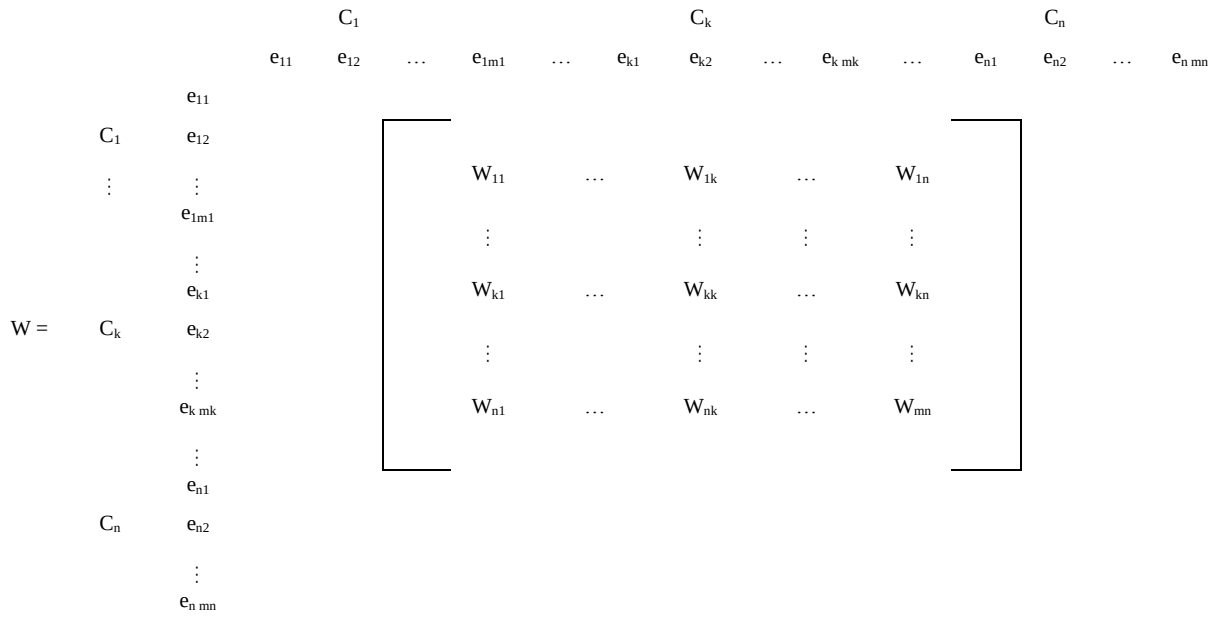
Step 1: Model construction and problem structuring
Step 2: Pairwise comparison matrices and priority vectors
Step 3: Supermatrix formation
Step 4: Selection of the best alternatives

The process starts with the definition of the problem and its decomposition into a rational system, similar to a network. Decision elements in each cluster are compared pairwise for their importance to the control criteria and the clusters are compared pairwise for their contribution to the objective. Interdependencies among elements of a cluster are studied pairwise and the influence of elements on other elements is represented by eigenvector. The values of relative importance (a_{ij}) are assigned from the Saaty's scale of absolute numbers (see Table 73) to elements of a row clusters over elements of column clusters in the matrix. Similarly, the inverse comparison is determined by $1/a_{ji}$. The local priority vector is obtained for the relative importance of elements from the pairwise comparison, using the following equation.

$$A \times w = \lambda_{max} \times w$$

Here, A is the matrix of pairwise comparison, w is the eigenvector and λ_{max} is the largest eigenvalue of A.

The global priorities in a system with interdependent influence can be obtained by entering the local priority vectors in the appropriate columns of a supermatrix. This is similar to the Markove chain process. Therefore, the matrix segments in a supermatrix represent the relationship between two clusters in a system. Their placement in the supermatrix tells the type of the influence they have, on other clusters or within. A supermatrix with clusters C_k where k = 1, 2, 3, …, n; having elements m_k, represented by e_{k1}, e_{k2}, …, $e_{k\,mk}$ is shown below.



Following supermatrices explain the hierarchical and network composition of the problem.

$$\text{For Hierarchy } W = \begin{bmatrix} 0 & 0 & 0 \\ w_{21} & 0 & 0 \\ 0 & W_{32} & I \end{bmatrix}$$

$$\text{For Network } W = \begin{bmatrix} 0 & 0 & 0 \\ w_{21} & W_{22} & 0 \\ 0 & W_{32} & I \end{bmatrix}$$

In the above matrices, w_{21} is a vector which represents the impact of goal on the criteria, W_{32} is a matrix for the impact of criteria on alternatives, I is the identity matrix and zero entries are for those elements with no influence. W_{22} is a matrix for the inner dependence of the criteria.

Whenever, there is inner dependence, the columns of supermatrix may sum higher than one. It should be modified to get the sum of columns equal to one. This can be achieved by determining the relative importance of the clusters in the supermatrix, using column cluster as controlling cluster. Eigenvector is obtained from the pairwise comparison matrix of the row clusters with respect to column cluster, so there is an eigenvector for each column cluster. The values of eigenvector are utilized to weight the cluster in each column to get the weighted supermatrix which is stochastic.

Limit supermatrix is developed to achieve convergence on the important weights by raising the weighted supermatrix to power of 2k + 1, where k is an arbitrarily large number. The final priorities can be obtained by normalizing each cluster of this supermatrix. Therefore, the weights achieved for the alternatives can be located in the column for alternatives in the normalized supermatrix.

The methods of AHP in SWOT and ANP in SWOT were utilized to determine the importance of the strategies for the textile and clothing system of Pakistan. The process is presented below. The comparison of results, achieved in both cases, was also developed to achieve the comprehensive insight. The steps, involved in the methods are compared below.

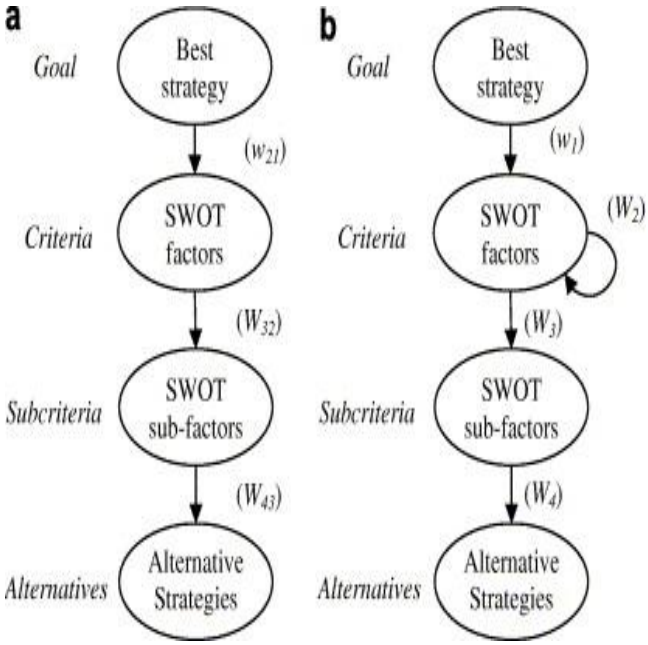
Table 71: A Comparison of the Progressing Steps in "AHP in SWOT" and "ANP in SWOT"

Kurttila et al. (2000): AHP in SWOT			Yuksel and Dagdeviren (2007): ANP in SWOT		
Steps	Developments	Process	Steps	Developments	Process
1	Identification of SWOTs	SWOT Analysis	1	Identification of SWOTs and Alternative Strategies	SWOT Analysis
2	Determination of the relative importance of SWOT factors	Hierarchical Prioritization	2	Determination of the relative importance of SWOT factors	Hierarchical Prioritization
3	Development of local priorities of sub-SWOTs and calculation of their global priorities	Hierarchical Prioritization	3	Determination of the inner dependence effect of SWOT factors	Inner dependence Model
4	Utilization of the results in the strategy formulation and evaluation process	Strategy Evaluation and Adjustment	4	Calculation of the interdependent priorities of the SWOT factors	Inner dependence Model
			5	Determination of local importance of sub-SWOTs	Hierarchical Prioritization
			6	Determination of global importance of sub-SWOTs	
			7	Determination of scaling factors of alternatives with respect to sub-SWOTs	Hierarchical Prioritization
			8	Determination of overall priorities of the alternatives	Hierarchical Prioritization

ANP in SWOT introduces the effects of inner dependence of criteria (SWOT) in the hierarchical formulation of the problem for AHP in SWOT.

The following figure presents the structural difference between AHP in SWOT and ANP in SWOT (Yuksel and Dagdeverin (2007)). The decision problem is organised at four levels with goal at first level, criteria and sub-criteria at second and third levels and the alternatives at the fourth level. In part (b) of the figure, the inner dependence loop is introduced for the criteria.

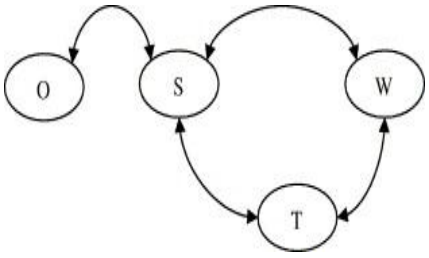
Figure 34: The Decision Structure with “AHP in SWOT” and “ANP in SWOT”



The importance of the SWOT factors is obtained by their relative comparison on the main objective. The inner dependence of the SWOT factors is calculated from the inner dependence model, presented at Figure 35. Then the importance of the sub-factors is calculated from their relative comparison on their parent element. In this way, the weights of the criteria and the local weights/priorities of the sub-factors are obtained. In the next steps, the local priorities of the sub-factors are transformed into their global priorities by multiplying the weights of the parent element. Finally, the alternatives are compared against each other on the sub-factors to obtain their relative importance which was multiplied with the global priorities of the sub-factors to calculate the final priorities.

In the above structure, w_{21} is the priority vector for the SWOT factors. W_{32} and W_{43} are the comparison matrices for sub-factors and alternatives with respect to their parent elements. W_2 represents the matrix for the inner dependence values for criteria (SWOT factors)..

Figure 35: Inner dependence Model



The inner dependence model considers that the opportunities can be seized by the system, if it has enough strength. Therefore, opportunities are dependent on strength. Higher opportunities bring higher strength and therefore, strength are dependent on opportunities. In general, a system with higher strengths has lower weaknesses and can minimize the effect of threats and also the opposite should be true. Therefore, threats, strengths and weaknesses are also dependent on each other. Such a relationship between the decision elements can be expressed in a super matrix to calculate the inner dependence and the overall effects of the factors and sub-factors on the alternatives. It is given below.

$$W = \begin{array}{l} \text{Goal} \\ \text{SWOT Factors} \\ \text{SWOT Sub-factors} \\ \text{Alternatives} \end{array} \begin{bmatrix} 0 & 0 & 0 & 0 \\ w_{21} & W_2 & 0 & 0 \\ 0 & W_{32} & 0 & 0 \\ 0 & 0 & W_{43} & I \end{bmatrix}$$

The super matrix presents the four levels of the decision hierarchy (goal, criteria, sub-criteria and alternatives). Inner dependence is represented by W_2.

We can obtain the exclusive hierarchical formulation of the decision by keeping the inner dependence matrix W_2 as null, as given below.

$$W = \begin{array}{l} \text{Goal} \\ \text{SWOT Factors} \\ \text{SWOT Sub-factors} \\ \text{Alternatives} \end{array} \begin{bmatrix} 0 & 0 & 0 & 0 \\ w_{21} & 0 & 0 & 0 \\ 0 & W_{32} & 0 & 0 \\ 0 & 0 & W_{43} & I \end{bmatrix}$$

The term Hierarchical Prioritization, used in the comparison of AHP in SWOT with ANP in SWOT (Table 71), is intended to calculate the hierarchical effects of the decision elements under Analytical Hierarchy Process. The elements were compared with respect to their parent element on the Saaty's 1-9 scale, which is given at Table 73.

SWOT analysis scans the strategic environment of the system and provides basis to develop the appropriate strategies. The AHP and ANP in SWOT help to evaluate the devised strategies on the basis of their importance in relation to strategic factors. Together, these provide means to decide the resource allocation and management of efforts at various dimensions of the strategic planning.

The following sections presents the decision model, the allocation of weights to criteria and sub-factors on the basis of the inputs of experts, the relative comparison of the decision alternatives and finally the calculation of their priorities.

IV.2.1.1. Application of ANP in SWOT

Step 1: Identification of SWOTs and Alternative Strategies

The sub-factors were developed from the resource-based SWOT analysis on the supply chain system. Five strengths, eleven weaknesses, seven opportunities and two threats were identified. After developing the criteria and the sub-factors, strategies were devised on four dimensions (SO, WO, ST and WT), in consultation with SC experts. In total, fifteen strategies were identified, five under SO dimension, five for WO, two for ST and three under WT dimensions. These inputs are presented in the next table.

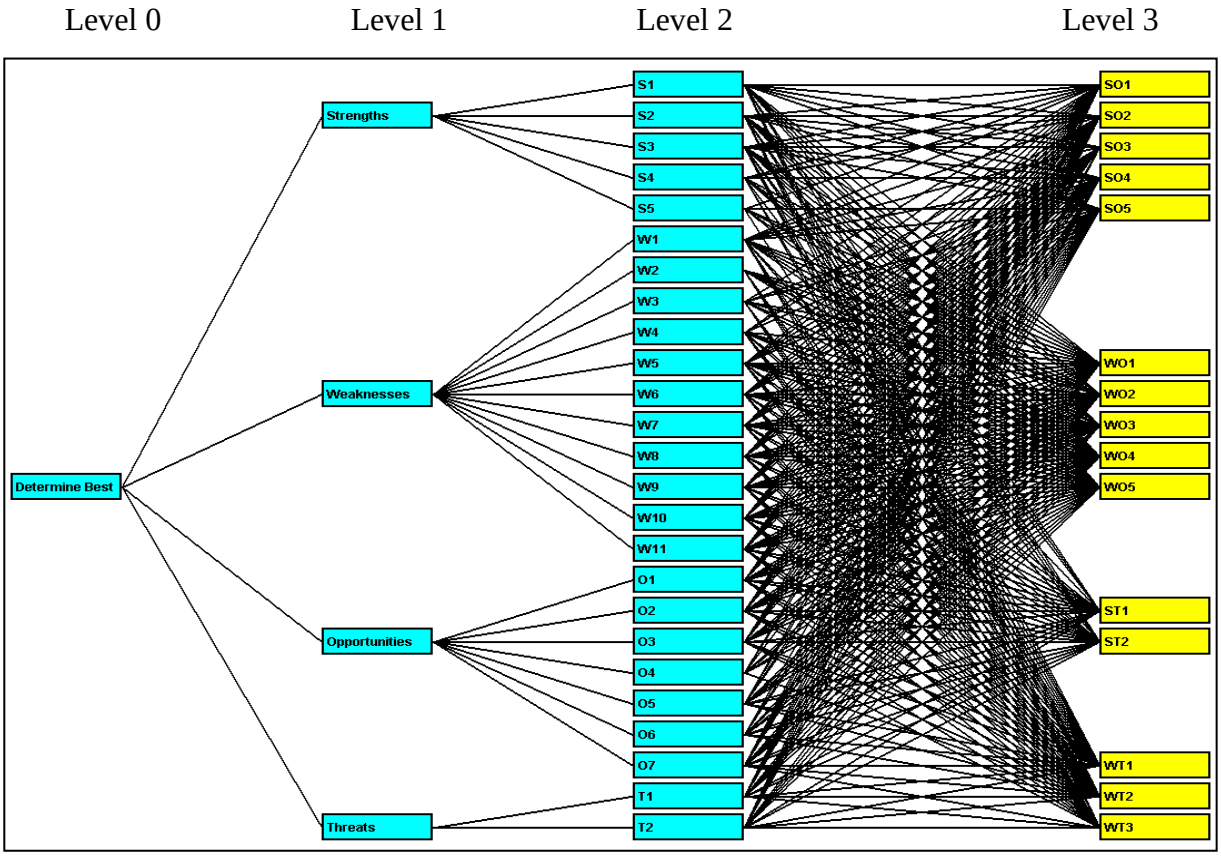
Table 72: SWOT Matrix and Strategic Plans for the T&C SC System of Pakistan

		Internal Factors	
		Strengths	Weaknesses
		S1 - Indigenous cotton crop S2 - Low wages/labour 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 fibres W2 - Weak ginning sector W3 - Lower cotton yield (per acre) W4 - Low application & usage of ICT W5 - Non-competitive behaviour 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 centres, ICT application centres 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 fibres base WO3 - Improving logistics WO4 - Developing effective linkage between industry, academia and R&D institutes WO5 - Developing domestic engineering industry
	Threats T1 - Political instability T2 - Regional competitors	ST Strategy ST1 - Development of markets access strategies ST2 - Establishing down-stream facilities in stable, near-to-market and competing regions	WT Strategy WT1 - Work in collaboration with competitors WT2 - Development and implementation of long-term and coordinated policies WT3 - Introduction of industry relief packages

The strategic planning problem was transformed into a hierarchical decision structure (Kurtilla et al. (2000) and Yuksel and Dagdeverin (2007)). The goal “Determining the Best Strategy” was placed on the top, followed by the SWOT factors and sub-factors at intermediate levels and the

alternative strategies at the lowest level. The decision model was constructed using Web-HIPRE[1] online decision support software, developed by Mustajoki (1999). It is shown below.

Figure 36: Decision Model for the Strategic Planning of Textile and Clothing SC System of Pakistan with AHP in SWOT



In this model, four levels include goal, "Determining the Best Strategy" at level 0, SWOT (Strengths, Weaknesses, Opportunities and Threats) criteria at level 1, sub-criteria (SWOT sub-factors) at level 2 and the alternatives at level 3.

Step 2: Measurement of the Relative Importance (w_1) of SWOT Factors

The matrix for pairwise comparison of SWOTs was constructed by introducing the preferences between elements of criteria (SWOT) in achieving the objective and using Saaty´s fundamental scale of absolute numbers, given below.

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

Table 73: Saaty´s Fundamental Scale of Absolute Numbers

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 favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring 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 values were assigned by experts in a group activity and the consensus approach was adopted to finalize the individual values. Otherwise it was difficult to maintain the consistency of the values as the number of comparisons was high. Saaty and Sodenkamp (2008) emphasized keeping the consistency ratio (CR) below 0.1 when constructing the comparison matrices of orders larger than 5×5. The consistency ratio was calculated from the consistency index (CI) and random index (RI) (Yuksel and Dagdeverin (2007)).

$$CR = CI / RI$$

The consistency index was calculated with the following equation.

$$CI = (\lambda_{max} - n) / (n - 1)$$

Here, λ_{max} is the maximum eigenvalue and n is the size of the matrix. The RI for the matrices of various sizes is given below (Saaty and Sodenkamp (2008)).

Table 74: Random Index

Order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49	1.52	1.54	1.56	1.58	1.59

When the size of matrices is large, it is difficult to maintain consistency below 0.1. This is the reason that we have initially applied this methodology in a small group of experts familiar with the process and the system. The process can be extended by including more experts and utilizing different approaches to finalize the values for the relative comparisons of decision factors. Although, this will increase the complexity of the problem to many folds and it will be much more difficult to visualize the sources of the variability. The calculated CR for each matrix is given at the particular matrix.

As stated, at this stage of the study, the utilization of approaches which take into account the effects of dispersion for preference values could increase the complexity of the decision analysis which we wanted to avoid. These strategies can better be utilized for the refinement of the results and for the value addition to the overall strategic planning process. Such refinements can be performed in the future revisions of the process, where it will be more valuable to expand the expert base and include more viewpoints.

The comparison matrix for the SWOTs with respect to the goal is presented below. The calculated weights are also presented.

Table 75: Pairwise Comparison of SWOT Factors and Their Weights

Goal	Strengths	Weaknesses	Opportunities	Threats	Criteria (SWOT Factors) Priorities w_1
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					

Step 3: Measurement of the Inner dependence ($W_2 * w_1$) in SWOT Criteria

The measurement of the inner dependence for the criteria (SWOT) was based on the inner dependence model; the values on the relative comparison and their effects are given below.

Table 76: Inner dependence with respect to Strengths

Strengths	Weaknesses	Opportunities	Threats	Priorities
Weaknesses	1	1/4	2	0.2113
Opportunities	4	1	4	0.6551
Threats	1/2	1/4	1	0.1334
CR: 0.01405				

Table 77: Inner dependence with respect Weaknesses

Weaknesses	Strengths	Threats	Priorities
Strengths	1	4	0.8
Threats	1/4	1	0.2

Table 78: Inner dependence with respect to Threats

Threats	Strengths	Weaknesses	Priorities
Strengths	1	1/4	0.2
Weaknesses	4	1	0.8

The comparison matrix (W_2) for the inner dependencies of the SWOT factors was produced from the above values. It is given below.

$$W_2 = \begin{bmatrix} 1 & 0.8 & 1 & 0.2 \\ 0.2113 & 1 & 0 & 0.8 \\ 0.6551 & 0 & 1 & 0 \\ 0.1334 & 0.2 & 0 & 1 \end{bmatrix}$$

Step 4: Calculation of the inner dependent priorities of the SWOT Criteria

Inner dependent priorities for the criteria ($W_{factors}$) were calculated by multiplying the matrix W_2 of inner dependence values with the independent priorities vector w_1; the results are presented below.

$$W_{factors} = W_2 * w_1 = \begin{bmatrix} 1 & 0.8 & 1 & 0.2 \\ 0.2114 & 1 & 0 & 0.8 \\ 0.6551 & 0 & 1 & 0 \\ 0.1334 & 0.2 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 0.141 \\ 0.237 \\ 0.531 \\ 0.091 \end{bmatrix} = \begin{bmatrix} 0.8798 \\ 0.3396 \\ 0.6233 \\ 0.1572 \end{bmatrix}$$

These values are normalized below.

$$W_{factors} = \begin{bmatrix} 0.4399 \\ 0.1652 \\ 0.3116 \\ 0.0786 \end{bmatrix}$$

Step 5: Developing the local importance (W_3) of sub-SWOTs

Local priorities (W_3) of the sub-SWOTs were produced from their pairwise comparison matrices (see appendix IV.A for Table 79 to Table 82). Pairwise comparison matrix for strengths is given

below as example. The strengths are compared against each other under their parent element; the local weights are also given.

Table 79: Pairwise Comparison of Strengths

Strengths	S1	S2	S3	S4	S5	Local Weights
S1	1	3	2	3	4	0.395
S2	1/3	1	½	1	3	0.147
S3	½	2	1	3	3	0.262
S4	1/3	1	1/3	1	2	0.124
S5	1/4	1/3	1/3	½	1	0.072
CR = 0.03166						

Table 80: (see Appendix III.A)

Table 81: (see Appendix III.A)

Table 82: (see Appendix III.A)

Step 6: Producing the Global Weights for the Sub-SWOTs

The local priorities of the sub-SWOTs were converted into their global priorities by multiplying them with the inner dependent priorities of the criteria $W_{factors}$, obtained in Step 4. These are given at the next table.

Table 83: Local and Global Priorities of the Criteria and Sub-Criteria

Criteria	Priorities of Criteria ($W_{factors}$) with Inner dependence (Step-4)	Sub-SWOTs	Local Priorities of the Sub-SWOTs (W_{32}) (Step-5)	Global Priorities of Sub-SWOTs ($w_{sub\text{-}factor}$ (global)) (Step-6)
Strengths	0.4399	S1	0.395	0.1737
		S2	0.147	0.0646
		S3	0.262	0.1152
		S4	0.124	0.0545
		S5	0.072	0.0316
Weaknesses	0.1698	W1	0.09	0.0152
		W2	0.035	0.0059
		W3	0.057	0.0096
		W4	0.128	0.0217
		W5	0.092	0.0156
		W6	0.262	0.0444
		W7	0.034	0.0057
		W8	0.034	0.0057

Criteria	Priorities of Criteria ($W_{factors}$) with Inner dependence (Step-4)	Sub-SWOTs	Local Priorities of the Sub-SWOTs (W_{32}) (Step-5)	Global Priorities of Sub-SWOTs ($w_{sub\text{-}factor}$ (global)) (Step-6)
		W9	0.149	0.0253
		W10	0.065	0.0110
		W11	0.055	0.0093
Opportunities	0.3116	O1	0.27	0.0841
		O2	0.292	0.0910
		O3	0.076	0.0236
		O4	0.158	0.0492
		O5	0.106	0.0330
		O6	0.059	0.0183
		O7	0.04	0.0124
Threats	0.0786	T1	0.8	0.0628
		T2	0.2	0.0157

Step 7: Determination of the Scaling Factors (W_{43}) for the Alternatives with-respect-to Sub-SWOTs

Finally the comparison matrices for the alternatives (strategies) with respect to each of the twenty five SWOT sub-factors were also constructed (see Appendix IV.B for Table 84 to Table 108). As an example, the relative comparison of the alternatives is produced in the following table in relation to the sub-factor S1. The scaling factors are also given.

Table 84: Comparison Matrix for the Alternatives in relation to S1

S1	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
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																

The scaling factors for all the alternatives are presented in the following matrix.

	S1	S2	S3	S4	S5	.	.	.																
SO1	.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
SO2	.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
SO3	.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
W_{43}=	.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

Step 8: Determination of the Overall Priorities of the Alternatives

The global priorities of the alternatives were calculated by multiplying the scaling factors of alternatives (W_{43}) and the global priorities of sub-factors ($w_{\text{sub-factor}}$ (global)), as shown below.

W_{43} * $w_{\text{sub-factors}}$ (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

The results produced with the Web-HIPRE online decision software, are presented below.

Table 109: The Importance of the Strategies with ANP in SWOT

	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3
Strengths	0.034	0.032	0.10	0.036	0.026	0.057	0.036	0.020	0.071	0.010	0.031	0.033	0.018	0.022	0.007
Weaknesses	0.007	0.012	0.005	0.015	0.007	0.019	0.011	0.008	0.022	0.004	0.014	0.016	0.015	0.006	0.005
Opportunities	0.030	0.028	0.008	0.014	0.028	0.040	0.031	0.017	0.045	0.014	0.017	0.022	0.011	0.009	0.003
Threats	0.004	0.008	0.002	0.003	0.002	0.007	0.005	0.004	0.007	0.001	0.011	0.013	0.006	0.002	0.002
Overall	0.075	0.080	0.025	0.067	0.062	0.123	0.082	0.050	0.144	0.029	0.073	0.084	0.049	0.040	0.017
Ranking	6	5	14	8	9	2	4	10	1	13	7	3	11	12	15

The weights of SWOT factors with inner dependence effect (produced in Step 4) were used as direct values to calculate the priorities with Web-HIPRE.

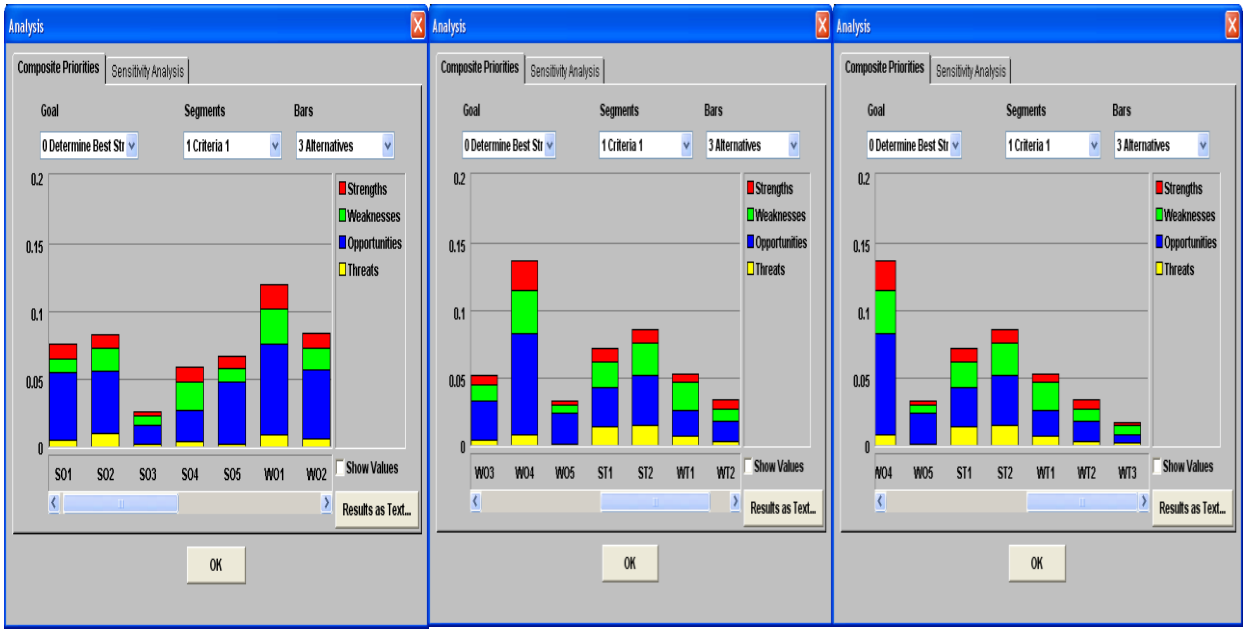
IV.2.1.2. Results with AHP in SWOT

The results of the hierarchical evaluation which was performed with Web-HIPRE, is given below.

Table 110: The Importance Values of Alternatives with AHP in SWOT

	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

Figure 37: The Importance of the Strategies with AHP in SWOT



IV.2.1.3. Comparison of Results

The results with AHP in SWOT and ANP in SWOT are compared next.

Table 111: Comparison of Results

Alternatives	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3
Importance with Inner Dependence	0.075	0.080	0.025	0.067	0.062	0.123	0.082	0.050	0.144	0.029	0.073	0.084	0.049	0.040	0.017
Ranking	6	5	14	8	9	2	4	10	1	13	7	3	11	12	15
Importance without Inner Dependence	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

Table 112: Categorisation of Strategies on their Importance Value

Rank	Strategy	Priorities	
		With Criteria Inner dependencies	Without Criteria Inner dependencies
	Group I		
1st	WO4: Developing Effective Linkage between Industry, Academia and R&D Institutes	0.144	0.137
2nd	WO1: Skill Development Programs	0.123	0.120
3rd	ST2: Establishing Down Stream Facilities in Stable, Near to Market and Competing Regions	0.084	0.086
4th	WO2: Expanding Non-cotton Fibre Base	0.082	0.084
	Overall Group Priority	0.433	0.427
	Group II		
5th	SO2: Establishing Industrial Parks with Common Facilities of Design & Development Centres, ICT Application Centres & Effluent Treatment Plants etc.	0.080	0.083
6th	SO1: Diversification of Product Range	0.075	0.076
7th	ST1: Development of Market Access Strategies	0.073	0.072
8th	SO4: Establishing Downstream Facilities in Competing Regions	0.067	0.059
9th	SO5: Improving Domestic Chemical Industry	0.062	0.067
10th	WO3: Improving Logistics	0.050	0.052
11th	WT1: Work in Close Collaboration with Competitors	0.049	0.053
	Overall Group Priority	0.456	0.462
	Group III		
12th	WT2: Development and Implementation of Long-term & Coordinated Policies	0.040	0.034
13th	WO5: Developing Domestic Engineering Industry	0.029	0.033
14th	SO3: Applying Export Incentives	0.025	0.026
15th	WT3: Introduction of Industry Relief Packages	0.017	0.017
	Overall Group Priority	0.111	0.11

The overall scores of the first group of strategies were 0.433 and 0.427 with ANP in SWOT and AHP in SWOT, respectively. The group is mainly focused on skill development and improving coordination between research institutes and different stakeholders in the chain. The downstream link of the chain (activities which are close to consumer) also achieved higher attention in the scenario of targeted opportunities. Reducing the gap between supply chain system and consumer can improve the confidence of consumers and the responsiveness in the supply chain; it will also reduce the effects of threats. This downstream focus needs higher usage of non-cotton fibres and the expansion of fibre base to help the diversification strategy.

The scores of the second group of strategies were 0.456 and 0.462 with ANP in SWOT and AHP in SWOT, respectively. It is focused on developing a more reliable supply side by improving the internal infrastructure which will also bring higher quality of products and services. It also identify the need to improve the communication and relationship with competitors. It addresses the effects of competition by establishing market access. Product diversification and the responsiveness, both dimensions have their constituents in this category. It should be emphasized that dependence on the strategies of market access can also decrease the desire to improve the competitive position of the industries.

The overall score of the third group of strategies was 0.11. It is focused on the gaps of policy, limited engineering base and the short term relief for the industry in the present scenario of political instability, energy shortfalls and higher support for competitors. This group covers dimensions other than diversification and responsiveness and is more general in its aspects.

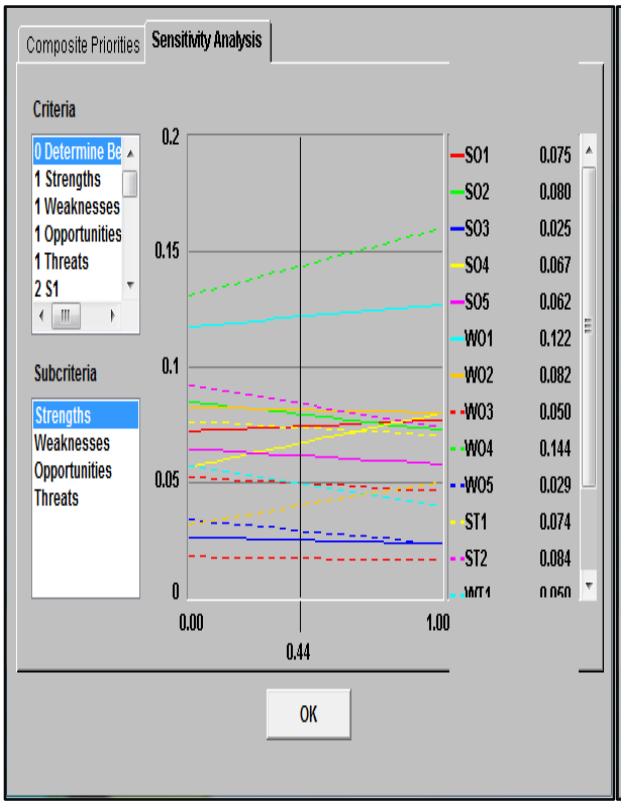
IV.2.1.4. Sensitivity Analysis on Results of the Performance Evaluation

In the process of strategic decision making, presented above, it is always difficult to validate the findings. The decision models are developed to design the future course of action. In the process of planning and implementation, the factors and their intensity for the importance of alternatives can change due to the strategic actions of various forces. In such situations, experts recommend to perform the sensitivity analysis which can help to visualize the effects of various factors.

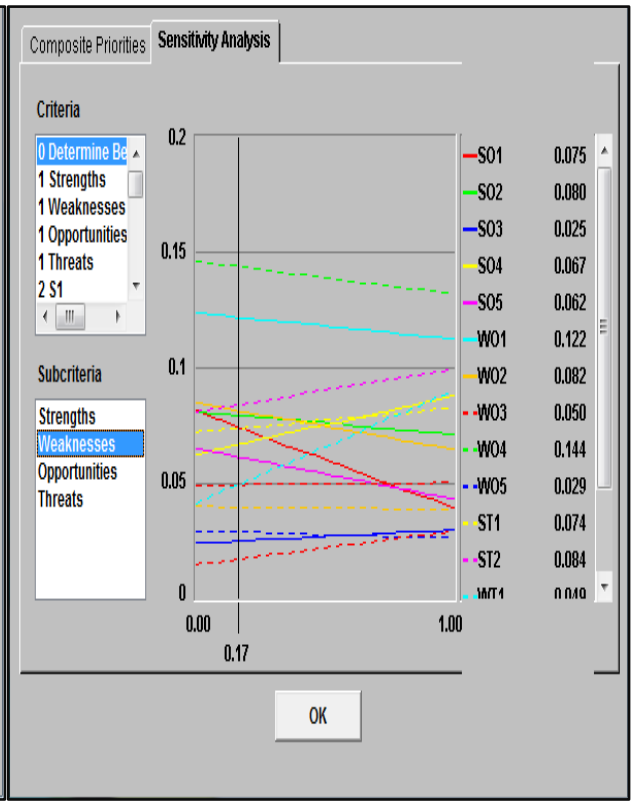
The sensitivity analysis, for the problem in study, is presented in the following figure.

Figure 38: Sensitivity Analysis on Results of Performance Evaluation

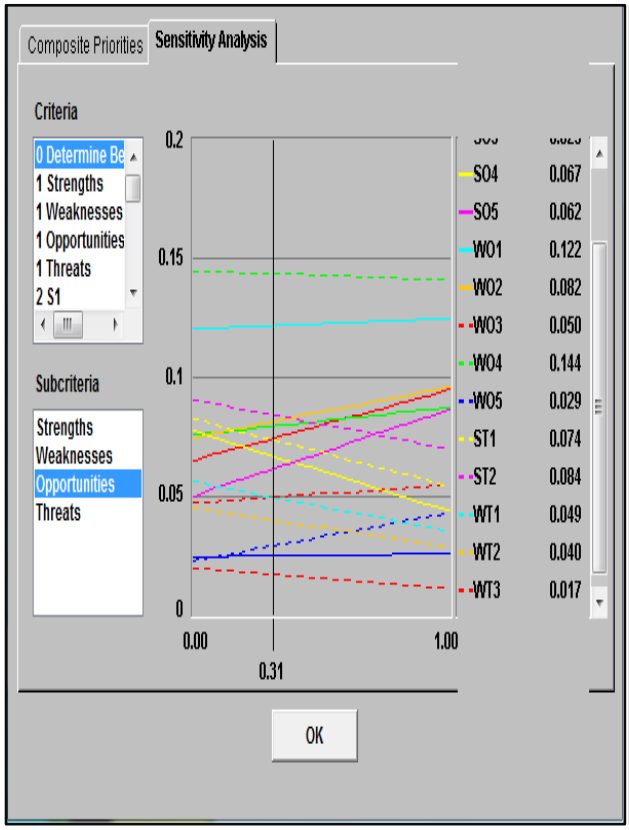
Sensitivity to Strengths



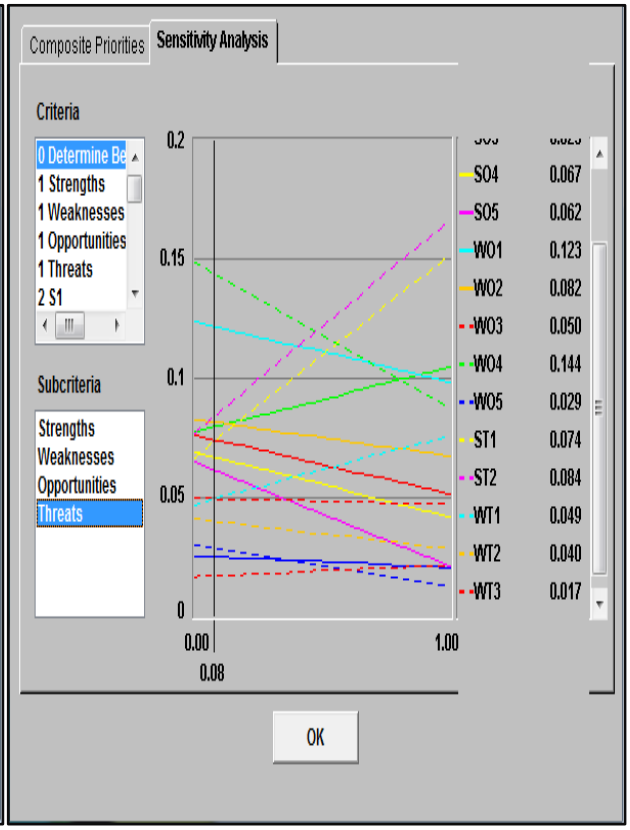
Sensitivity to Weaknesses



Sensitivity to Opportunities



Sensitivity to Threats



It was observed that the overall ranking of the alternatives was mostly stable in a reasonable range of weight, assigned to factors (strengths, weaknesses, opportunities and threats). Notably, ST1 and ST2 seem emerging strategies in case of higher importance to threats.

Increasing the weight of the opportunities, signifies four strategies, SO1, SO2, SO5 and WO2. These strategies address the areas of product diversification and improvement of domestic infrastructure in order to increase the market share in the non-traditional markets of the system. The collective weight of strength and opportunity factors is already high, i.e. 0.75 (0.44 and 0.31, respectively). Increasing the weight of one or the other will decrease the attention from the ones, which offer constraints to the system and include internal weaknesses and external threats. The Threats needs proper attention and serious efforts to neutralize them and should not be neglected while giving higher priority to other factors. In the current scenario, the effects of the external forces are high; the competition is increasing and the political and economic situation is getting worse. These are taking the opportunities away from the system. Therefore, there is a need to analyse and neutralize the comparative advantages of competing systems and other threats. Therefore, increase in the weight of the opportunity factor does not justify.

When the weight for weakness was increased, strategies SO4, ST1, ST2 and WT1 started emerging. These strategies are focused to improve the responsiveness of the system by establishing the downstream facilities in near-to-market and stable regions and by increasing the manufacturer confidence with market access. In the global perspective, the main weakness of the supply chain system is its low responsiveness, especially when we observe the existing potential of the system in the high profit markets. This can be improved by working with the above strategies or even designing other relevant strategies. Other weaknesses can be recognised by observing closely their competitors and improving the relationship with them. The broad insight can be developed by observing the Weaknesses with Threats and/or competition. The weight for the weakness should increase as there is high competition and higher level of threats, which means that to seize more opportunities or even to retain the traditional markets, the system should decrease its weaknesses. It is important to emphasize again that the share of the system is stagnant in the international export markets of textile and clothing. The producers (in south east Asian countries) with similar resources and capabilities are improving their potential. This will certainly increase the risk of losing the international markets share to the regional competitors.

Most important results were observed under the higher weight for Threats. In this scenario, many of the devised strategies seem losing their effectiveness in case the current situation of the political instability sustains and the regional competition grows. In that case, the only option of moving the facilities to more stable regions and developing market access remain a few effective choices for the system.

The sensitivity analysis also shows that the strategy SO2 maintain its effectiveness under most of the scenarios, presented above. Therefore, it can be advised that transforming the textile and clothing supply chain setup into a highly integrated structure will strategically benefit the country in both long and short term planning focus.

IV.2.2. Evaluation on the Implementation Characteristics of the Plans

In the last section, the strategies were evaluated for their importance to the identified opportunities. The existence or availability of these opportunities depends mainly on the time frame and the strategic moves of the competing players. Therefore, it should be desirable to improve the performance in shortest possible time with minimum resources. In such a scenario, the aspects of the implementation process are of different nature when compared to the last phases of the strategy evaluation. In the implementation process, we need criteria, which can provide better means to judge the effective implementation course of the strategic plans. The main constraints in the implementation process are the limited resources and the implementation time. It should be insightful to evaluate the designed strategies on these aspects and this is the main objective of this section.

In order to evaluate the implementation characters of the strategic plans, the Simple Additive Weighting (SAW) method was utilized. It was needed to develop relevant criteria for this phase keeping in view the above aspects of the process. The criteria for the implementation phase is discussed below which will follow the evaluation of the strategies on these criteria.

IV.2.2.1. Simple Additive Weighting (SAW)

Simple Additive Weighting (SAW) is a multicriteria method which is based on the Multi-Attribute Utility Theory (MAUT), devised by Keeney and Raiffa (1993). The SAW method is probably one of the best known and most widely used Multiple Attribute Decision Making

method (Rogers (2001)). It involves devising a function U that expresses the "utility" of an option in terms of a number of relevant decision criteria. Utility represents the satisfaction that each choice provides to the decision maker assuming that any decision is made on the basis of the utility maximization principle. The best choice is the one that provides the highest satisfaction to the decision maker.

In a multicriteria decision problem the decision maker must take into account several criteria whose utility functions are combined in order to produce one mathematical expression called the multi-attribute utility function. Each criterion will have its own utility function. This function is constructed by assigning points to a scale where the extremes represent the best and the worst possible outcomes for the criterion under analysis.

In the simplest approach, if the utility of each criterion is independent of the others (utility independence), than the multi-attribute utility function can be constructed as a weighted average of the utility functions for each individual attribute or criteria.

$$U(\mathrm{X}) = \sum_{all\ i} W_i\, U(x_i)$$

Where X is a vector containing the n criteria and W_i is the weight for criterion which specifies the relative contribution of each criterion to the final decision. A score in the SAW method is obtained by adding contributions from each attribute using a common numerical scaling system.

After having identified the most important criteria for the implementation phase, experts were asked to assign values for the strategies using those criteria. Thus we created a ranking of the strategies for the implementation phase. The criteria used are discussed below.

IV.2.2.2. Criteria for the Implementation Phase

Cost

Cost is an important factor to judge the implementation character of strategies. The motivation for the cost criteria is to estimate and/or compare the magnitude of the financial resources required by strategies. Cost scale is categorised on three levels including Low, Medium and High

ratings. Strategies requiring lower financial resources are favoured relatively to higher cost strategies in the prioritization process. Values for the cost criterion are shown below.

Table 113: Cost Scale

Intensity	Value
Low Cost	1
Medium Cost	2
High Cost	3

Time

Time is the other important criterion for the evaluation of the implementation character of the strategies. The time factor is also divided into three levels including Short, Medium and Long Time. The objective is to give priority to the strategies which can be implemented in shortest times. The values for the time scale are presented in the following table.

Table 114: Implementation Time Scale

Intensity	Value
Short Time (Less than 1 Year)	1
Medium Time (1 to 3 Years)	2
Long Time (Longer than 3 Years)	3

Implementability

It is meaningful to evaluate the strategies if these can be implemented with ease or difficulty. Some of these will require higher involvement and interaction of various players, which will ultimately make their implementation more difficult. Here, the implementability of the strategies is thought in terms of their dependency on the interaction of players and the development status of the activities in focus. Under this criterion, the objective is to favour those strategies which have less dependency on the commitment required or which are already at a higher level of implementation. The implementability scale is given below.

Table 115: Scale for Implementability

Intensity	Value
Easily Implementable	3
Implementable with Moderate Commitment	2
Difficult to Implement (Need Higher Commitment)	1

IV.2.2.3. Application of the SAW Method to Analyse the Implementation Character of the Strategic Plans

The evaluation is based on the expert assessment, performed on the strategies on the basis of the criteria developed above. The findings of the research in the previous stages were discussed with them in order to aid this assessment.

The weights for the criteria were calculated as weighted average on the basis of the values assigned by the group members to the individual criterion on a scale of 1-10. Then the values were assigned to the strategies under new criteria which are presented in the following table together with criteria weights.

Table 116: Values for the Implementation Behaviour of Strategies

Strategy	Criteria Values for Implementation Phase		
	Cost (0.5)	Time (0.3)	Implementability (0.2)
WO4	1	1	2
WT1	2	1	2
ST1	2	2	2
SO3	3	1	3
WT3	3	1	3
WO1	2	3	2
SO5	3	3	1
SO2	3	2	2
SO1	2	3	1
WT2	2	3	1

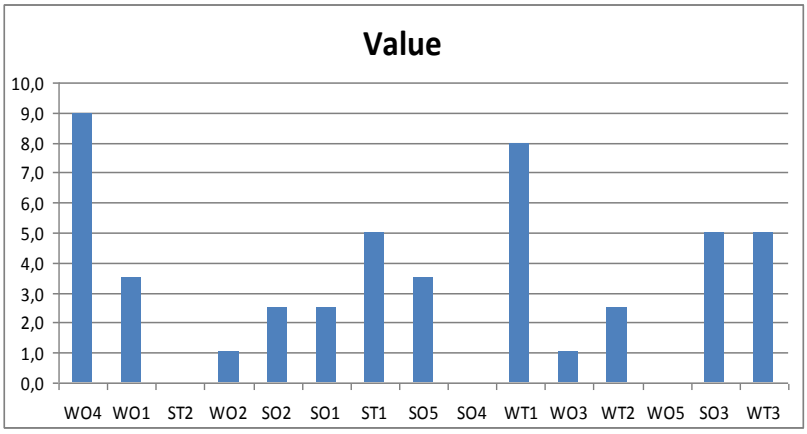
IV.2.2.4. Results on the Implementation Character

The ranking of the strategies was determined using the Simple Additive Weighting (SAW) method, described above. The values obtained for the strategies are presented below.

Table 117: Ranking of Strategies in Their Implementation Behaviour

Strategies	Value	Ranking
Short Term		
WO4: Developing Effective Linkage between Industry, Academia and R&D Institutes	9,0	1
WT1: Work in Collaboration with Competitors	8,0	2
Short-to-Medium Term		
ST1: Development of Markets Access Strategies	5,0	3
SO3: Applying Export Incentives	5,0	3
WT3: Introduction of Industry Relief Packages	5,0	3
Medium Term		
WO1: Skill Development Programs	3,5	4
SO5: Improving Domestic Chemical Industry	3,5	4
SO2: Establishing Industrial-Parks (with Common Facilities of Design & Development, ICT Centres, Effluent Treatment, etc.)	2,5	5
SO1: Diversification of Product Range	2,5	5
WT2: Development and Implementation of Long-term and Coordinated Policies	2,5	5
Long Term		
WO2: Expanding Non-cotton Fibre Base	1,0	6
WO3: Improving logistics	1,0	6
ST2: Establishing Down-stream Facilities in Stable, Near-to-market and Competing Regions	0,0	7
SO4: Establishing Down-stream links/facilities in Competing Regions (Turkey, Egypt, Bangladesh, Mexico etc.)	0,0	7
WO5: Developing Domestic Engineering Industry	0,0	7

Figure 39: Values of Implementation Phase for the Strategies



Depending upon the priority value, strategies were grouped into four categories with the highest to the lowest utility function values. These groups are discussed below.

Top Ranked (Short Term) Strategies (with utility value clearly above 5):

The strategies in this group are related to the improvement of the linkages among internal players and collaboration with external players. The implementation phase for these strategies can be

divided into two parts which cover the initiation and the accomplishment of the desired results. The former needs low resources and higher commitment whereas the later needs much more time and high commitment. In this evaluation, only the initiation part of the implementation phase is in focus. The initiation phase can be regarded as short term whereas the result realization part can be regarded as medium-to-long term.

Short to Medium Term Strategies (with utility values around 5):

In this group, strategies SO3 and WT3 are related to the internal aspects of the chain which can be implemented more easily but require higher resources. However, strategy ST1 covers external aspects and it is more difficult to implement although it needs less resources. Strategies SO3 and WT3 are focused to improve the present environment for the industrial activity in order to direct the products to value added segments.

Medium Term Strategies (with utility values clearly below 5 but greater than 1):

In this group, most of the strategies are focused on the development of infrastructure and skills. The level of development for the activities/segments of the SC system, which are in focus here, is at higher difference, so the requirement of effort and resources is also high. Similarly, the time to initiate these plans and to get the results will also be high. Strategies WO1 and SO2 are already in implementation, which caused their placement under this category.

Long Term Strategies (with utility values 1 or below):

The strategies in this group are the ones which require the highest level of resources because of their scope and their present level of development. To implement these strategies, many players from different segments of the system will need to be involved, which increase the difficulties in their implementation. The strategies under this group are more general in nature and also affect the other sectors of the industrial and business activities in the country, apart from textile and clothing. The resources needed for them can be drawn from the generic plans of development for the industrial activities.

IV.2.2.5. Sensitivity Analysis on the Results of the Implementation Character

The sensitivity analysis on the implementation character is presented below.

Figure 40: Sensitivity Analysis on the Results of Implementation Behaviour of Strategies under Cost Criterion

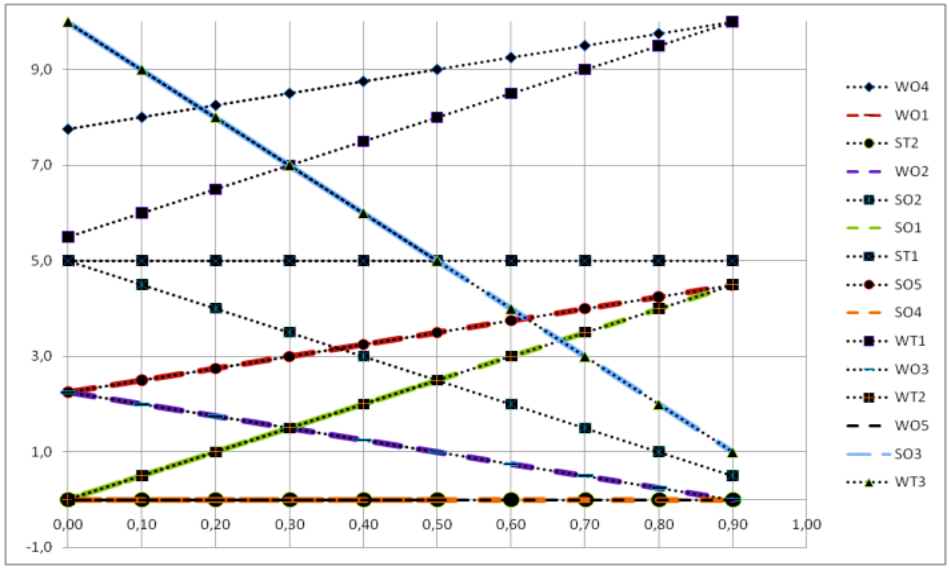


Figure 41: Sensitivity Analysis on the Results of Implementation Behaviour of Strategies under Time Criterion

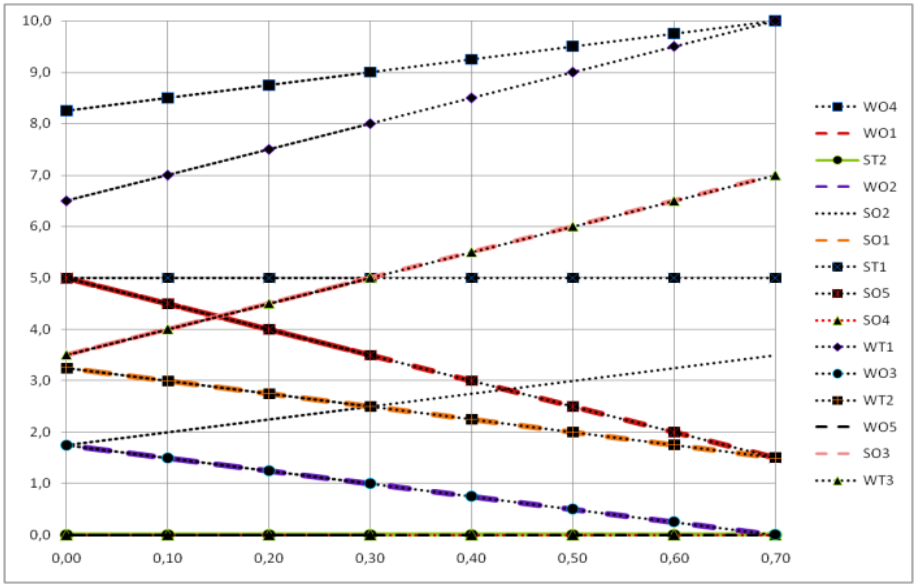
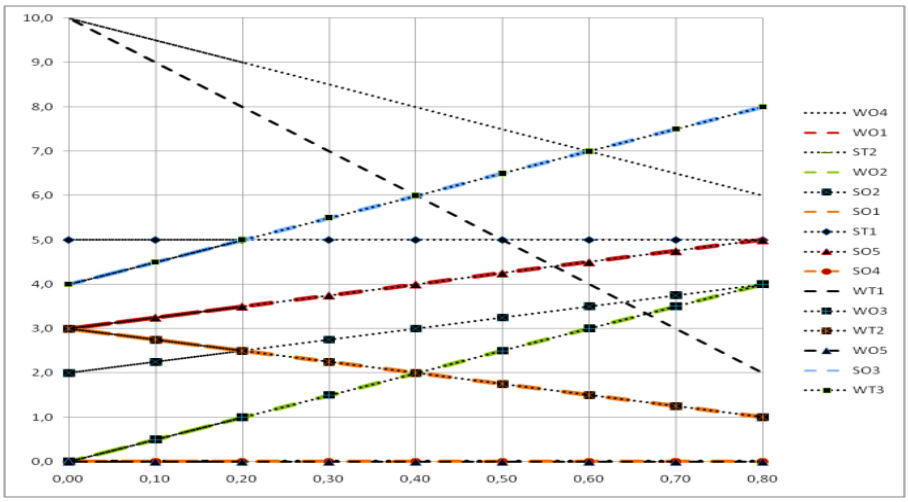


Figure 42: Sensitivity Analysis on the Results of Implementation Behaviour of Strategies under Implementability Criterion



The weights for the implementation criteria including cost, time and implementability were 0.5, 0.3 and 0.2, respectively. Changing these weights by ±50%, the ranking was stable for most of the strategies. No major changes were observed within this range of weights.

The findings on the strategic importance of the devised plans and their implementation behaviour were discussed and presented in our studies, Hussain et al. (2010), Hussain et al. (2012b).

After conducting the above evaluation, it is insightful to present the dependence behaviour of strategies on each other. For example, Strategy "SO1: Diversification of Product Range" depends on many others including WO2, WO1, ST2 etc. This will help to visualise and plan the implementation phase. An attempt is made below to identify this dependence (see Table 118) and later in the section on results and discussion, the implementation scenarios will be presented.

Table 118: Dependence Scenario of Strategies

Strategies		Dependence
SO1	Diversification of Product Range	SO3, ST2, SO5,WO1, WO2, WO4, WT1,
SO2	Establishing Industrial Parks with Common Facilities of Design & Development Centres, ICT Application Centres & Effluent Treatment Plants etc.	Financial Resources, WT2
SO3	Applying Export Incentives	Financial Resources
SO4	Establishing Downstream Facilities in Competing Regions	Financial Resources, WO3
SO5	Improving Domestic Chemical Industry	Financial Resources, WT2, WO4
WO1	Skill Development Programs	Financial Resources, WT2, WO4,
WO2	Expanding Non-cotton Fibre Base	Financial Resources, WO1, WO4, ST2
WO3	Improving Logistics	Financial Resources, SO2, WT2,
WO4	Developing Effective Linkage between Industry, Academia and R&D Institutes	WO1, WT2
WO5	Developing Domestic Engineering Industry	WO1, Financial Resources, WO4,
ST1	Development of Market Access Strategies	WT2, ST2
ST2	Establishing Down Stream Facilities in Stable, Near to Market and Competing Regions	Financial Resources, SO4, WO3
WT1	Working Close Collaboration to the with Competitors	WO3, ST2,
WT2	Development and Implementation of Long-term & Coordinated Policies	
WT3	Introduction of Industry Relief Packages	Financial Resources, (Short Term: SO3, ST1); (Long Term: WO3, WO1, SO2)

IV.2.3. Discussion on the Results of the Strategic Planning

The main findings of the Chapter III and IV are summarised below to discuss the insight developed on the SC system and its strategic dimensions.

The development status of the SC activities was presented at Table 65 and the SWOTs were identified at Table 68. The linkage of the SC activities to the market segments in textile and clothing was conceptualized in Figure 32. These were the inputs for the strategic planning of the system, which were produced from the scanning of the environment of the system. Together, these helped to devise the strategic plans which were given at Table 69. Important Characteristics of the strategic plans were also presented at Table 70. Later, the strategic importance of the plans was also evaluated with classical decision theory of AHP and ANP. The results of the analysis on the strategic importance of plans were presented at Table 112.

On the basis of the strategic importance, the plans were categorised into three groups which were discussed in section IV.2.1.3.

In the following table, the categorisation of the strategies is based on the SWOT dimensions. It shows the weight for the combination of various dimensions in the strategic planning process.

Table 119: Categorisation of the Strategies on SWOT Dimensions

Rank	Strategy	Importance Under Criteria Inner dependence
6th	SO1: Diversification of Product Range	0.075
5th	SO2: Establishing Industrial Parks with Common Facilities of Design & Development Centres, ICT Application Centres & Effluent Treatment Plants etc.	0.080
14th	SO3: Applying Export Incentives	0.025
8th	SO4: Establishing Downstream Facilities in Competing Regions	0.067
9th	SO5: Improving Domestic Chemical Industry	.062
	Overall Group Priority	0.309
2nd	WO1: Skill Development Programs	0.123
4th	WO2: Expanding Non-cotton Fibre Base	.082
10th	WO3: Improving Logistics	.050
1st	WO4: Developing Effective Linkage between Industry, Academia and R&D Institutes	.144
13th	WO5: Developing Domestic Engineering Industry	.029
	Overall Group Priority	0.428
7th	ST1: Development of Market Access Strategies	.073
3rd	ST2: Establishing Down Stream Facilities in Stable, Near to Market and Competing Regions	.084
	Overall Group Priority	0.157
11th	WT1: Work in Close Collaboration with Competitors	.049
12th	WT2: Development and Implementation of Long-term & Coordinated Policies	.040
15th	WT3: Introduction of Industry Relief Packages	.017
	Overall Group Priority	0.106

In this categorisation, more weight was received by the WO group of strategies, which identify the defensive course of action. Such behaviour should be based on the development status of the SC segments. Most of the downstream segments to the SC system, are weak and cannot support the offensive strategic moves in the system. The strategies of the ST group also got higher weights, which also justify the defensive strategic moves.

The results of the implementation behaviour were presented at Table 117. On the basis of the implementation behaviour, the strategies were placed in three categories. Those having values equal or higher than five were placed in short term planning, those with values lower than five but greater than two were placed in medium term and those with values equal or below one were placed in long term category. WO4 and WT1 are the two highly efficient strategies; meanwhile, WO4 has also the highest importance, which makes it most suitable to implement in the starting phases of the implementation phases.

The dependence scenario (see Table 118) and the implementation behaviour of the strategies (see Table 117) are combined together in the following table.

Table 120: Dependence Scenario and Implementation Behaviour of Strategies

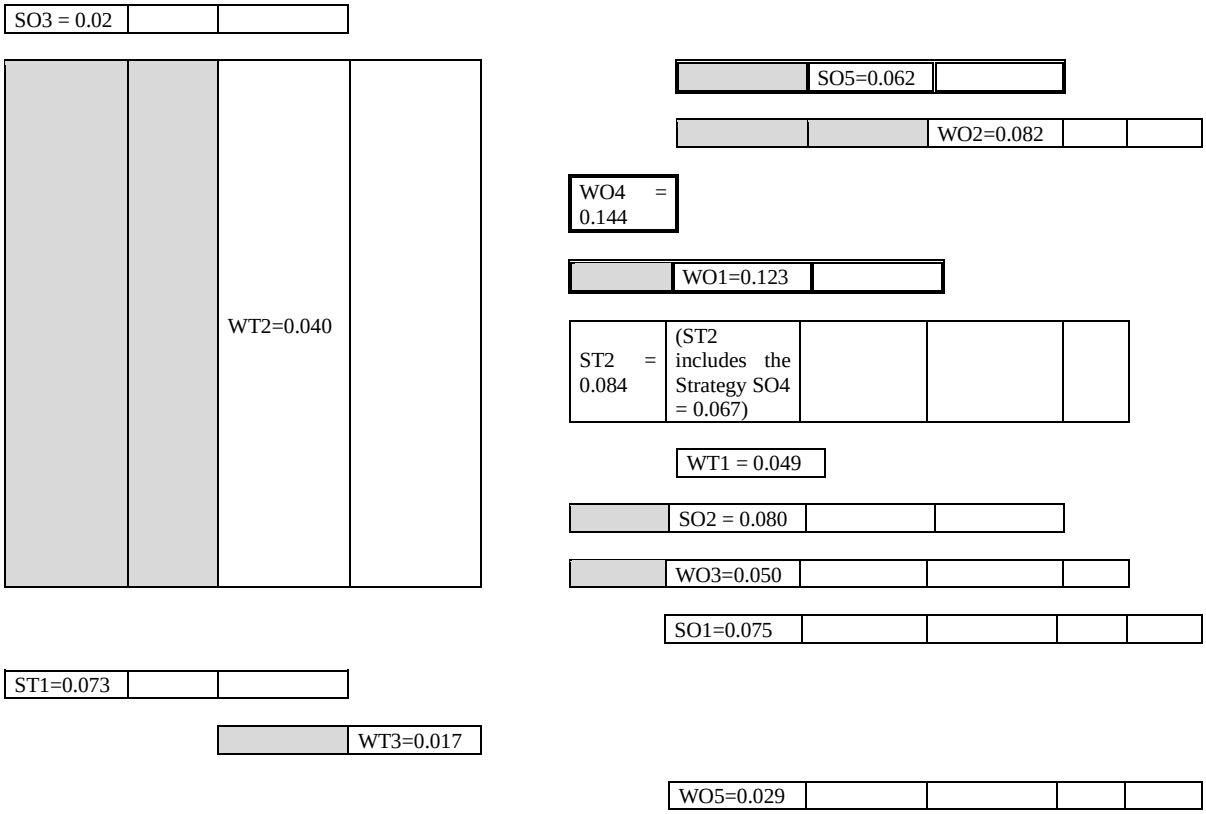
Implementation Effort	Implementation Efficiency	Strategies		Dependence
7.5	2.5	SO1	Diversification of Product Range	SO3, ST2, SO5,WO1, WO2, WO4, WT1,
7.5	2.5	SO2	Establishing Industrial Parks with Common Facilities of Design & Development Centres, ICT Application Centres & Effluent Treatment Plants etc.	Financial Resources, WT2
5	5	SO3	Applying Export Incentives	Financial Resources
10	0	SO4	Establishing Downstream Facilities in Competing Regions	Financial Resources, WO3
6.5	3.5	SO5	Improving Domestic Chemical Industry	Financial Resources, WT2, WO4
6.5	3.5	WO1	Skill Development Programs	Financial Resources, WT2, WO4,
9	1	WO2	Expanding Non-cotton Fibre Base	Financial Resources, WO1, WO4, ST2
9	1	WO3	Improving Logistics	Financial Resources, SO2, WT2, WO4,
1	9	WO4	Developing Effective Linkage between Industry, Academia and R&D Institutes	WO1, WT2
10	0	WO5	Developing Domestic Engineering Industry	WO1, Financial Resources, WO4,
5	5	ST1	Development of Market Access Strategies	WT2, ST2
10	0	ST2	Establishing Down Stream Facilities in Stable, Near to Market and Competing Regions	Financial Resources, SO4, WO3
2	8	WT1	Working Close Collaboration to the with Competitors	WO3, ST2,
7.5	2.5	WT2	Development and Implementation of Long-term & Coordinated Policies	
5	5	WT3	Introduction of Industry Relief Packages	Financial Resources, (Short Term: SO3, ST1); (Long Term: WO3, WO1, SO2)

Keeping in view the implementation behaviour, the dependence of the strategies on each other and their partial implementation in the system, the overall strategic planning of the SC system was visualized and discussed below. This evaluation also reflected on various strategic dimensions of competitiveness in the SC system, including diversification and responsiveness.

The weights, obtained from the evaluation of the implementation behaviour of strategies, are employed to identify the duration of their effective implementation. Effective implementation can be related to a stage, where the real effects of the plans start-to-realize. The efficient strategies were identified from the utility function values. We subtracted these from the overall score of 9 to

get the magnitude of required effort; this helped us to develop the implementation scenario. In the following figures, every cell on the horizontal dimension represents two points of the effort value. The grey shade represents the partial progress on various strategies.

Figure 43: Implementation Scenario of the Strategic Planning Process



The evaluation of the strategic environment, conducted in Chapter III guided that some of the above strategies including SO2, WO1, WO3 and WT2 are already in implementation but without any proper planning and control on their progress. Strategies, SO2 and WO3 are at higher level of progress than WO1 and WT2. Meanwhile, some improvement is seen on the direction of WO1. It is difficult to comment on the status of strategy WT2 without observing the actual policy making process. In general, the process of the system improvement is highly biased in the country; some regions obtain higher resources and efficient means to implement the strategies while others are allocated lower resources and inefficient means of implementations. In the same situation, strategy WT3 has the objectives to improve the system but it is mostly utilised to gain benefits for inefficient players through political negotiations.

Other strategies, especially those which are directed to improve the market linkages and which can speed up the process of improving the competitive behaviour in the system, are at poor level of implementation. It can be added that low attention is received by these moves in the system

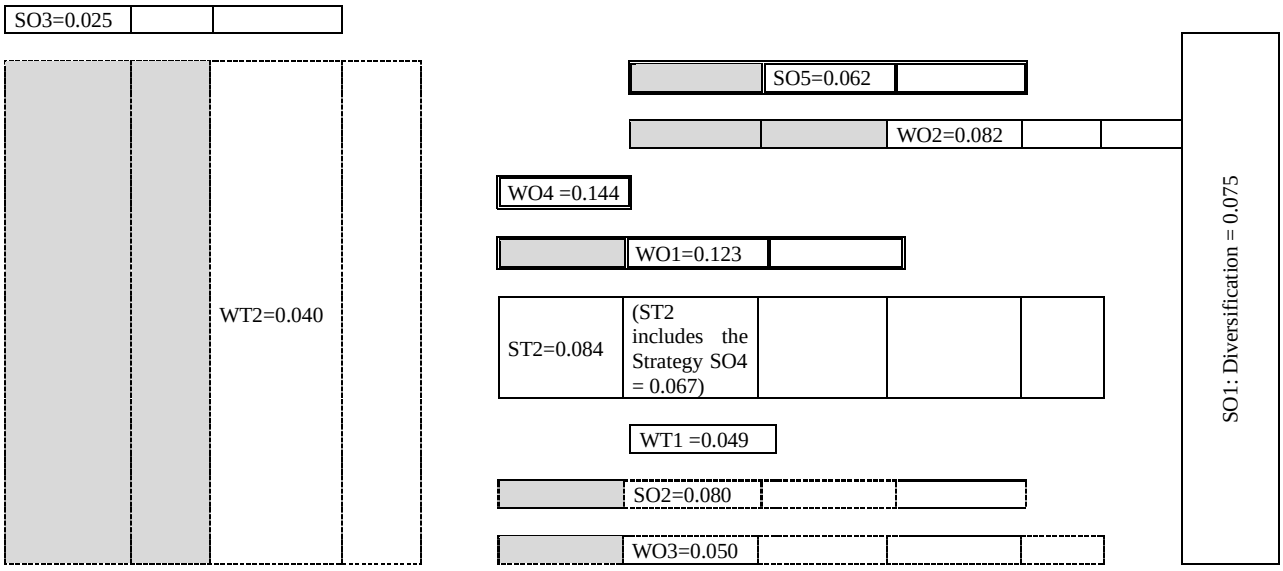
because of low willingness of industries to compete in the global markets. It seems much easier for them to produce standard products and earn low profit and also get some government support.

Looking at the above developments, it can be said that the overall situation of the system although is not very good but even then we can rate it as strong. Most probably, with strong effort and efficient utilisation of the resources, the system can be raised to very strong position in a period of five to eight years from the perspective of a realist.

The above scenario presents a wider picture of the strategic planning problem in study. Now, we can separate the efforts needed on various important dimensions of the strategic planning like product diversification, etc. to advance the insight which was needed to conclude the research.

The importance of various dimensions of competitiveness for the SC system can be identified now. The strategic planning scenarios for the product diversification and responsiveness are detached from the overall scenario to present the final justification of the research motivation and the means to achieve such a status in the system.

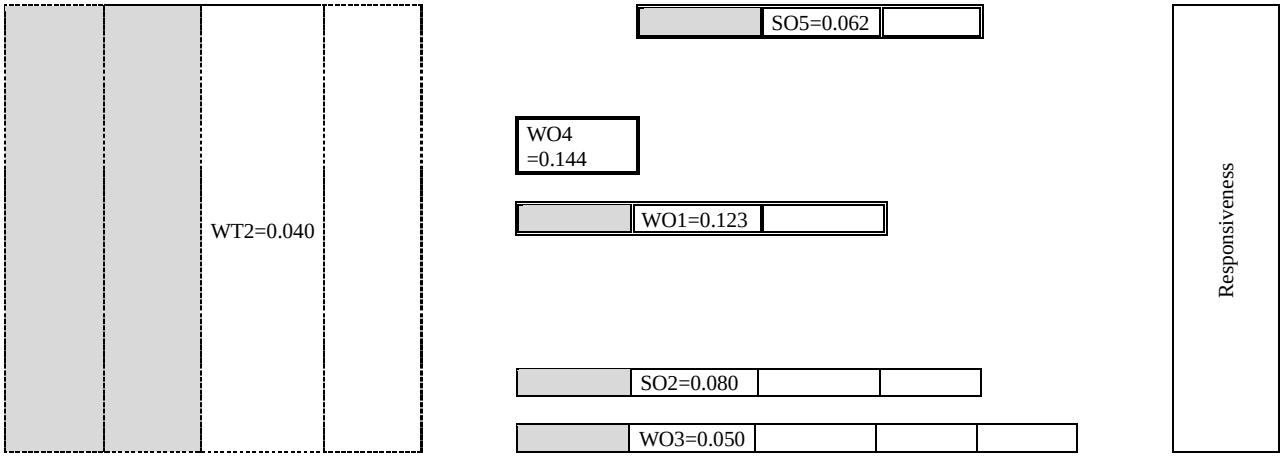
Figure 44: Strategies on the Diversification Dimension



Eight out of fifteen strategies are directly focused to improve the diversification in the SC system including SO1. The importance score of these strategies is 0.636 out of 1. The scores of strategies, WT2, SO2 and WO3 are not taken into account here. Strategy, WT2 frames the policy issues and strategies, SO2 and WO3 are more relevant to the responsiveness. These are shown here because of the dependence of some strategies on them. As mentioned above that some strategies are already in implementation, therefore the process of diversification can be achieved

earlier than identified. Acceptance and commitment are the main inputs for success in these situations, which lack in many cases.

Figure 45: Strategies on the Responsiveness Dimension



Five out of fifteen strategies have the direct role to improve the responsiveness. Their importance score is 0.459. The scores of three strategies, SO5, WO4 and WO1 were included in the dimension of diversification; therefore, leaving their scores will result in a value, 0.13, i.e. the combined score of strategies SO2 and WO3. While separating the scores of SO5, WO4 and WO1, we can add that the delivery efficiency is mainly addressed by strategies SO2 and WO3 whereas other aspects of responsiveness are covered in strategies SO2, SO5, WO4 and WO1. Therefore, improving the delivery efficiency gets a value around 0.13 out of 1. The implementation scenario of the strategies which are responsible for improving the responsiveness of the system is much higher than it was for the diversification process. WO1, SO2 and WO3 are already in better implementation status and the objective of improving the responsiveness of the system can be achieved much earlier than the diversification process.

IV.2.4. Conclusion

The strategic environment of the textile and clothing supply chain system of Pakistan was analysed in this research. The objective was to improve the competitiveness of the system on the dimensions of responsiveness and diversification in the identified product areas or opportunities. The strategic directions were identified and evaluated to measure their importance in relation to the objectives; their implementation behaviour was also analysed to observe the future scenario of developments. In general, the research identified the strategic importance of various factors and strategies and explained the implementation behaviour of the strategies. These were utilized to develop the overall strategic planning of the system.

The strategies which are at higher importance include WO4, WO1, ST2 and WO2 with score, 0.433 out of 1. Strategy, WO4 which is focused to the improvement of the linkages between industry (application of knowledge) and academic institutes (learning of knowledge) and research institutes (development of knowledge). It has the highest importance and it can be implemented most efficiently. Collectively, strategies WO4 and WO1 (WO1: Skills Improvement) can bring the major improvements in the system. In general, this group is mainly attributed to the diversification dimension of the system competitiveness.

The strategy, WO4 is the most important for example and it is also fast to implement with limited resources and therefore maintains its top rank and should be placed in short term strategic plans. Strategy, WO1 is the second most important, it needs high resources and time. Therefore, its implementation character placed it in the medium term strategic plans. Strategy, ST2 is ranked third according to its importance but it is one of the most difficult strategies to implement and much time and high resources are required, which led to place it in the long term plans. This strategy has both short term and long term effects on the system. Therefore, it needs further analysis to find how the implementation process of this strategy can be fasten or if the system can decrease the effects of the threat which are political in nature and political stability in the country can play its role in decreasing these. Meanwhile, the effects of the threats are already visible as the activities are shifting to countries which are more stable and offer higher attractiveness. This phenomenon was envisioned in our studies and it can be advised to encourage the relocation of some activity in the downstream segments in other countries of strategic importance for the international clothing markets. This will improve the competitiveness of the system in terms of its responsiveness and not just relocation to escape from temporary threats. Strategy, WO2 was ranked fourth in the strategic importance value, it require more resources and effort which advise its placement in the long time horizons. The strategy has both short and long term effects, therefore some sectors can be chosen in the short term expansion while others in longer plans.

In a different categorisation of the strategies, based on the SWOT dimensions, higher weight was received by the WO group of strategies. This identifies a defensive course of action. Such behaviour can be justified in the development status of the SC segments, which are weak in the downstream activities and cannot support the offensive strategic moves in the system. The strategies of the ST group also got higher weights, which also support the defensive strategic moves.

The importance values provide the criteria to allocate the resources and efforts on the strategic dimensions. The other important aspect of the strategic planning is the scheduling of the activities (strategies) under constraints and available resources including cost, time to implement, complexity of implementation, etc. This task of scheduling can be based on the implementation behaviour of strategies. We recommend the results of the research for the allocation of the resources and for planning the strategies in short, medium and long planning horizons. Moreover, the resources can be spared and channelled according to the requirement of the time horizons.

The planning scenario actually explains the strategic moves and their sequence in this situation. For example, under strategy WO2 the fibres which can expand the product base of fashion and other clothing and home textiles (the areas which are relatively mature in present) can be placed in short-to-medium term plans whereas the advance fibres (for areas which are in process of development including technical and functional textiles) can be placed in the long term plans. It is added the devised strategies will improve the status of the system on the opportunity areas including O2, O3, O5 and O7. Further, it will bring partial improvements in the system for opportunities, O1 and O6.

The sensitivity analysis evaluated the changes in the results under different values of the criteria or factors. In the evaluation of strategic importance, the increase in the weight of factor “threat” recognised a visible change for some strategies, which is associated with the unstable political environment in the country. The cost factor identified some changes in the implementation behaviour of the plans. In general, within a reasonable range of criteria’s weights, the performance of the strategies was stable.

The significance of the strategies can be viewed both in global context and also for the system in focus. The strategies, WO4 and WO1 which have higher importance in the above evaluation also have universal significance in many strategic planning situations. Their scores, 0.144 and 0.123, are more relevant to the textile and clothing system in Pakistan. Similarly, strategies, ST2 and WO2, are mainly related to the system; whereas, these have lower universal significance. Therefore, some of the strategies developed above can be applicable in similar situations in other systems but their importance values are specific for the system in study at this stage of its development.

Chapter V	An Insight on the Tactical Issues of a Modern Textile and Clothing SC	Page

V.1. Introduction

The behaviour of supply chains which produce for the global SCs networks, should follow the global competitive behaviour. Also, their structures should be configured according to the needs of the global networks. The SC which is discussed here is based in Portugal. It is an advance and complex network of activities. It imports raw material, supplies and intermediate products to manufacture textiles, shirting cloth and shirts for its domestic and international consumers. The products are positioned in specific customer segments which are discussed in the following sections. The SC is successfully satisfying its customers for a couple of decades. In the recent developments in the global textile and clothing scenario, it is observing pressure and a need is being felt to review the overall order fulfilment strategy and to improvement the functional performance of activities.

The objectives, to develop order fulfilment model on time and to analyse various time elements and time performance of chain segments are desired in this detailed case study of textile and clothing chain. The study is exploratory in nature to observe in-depth various phenomena which affect the time performance of chain segments and order flow. We believe that it will discover many interesting aspects for further studies. The flow of study is based on the concepts of the Tersine and Hummingbird (1995), which focuses on the flow of material and information, separates the time elements for various activities in the value chain, measures the identified elements and finally concludes with the analysis of those elements which should identify the areas of time waste and help in reducing them. The flow of the study was conceptualized in Figure 3 (see page 18).

Here, the product environment of the fabric manufacturing segment is in focus and was identified first, which is discussed in the section on the production strategy. Later, the flow of orders in the process was developed and associated with those product environments, which is covered in section on order fulfilment. The process followed the separation of time elements and their measurement for the internal functions in the fabric manufacturing and the outsourced activities. The linkages of internal and outsourced functions were also developed and their expected lead times were identified. They were used to analyse the time performance of the chain on order flows and the productivity and gaps in the chain. In general, the nature of such a process is continuous and it does not stop at this iteration and should be considered as a part of continuous improvement cycle. Our analysis should be regarded a part of an iteration of the continuous

improvement cycle which is performed on discrete time events. We will present the importance of these discrete events at relevant sections, which should be considered as an important basis for such analysis in similar situations.

To conduct the study two main strategies were adopted; one was to observe the functions and processes during the actual flow of specific orders through all the functions of the chain; the second strategy was based on conducting the detailed non-structured interviews and open-discussions with the managers of the functions in order to develop the integration of the chain activities and therefore to develop the linkage of those activities in the overall configuration of the value chain.

In the observation and data collection phases, the author observed the activities performed in a Capable-to-Promise (CTP) order fulfilment process on the internal links of the chain and measured the time elements for the order fulfilment activities. Various order fulfilment processes are discussed in the respective section in the following paragraphs and shown in Fig. 5, 7 and 8. The main activities in the order fulfilment process, depending upon the product characteristics and environment, include order receiving and acceptance, planning, raw material sourcing/reservation, dyeing of yarn, preparation for weaving, mounting in weaving, weaving, inspection, finishing and shipment to the customer.

In the interviews and open-discussions, main target group included the managers of logistics, technical design (Debuxo), planning, yarn store, preparation, mounting, weaving, cloth inspection, cloth store, information system and creation/design functions. The main focus was on the functioning of the operations, their management structures and linkage to other functions and the expected response times. These characteristics of the chain were studied in the observation strategy described above and also from the structure of the information system. Thus the linkages of the chain segments and its configuration were developed from three different views which included the observation on the actual product flow, the understandings/knowledge of managers for their system and the structure of the information system. It provides a more global view of the chain and detailed insight is developed on the factors responsible for time performance in the chain and on various orders fulfilment strategies.

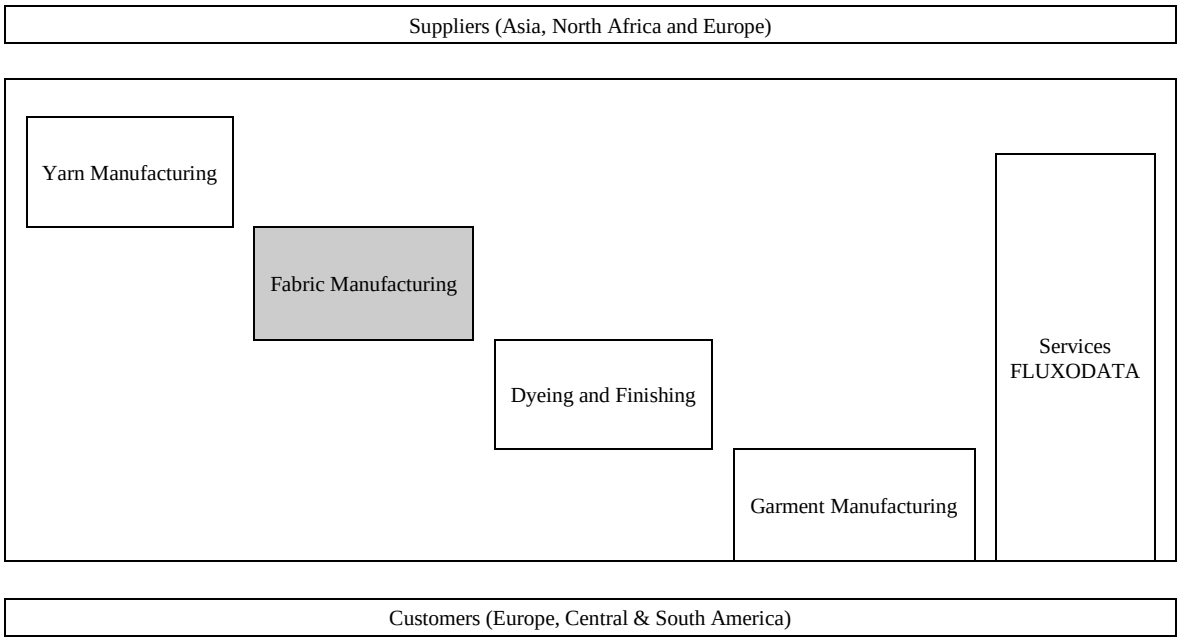
Various means of triangulation were adopted to reach at a detailed insight, including personal observation on the actual order flow, open discussions and in depth non-structured interviews

with managers and operators and the study of information and management systems. It is also important to mention that the data is limited to specific orders and to discrete sets of time for evaluating the performance of activities. It does not provide a continuous evaluation of all orders which entered into the production system. It does not cover the effects of interference of order preference and the availability and utilization of resources, waiting times, etc. It do cover the overall environment in which the firm operates, the evaluations of time performance of main production activities. It also suggests the directions to improve the linkage of the activities in order to improve the competitiveness on response time of supply chain.

V.2. The Case Study: A Textile and Clothing Chain from Portugal

The supply chain produces woven shirting fabric for their customer segments. The fabric manufacturing facility, discussed here is part of their vertical chain which produces the textile and clothing products and also develops software for planning and control in textile and clothing. The company is located in the north of Portugal; it has close working relations with textile and clothing SCs in Brazil. The chain consists of the activities of yarn and fabric manufacturing, dyeing and finishing and garment manufacturing (see Fig. 46).

Figure 46: The Vertical Chain of the Textile and Clothing Company



V.2.1. Configuration and Attributes of the Supply-Production-Delivery Chain

Based on the typology of the supply chains (Myer et al. (2002)), Fleischmann and Myer (2003) described various attributes for supply chains; they were grouped into functional and structural categories. The functional attributes refer to the characteristics of functions and the structural attributes to their linkage with other segments. These attributes for the value chain segment of the company are presented in Table 121 and discussed, in some detail, in the following paragraphs.

Table 121: Main attributes of the Textile and Clothing Supply Chain

Category	Attributes	Existence in the Chain
Functional		
Procurement Type	Products procured	Standard and Specific
	Sourcing type	Multiple
	Supplier lead time	Long but Reliable
	Number of raw materials	Many
	Materials' life (cycle)	Several years
Production Type	Organization of the production process	Job shop
	Repetition of operations	No repetition
	Changeover characteristics	Sequence dependent setup times
	Bottlenecks in production	Known bottlenecks/Low influence
	Working time flexibility	Low
Delivery Type	Delivery structure	Single Stage
Sales Type	Products being sold	Standard/customized
	Products' life cycle	Few months
	Shelf lives	Stable
	Bill of materials	Divergent
	Seasonal demand patterns	Highly seasonal
Structural		
Topography of a SC	Network structure	Mixture
	Location of the decoupling point(s)	Make-to-Stock; Make-to-Order; Deliver-to-order
	Major constraints	Design Change Capacity in Weaving (Mounting); Yarn Dyeing Capacity; Fixed Lead Time at Yarn/Fabric Dyeing and Finishing Facilities
Integration and coordination	Legal position	Inter- and intra-organizational
	Control over suppliers	High

V.2.1.1. Supply/Procurement Strategy

Most of the yarn supplies are procured in South Asia, North Africa and inside country and various accessories and equipment are acquired in Europe and Asia. The sourcing strategy is mainly based on source-to-stock various standard and generic products from multiple suppliers with long and reliable lead times. The life (cycle) of procured raw materials is mostly many

months or up to years. Depending upon the response time required on specific customer orders, yarn can also be procured from the yarn manufacturing facility of the chain which can supply yarn in very short time as compared to other yarn sources. Because of high production costs, the use of own-facility yarn costs higher as compared to above locations. The growth of textile manufacturing in regions near to raw material resources and cheap labour availability have make the lower prices of textiles possible in those regions (Bolisani and Scarso (1996), Loo (2002) and Palpacuer et al. (2005)); these region support the downward activities of fashion designing and marketing near the main markets like Europe. Therefore, the focus of these activities in developed countries is shifted to identify and offer customer oriented products and services. They can be difficult to observe and forecast for the manufacturing regions which are geographically far away and culturally very different like south Asian and European countries for example. Therefore, regions can adopt the manufacturing strategies of standard and generic products which are later converted into products in demand according to seasons and fashion through a postponement strategy. For such generic products in textile and clothing, many Asian countries have already improved their industries to fulfil the needs of various markets like Portugal which transforms many generic and standard items of textiles into more value added items of fashion clothing, home textile etc. for their European markets. The same is true for the studied chain which purchases various types of yarns from international markets and converts it into shirting fabrics according to seasonal trends.

V.2.1.2. Production Strategy

The production in the fabric manufacturing segment is based on two main strategies which include collection development under specific themes (see Table 122 and 123) and the production of standard products including white mercerized shirting fabric of standard characteristics and the popular designs from the last seasons. The later production strategy also suggests that the seasonal or fashion cycles follow an iterative process where some of the old designs or styles enter into standard production zone before leaving the customer demand intensity and becoming completely obsolete.

Majority of the products are produced in yarn-dyed process flow and some are dyed-in-piece. Such choices of process flow apply constraints on the lead time of the respective customer orders in the order fulfilment process specially when fixed and longer-than-necessary response times are

present in the chain. Such effects are identified in later sub-sections where specific orders are studied with their lead times.

Collection Development: Two collections are produced each year for each season of summer and winter. Working on them starts a year in advance and they are presented in national and international clothing fairs to attract customer orders. Standard and non-seasonal products are produced in low demand periods and the seasonal items are produced near or during the season where the seasonal trends are more visible and/or customer demands arrive in the system. In this way the long-term production is spread out in low and high demand seasons from standard and seasonal products. In this context, the overall productions strategy is to produce standard products and collections with produce-to-stock or produce-to-present in non-season periods of the year and to focus on the seasonal products near and during the seasons with strategies of produce-to-order or even produce-to-stock for high demand items.

The development of collections starts February and October for following year´s summer and winter seasons respectively. The collection development process, in year 2011 for the collections of summer and winter 2012, is presented in Fig.47 and the related activities are identified in Table 122.

Figure 47: The Plan of the Collection Development Process of Year 2011 (for the collections of summer and winter 2012)

Table 122: Main Activities of the Collection Development Cycle

Phases of the Collection Development Process	Activities	Activity Codes
Trends and Tendencies Forecasting	Analysis of Sales: Identification of popular designs of the last season Forecast on New Trends and Tendencies: Identification of trends and tendencies for the following years summer and winter collections with design consultant	I
Design and Production Development	Start of designs entering into the Debuxo* function and the production process	II
	End of design entering into the Debuxo function	III
	End of the collection development in the weaving production	IV
	End of the collection development in the finishing process	V
	Collection development process is completed	VI
	Coupon and Samples are ready	VII
Presentation of Collection	Presentation of collection at national and international fairs	VIII
Order Receiving and Fulfilment	Order receiving and fulfilment activities	IX
Note: * Debuxo is the function which is responsible for the development and record of the technical specifications of all the designs		

The main inputs for the collection development process are the forecasts of trends and tendencies, advice of the design consultant for the product lines and the historical data on sales. A collection of the company normally consists of around 1500 designs; half of those are based on new trends and styles and others are based on the popular designs of last season. The collection sheet of Winter-2012 is presented in the appendix. Various characteristics of the collections are described in Table 123, including the styles, customer groups, product and price segments, fabric designs and material requirements.

Table 123: Characteristics of the Seasonal Collection

Characteristics		Raw Material	Product Segment	Customer Segment	Price Segment
Collection Themes	CLASSIC: Classical (simple dobby) designs in stripes and checks with two or three colours	Finer yarn counts of Ne 200/2, 100/2 and 80/2	Shirts and Tie	Executives	Expensive
	CASUAL: Semi-classic (more dobby worked) designs, more colourful and various tones	Medium and finer yarn counts of Ne 50/1, 60/1, 80/1	Shirts	Casual and City-life (Probably high-street)	Expensive and Medium
	CLUB: Sportive designs with all imaginations and colours which can be produced in process constraints.	Coarse yarn counts of Ne 24/1, 30/, 40/1	Shirts	Youth Fashion	Different
	STRETCH: Soft and simple designs mostly for girls; sometimes produced under Classical themes for males	Stretchable yarns of medium to finer counts of Ne 60/1 and higher counts with core-spun.	Shirts	Ladies and Male Classic	Medium and Expensive
Seasonal Attributes	Summer: Designs in light colour and weight; finer cotton and linen yarns; crepe effects Winter: Fabrics of higher weight, twill structures, carded yarns, mélange; flannel finish				
Volume	Approx. 1500 (Half of the collection is based on past demands and rest is based on forecast of future trends				
Forecast Origins	Half of the collection is based on the previous popular designs and their sales (Quantitative Forecasting); the rest is based on the future forecasts of international forecasters on the trends and tendencies (Qualitative Forecasting)				

It can be observed that the process is a complex process and planning and performing these activities in the production process need a lot of care and control where the process constraints can decrease the overall time performance of the chain.

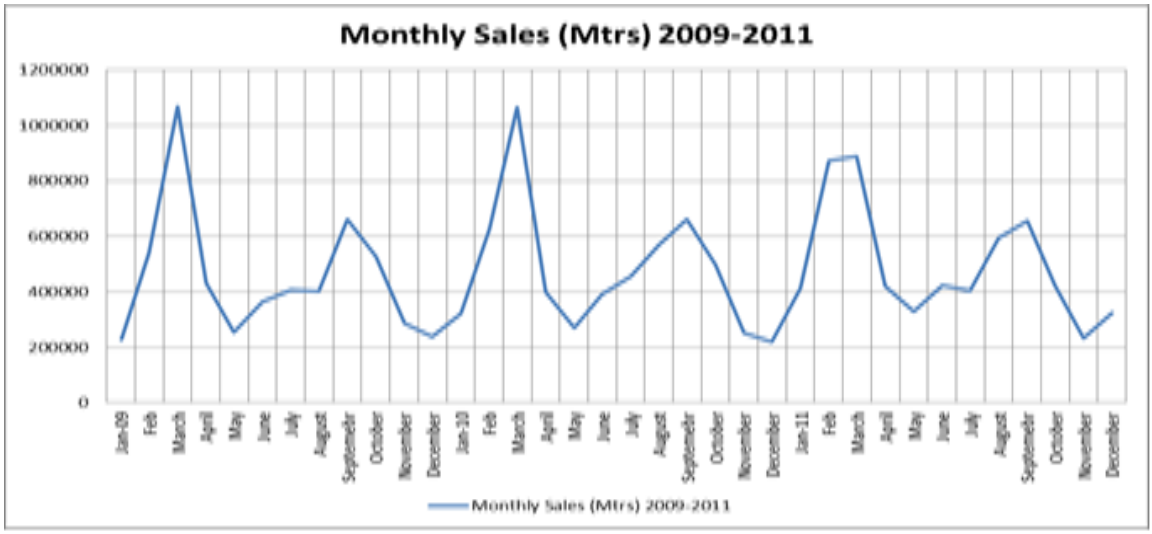
V.2.1.3. Delivery Strategy

The customer's base of the chain is dispersed in Portugal, Europe, Central and South America. The delivery operation in the segment is a single-stage process without any distribution centre. Various modes of delivery are adopted including own transport carriers and third party transport carriers. The vehicles of the company deliver products within country, mainly in the north zone. National carriers are utilized for other areas including central and southern zones. International carriers and air modes are used for countries in Europe and outside which makes the delivery process faster than usual. The time-to-deliver with company transport is less than 8 hours; deliveries inside Portugal are covered in a day time and international deliveries inside Europe take a couple of days to a week time. Deliveries in Central and South America are covered by air carriers and completed in a week time. Therefore, the delivery times range from couple of hours to couple of weeks. The strategy of short quantity orders of specialized items made it possible to supply the customer orders through air delivery which otherwise was costly to implement.

V.2.2. Sales and Demand Behaviour of the Markets for the Products of the Company

The sales patterns of the chain identify the main buying periods for summer and winter seasons and the normal demand periods round the year. The sale for summer season starts in January and February while March and April are the peak demand months. Similarly, the winter sale starts in July and August and peak demand is observed in September and October (see Fig. 48). The production strategy which was discussed above is designed to follow these seasonal patterns.

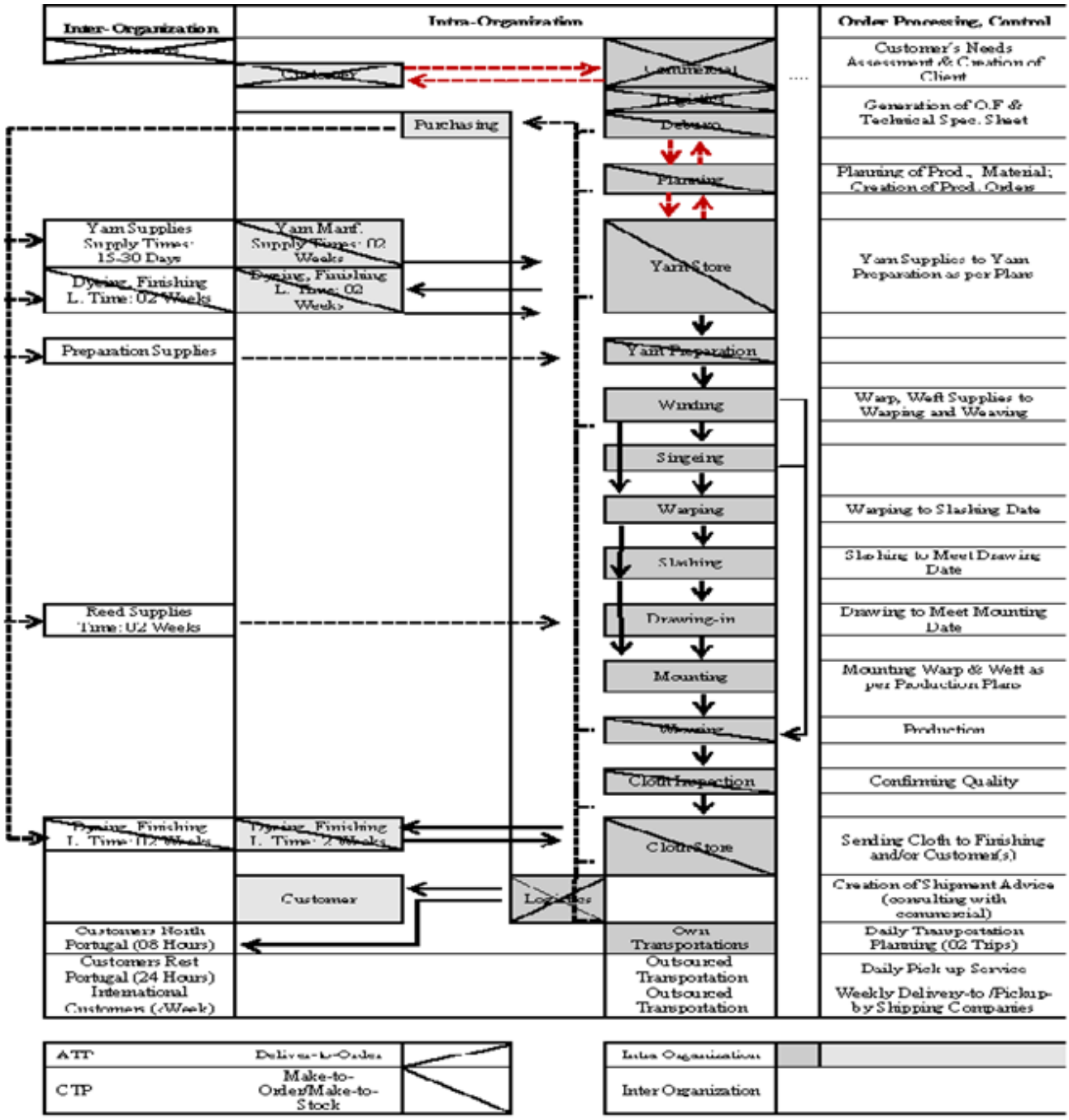
Figure 48: Month-wise Sales of Fabric (January, 2009 to December, 2011)



V.2.3. Linkage and Structure of Segments and Functioning of Chain on Order Fulfilment Process

In this section, we will develop and discuss the linkage of activities and the functioning of the chain in relation to the order fulfilment process. Later we will identify various time elements in the order fulfilment process and analyse them for improvement of time performance. The process should present a logical approach to analyse the time performance of various segments linked in intra-company and inter-company setting in the chain. The linkage of chain segments and activities is shown in Fig. 49. The discussion on order fulfilment under various product environments will continue in the following sub-section and subsequent sections.

Figure 49: Structure and Linkages of the Segments in the Supply Chain and Their Response Times



It can be observed in Fig.46 and Fig. 49, that the company has developed a mature supply chain network of a woven shirt manufacturing value-chain within an intra-company set-up. In Fig.49, the structure of the fabric manufacturing segment is shown in detail at the central part, under the heading of Intra-organization. Supply, delivery, and outsourced activities including yarn supplies and manufacturing, yarn and fabric dyeing and finishing and garment manufacturing etc. are also briefly attached on the network with their fixed lead times which will help us to study various

types of order flows in the fabric manufacturing. Further, in this part of the figure, the continuous lines with arrows show the existence of material and information flows whereas the broken lines with arrow represent the sharing of information through activities. Various order fulfilment flows like Available-to-Promise (ATP) and Capable-to-Promise (CTP), are also identified with diagonal lines on the activity boxes. Some boxes are linked through multiple continuous lines which represent the process flow options. Various activities including data and information management, execution of plans, control of activities and processes, communication etc. are supported with central management execution system.

Let us observe the functioning of the chain on different types of order fulfilment process and the role of the various functions and segments.

V.2.3.1. Functioning of the Chain on Order Fulfilment Process

The commercial function is the outer link of the chain segment to customer markets. It receives enquiries and consults customers to define their needs including design and delivery times. When the needs are defined, the orders are entered into the system to check their fulfilment feasibility under ATP and CTP order fulfilment strategies. After the orders are entered into the system, logistics and planning function take control of these. The system monitors the flow in every function of the fabric manufacturing facility but it does not cover other segments of chain. The system facilitates integrated planning and management of customer orders, information sharing and decision making in the scenario of huge number of customer orders flowing through the value chain segment, which is rare in such facilities elsewhere. We have identified some aspects of the decision environment at different levels of the order processing activity in Fig. 49 at the right most part of the figure. They cover the general decision making process on these stages.

The flow of orders in the preparation, production and other stages is controlled by the planning function which is responsible for the induction of all customer orders into the process. The planning function serves two objectives; at one side it assists the logistics for checking the availability of delivery dates for new orders and to insert the new orders into the production process. On the other side it monitors the flow of orders in the process and exercises the authority to introduce and/or perform updates on deviations of the schedules in the actual flow of orders. The role of planning department should be very important in the situations of quick response as it is the main decision making authority in the delivery dates decisions. Collectively, planning and

logistics have the key to implement various order fulfilment strategies in the value chain and they can provide the transformation from existing order fulfilment strategies towards quick response strategies.

The production status and productions plans are updated regularly in the system at required stages of the process; such inputs include for example the production data and status of quality and time schedules. Meanwhile, all the information including progress on orders is available to the concerned departments and decision makers in real times. The system also identifies the constraints on the resources, which help to decide the appropriate delivery times and to arrange required resources at various levels of the process at due time. When the production phase is completed, the logistics and commercial manage the delivery with the cloth store and dispatch function. The dispatch process is systemized to provide better delivery quality and better inside controls.

The system does not provide the information on production or other delays to the logistics or commercial functions and, as a result, the information do not pass to the customers in case some adjustments are needed and thus the information cycle breaks in the order control system and do not fulfil the objectives of sharing information across the systems. Although, the planning function accommodates deviations of plans within the system but at times it should worth more that such information is available to logistics function that normally has better knowledge on the customer requirements and their reaction on delay. Keeping in view the number of orders, it should not be easy to develop such feedback system at various levels of process but it should be important when focusing the time based performance of the customer orders.

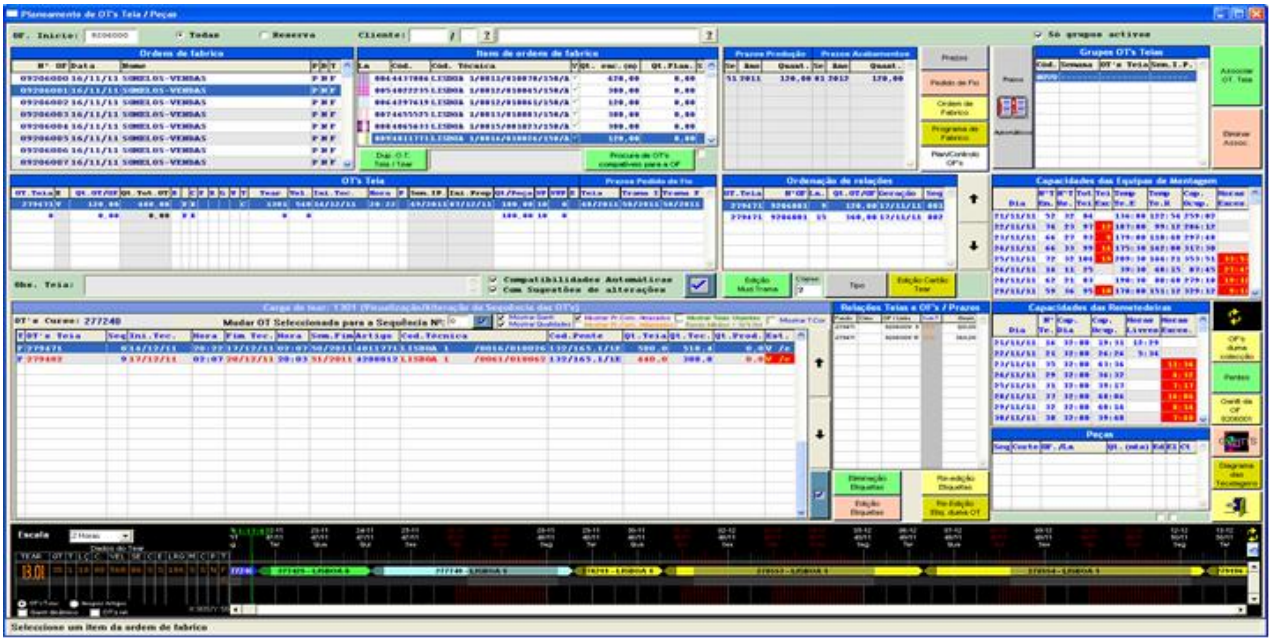
It was observed that the management practices are not yet standardized in accordance with the advance planning system which is searching for management confidence to approve its authority and utilization.

V.2.3.2. Structure of the Fabric Manufacturing Segment

The process of fabric manufacturing is separated into the preparation and main production stages. Yarn store is responsible for yarn stock and availability. The procurement of yarn is arranged on the basis of production plans which are updated regularly for the future production and the historical consumption of yarn is also taken into account during the process. Winding, warping,

slashing, drawing-in, knotting and mounting operations schedule their plans to meet the starting date in weaving thus they react to feed the production at weaving stage. We can say that the weaving stage is the active stage in the planning system and most of the processes before it are reactive ones. There is slack capacity available at the preparation stages. Mounting and drawing-in processes are the main capacity bottlenecks especially in high design change seasons of peak demand and collection development. GPAC is the main program for management execution and control of activities and resources to respond to the customer orders. It is developed internally and its main components are captured in Fig. 50.

Figure 50: Production Planning and Execution Program (GPAC)



Like many other planning programs, it is based on the spread sheet modelling and takes into account the constraints on resources of the chain. In the above figure, the Gantt chart in the lower part shows the schedule of planned and running orders on the weaving machines. The sections in the central right part cover the mounting and drawing-in activities including their schedules, capacities and resources short comings. The central parts provide the control and planning of warps in preparation sections. The sections at top deal with the design and material requirements.

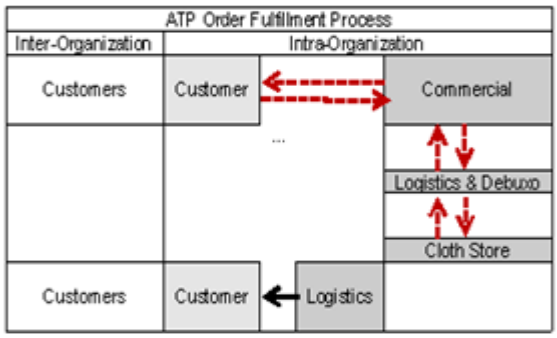
V.2.4. Time Elements in the Order Fulfilment Process

As discussed earlier, the fabric manufacturing segment operates with two main production strategies, make-to-stock and make-to-order. In the make-to-order situation, the customer orders

have to penetrate upward in the value chain following a CTP order fulfilment course. On the other hand, make-to-stock strategy is focused for the standard designs and the popular styles of last season. Majority of the orders lie in the yarn-dyed and piece-dyed process categories and only a small share of orders belong to the category of white mercerized fabric. The order fulfilment process under ATP and CTP for these process types were developed with a general order fulfilment view in Fig. 49. They will help us to analyse the time response of make-to-order and deliver-to-order situations while separate models for these categories are developed in the following paragraphs.

Whenever the fabric, inquired by a customer is available in stock, orders are processed under ATP and deliveries are arranged through logistics. On the other hand, in case of CTP orders, production orders are issued to initiate the subsequent activities of planning, preparation, production and delivery etc. This way, the ATP orders penetrate though commercial and logistics to cloth store (see Fig. 51) and delivery (or dispatch process) is arranged within couple of days or even on the same day. The ATP order fulfilment is a result of the strong linkage of the commercial department with demand markets and the forecasting abilities of the commercial and design development sections on the demand behaviour of these markets. They work closely with the marketing forces of the downward chain.

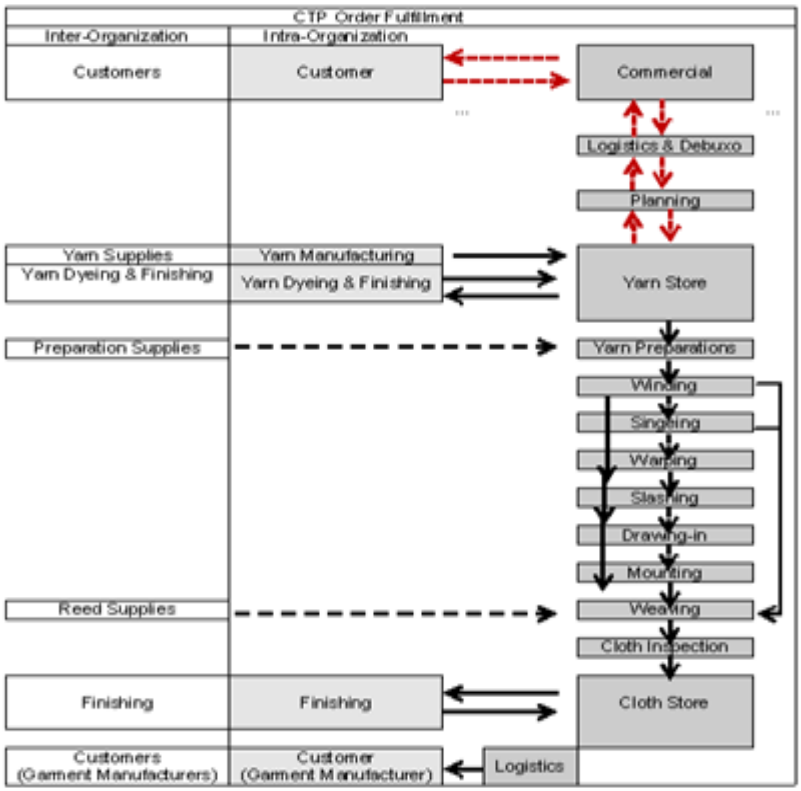
Figure 51: ATP Order Fulfilment



On the other hand, the CTP orders enter in the planning and yarn store to confirm the availability of production capacity and raw material under the make-to-order process; they follow the negotiation process with customers on delivery times and prices. Involving the yarn store in the initial stages helps to determine better delivery schedules as the activity of yarn processing can be saved if different lots of yarns can be used in intended customer order, therefore reducing the order lead time. In general, the time allocation for the activities of yarn dyeing, weaving and finishing processes is around two weeks for each activity, which make six weeks of production

and processing time for orders. In total, eight to ten weeks of lead time is offered to customers on their orders under CTP. Sometimes a finish in fabric is needed which is not available inside the chain; in such cases outside finishing services are hired which increase the lead time by two extra weeks. Therefore the overall customer order lead time may range in between eight to twelve weeks under CTP, depending on the process and material requirements. Order fulfilment process under CTP is more complex than ATP, as shown in Fig. 52 (for a yarn-dyed fabric).

Figure 52: CTP Order Fulfilment for Yarn-dyed Fabrics



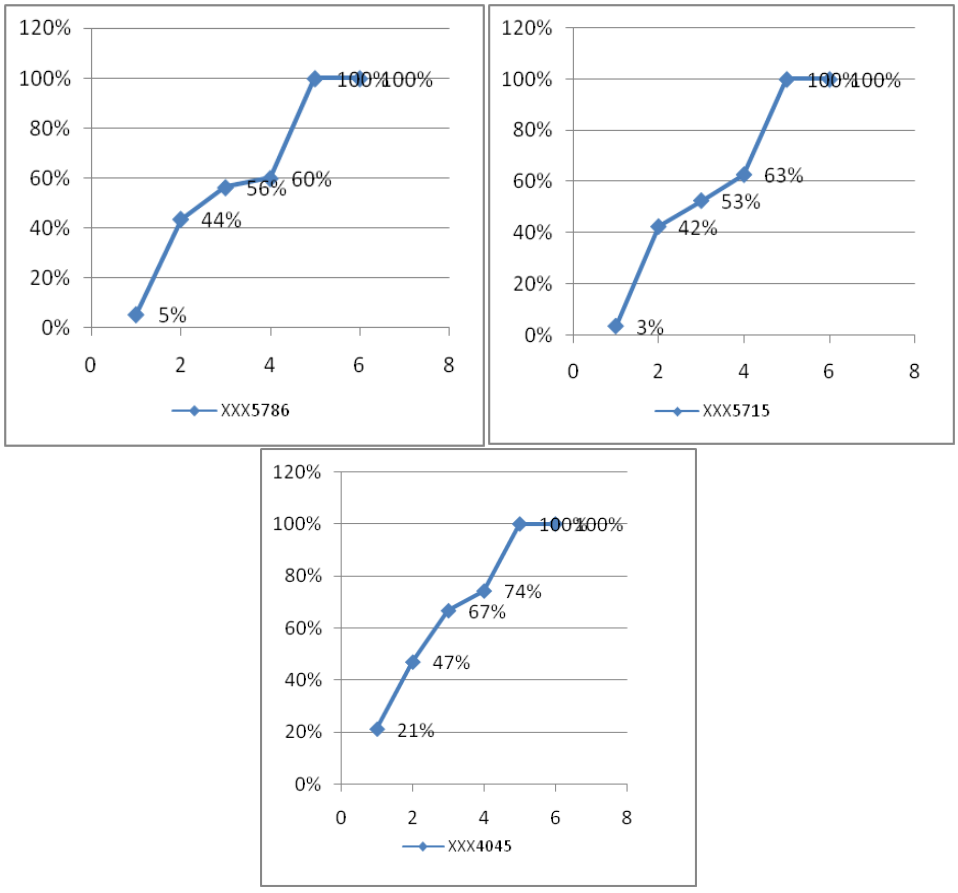
V.2.4.1. Data Analysis on the Time Elements in CTP Orders

The time elements for the activities in the chain, under CTP orders for yarn-dyed fabrics are measured for actual orders and the flow of orders was observed through activities of order inquiry to dispatch/shipment to the customer. Time data on these orders is summarized in Table 124 and in Fig. 53 and Fig. 54. In this data the transportation time and delivery-to-customer period is not included, which can extend the order lead time in case of long delivery durations. In general, the opted means of delivery are faster and are compatible with the customer requirements on the delivery quality.

Table 124: Data Summary on the Time Elements in the CTP Order Fulfilment for Yarn-dyed Fabrics

Order Numbers	XXX5786	XXX5715	XXX4045	XXX4655	XXX4245
Fabric Quantity in Meters for Various Styles	360+360+480+360	720+480	240+420	1140+1200+540+360+ 365+420+840+480+420+420	540+360
Time Elements	Completion Time in Days				
Order Received (O. R.) to Planning	0 to 3	0 to 2	0 to 14	0 to 15	0 to 2
O. R. to Start Preparation	19 to 24	22 to 25	30 to 31	35 to 50	31 to 34
O. R. to Start Production	24 to 31	25 to 31	41 to 44	38 to 56	42 to 45
O. R. to End Production	26 to 33	30 to 37	44 to 49	45 to 59	45 to 49
O. R. to Finishing	55	58 to 59	66	60 to 73	58 to 64
O. R. to Shipment	55	59	66	73	64

Figure 53: Cumulative Time Share of the Activities in the CTP Order Fulfilment



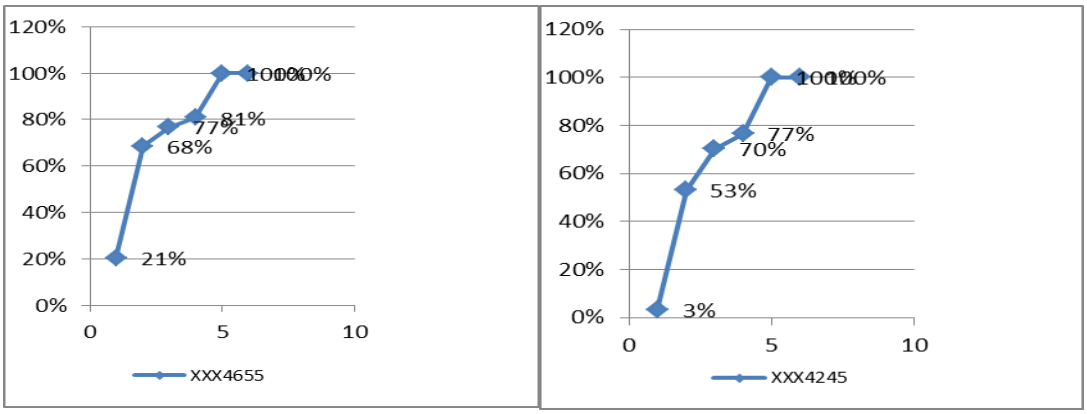
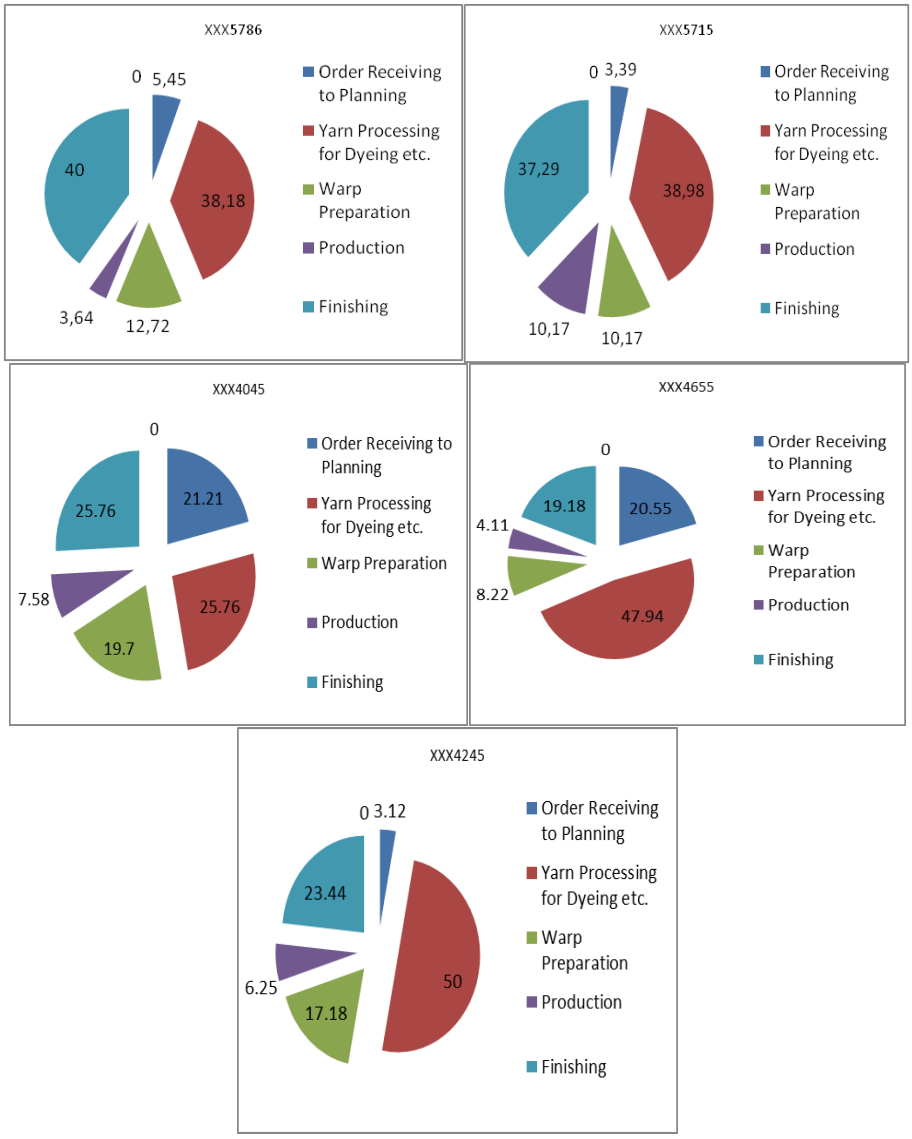


Figure 54: Time Share of Individual Activities in the CTP Order Fulfilment



Let us observe the data and discuss the effects of production strategies on the time performance of the order fulfilment and also on the performance of the fabric manufacturing segment.

In Table 124, Fig. 53 and Fig. 54, the time elements are separated for the activities of: a) Order Receiving to Planning, b) Yarn Processing, c) Warp Preparation, d) Fabric Production, e) Fabric Finishing and f) Shipment. The time elements for activities “a” to “e” are collected and these are presented in these diagrams as a cumulative sum on the preceding activities whereas the data end i.e. activity “e” is considered as the start of the dispatch/shipment activity which is element “f” in this case. Although, for many orders the delivery activity is not controlled internally, as it is outsourced, and the delivery durations are not available, it was observed that the dispatch function takes care of delivery quality including time with the help of the concerned carrier service.

In the order flow of yarn-dyed fabrics, the highest time shares are present at the external links of the chain or outsourced activities of yarn dyeing and cloth finishing. On these links, the lead times are fixed and these are not based on the actual work content of orders. Control on their lead times is not explained and is not exercised in the order execution system of fabric manufacturing facility. In the scenario of time based performance on the customer orders, the reduction of the fixed lead times on these external links can be focused for such strategies and major reductions on order lead times can be achieved. The uncertainties of the preparation stage of yarn processing (yarn dyeing and finishing) increase the uncertainty of planning at weaving stage which can be reduced by inducting the production control of yarn processing in the weaving preparation. Such a change should not be difficult to implement while the process of yarn dyeing has not a complex structure but it’s restructuring in terms of its production control under weaving segment and its modified linkage will ease communication load and streamline the decision making at planning stage in the fabric manufacturing. Additionally, it will help to reduce the order fulfilment time and most probably increase the weaving shed time efficiency because of reduced planning uncertainty and also because of improved performance in preparatory process due to higher visibility.

The highest time share in the internal activities of fabric manufacturing segment lie on the warp preparation activity which has a share of 10 to 15 % of order lead time in the observed customer orders; they need further evaluation in terms of expansion of data to more customer orders and evaluation of participating activities. Following section will contribute in these aspects as a main preparation activity is analysed there in terms of its effects on the time performance of the weaving production and as a capacity constraint in the style change process.

V.2.5. Style Change Activity and the Analysis of Its Performance

The style change or mounting operation is the main bottle neck in the fabric manufacturing segment of the chain and similar constraints should exist in facilities which follow same production strategies. Studying the characteristics and analysing the time performance of the process will identify the effects of mounting on weaving production and order fulfilment process. Further, these will suggest the improvements which are required in the operation, structure of the mounting team and the process. This will reduce the effects of capacity constraints in the high style change periods of the year. These high style change periods are associated with the high demand seasons and collection development phases.

The mounting operation is performed to change the fabric design on the weaving machine. The fabric design includes various properties of fabric such as thread interlacement or weave, threads density in horizontal and vertical dimensions, fabric width, patterns of colour in yarn directions, thread thicknesses, etc. The required amount of changes affects the mounting time and it require much time to perform a mounting operation when design properties vary a lot from the design which was previously being produced on the machine. In situations where the two styles are similar in terms of these properties, the conversion process needs less effort and time and even the skills of workers.

The classification of type of mounting operations is given in Table 125. The process time standard of the company is also shown.

Table 125: Time Standard for Various Types of Mounting Operations

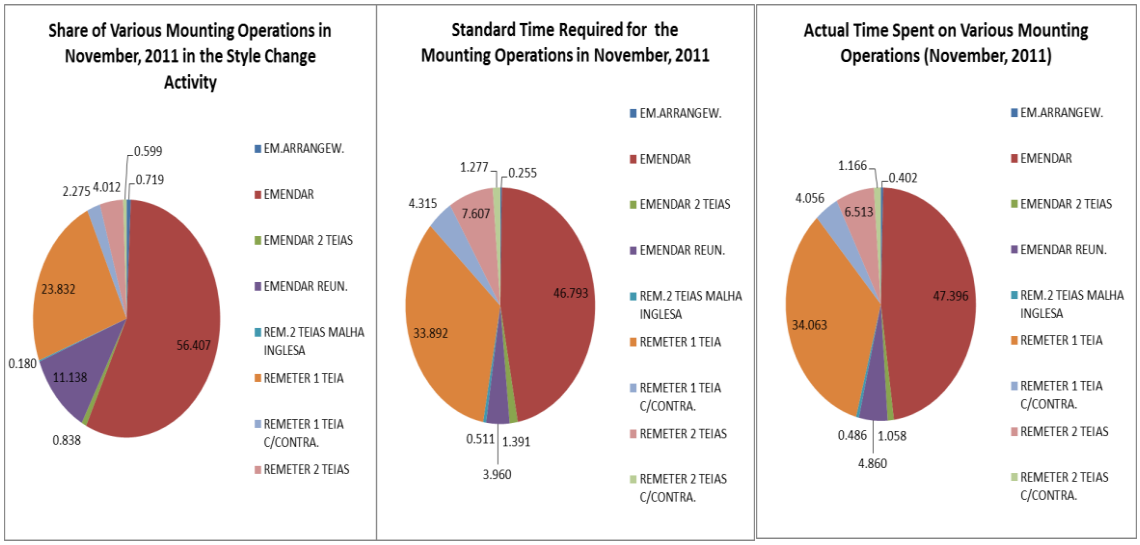
Mounting Type	Time Standard	
	Hours	Minutes
Knotting (one warp with similar width as old warp)	N/A	N/A
Knotting (one warp with different width from old warp)	07	420
Knotting (two warps; similar width)	N/A	N/A
Knotting (two warps; different width)	14	840
Remeter (one warp; almost similar widths)	N/A	N/A
Remeter* (one warp; different width)	12	720
Remeter with Contra- Marche* (one beam; different width)	16	960
Remeter (two warps; similar width)	N/A	N/A
Remeter (two warps; different width)	16	960
Remeter with Contra-Marche** (two warps; different width)	18	1080
Sample Knotting (probably on sample machine)	03	180
Note: * The term Remeter is used for Drawing-in process in Portuguese language; ** The term Contra-Marche is used for fabric manufacturing process with varying weft densities		

Keeping in consideration the above standards of time, let us observe and analyse the time performance of mounting operations for the month of November, 2011. The data on various types of mounting operations and their time share, actual, standard time and wasted time and other summaries are presented in Table 126 and Fig. 55.

Table 126: Month Data Summary on Mounting Operations (November, 2011)

Total Non-working Time in Weaving in the Month of November, 2011 = 22491.45 Hours											
Operation Type	Standard "Min"	Operations	Share % "Quantity"	Required Std. Min.	Share % "Std. Time"	Act Min Used	Share % "Act. Time"	Diff=Act-Std	Share % of Diff.	Wasted Time per Operation	Avg. Minutes Used
	a	b	b/Σb	a*b	a*b/Σ(a*b)	c	c/Σc	(c-a)*b			c/b
EM.ARRANGEW.	180	12	0.719	2160	0.255	4362	0.402	2202	1	183.5	363.50
Knotting (1-warp; Different-width)	420	942	56.407	395640	46.793	514118	47.396	118478	50	125.8	545.77
Knotting (2 Warps)	840	14	0.838	11760	1.391	11475	1.058	-285	0	-20.4	819.64
Sample Knotting	180	186	11.138	33480	3.960	52714	4.860	19234	8	103.4	283.41
Remeter (2 Warps) MALHA INGLESA	1440	3	0.180	4320	0.511	5277	0.486	957	0	319.0	1759.00
Remeter (1-warp; Different-width)	720	398	23.832	286560	33.892	369485	34.063	82925	35	208.4	928.35
Remeter with Contra-Marche (1 Warp)	960	38	2.275	36480	4.315	44000	4.056	7520	3	197.9	1157.89
Remeter (2-warps; Different-width)	960	67	4.012	64320	7.607	70645	6.513	6325	3	94.4	1054.40
Remeter with Contra-Marche (2 Warps)	1080	10	0.599	10800	1.277	12643	1.166	1843	1	184.3	1264.30
Total (Σ)		Σb = 1670		Σ(a*b) = 845520		Σc = 1084719		Σ(c-a)*b = 239199	100		
				Required Hours =14092		Hours Consumed = 18078.65		Wasted Hours = 3986.65			
						Share in Total Non-working hours = 80.38 %		Share in Total Non-working hours = 17.73 %			

Figure 55: Share of Different Mounting Operations in November, 2011



The data summary informs that the main time share in the mounting is composed of Knotting (1-warp; Different-width), Remeter (1-warp; Different-width) and Remeter (2-warps; Different-width). The operation, Remeter with Contra-Marche (1-warp; Different-width) also has a good share in total spent time due to the fact of its higher time requirement in a single operation and is significantly higher than the time required by other types of mounting operations. Such a relative comparison of required time is developed for various mounting operations by considering the standard time of Knotting (1-warp; Different-width) as value 1 and transforming other standard operation times against this index value (see Table 127).

Table 127: Relative Comparison of Mounting Operation Times

Mounting Type	Relative Time for Various Mounting Operations Against the Index value of Time for "Knotting (1 warp; different width)"
Knotting (one warp; similar width)	N/A
Knotting (two warps; similar width)	N/A
Remeter (one warp; almost similar widths)	N/A
Remeter (two warps; similar width)	N/A
Sample Knotting (probably on sample machine)	0.43
Knotting (one warp; different width)	1.00
Remeter (one warp; different width)	1.71
Knotting (two warps; different width)	2.00
Remeter with Contra-marche (one beam; different width)	2.28
Remeter (two warps; different width)	2.28
Remeter with Contra-marche (two warps; different width)	2.57

Other important summary (see Table 126) is the amounts of wasted time and their shares. Again, three operations, Knotting (1-warp; Different-width), Remeter (1-warp; Different-width) and Sample Knotting have around 93 per cent share in the wasted time whereas. Adding the share of two other operations, Remeter with Contra-Marche (1-warp; Different-width) and Remeter (2-warps; Different-width) will raise their total wasted time share to 99 per cent. Initially, these operations can be focused for standardization, training of technicians and for other strategies of efficient performance. It is important to mention that our data analysis does not identify these factors but their relevance was felt during the observation of the operation. The highest waste of time in terms of wasted amount per operation has occurred on operations of Remeter and Remeter with Contra-Marche which should be the obvious candidates for further analysis.

The number of non-working hours in weaving in the same month, caused by the mounting operation is 18078.65 out of the total non-working machine hours of 22491.45, which accounts for the 80.38 per cent share of the non-working time in the weaving, which is huge. Waste of time due to various inefficiencies in the mounting operation caused a 17.37% loss of time, which is also huge amount and can bring additional useful production time if planned and controlled more efficiently. It is clear that the role of mounting activity has the highest share in non-working hours of the weaving room; measures should be taken to reduce time waste here which will improve the overall performance of the chain.

In this study, the standard time does not represent the theoretical time needed by relevant operations but it is the time standard, developed in the case company considering many factors including technician skills, their availability to perform the operation and availability of various other requirements which are needed for the uninterrupted performance of mounting. We cannot verify the authenticity of these standards in terms of the above factors which were identified by concerned functions; but we want to add that they need more rigorous inputs as our general observation is that the standards have a wide slack. Our assumption has its basis in the observation of actual mounting operations; they should be analysed in greater detail to construct a more precise planning program to avoid the planning inconsistencies, resulting from such wide slacks which make it inconsistent. Additionally, the above data can be extended to other months to study the seasonal effects of demand on the mounting operation and to observe the variation of process performance under those seasonal effects and similarly under different phases of production strategies. This will help to design relevant strategies on load balancing in those high design change periods.

V.2.6. Discussion

The structure and the characteristics of a textile and clothing supply chain are studied; the focus was on the order fulfilment process in the fabric manufacturing segment of the chain. The partial results were presented in our study, Hussain et al. (2012a) and the detail on the overall findings is covered here.

The fabric manufacturing is supported with up and downward value chain segments; the support of program development for data management and order execution is also available in the chain (Fig. 50). In the last couple of decades, the supply chain has gone through many phases of evolution and has developed very strong customer relations on the basis of quality and innovativeness in their designs. The changes in the global textile manufacturing moved the business strategy of the chain towards lower quantities and higher number of fabric styles. Such moves brought higher loads on the planning and execution system and on the activity of design change (mounting) and converted them into the main bottle necks. Higher working times for machine setup reduced the time performance in production, which was compensated with higher prices of the high-end markets. The study on such comparisons is not included here but it can bring further facts on the profit scenario of the value chain.

Here, the process of order fulfilment was modelled and the time based performance of the chain including lead time performance was analysed. Currently, the order fulfilment strategies of the chain are not based on achieving shorter lead times but they can bring additional benefits for the chain, although with a lot of effort. We have identified the restructuring of specific functions in the chain including planning, yarn dyeing and the mounting activities to initiate the transition for shorter lead times, and also to improve the performance of the chain even in its current configuration. The planning activity is kept closer to production in terms of its functionality and/or control than to logistics which should be the logical companion or authority of the planning function. Together, they should be more effective in implementing various planning situations without creating planning inconsistencies, thus reducing rework. Specially, their combination will help implementing short lead time strategies. Yarn dyeing is located on external link for fabric manufacturing and thus the planning and start-of-production for specific orders is mainly dependent on the fixed lead time of this activity. Bringing its production control under fabric manufacturing can help reduce the Planning-to-Production duration to a period of 2 to 3 weeks, which in many orders is around 4 to 7 weeks.

The amount of work load on mounting operation will always exist in these situations and there is a strong need to restructure and develop a mounting team on the basis of detailed scientific studies to guide the required restructuring. There are many factors to study as identified in section 3.5. Similarly, there are areas to improve in mounting operation such as to revise the time standards, to focus on particular training needs of technicians, pooling of technicians and expansion of the mounting team. Again, the restructuring and training not only will benefit in the scenario of short lead times but it will also help to improve the current production performance of weaving.

The preparation process in general is configured in the management execution system to meet the production starting-dates in weaving; this reactive functioning of the preparatory processes is not covered here and it needs to be analysed. The time performance for the order flows of piece-dyed and grey fabrics should also be studied on their effects on the value chain; these were also not studied here because of non-access to the relevant data and due to time limitations.

By observing the strategic performance of the weaving production in the various demand cycles and related activities can also offer an insightful way to find causes of low performance and suggest effective strategies. Weekly working and non-working time in weaving and the time efficiencies are presented in Fig. 56 (A) and (B).

Figure 56 (A): Time Performance of Weaving Room (2011)

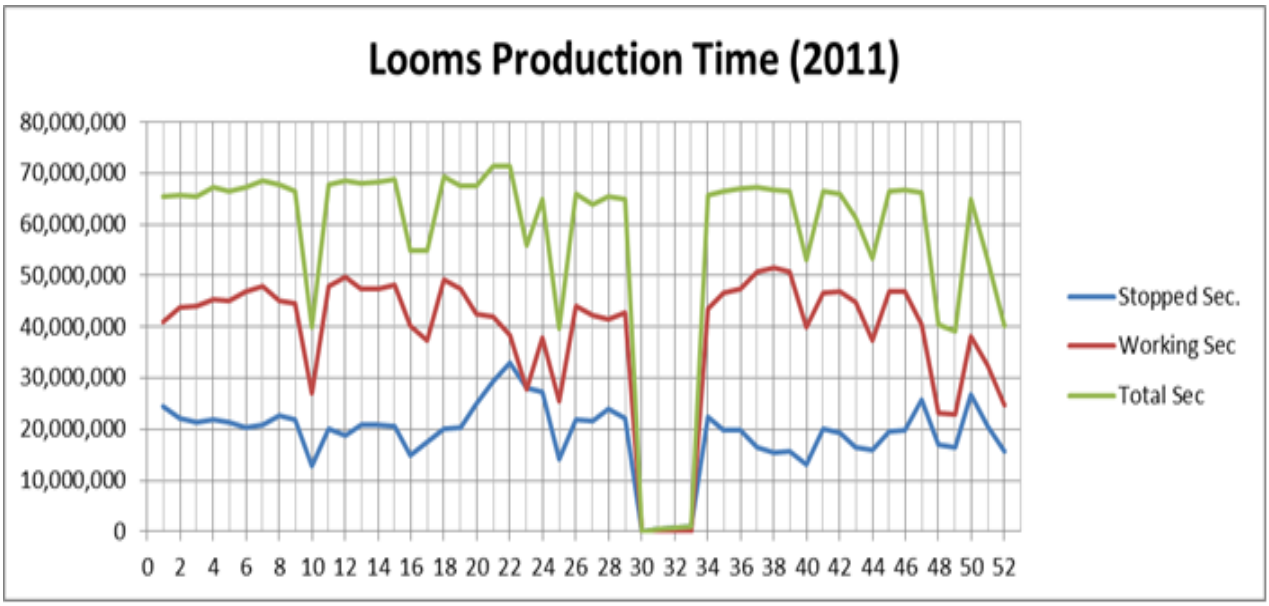
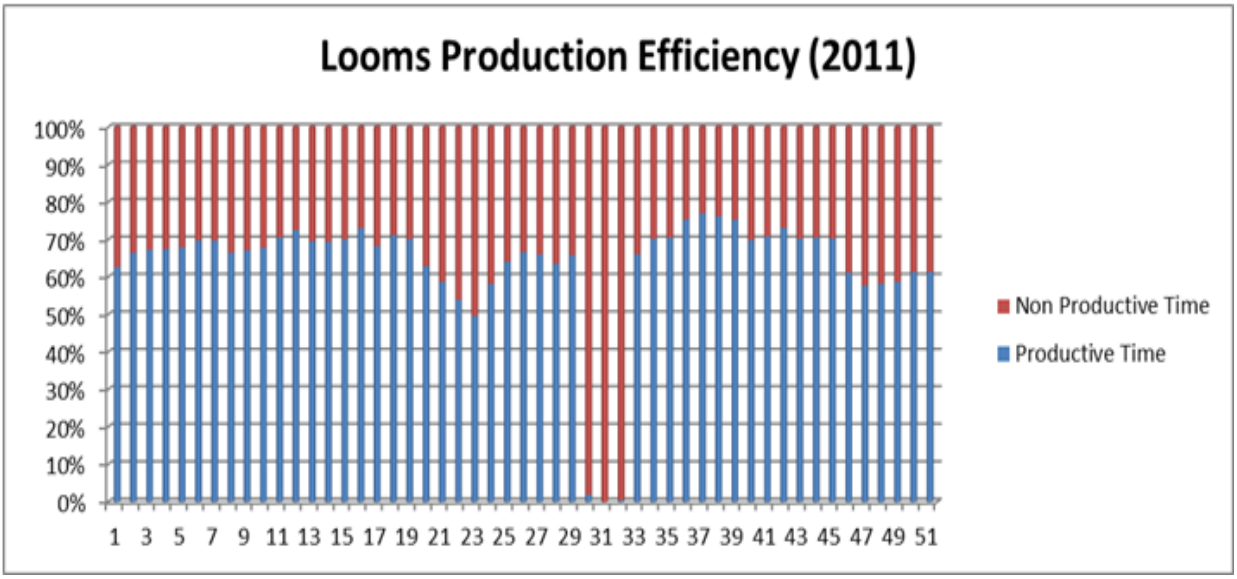


Figure 56 (B): Time Performance of Weaving Room (2011)



On average, almost 30% of the time in weaving is non-productive. It can be observed that there is an extra production loss of 10 to 20 per cent in weeks 20 to 29 and 46 to 52. Let us observe the various phenomena happening in weaving during weeks 10 to 30 and 41 to 55 in order to identify the factors which are responsible for this loss.

The collection development plan (see Fig. 47) shows that the activities II to V involve production activity of the process and affect the normal working of the weaving room and preparation departments. The period in which these activities were planned and carried out in the year 2011, for Summer-2012 collection, ranges from week 10 to 30 i.e. around 21 weeks. The lowest production performance can be observed in weeks 20 to 27, which is a transition phase from highest seasonal demand (see Fig. 48) to normal demand. This transition and/or effect of collection development should be the main cause for low performance in these weeks. The collection development activities for the Winter-2012 collection took place from week 41 to 55 (3rd week of following year, 2012), which makes a period of around 15 weeks. Again, the poor production performance in weaving can be observed from week 46 and onward and a transition from normal demand to seasonal growth is taking place. Various demand cycles, collection activities and other factors are responsible for low production performance in various time periods in weaving. Design and production periods for summer and winter collections development vary and thus there should be more pressure on the production process for the winter collection as compared to the summer collection.

We have already observed in the data analysis of mounting activity of November, 2011, that the share of this activity is around 80% in overall non-productive time in weaving. Further, the waste of time by mounting operation stands to be around 5% of total available time, and this makes considerable loss of working time.

The number of monthly mounting operations and the required time for the activity is very high in comparison to many other fabric manufacturing facilities which operate under mass-production or other production strategies. Such a characteristic is specific for a diversification-in-design business strategy and this brings high planning and other work load for the system. In reality, it is very difficult to control and manage the supply chain system without proper planning and management execution systems. The factors which can improve the time performance of the activity include for example the automation in the process, experience and skills of the technicians, their physical and psychological health, distribution of work load on the basis of complexity of the operation and the capacity of the technicians. The studies which can quantitatively explain the relationship of these factors to the time performance of the activity under various workload situations will help further to identify the required adjustments in design and training of the mounting teams and developing working strategies in such situations.

V.2.7. Conclusion

The time based competitive position of the supply chain is not very strong on CTP orders which take around 8 to 12 weeks of order fulfilment time. In general, the lead times and the time performance of the chain in various activities point out that time is not part of the competitive strategy of the chain yet. The main competitive strengths are style diversification and quality and these are well-suited to fulfil the needs of their customers. Improving the time performance can bring additional capacity and add value to responsiveness on customer orders and will enhance customer confidence in the supply chain. This will improve the competitive position of the supply chain in the global context as many other similar supply chains can try to achieve similar quality and design strengths and even adopt configurations to fulfil customer orders in lower lead times.

In the current state of the value chain, important areas which can contribute for reducing the order fulfilment time are external links of yarn dyeing and cloth finishing. Our analysis suggests that the segments of yarn processing and mounting operation should be considered for further evaluation and for reorientation and/or restructuring. Moreover, the control and monitoring of the

yarn processing segment should be included in the order execution system. These changes will reduce the fix response time of the segment and will also help to improve the time performance of the weaving room, which in the current situation absorbs a lot of planning inconsistency due to the uninformed yarn processing stage. Also, the order execution system does not inform on the deviations from the planned activities to the logistics and commercial functions, which it should in order to emphasize the time performance on order fulfilment.

The management process in the supply chain is in transition. Advance information and management systems were inducted into the system to enhance the competitive position of the chain but effective utilization of these systems was not achieved yet. The process needs flexibility to transform itself according to the needs of the changing production cycles in different seasons and changes in the strategic environment and this flexibility is limited in the chain. The supply chain has its own evolution pace depending upon many factors including those mentioned above and collectively they are the main constraints to the time based performance in the chain.

The strategies chosen in the value chain are demanding and the decision making system is more centralized. It should be difficult to monitor and control such complexity with such central control. We believe that the decentralization of the decision making process and increasing the participation of various levels of management should reduce the overall complexity. Such a complexity should not be considered as a particular characteristic of the supply chain in study but it should exist in other areas too where there is high competition, abundance of business models to occupy customer segments, and low barriers of entry including capital, skills, and technology etc.

Moving towards short lead times is a choice or option in the studied supply chain but there are many product and service areas where time based performance and time based order fulfilment are not a choice but a compulsion. There are potentially hundreds of areas including health, perishable items and food chains for example where such compulsions exist and the research directions and findings of this study can be utilized there effectively.

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VI.1. Conclusion

Textile manufacturing, textile made-ups and the cotton production sectors are the strongest in the textile and clothing system of Pakistan. At this stage of the development, the system is demanding to restructure the fashion clothing and apparel sectors which will bring higher value addition and more opportunities for the system. Logistics is an important area which is poorly developed. It needs proper development to enhance the performance of the supply and delivery processes which will improve the customer service. The country has better development in information and communication technologies. There is a need to utilize these technologies in the management and production systems. The marketing functions are weak in most of the sectors. By improving these functions, the image of the system will improve. Further, the supply performance of the system can be enhanced by analysing the trends of the international markets in various product segments. Improving the above areas will bring many opportunities for the system in the international markets and emerging markets of South Asia and Middle East.

Positive developments were observed in the skill development programs. The number of study programs has increased in science, engineering and design fields of textile, clothing and related areas. Meanwhile, these programs are being offered at limited number of locations similar to the expansion behaviour of the industry. It is needed to expand the skill programs to district level in order to improve the performance of the industry. The quality of these programs can be improved by improving the share of advance technology and research components.

In Sindh and KP regions, the industry is concentrated at limited locations. It is required to expand the industry to the districts where the other inputs have improved recently including raw material supply and labour skills. The focus on the development of infrastructure can help these regions to develop their industry and the government should act as a facilitator instead of wasting the resources on supporting the incompetent industries.

The importance of the strategic directions was also evaluated. The strategies with higher importance include WO4, WO1, ST2 and WO2 having a score of 0.433 out of 1.

Strategy WO4 which is focused to improve the linkages between industry (application of knowledge), educational institutes (learning of knowledge) and research centres (development of knowledge), has the highest importance. Further, it can be added from the evaluation of its

implementation behaviour that it can be followed efficiently. Strategy WO1 (Skills improvement) requires higher resources and time and thus its implementation character places it in the medium term strategic plans. Together, strategies WO4 and WO1 will bring the main improvements in the system on short to medium term opportunities.

Strategy ST2 (Establishing Down Stream Facilities in Stable, Near to Market and Competing Regions) is one of the most difficult in terms of implementation. It will require high implementation time and cost, which place it in the long term plans. This strategy has both short term and long term effects and needs further evaluation to find out how the implementation process of this strategy can be enhanced or if the system can decrease the effects of the threats which are political in nature and can be decreased with political stability in the country. Meanwhile, the effects of the threats are already visible as the manufacturing activities are migrating to countries which are more stable and offer higher attractiveness. It can be advised to encourage the relocation of some manufacturing activity, in the downstream segments of SC system, in countries of strategic importance for the international clothing markets instead of looking for short term protection. This will improve the competitiveness of the system in terms of responsiveness.

Strategy WO2 (Expanding Non-cotton Fibre Base) was ranked fourth in the strategic importance value. It requires more resources and effort which advise its placement in the long time horizons. The strategy has both short and long term effects, therefore some sectors can be chosen in the short term expansion while others in longer plans. The sectors which can bring product diversification in textile and clothing sectors can be considered in short to medium term plans whereas those which can bring strengths in the advance areas of functional and technical textiles can be placed in the long term plans. The planning scenario which was developed, also explains the strategic moves and their sequence in this situation. For example, under strategy WO2 the fibres which can expand the product base of fashion and other clothing and home textiles (the areas which are relatively mature in present) can be placed in short-to-medium term plans whereas the advance fibres (for areas which are in process of development including technical and functional textiles) can be placed in the long term plans.

In general, the above strategies are mainly attributed to the diversification dimension of the competitiveness. The overall strategies will improve the status of the system on the opportunity

areas including O2, O3, O5 and O7. Further, it will bring partial improvements in the system for opportunities, O1 and O6.

In a different categorisation of the strategies, based on SWOT dimensions, higher weight was received by the WO group of strategies. This identifies a defensive course of actions in the strategic planning. Such behaviour is justified in the current status of the SC segments; these are weak on the downstream side and cannot support the offensive strategic moves. The strategies of the ST group also got higher weights, which also support the defensive strategic approach.

These values can be utilised to allocate the resources and efforts on the strategic dimensions. The other important aspect of the strategic planning is the scheduling of the activities (strategies) under various constraints and available resources. The task of scheduling can be based on the implementation behaviour of strategies, which was based on the implementation criteria of cost, time and implementability. We strongly recommend that the results are suitable for the allocation of resources and for the planning of strategies on short, medium and long planning horizons.

The significance of the strategies can be viewed both in global context and also for the system in focus. Strategies WO4 and WO1 which have higher importance in the above evaluation, also have universal significance in other planning situations. Their scores, 0.144 and 0.123, are primarily relevant to the textile and clothing system in Pakistan. Meanwhile, strategies ST2 and WO2 are only related to the system and have lower universal significance. Therefore, some of the strategies developed above can be applicable in similar situations in other systems but their importance values are specific for the system in study and its current state of development.

An important and detailed insight was developed from the case study, conducted in an advanced textile and clothing supply chain in Portugal. The transformation of the production strategy from mass production to minimum customer orders has a huge impact on the case supply chain. The supply chain is operating with the competitive strategies of quality and design diversification. It was observed that the time-based performance of the supply chain was low even with the introduction of advanced production control systems. The human factor should be the most important in the evolution of the systems. The external system, in which the supply chain operates, evolved faster than the system, especially after the emergence of the European Union. The factor of human development was not improved at proper pace which has restricted the evolution of the textile and clothing systems, more specifically in the case supply chain. Various

types of pressures were observed on different functions including planning, design, delivery, etc. Such pressures are characteristics to the adopted competitive strategies and because of the recent developments in the global textile and clothing sectors.

The production strategies which are followed in most of the textile and clothing industry in Pakistan are mass production, and the product diversification is very limited. Mostly, standard products are produced. This situation will change in the near future as the regional competitors will force the textile and clothing sectors to adopt other strategies to improve the competitiveness. In the recent situation, the system has some support of cheap raw material and low cost labour. The conversion of raw material into low value products will not work long as the new players will evolve to add higher value to their products, which will bring pressure to the clothing and fashion industry in Pakistan and ultimately will force its closure. The worse development state of the logistics will further deteriorate the competitive position of the country.

The findings of the case study support the recommendations of the strategic planning. The high rating of strategies WO4, WO1, ST2 and WO2, is asking for the attention of various entities to address these issues with their due importance. This will improve the performance of the supply chain entities on their tactical dimensions and develop the strategic strengths in the system.

The status of the SC activities and the poor coordination between various entities identify that product areas of fashion and clothing are not well prepared to compete to other main producers of clothing. The findings also guide to raise the following issues on the other strategic opportunities.

Concerning the areas of functional and technical textiles, there are a many factors which need attention to achieve success in the international and domestic markets and to gain a competitive position. The behaviour and characteristics of the technical textile industry are reasonably different in terms of product and market segments as compared to textiles for clothing and furnishing. This is an application oriented field for textile manufacturing, which is based on research rigor and creative and efficient application of materials and the structural properties of textile products. Therefore, the factors of research, development of advance materials and structures, application creativity, etc. are the main inputs for these areas. Such developments lack in Pakistan. Therefore, at this stage, it should be difficult to gain some share in the international export markets in these areas. At this stage, it is advisable to produce for the domestic markets which can consume the products, developed initially, to validate their performance. Meanwhile, it

should be important to improve the research skills in these areas and to introduce the interdisciplinary approach to create proper environment for the product development process.

These textiles can be categorised into various application fields including textiles for medical, automobile, agriculture, construction, etc. The development of industry in some of these areas should be easier in Pakistan. The country has a strong agricultural base. The development and application capability of the textile products can be focused for this area. This will require interdisciplinary research groups with knowledge of textiles, materials, agriculture, etc. Similar research groups can be developed for other technical textile areas as mentioned above. The research laboratories will play an important role in these areas, where the prototypes can be developed and experimentation on the industrial production process can be initiated to validate the production economies. The skills and expertise will evolve with time and the increase in the industry. The strong base of research will develop the confidence in the utility of the products and the economies of scale in production. The acceptance of the developed products will depend on various factors of the markets, including market maturity, product acceptance, etc.

The industrial activity in fashion clothing is usually strengthened with the diversification of materials, designs and styles, artistic skills and understanding of the customer segments and their needs. Infrastructure and logistics further strengthen the competitive muscle by improving the responsiveness. The basic requirements for the standard clothing are raw material, production technology and skills. The infrastructure and logistics play a minor role in the competitive strengths. The time gaps are larger for standard products and it is easy to follow the production demands of various markets around the world. In case of fashion clothing the time gaps are shorter and when there is a large space gap, then the under developed infrastructure restricts the required responsiveness. In product segments of home textile, taste of customers and the aesthetics of products are main driving factors to gain market share. Therefore, knowing the customer needs has higher importance. The gaps of time are wider in the areas of home textiles in order to plan and produce the trends or seasonal requirements of markets. In the case of technical textiles, the superiority and performance of the products ultimately provide the acceptance to the products and serve as their competitive strengths.

The main factors, which contribute for the production of technical textiles, are at low level of development as observed in Chapter III and IV. Therefore, the industrial activity in technical

textiles should be difficult to initiate in Pakistan. However, fashion and clothing, home textiles and furnishing areas can be improved with little effort, as the main inputs are already developed.

VI.2. Future Directions

It can be confirmed that the potential of the regional producers will not hurt the textile manufacturing base of Pakistan due to its strength in cotton supplies. Meanwhile, the clothing and apparel sectors will be under intense competition. The findings of the case study on the structure and performance of an advanced textile and clothing SC and its production strategies provide insight on the approaches to improve the competitive position of the clothing industry in Pakistan. Therefore, similar studies in Pakistan can help to develop a comparative scenario and to identify the current potential and the shortcomings of the industries.

The dimension of the production times for various order fulfilment strategies in Pakistan will help to establish the order lead time for various markets and product segments. This will provide insight on the time based competitive scenario for the country and will explain the choice of strategies. There are many product segments in the high profit markets, which can be supplied from Pakistan with the improvement of the responsiveness in the system. The time for transporting the goods from Pakistan is presented at Table 128 and Table 129 (see Appendices V.A and V.B). These will explain the role of delivery process in the overall responsiveness of the country. The delivery process can be analysed further to find the areas of time waste, which will help to improve the delivery efficiency.

The limitation of resources did not allowed us to conduct case studies in Pakistan, therefore, these are placed in the future directions of this research. These will conclude the incomplete parts 7 and 9 of the Study II, which was designed in Chapter II. These will also allow us to generalize the results of these case studies for textile and clothing supply chains in a broader context.

The process of strategic planning was based on the analysis of the secondary data of the supply chain. The past studies on the system were also considered in this analysis. It is possible to validate the findings with expert surveys. Although, our experience guide that it is not easy to find experts, who can fill these surveys of such a wide research scope, with confidence. At least, we were not successful to find many people to complete the survey. The survey form is provided

at Appendix III.B. Keeping in view the above problems, this task is placed in the future directions.

Following studies are also the logical flow of this research.

1. The study on the demand patterns of global textile and clothing markets to identify the prospective markets for the SC system
2. The growth of responsiveness, diversification and flexibility as competitive strategies in the textile and clothing SCs of Pakistan
3. The characteristics and growth of the manufactured and non-cotton fibre sectors
4. The characteristics and growth of the technical and functional textile industry

Studies 1, 2 and 3 will further clarify the objectives of the planning horizons for the existing sectors and studies 3 and 4 will explain the strategic moves for the areas of advanced textiles.

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Appendices

Appendix III.A. Data Tables for the Textile and Clothing Sectors

Table 6: Supply and Consumption of Cotton in Pakistan ('000' kilograms)

Years	Supply/Availability of Cotton				Demand/Consumption of Cotton				
	Stock	Production	Imports	Total	Consumption (Mills & Non-Mill Sectors)	Losses	Export	End Season Stock	Total
1971-72	13691	770264	889	784845	476881	282537	0	25427	784845
1972-73	25427	764219	533	790179	587122	185987	3912	13158	790179
1973-74	13158	717100	356	730613	586055	53342	0	91216	730613
1974-75	91216	690428	356	782000	471191	257999	0	52809	782000
1975-76	52809	559384	711	612904	506397	82147	10491	13869	612904
1976-77	13869	473503	1600	488972	449143	14758	0	25071	488972
1977-78	25071	601880	356	627307	431362	114331	8357	73257	627307
1978-79	73257	495551	533	569341	450032	56543	0	62766	569341
1979-80	60044	728355	680	789080	402960	25855	0	127573	789080
1980-81	127573	757102	1021	885695	468447	330839	0	86409	885695
1981-82	86409	748427	1021	835857	509951	237796	0	88110	835857
1982-83	88110	823950	850	912911		27556	170	104780	912911
1983-84	104780	494472	64467	663718	507059	60384	0	96275	663718
1984-85	96275	1008675	2041	1106991	550094	306345	0	250553	1106991
1985-86	250553	1217044	1361	1468958	541589	693826	0	233543	1468958
1986-87	233543	1319953	510	1554006	709645	606226	510	237626	1554006
1987-88	237626	1468447	1021	1707093	781936	559959	1871	363327	1707093
1988-89	363327	1426263	1361	1790951	874809	759483	1021	155639	1790951
1989-90	155639	1454499	3572	1613710	1116347	306685	0	190679	1613710
1990-91	190679	1637694	340	1828713	1357374	268923	340	202075	1828713
1991-92	202075	2180984	4252	2387311	1440041	433237	0	514033	2387311
1992-93	514373	1540058	5613	2060045	1517435	254805	0	287804	2060045
1993-94	287804	1367750	106651	1762205	1577820	55282	0	129104	1762205
1994-95	129104	1479334	109713	1718150	1510631	36571	0	170947	1718150
1995-96	170947	1802178	34019	2007145	1550094	307535	0	149515	2007145
1996-97	149515	1594489	61915	1805920	1561831	35720	0	208369	1805920
1997-98	208369	1562171	51199	1821739	1598572	86579	0	136588	1821739
1998-99	136588	1495153	223337	1855078	1587345	1531	0	266202	1855078
1999-00	266202	1911890	71611	2249703	1691274	99677	0	458752	2249703
2000-01	441402	1825481	113965	2380848	1521177	120599	0	494472	2289336
2001-02	328968	1805069	18370	2317742	1931962	45586	0	340	2317742
2002-03	458241	1736860	187617	2382719	2032999	50349	0	29937	2382719
2003-04	29937	1978568	393264	2401770	2025005	37081	0	339684	2401770
2004-05	339684	2426434	382548	3148666	2208880	119748	0	700800	3148666
2005-06	70080	2214493	293928	3209220	2533765	59874	0	615581	3209220
2006-07	615581	2186767	502126	3304474	2649941	47287	0	60725	3304474
2007-08	60725	1982481	850995	3440722	2629700	58513	0	752509	3440722

Years	Supply/Availability of Cotton				Demand/Consumption of Cotton				
	Stock	Production	Imports	Total	Consumption (Mills & Non-Mill Sectors)	Losses	Export	End Season Stock	Total
2008-09	723593	2010376	417758	3151727	2615752	7654	0	458071	3151727
2009-10	458071	2159041	34189	2959007	2403130	156489	0	399388	2959007
2010-11	399388	1989795	340534	2729717	2445655	130805	0	153257	2729717

Source: PCCC (Data available at www.aptma.org.pk)

Note: Mill & Non Mill Consumption and End Season Stock figures are Provisional

Table 7: Cotton Production, Area and Per Hectare Yield

Period	Area ('000' Hectares)			Production (Kilograms)			Yield (Kilogram Per Hectare)		
	Sindh	Punjab	Total	Sindh	Punjab	Total	Sindh	Punjab	Total
1947-48	280	734	1035	58321	110063	168384	208	146	163
1948-49	263	620	883	50142	98150	148292	191	158	168
1949-50	302	677	979	58143	143847	201990	193	212	206
1950-51	316	737	1053	80369	141713	222082	254	192	211
1951-52	319	823	1142	69345	152737	222082	217	186	194
1952-53	358	831	1189	95661	192033	287693	267	231	242
1953-54	328	649	977	96016	128733	224749	293	198	230
1954-55	321	717	1038	88015	155404	243419	274	217	235
1955-56	376	818	1194	87482	171407	258888	233	210	217
1956-57	406	825	1231	91749	174074	265823	226	211	216
1957-58	391	842	1233	91038	174074	265112	233	207	215
1958-59	383	769	1152	93705	161983	255688	245	211	222
1959-60	358	790	1148	86059	175496	261556	240	222	228
1960-61	372	757	1129	93171	177097	270268	250	234	239
1961-62	377	826	1203	84637	202701	287338	225	245	239
1962-63	357	841	1198	92460	246442	338902	259	293	283
1963-64	368	924	1292	99217	291783	391000	270	316	303
1964-65	316	1006	1322	75035	280581	355616	237	279	269
1965-66	350	1031	1389	121087	268668	389755	346	259	281
1966-67	350	1087	1437	112730	320054	432785	322	294	301
1967-68	384	1189	1573	119131	361306	480437	310	304	305
1968-69	371	1178	1549	128911	366818	495729	347	311	320
1969-70	368	1224	1592	128200	378020	506219	348	309	318
1970-71	390	1221	1611	137979	379798	517777	354	311	321
1971-72	411	1386	1797	163939	507108	671047	399	366	373
1972-73	388	1461	1849	183853	482215	666069	474	330	360
1973-74	435	1265	1700	196656	429229	625884	452	339	396
1974-75	435	1450	1885	179408	423716	603125	412	292	352
1975-76	423	1274	1697	156827	326100	482927	371	256	314
1976-77	498	1238	1736	150603	262445	413048	302	212	257
1977-78	514	1188	1702	208035	335524	543559	405	282	344
1978-79	469	1247	1716	133889	302985	436874	285	243	264
1979-80	554	1312	1866	235754	456030	691784	426	248	337
1980-81	563	1377	1940	229801	454499	684300	408	330	369

Period	Area ('000' Hectares)			Production (Kilograms)			Yield (Kilogram Per Hectare)		
	Sindh	Punjab	Total	Sindh	Punjab	Total	Sindh	Punjab	Total
1981-82	600	1446	2046	252594	464535	717129	421	321	371
1982-83	612	1489	2101	258718	533594	792312	423	358	391
1983-84	617	1461	2078	196972	275387	472359	319	188	254
1984-85	632	1482	2114	240347	742133	982480	380	501	441
1985-86	582	1665	2247	236775	956455	1193230	407	574	491
1986-87	603	1788	2391	215343	1082497	1297840	357	605	481
1987-88	596	1867	2463	224358	1221467	1445825	376	654	515
1988-89	533	1987	2520	180983	1226059	1407042	340	617	479
1989-90	529	1979	2508	180643	1257187	1437830	341	635	488
1990-91	508	2067	2575	185576	1434938	1620514	365	694	530
1991-92	521	2222	2743	232693	1927369	2160062	447	867	657
1992-93	379	2379	2758	135057	1390033	1525090	356	584	470
1993-94	532	2193	2725	252934	1099167	1352101	475	501	488
1994-95	389	2182	2571	214152	1246131	1460283	551	571	561
1995-96	515	2407	2922	313659	1472360	1786019	609	612	611
1996-97	592	2482	3074	381017	1195952	1576969	643	482	563
1997-98	595	2284	2879	396156	1146794	1542950	666	502	584
1998-99	625	2220	2845	362137	1115666	1477803	579	503	541
1999-00	634	2329	2983	404321	1497534	1901855	638	643	641
2000-01	524	2386	2910	364178	1452628	1816806	695	608	652
2001-02	547	2526	3073	415547	1368600	1784147	756	541	650
2002-03	543	2208	2751	410274	1303623	1713897	756	590	673
2003-04	561	2387	2948	381528	1310087	1691615	680	549	615
2004-05	635	2549	3184	510291	1956116	2466407	760	808	784
2005-06	637	2426	3063	450417	1896411	2346828	714	707	711
2006-07	570	2463	3033	407893	1760504	2168397	715	714	715
2007-08	607	2425	3055	431366	1541419	1982481	710	635	649
2008-09	562	2224	2786	506549	1488519	2010376	902	669	713
2009-10	635	2436	3071	726484	1454670	2181154	1144	597	710
2010-11	457	2689	3146	601633	1335942	1937575	1316	607	616

Source: PCCC (Data available at www.aptma.org.pk)

Till year 1978-79, the weight of the cotton bale was 177.808 Kilogram and later changed to 170.097 Kilogram

Cotton Production of Balochistan is 98 and NWFP is 5 (000) Bales

Cotton Area of Balochistan is 39. (000 hectares)

Table 8: Staple-wise Production of Cotton ('000' Kilograms)

Period	Short Staple (Below 20.64mm)	Medium Staple (20.64 To 25.40 mm)	Medium-Long Staple (26.19 To 27.78 mm)	Long Staple (28.57 To 33.34 mm)	Total Production
1947-48	30583	166073			196656
1948-49	26671	144736			171407
1949-50	21337	198967			220304
1950-51	47119	202879			249998
1951-52	47119	201279			248398
1952-53	50497	266890			317209
1953-54	43563	209813			253376
1954-55	56721	224749			281470
1955-56	55298	243064			298362
1956-57	54409	249820			304229
1957-58	54587	249109			303696
1958-59	42496	239330	356		282181
1959-60	48719	236307	6401		291427
1960-61	41074	247687	12091		300851
1961-62	45519	259955	18670		324144
1962-63	37517	304941	23826		366284
1963-64	39296	349037	30227		418560
1964-65	31472	314187	32005		377664
1965-66	31650	345659	37162		414470
1966-67	39118	378909	45341		463368
1967-68	38762	423539	55298		517599
1968-69	40896	420338	65433	889	527556
1969-70	37695	427628	66678	3556	535558
1970-71	26849	443098	70590	1778	542314
1971-72	37340	575209	94060	889	707498
1972-73	38407	539469	117887	6045	701808
1973-74	37340	502308	116109	2845	658601
1974-75	36806	479015	116464	1956	634241
1975-76	35028	391000	86415	1245	513687
1976-77	40540	357750	27205	9424	434918
1977-78	31294	456078	75924	11558	574853
1978-79	41785	368418	55120	8001	473325
1979-80	32999	496173	186086	13097	728355
1980-81	30277	296989	377105	10206	714577
1981-82	31128	325225	381528	10206	748087
1982-83	31638	271815	477973	42524	823950
1983-84	22113	212281	187447	72802	494642
1984-85	26195	257697	446505	278279	1008675
1985-86	23643	248172	630039	315020	1216874
1986-87	22113	103759	894200	299881	1319953
1987-88	22623	141691	874639	429495	1468447
1988-89	19221	203946	937064	266032	1426263
1989-90	18200	372512	951693	113625	1456030
1990-91	17180	66338	973975	580201	1637694

Period	Short Staple (Below 20.64mm)	Medium Staple (20.64 To 25.40 mm)	Medium-Long Staple (26.19 To 27.78 mm)	Long Staple (28.57 To 33.34 mm)	Total Production
1991-92	20922	195952	1331689	632421	2180984
1992-93	14969	47287	1136248	341555	1540058
1993-94	15649	320463	976187	55452	1367750
1994-95	18881	297840	1079265	83348	1479334
1995-96	16329	964280	817996	3572	1802178
1996-97	17520	592108	939106	45756	1594489
1997-98	19221	219085	1124001	199864	1562171
1998-99	17350	555707	882293	39803	1495153
1999-00		630039	1204457	77394	1911890
2000-01		226399	1522368	76714	1825481
2001-02	9015	513693	1224868	57493	1805069
2002-03					1646199
2003-04					1665930
2004-05					2439021
2005-06					2107162
2006-07					2110904
2007-08					1930941
2008-09					1930431
2009-10					2159041
2010-11					1989795
Source: PCCC/PCGA (Data available at www.aptma.org.pk)					

Table 9: District-wise Cotton Production

(Qty. in Bales of 170 kilogram)

Districts\Year	2000-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
Punjab											
Multan	428058	520747	585207	589120	979192	879946	767006	588689	442165	399246	444899
Lodhran	371507	497396	477280	342036	583506	553859	522177	332328	268118	200979	262732
Khanewal	415655	405638	429833	588992	755471	704457	673581	639046	624959	700524	757520
Muzaffargarh	465974	472973	404444	435910	698067	611347	630602	532282	470511	385673	241050
D.G. Khan	498364	448427	383319	419570	598592	467884	477561	430536	353228	328361	306655
Rajanpur	532575	583975	431066	426888	678393	486857	574133	476841	373305	464273	206182
Layya	50454	52467	44313	68386	110764	78320	115813	122436	143383	187939	179554
Vehari	672035	533811	596132	674289	1064139	963821	972407	757969	670003	825489	781080
Sahiwal	353083	312537	277438	322125	478434	415981	435257	507822	527012	528045	542366
Pakpattan	126443	131398	67016	111955	167269	95130	186244	301204	276116	259680	269620
Okara	60813	44830	28811	19894	38731	17225	35690	48135	59685	54175	52600
Kasur	13043	19800	12000	18200	39500	34550	25100	38400	41000	40000	8200
T.T. Singh	231544	208223	195920	205179	320090	257276	245661	260121	331571	328837	278287
Faisalabad	158867	125849	102992	139842	236323	196246	184201	143886	135703	143350	116500
Jhang	151937	165768	112803	145094	209744	170330	207597	210973	198945	180709	158211
Mianwali	6662	6979	5800	10354	9220	12000	32400	50800	77305	76711	173714
Bhakkar	35621	28390	19385	37850	41200	39178	50653	52900	57102	79450	94226
Sargodha	0	0	0	0	0	3700	0	4600	19800	24700	41052

Districts\Year	2000-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
Rahim Yar Khan	1304152	1291624	1420902	1132933	1840132	1611304	1490324	1175005	1160815	1277391	1069302
Bahawalpur	1380825	1344027	1184462	1156492	1393595	1335583	1334846	1073879	1072887	898882	896445
Bahawal Nagar	751221	764374	678342	819864	1054297	914290	1129024	1083765	1049991	1074069	1024052
Total Punjab	8008833	7959233	7457465	7664973	11296659	9849284	10090277	8831617	8353604	8458483	7904247
Sindh											
Hyderabad	196074	171864	123540	119865	189834	182606	208503	244191	334051	447974	362675
Tharparker	144964	146855	122660	103050	235539	179647	176092	216755	303517	387560	407461
Sanghar	715196	566970	504544	637772	936081	909162	793071	885310	1322084	1877582	1599526
Nawabshah	240892	257551	212539	267516	286280	280694	197099	248178	214778	371156	349168
Naushehro Feroz	148683	197157	157473	161245	230682	182229	175819	155442	149073	226965	194458
Khairpur	122088	176026	199343	200975	235864	170636	155951	172393	168614	215294	208542
Ghotki	401208	560371	573895	358664	511242	330645	315579	277163	210443	287021	220324
Sukkur	171985	217928	239644	228942	283286	208204	192238	224543	197684	279990	308770
Dadu	37463	56511	77423	47928	111178	87782	95574	80933	85781	119210	118877
Total Sindh	2178553	2351233	2211061	2125957	3019986	2531605	2309926	2504908	2986025	4212752	3769801
Baluchistan											
Baluchistan	-	3779	9875	3596	30387	13900	10417	16400	9400	22033	24118
Pakistan											
Grand Total	10187386	10314245	9678401	9794526	14347032	12394789	12410620	11352925	11349029	12693268	11698166
Source: PCGA (Data available at www.aptma.org.pk)											

Table 10: District-wise Cotton Production Share

Districts	2000-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	Average
Rahim Yar Khan	12.8	12.5	14.7	11.6	12.8	13.0	12.0	10.3	10.2	10.1	9.1	11.7
Bahawalpur	13.6	13.0	12.2	11.8	9.7	10.8	10.8	9.5	9.5	7.1	7.7	10.5
Sanghar	7.0	5.5	5.2	6.5	6.5	7.3	6.4	7.8	11.6	14.8	13.7	8.4
Bahawal Nagar	7.4	7.4	7.0	8.4	7.3	7.4	9.1	9.5	9.3	8.5	8.8	8.2
Vehari	6.6	5.2	6.2	6.9	7.4	7.8	7.8	6.7	5.9	6.5	6.7	6.7
Khanewal	4.1	3.9	4.4	6.0	5.3	5.7	5.4	5.6	5.5	5.5	6.5	5.3
Multan	4.2	5.0	6.0	6.0	6.8	7.1	6.2	5.2	3.9	3.1	3.8	5.2
Muzaffargarh	4.6	4.6	4.2	4.5	4.9	4.9	5.1	4.7	4.1	3.0	2.1	4.2
Rajanpur	5.2	5.7	4.5	4.4	4.7	3.9	4.6	4.2	3.3	3.7	1.8	4.2
D.G. Khan	4.9	4.3	4.0	4.3	4.2	3.8	3.8	3.8	3.1	2.6	2.6	3.8
Sahiwal	3.5	3.0	2.9	3.3	3.3	3.4	3.5	4.5	4.6	4.2	4.6	3.7
Lodhran	3.6	4.8	4.9	3.5	4.1	4.5	4.2	2.9	2.4	1.6	2.2	3.5
Ghotki	3.9	5.4	5.9	3.7	3.6	2.7	2.5	2.4	1.9	2.3	1.9	3.3
Nawabshah	2.4	2.5	2.2	2.7	2.0	2.3	1.6	2.2	1.9	2.9	3.0	2.3
T.T. Singh	2.3	2.0	2.0	2.1	2.2	2.1	2.0	2.3	2.9	2.6	2.4	2.3
Sukkar	1.7	2.1	2.5	2.3	2.0	1.7	1.5	2.0	1.7	2.2	2.6	2.0
Hyderabad	1.9	1.7	1.3	1.2	1.3	1.5	1.7	2.2	2.9	3.5	3.1	2.0
Tharparker	1.4	1.4	1.3	1.1	1.6	1.4	1.4	1.9	2.7	3.1	3.5	1.9
Khairpur	1.2	1.7	2.1	2.1	1.6	1.4	1.3	1.5	1.5	1.7	1.8	1.6
Naushehro Feroz	1.5	1.9	1.6	1.6	1.6	1.5	1.4	1.4	1.3	1.8	1.7	1.6
Pakpattan	1.2	1.3	0.7	1.1	1.2	0.8	1.5	2.7	2.4	2.0	2.3	1.6
Jhang	1.5	1.6	1.2	1.5	1.5	1.4	1.7	1.9	1.8	1.4	1.4	1.5

Districts	2000-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	Average
Faisalabad	1.6	1.2	1.1	1.4	1.6	1.6	1.5	1.3	1.2	1.1	1.0	1.3
Layya	0.5	0.5	0.5	0.7	0.8	0.6	0.9	1.1	1.3	1.5	1.5	0.9
Dadu	0.4	0.5	0.8	0.5	0.8	0.7	0.8	0.7	0.8	0.9	1.0	0.7
Bhakkar	0.3	0.3	0.2	0.4	0.3	0.3	0.4	0.5	0.5	0.6	0.8	0.4
Okara	0.6	0.4	0.3	0.2	0.3	0.1	0.3	0.4	0.5	0.4	0.4	0.4
Mianwali	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.7	0.6	1.5	0.4
Kasur	0.1	0.2	0.1	0.2	0.3	0.3	0.2	0.3	0.4	0.3	0.1	0.2
Baluchistan	0.0	0.0	0.1	0.0	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1
Sargodha	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.4	0.1
Total Punjab	78.6	77.2	77.1	78.3	78.7	79.5	81.3	77.8	73.6	66.6	67.6	76.0
Total Sindh	21.4	22.8	22.8	21.7	21.0	20.4	18.6	22.1	26.3	33.2	32.2	23.9
Baluchistan	0.0	0.0	0.1	0.0	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1
Total Pakistan	100	100	100	100	100	100	100	100	100	100	100	100
Source: PCGA (Data available at www.aptma.org.pk)												

Table 22: Growth of the Yarn Manufacturing Capacity

Period	Number of Textile Units	Installed Machines (000)		Working Machines (000) and their Growth on the Previous Year			
		Spindles	Rotors	Spindles	Working Spindles Growth (GOPY)	Rotors	Working Rotor Growth (GOPY)
1948		78	0	78		0	0.00
1949		137	0	137	75.64	0	0.00
1950		182	0	182	32.85	0	0.00
1951		225	0	225	23.63	0	0.00
1952		499	0	302	34.22	0	0.00
1953		649	0	600	98.68	0	0.00
1954		1113	0	940	56.67	0	0.00
1955		1449	0	1355	44.15	0	0.00
1956		1518	0	1422	4.94	0	0.00
1957		1568	0	1447	1.76	0	0.00
1958		1569	0	1459	0.83	0	0.00
1958-59	70	1581	0	1488	1.99	0	0.00
1959-60	72	1582	0	1491	0.20	0	0.00
1960-61	74	1586	0	1531	26.80	0	0.00
1961-62	71	1644	0	1524	-0.46	0	0.00
1962-63	76	1850	0	1810	18.77	0	0.00
1963-64	81	1913	0	1792	-0.99	0	0.00
1964-65	83	1967	0	1852	3.35	0	0.00
1965-66	89	2056	0	1871	1.03	0	0.00
1966-67	94	2043	0	1888	0.91	0	0.00
1967-68	95	2048	0	1916	1.48	0	0.00
1968-69	100	2175	0	2090	9.08	0	0.00
1969-70	107	2397	0	2327	11.34	0	0.00
1970-71	113	2605	0	2491	7.05	0	0.00
1971-72	131	2863	0	2650	6.38	0	0.00
1972-73	150	3266	0	3057	15.36	0	0.00

Period	Number of Textile Units	Installed Machines (000)		Working Machines (000) and their Growth on the Previous Year			
		Spindles	Rotors	Spindles	Working Spindles Growth (GOPY)	Rotors	Working Rotor Growth (GOPY)
1973-74	155	3346	0	3034	-0.75	0	0.00
1974-75	144	3366	0	2823	-6.95	0	0.00
1975-76	147	3455	2	2579	-8.64	1	0.00
1976-77	153	3546	5	2650	2.75	1	0.00
1977-78	174	3585	4	2585	-2.45	3	200.00
1978-79	184	3729	14	2645	2.32	13	333.33
1979-80	187	3781	16	2701	2.12	14	7.69
1980-81	203	4033	19	2833	4.89	15	7.14
1981-82	210	4229	23	2832	-0.40	19	26.67
1982-83	215	4313	27	2986	5.44	25	31.58
1983-84	216	4272	29	2919	-2.24	23	-8.00
1984-85	219	4445	29	2872	-1.61	21	-8.70
1985-86	227	4485	37	3151	9.71	25	19.05
1986-87	226	4356	48	3469	10.09	40	60.00
1987-88	224	4393	55	3607	3.98	46	15.00
1988-89	247	4853	66	4026	11.62	60	30.43
1989-90	266	5271	72	4489	11.50	64	6.67
1990-91	277	5568	75	4827	7.53	67	4.69
1991-92	307	6216	81	5333	10.48	67	0.00
1992-93	334	6860	95	5520	3.51	79	17.91
1993-94	471	8419	138	6105	10.60	84	6.33
1994-95	494	8610	132	6262	2.57	74	-11.90
1995-96	503	8717	143	6548	4.57	80	8.11
1996-97	440	8230	143	6538	-0.15	87	8.75
1997-98	442	8368	150	6631	1.42	80	-8.05
1998-99	442	8392	166	6671	0.60	66	-17.50
1999-00	443	8477	150	6825	2.31	66	0.00
2000-01	444	8601	146	6913	1.29	70	6.06
2001-02	450	9060	141	7440	7.62	66	-5.71
2002-03	453	9260	148	7676	3.17	70	6.06
2003-04	456	9592	146	8009	4.34	66	-5.71
2004-05	458	10485	155	8492	6.03	79	19.70
2005-06	461	10437	155	9415	10.87	77	-2.53
2006-07	461	10513	150	7989	-15.15	70	-9.09
2007-08	521	11834	188	9960	25.00	114	63.00
2008-09	521	11280	194	10241	1.00	114	0.00
2009-10	526	11392	195	10631	4.00	140	23.00
2010-11	524	11762	196	10757	1.00	143	2.00
Source : TCO (Data available at www.aptma.org.pk)							

Table 24: Province-wise Growth of Textile Manufacturing Capacity

PERIOD	Textile Units						Installed Spindles in "000"						Installed Rotors					Installed Looms					
	S	B	P	K	KP	Pak	S	B	P	K	KP	Pak	S	B	P	KP	Pak	S	B	P	K	KP	Pak
1971-72	76	1	45	0	9	131	1606	12	1080	0	165	2863	0	0	0	0	0	14000	0	15000		1000	30000
1972-73	89	1	51	0	9	150	1816	12	1229	0	209	3266	0	0	0	0	0	14000	0	14000		1000	29000
1973-74	87	1	56	1	10	155	1777	12	1323	13	221	3346	0	0	0	0	0	14000	0	14000		1000	29000
1974-75	75	1	58	1	9	144	1755	12	1377	13	209	3366	0	0	0	0	0	14000	0	14000		1000	29000
1975-76	79	1	57	1	9	147	1796	12	1425	13	209	3455	1536	0	0	0	1536	14000	0	14000		1000	29000
1976-77	79	1	60	1	12	153	1796	12	1502	13	223	3546	1536	0	3600	0	5136	14000	0	14000		1000	29000
1977-78	90	1	69	2	12	174	1777	25	1539	25	219	3585	1200	0	2400	0	3600	12441	0	12379		1510	26330
1978-79	93	1	76	2	12	184	1826	25	1634	25	219	3729	8800	0	5650	0	14450	12766	0	11967		1827	26560
1979-80	95	1	76	3	12	187	1857	25	1633	50	216	3781	11200	0	5000	0	16200	12666	0	11598		1898	26162
1980-81	99	3	86	3	12	203	1914	75	1778	50	216	4033	12400	1200	5000	0	18600	12300	1100	10044		1530	24974
1981-82	100	4	90	3	13	210	1973	125	1841	48	242	4229	11800	1200	9600	0	22600	11611	2200	9196		1500	24507
1982-83	103	4	92	3	13	215	1966	125	1931	48	243	4313	14800	1200	10800	0	26800	10835	2200	9832		1494	24361
1983-84	103	5	92	3	13	216	1927	125	1928	48	244	4272	16000	1984	11400	0	29384	10812	2200	9518		1495	24025
1984-85	104	5	94	3	13	219	1976	125	2063	49	232	4445	16000	1484	11400	0	28884	10629	2200	9119		1495	23443
1985-86	106	6	99	4	12	227	1991	100	2099	63	232	4485	19080	4976	13400	0	37456	7680	2200	8447		1045	19372
1986-87	103	6	101	4	12	226	1792	100	2157	63	244	4356	26842	5376	15976	0	48194	7001	2328	7097		1045	17471
1987-88	101	8	102	4	9	224	1806	112	2186	63	226	4393	30848	6816	17969	0	55633	6050	2328	7607		384	16369
1988-89	107	10	117	4	9	247	1851	112	2592	63	235	4853	35072	9480	21856	0	66408	6678	2300	7315		360	16653
1989-90	109	11	132	5	9	266	1908	129	2919	75	240	5271	38604	9432	23992	0	72028	5596	2300	7252		436	15584
1990-91	110	11	142	5	9	277	1910	129	3210	75	244	5568	38820	9840	25862	0	74522	5189	2300	7278		546	15313
1991-92	111	11	171	5	9	307	1948	129	2806	75	258	5216	40988	10240	29792	0	81020	5131	2300	6925		454	14810
1992-93	112	11	195	6	10	334	2053	129	4245	92	341	6860	44444	12808	37036	400	94688	4694	2300	6587		454	14035
1993-94	124	12	271	6	16	429	2084	151	5513	94	434	8276	55644	15688	64524	400	136256	4942	2300	5864		454	13560
1994-95	125	12	286	6	17	446	2080	151	5627	94	449	8401	55980	14536	59488	400	130404	5746	2300	5557		454	14057
1995-96	128	13	297	6	17	461	2128	166	5740	94	459	8587	59420	15688	66472	0	141580	4815	2300	5761		442	13318
1996-97	114	10	293	6	17	440	1948	70	5654	94	464	8230	57236	14592	71632	0	143460	4626	100	4769		442	9937
1997-98	114	10	295	6	17	442	1958	70	5749	94	497	8368	58632	14592	76412	0	149636	4167	100	5055		442	9764
1998-99	114	10	295	6	17	442	1982	70	5715	94	531	8392	58968	13632	93765	0	166365	4158	100	5176		442	9876
1999-00	114	10	296	6	17	443	1997	70	5775	94	541	8477	58200	14400	77180	0	149780	4200	100	5202		442	9944
2000-01	114	10	297	6	17	444	1991	83	5858	94	574	8600	56576	14592	74360	0	145528	4356	100	5083		442	9981
2001-02	115	10	302	6	17	450	2024	96	6199	94	648	9061	53968	14592	72624	0	141184	4428	100	5144		442	10114
2002-03	116	10	304	6	17	453	1997	91	6424	94	655	9261	56428	14592	77104	0	148124	4713	100	5112		442	10367
2003-04	116	10	307	6	17	456	1996	94	6698	93	709	9590	56404	14592	75644	0	146640	4673	100	5428		442	10646
2004-05	118	10	307	6	17	458	2512	99	6998	93	781	10485	62052	14592	78516	0	155160	4184	100	4324		442	9050
2005-06	119	10	309	6	17	461	2100	103	7328	93	812	10437	63836	14016	77052	200	155104	3858	100	4347		442	8747
2006-07	119	10	309	6	17	461	2132	127	7349	94	812	10514	60748	14016	75068	200	150032	3318	100	4021		160	7599
2007-08	119	10	309	6	17	461	2132	127	7349	94	812	10513	62748	14962	80068	200	157995	3318	100	4021		160	7599
2008-09	119	10	309	6	17	461	2132	127	7349	94	813	10513	62748	14962	80068	200	157995	3318	100	4021		160	7899
2009-10	118	9	316	6	17	466	2056	125	7606	94	745	10626	65356	10300	81538	2008	159219	3578	0	3592		0	7170
2010-11	116	9	316	6	17	464	2188	130	7841	94	712	10965	63892	13180	81538	2008	160635	3578	0	3592		0	7170

Source: TCO (Data available at www.aptma.org.pk)

Abbreviations: S = Sindh, B = Baluchistan, P = Punjab (Pakistan), K = Kashmir (Pakistan), KP = Khaiber Pakhtunkha,

Table 26: Province-wise Production of Yarn ("000" Kilograms)

Period	Punjab	Sindh	KP	Baluchistan	Total	Growth in %
1971-72	149.07	161.878	24.754	0	335.702	
1972-73	167.934	180.303	27.885	0	376.122	12.04
1973-74	171.87	176.447	31.143	0	379.46	0.89
1974-75	176.793	148.775	25.632	0	351.2	-7.45
1975-76	176.247	144.365	29.041	0	349.653	-0.44
1976-77	149.564	112.371	20.705	0	282.64	-19.17
1977-78	158.758	117.824	21.312	0	297.894	5.4
1978-79	173.148	135.485	19.165	0	327.798	10.04
1979-80	193.374	150.934	18.554	0	362.862	10.7
1980-81	193.41	159.362	21.22	0.955	374.947	3.33
1981-82	223.861	176.336	22.227	7.73	430.154	14.72
1982-83	231.225	186.56	25.043	5.602	448.43	4.25
1983-84	221.992	188.646	19.885	1.057	431.58	-3.76
1984-85	230.838	178.896	20.012	1.985	431.731	0.03
1985-86	263.815	194.137	21.476	2.758	482.186	11.69
1986-87	318.381	230.936	26.885	10.169	586.371	21.61
1987-88	352.9	291.666	27.81	12.655	685.031	16.83
1988-89	419.803	305.816	26.777	15.038	767.434	12.03
1989-90	532.989	342.522	27.877	21.994	925.382	20.58
1990-91	626.978	376.794	26.405	25.051	1055.228	14.03
1991-92	734.927	398.344	28.478	26.521	1188.270	12.61
1992-93	823.961	354.643	27.418	28.517	1234.539	3.89
1993-94	1070.422	347.375	47.363	33.788	1498.948	21.42
1994-95	1020.640	315.258	44.969	32.781	1413.648	-5.69
1995-96	1100.914	324.152	47.931	32.247	1505.244	6.48
1996-97	1095.740	332.547	65.879	36.689	1530.855	1.7
1997-98	1099.311	335.862	68.02	37.527	1540.720	0.64
1998-99	1107.240	333.622	70.588	36.182	1547.632	0.45
1999-00	1194.377	367.173	81.95	35.036	1678.536	8.46
2000-01	1239.358	365.029	87.133	37.609	1729.129	3.01
2001-02	1283.964	391.492	104.081	38.808	1818.345	5.16
2002-03	1353.027	417.513	91.857	51.784	1914.181	5.27
2003-04	1411.817	428.411	95.397	49.494	1985.119	3.71
2004-05	1475.853	446.309	104.504	50.841	2077.507	5.14
2005-06	1562.670	482.746	109.145	52.264	2206.825	11.17
2006-07					2727.556	23.6
2007-08					2809.383	3
2008-09					2862.411	1.89
2009-10					2880.970	0.65
2010-11					2956.972	2.64
Source: TCO (Data available at www.aptma.org.pk)						

Table 28: Count-wise Production of Yarn

Count-wise Production of Yarn in Pakistan (Metric Tons)																											
Period	Coarse Yarn Counts							Coarse Yarn Counts (1-20 Ne)	Medium Fine Yarn Counts						Medium Fine Yarn Counts (21-34 Ne)	Fine Yarn Counts			Fine Yarn Counts (36-47 Ne)	S. Fine Yarn Counts			S. Fine Yarn Counts (48-80 Ne)	Mixed fibre Yarns		Mixed fibre Yarns	Mixed Fibres	Total
	1-9s	10s	12s	14s	16s	18s	20s	sub-total	21s	24s	28s	30s	32s	34s	sub-total	36s	40s	47s	sub-total	48s	60s	80s	sub-total	Poly/Viscose	Poly/Cotton	sub-total	Waste	
71-72	12.062	30.734	13.573	14.993	28.316	1.367	56.817	157.862	106.616	N.A	13.868	23.788	12.299	1.42	157.991	7.35	8.46	540	16.35	1.698	1.138	663	3.499	0	0	0	0	335.702
72-73	15.585	51.478	13.436	7.546	26.678	1.148	82.525	198.396	110.678	N.A	13.271	24.345	10.951	1.921	161.166	6.131	7.126	510	13.767	493	1.348	502	2.793	0	0	0	0	376.122
73-74	10.686	57.863	13.237	8.281	25.262	1.276	92.515	209.12	76.822	N.A	11.309	30.454	22.932	1.995	143.512	4.51	11.088	1.25	16.848	656	2.404	431	3.491	0	4.364	4.364	2.125	379.46
74-75	7.346	47.889	9.152	8.503	31.616	1.745	96.672	202.923	71.911	N.A	14.416	23.201	16.405	850	126.783	3.731	6.6	907	11.238	655	2.423	365	3.443	0	5.584	5.584	1.229	351.2
75-76	12.08	70.879	11.151	7.894	23.836	1.164	88.696	215.7	63.195	N.A	13.115	22.311	14.055	577	113.253	4.553	6.07	741	11.364	661	2.752	398	3.811	0	4.755	4.755	770	349.653
76-77	5.285	44.904	8.575	5.756	19.814	940	76.791	162.065	53.048	N.A	10.785	16.283	12.754	401	93.271	2.758	5.95	675	9.383	504	2.098	367	2.969	0	14.415	14.415	537	282.64
77-78	4.666	48.82	8.153	4.254	25.132	645	80.562	172.222	46.812	N.A	12.108	19.851	12.055	653	91.479	2.409	7.369	630	10.408	209	2.374	454	3.037	0	19.897	19.897	841	297.894
78-79	5.449	56.018	10.733	3.804	41.664	1.111	53.67	172.449	60.43	N.A	13.53	18.769	16.566	1.048	110.343	2.993	7.19	682	10.865	313	1.558	859	2.548	0	29.031	29.031	2.562	327.798
79-80	4.313	70.335	11.982	6.167	41.682	3.829	49.067	187.405	55.271	N.A	19.004	24.835	18.61	1.12	118.84	4.872	5.408	1.371	11.651	104	2.623	942	3.669	0	33.217	33.217	8.08	362.862
80-81	13,533	56.962	11.362	10.421	26.462	5.943	41.041	165.724	68.481	N.A	28.054	23.328	20.872	4.392	145.127	4.867	6.161	1.399	12.427	243	3.152	1.229	4.624	0	38.785	38.785	8.26	374.947
81-82	15.63	36.774	29.624	26.598	31.417	23.529	22.06	185.632	48.565	19.853	21.082	30.804	24.046	21.538	165.888	6.101	8.361	3.666	18.128	2.483	3.869	2.007	8.359	18.032	14.753	32.785	19.362	430.154
82-83	19.249	29.358	29.483	23.015	29.481	27.825	33.342	191.753	42.182	18.916	20.087	33.86	30.879	36.606	182.53	7.638	7.229	5.266	20.133	4.445	3.847	2.943	11.235	16.779	16.489	33.268	9.511	448.430
83-84	13.726	30.298	24.895	23.557	23.559	21.75	25.549	163.334	37.479	18.001	19.114	38.225	38.982	27.737	179.538	2.478	10.047	7.264	19.789	5.133	6.101	4.311	15.545	22.441	21.561	44.002	9.372	431.580
84-85	19.303	42.609	20.536	21.664	26.26	13.717	20.465	164.554	79.508	20.496	21.763	24.601	25.255	20.061	191.684	7.908	7.185	6.304	21.397	2.223	6.243	4.278	12.744	15.821	17.14	32.961	8.391	731.731
85-86	10.472	57.278	12.748	9.188	30.019	5.243	21.296	146.867	140.375	22.532	23.926	21.455	16.098	13.74	238.126	16.392	7.606	4.5	28.498	1.781	8.167	5.596	15.544	20.359	24.883	45.242	7.909	482.186
86-87	16.762	71.664	8.774	17.213	41.717	7.369	61.006	224.505	152.054	22.809	24.22	31.444	14.683	17.07	262.28	13.776	7.708	7.741	29.225	2.072	9.821	1.707	13.6	21.22	25.935	47.155	9.606	586.371
87-88	19.749	81.789	12.914	21.698	45.045	5.909	62.616	249.72	169.508	28.066	33.617	44.35	22.039	13.979	311.559	11.33	11.004	6.938	29.272	1.403	14.023	1.662	17.088	26.881	40.322	67.203	10.189	685.031
88-89	18.542	89.571	13.483	19.402	52.387	6.891	75.026	275.302	196.099	37.681	42.934	46.35	18.858	7.078	349	8.587	4.019	2.337	14.943	991	8.858	1.323	11.172	35.77	67.863	103.633	13.384	767.434
89-90	33.913	91.199	14.78	25.967	72.001	7.539	105.863	351.262	207.816	55.418	53.603	71.882	20.583	2.847	412.149	9.168	5.175	1.967	16.31	503	6.049	1.187	7.739	32.771	90.941	123.712	14.21	925.382
90-91	42.588	100.096	14.832	27.016	88.787	5.071	146.337	424.727	211.651	71.561	52.239	76.917	20.173	2.737	435.278	10.077	5.883	1.2	17.16	1.541	6.695	901	9.137	43.25	109.85	153.1	15.826	1055.228
91-92	44.873	99.421	14.694	27.763	89.293	8.47	180.146	464.660	211.049	80.42	54.326	103.551	29.279	3.425	482.05	22.283	9.124	505	31.912	3.074	10.256	1.425	14.755	68.094	109.973	178.067	16.826	1188.270
92-93	52.665	93.555	16.514	26.518	99.671	12.919	219.633	521.475	182.852	70.903	51.617	111.07	33.038	2.077	451.557	18.18	10.379	1.522	30.081	4.559	12.696	3.694	20.949	110.348	81.621	191.969	18.508	1234.539
93-94	56.614	91.922	23.835	28.687	99.983	14.692	272.87	588.603	151.402	57.891	41.207	136.121	31.845	5.661	424.127	18.262	12.071	2440	32.773	2.827	7.483	5.758	16.068	121.265	120.107	241.372	23.733	1326.676
94-95	41.07	95.362	22.646	27.764	115.034	10.78	308.217	620.691	135.629	73.511	30.613	162.261	34.373	7.375	443.762	25.288	22.461	1.8	49.549	2.511	6.046	10.941	19.498	89.554	135.314	224.868	22.334	1380.702
95-96	55.889	110.148	26.1	24.623	128.365	22.875	316.913	684.913	129.575	79.112	32.859	154.975	47.066	8.059	451.646	28.908	29.412	1.857	60.177	4.42	8.404	10.003	22.827	99.68	134.784	234.464	21.044	1475.071

Count-wise Production of Yarn in Pakistan (Metric Tons)																											
Period	Coarse Yarn Counts							Coarse Yarn Counts (1-20 Ne)	Medium Fine Yarn Counts						Medium Fine Yarn Counts (21-34 Ne)	Fine Yarn Counts			Fine Yarn Counts (36-47 Ne)	S. Fine Yarn Counts			S. Fine Yarn Counts (48-80 Ne)	Mixed fibre Yarns		Mixed fibre Yarns	Mixed Fibres	Total
	1-9s	10s	12s	14s	16s	18s	20s	sub-total	21s	24s	28s	30s	32s	34s	sub-total	36s	40s	47s	sub-total	48s	60s	80s	sub-total	Poly/Viscose	Poly/Cotton	sub-total	Waste	
96-97	55.486	115.669	29.43	34.674	129.887	27.292	307.455	699.893	102.899	74.771	31.419	149.006	55.857	11.213	425.165	31.912	24.166	2.087	58.165	4.861	6.622	11.56	23.043	104.502	192.996	297.462	27.127	1530.855
97-98	53.247	100.059	33.273	31.438	135.391	39.757	293.553	686.718	95.495	78.828	32.676	145.204	50	11.091	413.294	31.127	25.031	3.982	60.14	5.369	4.367	7.855	17.591	100.78	242.589	343.369	19.608	1540.720
98-99	52.855	105.349	34.666	25.981	149.829	34.403	304.64	707.723	83.94	60.667	32.996	145.238	33.937	11.646	368.424	14.195	18.603	3.171	35.969	5.118	5.192	8.127	18.437	117.452	277.149	394.601	22.478	1547.632
99-00	59.942	110.392	38.34	35.519	151.06	46.86	364.443	806.556	75.082	64.039	32.016	158.274	32.303	20.616	328.33	9.953	22.885	3.476	36.014	4.292	4.05	10.784	19.126	129.229	273.212	402.443	32.069	1678.536
00-01	68.935	99.077	41.485	35.547	167.358	40.713	379.285	832.400	74.843	66.981	40.929	166.427	42.906	18.824	410.91	10.089	24.261	3.542	37.892	5.067	3.557	11.58	20.204	112.289	281.212	393.501	34.222	1729.129
01-02	84.62	124.784	49.069	31.198	169.389	39.522	387.307	885.889	74.389	66.035	36.673	149.734	38.274	16.282	381.387	11.896	37.501	4.277	53.674	5.033	4.514	15.863	25.41	101.823	331.619	433.442	38.545	1818.347
02-03	101.745	131.356	63.245	34.589	156.59	60.246	368.923	916.370	84.461	60.395	53.045	166.755	45.294	20.18	430.13	15.95	37.076	7.256	60.282	10.67	8.76	15.656	35.086	84.492	371.391	455.883	27.185	1924.936
03-04	104.697	127.251	65.97	36.794	160.72	54.906	378.251	928.589	74.973	56.118	58.148	153.308	56.907	18.324	417.778	11.225	41.338	13.47	66.033	9.448	9.805	15.437	34.69	89.624	376.044	465.668	26.15	1938.908
04-05	118.346	153.753	75.432	39.349	163.019	56.506	397.231	1003.636	72.717	80.572	47.678	180.163	58.614	17.799	457.543	18.391	58.877	14.486	91.754	8.982	10.28	18.744	38.006	90.833	378.032	468.865	27.483	2087.287
05-06	131.885	153.588	88.65	43.683	170.993	43.209	413.364	1045.372	71.533	75.496	55.336	191.297	65.968	20.078	479.708	19.864	74.103	8.013	101.98	12.845	17.089	23.822	53.756	95.671	403.866	499.531	36.255	2216.602
06-07	140.648	159.842	93.592	55.728	170.297	67.983	376.494	1064.584	75.108	92.589	76.493	190.813	79.798	32.649	547.45	25.752	91.448	24.343	141.543	16.678	34.622	29.305	80.605	81.082	259.176	340.258	66.706	2241.146
07-08	135.048	153.,342	90.667	53.901	167.37	67.413	359.273	1027.014	72.605	89.089	73.993	186.423	77.798	32.149	532.066	20.852	88.698	21.993	131.543	16.678	33.122	26.305	75.605	100.254	375.924	476.178	6	2309.400
08-09	135.548	154.423	91.167	54.109	168.73	67.913	361.124	1033.014	73.108	89,598	74.493	186.932	78.298	32.631	535.066	26.258	92.698	23.159	142.115	17.073	35.397	27.53	80	102	376	478	67.028	2335.217
09-10	135.854	154.234	91.761	54.901	168.97	68.319	364.421	1038.460	73.801	89.895	74.943	187.239	78.928	34.661	539.467	26.852	95.968	28.195	151.015	17.473	35.897	27.617	80.987	102	376	478	67.028	2335.217

Source: TCO (Data available at www.aptma.org.pk)

Table 30: Count-wise Yarn Production Shares

Year				Coarse						Medium					Fine			S. Fine	
	1- 9s	10s	12s	14s	16s	18s	20s	21s	24s	28s	30s	32s	34s	36s	40s	47s	48s	60s	80s
1971-80	2.6	16.4	3.4	2.3	9.1	0.4	23.2	21.7	0.0	4.2	6.9	4.7	0.3	1.3	2.2	0.2	0.2	0.6	0.2
1981-90	3.7	11.3	4.2	4.4	7.6	3.1	8.6	22.2	5.2	5.6	7.5	5.2	4.2	1.9	1.6	1.1	0.5	1.5	0.6
1990-91	4.8	11.3	1.7	3.0	10.0	0.6	16.5	23.9	8.1	5.9	8.7	2.3	0.3	1.1	0.7	0.1	0.2	0.8	0.1
1991-92	4.5	10.0	1.5	2.8	9.0	0.9	18.1	21.2	8.1	5.5	10.4	2.9	0.3	2.2	0.9	0.1	0.3	1.0	0.1
1992-93	5.1	9.1	1.6	2.6	9.7	1.3	21.4	17.9	6.9	5.0	10.8	3.2	0.2	1.8	1.0	0.1	0.4	1.2	0.4
1993-94	5.3	8.7	2.2	2.7	9.4	1.4	25.7	14.3	5.5	3.9	12.8	3.0	0.5	1.7	1.1	0.2	0.3	0.7	0.5
1994-95	3.6	8.4	2.0	2.4	10.1	1.0	27.2	12.0	6.5	2.7	14.3	3.0	0.7	2.2	2.0	0.2	0.2	0.5	1.0
1995-96	4.6	9.0	2.1	2.0	10.5	1.9	26.0	10.6	6.5	2.7	12.7	3.9	0.7	2.4	2.4	0.2	0.4	0.7	0.8
1996-97	4.6	9.6	2.4	2.9	10.8	2.3	25.5	8.5	6.2	2.6	12.4	4.6	0.9	2.6	2.0	0.2	0.4	0.5	1.0
1997-98	4.5	8.5	2.8	2.7	11.5	3.4	24.9	8.1	6.7	2.8	12.3	4.2	0.9	2.6	2.1	0.3	0.5	0.4	0.7
1998-99	4.7	9.3	3.1	2.3	13.3	3.0	26.9	7.4	5.4	2.9	12.8	3.0	1.0	1.3	1.6	0.3	0.5	0.5	0.7
1999-00	4.8	8.9	3.1	2.9	12.1	3.8	29.3	6.0	5.1	2.6	12.7	2.6	1.7	0.8	1.8	0.3	0.3	0.3	0.9
2000-01	5.3	7.6	3.2	2.7	12.9	3.1	29.1	5.8	5.1	3.1	12.8	3.3	1.4	0.8	1.9	0.3	0.4	0.3	0.9
2001-02	6.3	9.3	3.6	2.3	12.6	2.9	28.8	5.5	4.9	2.7	11.1	2.8	1.2	0.9	2.8	0.3	0.4	0.3	1.2
2002-03	7.1	9.1	4.4	2.4	10.9	4.2	25.6	5.9	4.2	3.7	11.6	3.1	1.4	1.1	2.6	0.5	0.7	0.6	1.1
2003-04	7.2	8.8	4.6	2.5	11.1	3.8	26.1	5.2	3.9	4.0	10.6	3.9	1.3	0.8	2.9	0.9	0.7	0.7	1.1
2004-05	7.4	9.7	4.7	2.5	10.2	3.6	25.0	4.6	5.1	3.0	11.3	3.7	1.1	1.2	3.7	0.9	0.6	0.6	1.2
Source: TCO Pakistan																			

Appendix III.B. Survey Form on the Strategic Environment of the System

Semi-Structured Interview & Survey
Global Textile & Clothing Supply Chain Systems and Pakistan

Instructions to Complete the Survey:
Please write your inputs in the area shaded blue for the following sections 1 to 9 and use the scales shaded in brown or green, where advised.

1. Detail of the Survey Responder	
Name	
Education/Qualification	
Areas of Interest/Work & Experience	
Activities (Production, Manufacturing, Sourcing, Trading, Reatiling etc. of Products and/or Services)	
Countries of Operations	
Supplier or Sourcing Countries of the Company (or Person)	
Delivery Countries and the Markets of the Company	
Company/Individual Contacts	Email:
	Phone:

2. The Image of the Countries, their Products and Companies in the International Textile and Clothing Markets								
Scale: (1 = Poor 5 = Average 9 = Excellent N/A = No Idea)								
Country	Environment			Product Image			Company Image	
	Political	Economic	Responsiveness	Design	Quality	Cost	Commitment	Responsiveness
Brazil								
Bngladesh								
China								
Germany								
India								
Indonesia								
Italy								
Mexico								
Pakistan								
Portugal								
Sri Lanka								
Turkey								
Vietnam								

3. Image of the Products & Companies of Pakistan				
Scale: 1 = Poor 5 = Average 9 = Excellent N/A = No Idea				
Product Categories & Sub-Categories	Quality	Costs	Design	Responsiveness
Textiles				
Yarns				
Grey Fabrics				
Dyed Fabrics				
Printed Fabrics				
Clothing				
Ready Made Garments				
Men's Wear				
Women Wear				
Wedding Dresses				
Fashion				
Children's Clothing				
Denim Jeans				
Hosiery & Knits				
Under Garments Women				
Under Garments Men				
Sportswear				
Towels				
Home Textiles				
Carpets				
Tents and Canvas				
Textiles for Agriculture				
Textiles for Automobiles				
Textiles for Medical				
Industrial Textiles				
Protective Clothing				
Textiles for Construction				

4. Strengths and Weaknesses of the Countries in Textile, Clothing and Related Areas		
Country	Strengths	Weaknesses
Brazil		
Bangladesh		
China		
Germany		
India		

Indonesia		
Italy		
Mexico		
Pakistan		
Portugal		
Sri Lanka		
Turkey		
Vietnam		

5. The Importance of the Strengths and Weaknesses of Pakistan for Improving Its Textile and Clothing System

Scale: 1 = No Importance, 2 = Slight Importance, 3 = Moderate Importance, 4 = Moderate Plus Imp., 5 = Strong Imp., 6 = Strong Plus Imp., 7 = Very Strong Imp., 8 = Very V. Strong Imp., 9 = Excellent Imp.

	Strengths	Value	Weaknesses	Value
Pakistan				

6. Growing Markets in Textile & Clothing and Related Areas What are the growing segments in textile, clothing and related areas in different regions of the world ?	
World Markets	Product Segments
East Europe	
North Europe	
Central Europe	
South Europe	
N. America	
South and Central America	
China, India, Pakistan	
Middle East	
Far East	
Identify Important Opportunities for Pakistan Textile and Clothing	

7. The Importance of the Opportunities in the Textile and Clothing System of Pakistan		
Scale: 1 = No Importance, 2 = Slight Importance, 3 = Moderate Importance, 4 = Moderate Plus Imp., 5 = Strong Imp., 6 = Strong Plus Imp., 7 = Very Strong Imp., 8 = Very V. Strong Imp., 9 = Excellent Imp.		
	Opportunities	Importance
Pakistan		

8. What are the main threats to the Textile and Clothing System of Pakistan and how important are these?		
Scale: 1 = No Importance, 2 = Slight Importance, 3 = Moderate Importance, 4 = Moderate Plus Imp., 5 = Strong Imp., 6 = Strong Plus Imp., 7 = Very Strong Imp., 8 = Very V. Strong Imp., 9 = Excellent Imp.		
	Threats	Importance
Pakistan		

9. Development Status of the Activities in Textile, Clothing and Related Areas in the Supply Chain System of Pakistan					
Scale: 1-Poor, 2-Poor-to-Medium, 3-Medium, 4-Medium-to-Strong, 5-Strong					
Activities in the Supply Chain System & their Development Status		Extended Functions in the Supply Chain System and their Development Status			
Activities & Sub-Activities	Development Status	Marketting	Research	Technology (Equipment & Processes)	Skills
Fiber Production					
Cotton Farming					
Cotton Research					
Ginning (Organized)					
Ginning (Un-Organized)					
Other Natural Fibers (Jute, Silk, Wool, ...)					
Man Made Fibers					
Yarn Manufacturing (Mostly Organized Sector)					
Ring Spinning					
Rotor (Open End) Spinning					
Other Yarn Manufacturing (Air Jet, …)					
Fabric Manufacturing					
Weaving (Organized)					
Weaving (Un-Organized)					
Knitting (Organized)					
Other Fabric Manufacturing (Braiding, Nonwoven, …)					
Fabric Coloration & Finishing					
Dyeing (Organized)					
Dyeing (Un-Organized)					
Printing (Organized)					
Printing (Un-Organized)					
Finishing (Organized)					
Finishing (Un-Organized)					
Clothing (Organized)					
Clothing (Un-Organized)					
Input Industries					
Dyes and Chemical Mnf. (Organized)					
Dyes and Chemical Mnf. (Un-Organized)					
Machine Manufacturing					
Helping Areas					
ICT and Applications (in Organized)					
ICT and Applications (in Un-Organized)					
Logistics Companies					
Infrastructure					
Rail					
Roads					
Ports					
Storage					

We offer our thanks for your valuable feedback!

Appendix IV.A. Pairwise Comparison Matrices for SWOT Sub-factors with Their Weights

Table 79: Pariwise Comparison Matrix for Strengths

Strengths	S1	S2	S3	S4	S5	Local Weights
S1	1	3	2	3	4	0.395
S2	1/3	1	½	1	3	0.147
S3	½	2	1	3	3	0.262
S4	1/3	1	1/3	1	2	0.124
S5	1/4	1/3	1/3	½	1	0.072
CR = 0.0316						

Table 80: Pairwise Comparison Matrix for Weaknesses

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 = 0.0188												

Table 81: Pairwise Comparison Matrix for Opportunities

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 = 0.0216								

Table 82: Pairwise Comparison Matrix for Threats

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

Appendix IV.B. Pairwise Comparison Matrices for Alternatives

Table 84: Pairwise Comparison Matrix for Alternatives on S1

S1	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
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																

Table 85: Pairwise Comparison Matrix for Alternatives on S2

S2	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/4	3	4	3	1/4	1	1	1/5	4	1/3	4	3	1/3	4	0.068
SO2	4	1	4	5	3	1	1	3	1/3	5	1	5	3	2	4	0.102
SO3	1/3	1/4	1	3	2	1/4	1/3	1/3	1/4	3	1/4	2	1/2	1/3	3	0.036
SO4	1/4	1/5	1/3	1	1/2	1/5	1/4	1/3	1/5	1	1/5	1	1/3	1/3	1	0.019
SO5	1/3	1/3	1/2	2	1	1/2	2	1/2	1/3	3	1/3	2	1	1/3	2	0.037
WO1	4	1	4	5	2	1	1	4	1	4	2	5	3	2	4	0.135
WO2	1	1	3	4	2	1/2	1	2	1/3	4	1/3	3	3	1	4	0.075
WO3	1	1/3	3	3	2	1/4	1/2	1	1/4	4	1/3	4	2	1	4	0.060
WO4	5	3	4	5	4	1	3	4	1	4	3	5	4	3	4	0.173
WO5	1/4	1/5	1/3	1	1/3	1/4	1/4	1/4	1/4	1	1/4	1	1/3	1/4	1/2	0.019
ST1	3	1	4	5	3	1/2	3	3	1/3	4	1	4	3	3	4	0.118
ST2	1/4	1/5	1/2	1	1/2	1/5	1/3	1/4	1/5	1	1/4	1	1/2	1/2	1	0.021
WT1	1/3	1/3	2	3	1	1/3	1/3	1/2	1/4	3	1/3	2	1	1/3	2	0.038
WT2	3	1/2	3	3	3	1/2	1	1	1/3	4	1/3	2	3	1	4	0.076
WT3	1/4	1/4	1/3	1	1/2	1/4	1/4	1/4	1/4	2	1/4	1	1/2	1/4	1	0.022
CR = 0.058																

Table 86: Pairwise Comparison Matrix for Alternatives on S3

S3	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	2	4	1/4	2	1/3	1/3	3	1/4	4	2	1/4	3	3	4	0.064
SO2	1/2	1	3	1/5	2	1/4	1/4	2	1/4	4	1/2	1/5	3	2	4	0.047
SO3	1/4	1/3	1	1/6	1/3	1/5	1/5	1/3	1/5	1/3	1/4	1/6	1/3	1/2	1/2	0.015
SO4	4	5	6	1	1/4	3	2	3	1	5	3	1	4	4	5	0.149
SO5	1/2	1/2	3	1/4	1	1/3	1/2	2	1/3	3	1/2	1/4	2	2	3	0.046
WO1	3	4	5	1/3	3	1	1	3	1	5	3	1/3	4	5	5	0.103
WO2	3	4	5	1/2	2	1	1	3	1/3	5	2	1/2	4	4	5	0.098
WO3	1/3	1/2	3	1/3	1/2	1/3	1/3	1	1/3	3	1/3	1/3	2	2	3	0.037
WO4	4	4	5	1	3	1	3	3	1	5	3	1	5	4	5	0.138
WO5	1/4	1/4	3	1/5	1/3	1/5	1/5	1/3	1/5	1	1/4	1/5	1/3	1/2	2	0.020
ST1	1/2	2	4	1/3	2	1/3	1/2	3	1/3	5	1	1/3	3	2	4	0.061
ST2	4	5	6	1	4	3	2	3	1	5	3	1	4	4	5	0.149
WT1	1/3	1/3	3	1/4	1/2	1/4	1/4	1/2	1/5	3	1/3	1/4	1	1	2	0.028
WT2	1/3	1/2	2	1/4	1/2	1/5	1/4	1/2	1/4	2	1/2	1/4	1	1	2	0.027
WT3	1/4	1/4	2	1/5	1/3	1/5	1/5	1/3	1/5	1/2	1/4	1/5	1/2	1/2	1	0.018
CR = 0.046																

Table 87: Pairwise Comparison Matrix for Alternatives on S4

S4	SO1	SO2	SO4	WO1	WO3	WO4	WO5	ST2	WT1	WT2	Local Priorities
SO1	1	1/3	3	1	1/2	1/4	3	3	3	3	0.102
SO2	3	1	4	3	2	1/3	4	4	3	3	0.183
SO4	1/3	1/4	1	1/3	1/3	1/4	2	1	1/2	1/3	0.038
WO1	1	1/3	3	1	1/2	1/3	3	3	3	3	0.104
WO3	2	1/2	3	2	1	1/2	4	3	3	3	0.139
WO4	4	3	4	3	2	1	4	4	3	3	0.241
WO5	1/3	1/4	1/2	1/3	1/4	1/4	1	1/2	1/3	1/4	0.029
ST2	1/3	1/4	1	1/3	1/3	1/4	2	1	1/2	1/3	0.038
WT1	1/3	1/3	2	1/3	1/3	1/3	3	2	1	1/2	0.055
WT2	1/3	1/3	3	1/3	1/3	1/3	4	3	2	1	0.073
CR = 0.054											

Table 88: Pairwise Comparison Matrix for Alternatives on S5

S5	SO1	SO5	WO1	WO2	WO4	WO5	WT1	Local Priorities
SO1	1	1/4	3	2	3	4	5	0.207
SO5	4	1	5	3	3	5	5	0.381
WO1	1/3	1/5	1	1/2	1	3	3	0.089
WO2	1/2	1/3	2	1	2	3	4	0.141
WO4	1/3	1/3	1	1/2	1	3	3	0.096
WO5	1/4	1/5	1/3	1/3	1/3	1	1	0.044
WT1	1/5	1/5	1/3	1/4	1/3	1	1	0.041
CR = 0.041								

Table 89: Pairwise Comparison Matrix for Alternatives on W1

W1	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	4	4	3	1/2	2	1/4	3	1	4	3	3	3	3	4	0.108
SO2	1/4	1	2	1/2	1/4	1/3	1/5	1	1/4	2	1/2	1/2	1/2	3	3	0.035
SO3	1/4	1/2	1	1/3	1/4	1/3	1/5	1/2	1/4	2	1/3	1/3	1/3	2	2	0.026
SO4	1/3	2	3	1	1/3	1/3	1/4	2	1/3	3	2	1	2	3	4	0.058
SO5	2	4	4	3	1	2	1/3	3	1	4	3	3	3	4	5	0.122
WO1	1/2	3	3	3	1/2	1	1/3	2	1/2	3	2	3	2	2	4	0.082
WO2	4	5	5	4	3	3	1	5	3	5	4	4	3	5	5	0.200
WO3	1/3	1	2	1/2	1/3	1/2	1/5	1	1/3	2	1/2	1/2	1/2	3	3	0.038
WO4	1	4	4	3	1	2	1/3	3	1	4	3	3	3	3	4	0.113
WO5	1/4	1/2	1/2	1/3	1/4	1/3	1/5	1/2	1/4	1	1/3	1/3	1/3	1/2	2	0.021
ST1	1/3	2	3	1/2	1/3	1/2	1/4	2	1/3	3	1	1/2	1	2	3	0.047
ST2	1/3	2	3	1	1/3	1/3	1/4	2	1/3	3	2	1	2	3	4	0.058
WT1	1/3	2	3	1/2	1/3	1/2	1/3	2	1/3	3	1	1/2	1	2	3	0.048
WT2	1/3	1/3	1/2	1/3	1/4	1/2	1/5	1/3	1/3	2	1/2	1/3	1/2	1	3	0.027
WT3	1/4	1/3	1/2	1/4	1/5	1/4	1/5	1/3	1/4	1/2	1/3	1/4	1/2	1/3	1	0.017
CR = 0.046																

Table 90: Pairwise Comparison Matrix for Alternatives on W2

W2	WO1	WO2	WO3	WO4	WO5	WT1	WT2	WT3	Local Priorities
WO1	1	5	3	1	3	4	4	3	0.261
WO2	1/5	1	1/2	1/5	1/2	2	2	1/3	0.059
WO3	1/3	2	1	1/3	2	3	3	1/2	0.110
WO4	1	5	3	1	3	4	4	3	0.261
WO5	1/3	2	1/2	1/3	1	2	2	1/2	0.082
WT1	1/4	1/2	1/3	1/4	1/2	1	1	1/2	0.048
WT2	1/4	1/2	1/3	1/4	1/2	1	1	1/3	0.045
WT3	1/3	3	2	1/3	2	2	3	1	0.133
CR = 0.030									

Table 91: Pairwise Comparison Matrix for Alternatives on W3

W3	SO1	SO4	SO5	WO1	WO2	WO4	WO5	WT1	WT2	WT3	Local Priorities
SO1	1	1/2	1/4	1/5	1/3	1/5	1/2	1/2	1	1	0.034
SO4	2	1	1/3	1/4	1/3	1/4	2	1	2	2	0.060
SO5	4	3	1	1/3	1	1/3	3	2	4	4	0.122
WO1	5	4	1/3	1	3	1	5	4	5	5	0.237
WO2	3	3	1	1/3	1	1/3	3	3	4	4	0.125
WO4	5	4	3	1	3	1	5	4	5	5	0.237
WO5	2	1/2	1/3	1/5	1/3	1/5	1	1/2	3	3	0.053
WT1	2	1	1/2	1/4	1/3	1/4	2	1	3	3	0.068
WT2	1	1/2	1/4	1/5	1/4	1/5	1/3	1/3	1	1/2	0.029
WT3	1	1/2	1/4	1/5	1/4	1/5	1/3	1/3	2	1	0.034
CR = 0.023											

Table 92: Pairwise Comparison Matrix for Alternatives on W4

W4	SO1	SO2	SO4	WO1	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/2	1/4	1/3	1/3	1/2	3	1/3	1/4	1/4	1/2	2	0.029
SO2	5	1	4	4	4	3	5	4	4	3	5	5	0.239
SO4	4	1/4	1	3	3	1/4	4	3	1	1	3	3	0.099
WO1	3	1/4	1/3	1	1	1/3	3	1	1/3	1/3	3	3	0.056
WO3	3	1/4	1/3	1	1	1/3	3	1	1/3	1/3	3	3	0.056
WO4	5	1/3	4	3	3	1	5	3	4	3	4	4	0.181
WO5	1/3	1/5	1/4	1/3	1/3	1/5	1	1/3	1/4	1/4	1/3	1/2	0.021
ST1	3	1/4	1/3	1	1	1/3	3	1	1/3	1/3	3	3	0.056
ST2	4	1/4	1	3	3	1/4	4	3	1	1	3	3	0.099
WT1	4	1/3	1	3	3	1/3	4	3	1	1	3	3	0.102
WT2	2	1/5	1/3	1/3	1/3	1/4	3	1/3	1/3	1/3	1	3	0.037
WT3	1/2	1/5	1/3	1/3	1/3	1/4	2	1/3	1/3	1/3	1/3	1	0.026
CR = 0.062													

Table 93: Pairwise Comparison Matrix for Alternatives on W5

W5	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/2	2	1/4	3	1/3	1/2	2	1/3	3	4	1/4	1/4	3	4	0.051
SO2	2	1	3	1/3	3	1/2	1	2	1/2	4	4	1/3	1/3	2	4	0.063
SO3	1/2	1/3	1	1/5	2	1/4	1/3	1/2	1/4	2	2	1/5	1/5	1	3	0.029
SO4	4	3	5	1	5	3	4	4	2	5	5	1	1	4	5	0.151
SO5	1/3	1/2	1/2	1/5	1	1/4	1/3	1/3	1/4	2	2	1/5	1/5	1/2	3	0.025
WO1	3	2	4	1/3	4	1	3	3	1	4	4	1/3	1/3	3	4	0.092
WO2	2	1	3	1/4	3	1/3	1	2	1/3	4	4	1/4	1/4	2	4	0.059
WO3	1/2	1/2	2	1/4	3	1/3	1/2	1	1/3	3	3	1/4	1/4	2	3	0.042
WO4	3	2	4	1/2	4	1	3	3	1	4	4	1/2	1/2	3	4	0.097
WO5	1/3	1/4	1/2	1/5	1/2	1/4	1/4	1/3	1/4	1	1	1/5	1/5	1/2	2	0.020
ST1	1/4	1/4	1/2	1/5	1/2	1/4	1/4	1/3	1/4	1	1	1/5	1/5	1/2	2	0.020
ST2	4	3	5	1	5	3	4	4	2	5	5	1	1	4	5	0.151
WT1	4	3	5	1	5	3	4	4	2	5	5	1	1	4	5	0.151
WT2	1/3	1/2	1	1/4	2	1/3	1/2	1/2	1/3	2	2	1/4	1/4	1	3	0.032
WT3	1/4	1/4	1/3	1/5	1/3	1/4	1/4	1/3	1/4	1/2	1/2	1/5	1/5	1/5	1	0.016
CR = 0.039																

Table 94: Pairwise Comparison Matrix for Alternatives on W6

W6	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/3	1	1/3	2	1/5	1/2	1/3	1/5	2	1/4	1/3	1/3	1/3	3	0.028
SO2	3	1	2	1/2	3	1/4	2	1	1/4	3	1/3	1/2	1/2	1/2	4	0.049
SO3	1	1/2	1	1/2	2	1/4	1/2	1/2	1/4	2	1/3	1/2	1/2	1/2	3	0.033
SO4	3	2	2	1	3	1/4	2	2	1/4	4	1/3	1	1	3	4	0.072
SO5	1/2	1/3	1/2	1/3	1	1/5	1/3	1/3	1/5	2	1/3	1/3	1/2	1/3	3	0.025
WO1	5	4	4	4	5	1	4	4	2	5	3	3	3	4	5	0.184
WO2	2	1/2	2	1/2	3	1/4	1	1/2	1/4	3	1/3	1/2	1/2	1/2	4	0.042
WO3	3	1	2	1/2	3	1/4	2	1	1/4	3	1/3	1/2	1/2	1/2	4	0.049
WO4	5	4	4	4	5	1/2	4	4	1	4	3	3	3	4	5	0.166
WO5	1/2	1/3	1/2	1/4	1/2	1/5	1/3	1/3	1/4	1	1/4	1/4	1/4	1/4	2	0.020
ST1	4	3	3	3	3	1/3	3	3	1/3	4	1	2	2	3	4	0.110
ST2	3	2	2	1	3	1/3	2	2	1/3	4	1/2	1	1	3	4	0.075
WT1	3	2	2	1	3	1/3	2	2	1/3	4	1/2	1	1	3	4	0.074
WT2	3	2	2	1/3	3	1/4	2	2	1/4	4	1/3	1/3	1/3	1	4	0.056
WT3	1/3	1/4	1/3	1/4	1/3	1/5	1/4	1/4	1/5	1/2	1/4	1/4	1/4	1/4	1	0.016
CR = 0.048																

Table 95: Pairwise Comparison Matrix for Alternatives on W7

W7	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/3	2	1/4	1	1/3	1/2	1/4	1/3	3	1/4	1/4	1/3	1	3	0.031
SO2	3	1	3	1/3	2	1/2	2	1/3	1/2	4	1/3	1/3	1/2	3	3	0.054
SO3	1/2	1/3	1	1/4	1/2	1/3	1/3	1/4	1/3	2	1/4	1/4	1/4	1	2	0.024
SO4	4	3	4	1	4	3	3	3	4	5	2	1	2	4	5	0.152
SO5	1	1/2	2	1/4	1	1/3	1/3	1/3	1/3	2	1/4	1/4	1/3	1	2	0.029
WO1	3	2	3	1/3	3	1	3	1/3	2	4	1/3	1/3	1/2	3	4	0.071
WO2	2	1/2	3	1/3	3	1/3	1	1/3	1/3	3	1/3	1/3	1/3	2	3	0.044
WO3	4	3	4	1/3	3	3	3	1	3	4	1/2	1/3	2	4	5	0.108
WO4	3	2	3	1/4	3	1/2	3	1/3	1	4	1/3	1/4	1/3	3	4	0.062
WO5	1/3	1/4	1/2	1/5	1/2	1/4	1/3	1/4	1/4	1	1/4	1/5	1/4	1/2	1/2	0.017
ST1	4	3	4	1/2	4	3	3	2	3	4	1	1/2	2	3	4	0.120
ST2	4	3	4	1	4	3	3	3	4	5	2	1	2	4	5	0.152
WT1	3	2	4	1/2	3	2	3	1/2	3	4	1/2	1/2	1	3	4	0.089
WT2	1	1/3	1	1/4	1	1/3	1/2	1/4	1/3	2	1/3	1/4	1/3	1	2	0.028
WT3	1/3	1/3	1/2	1/5	1/2	1/4	1/3	1/5	1/4	2	1/4	1/5	1/5	1/2	1	0.019
CR = 0.045																

Table 96: Pairwise Comparison Matrix for Alternatives on W8

W8	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/3	3	1/3	1/2	1/3	1/2	1/4	1/3	4	1/3	1/3	2	1	3	0.038
SO2	3	1	4	1/2	3	3	2	1/3	2	4	2	1/2	3	3	4	0.099
SO3	1/3	1/4	1	1/4	1/3	1/4	1/4	1/5	1/4	1/2	1/4	1/3	1/2	1/3	1	0.019
SO4	3	2	4	1	3	3	2	1/3	2	4	2	1	3	4	5	0.115
SO5	2	1/3	3	1/3	1	1/2	1/2	1/5	1/2	4	1/3	1/3	2	2	4	0.046
WO1	3	1/3	4	1/3	2	1	1/2	1/3	1	3	1/3	1/3	3	3	4	0.060
WO2	2	1/2	4	1/2	2	2	1	1/3	2	4	1/2	5	3	3	4	0.074
WO3	4	3	5	3	5	3	3	1	3	3	2	3	4	4	5	0.175
WO4	3	1/2	4	1/2	2	1	1/2	1/3	1	3	1/2	1/2	3	3	4	0.065
WO5	1/4	1/4	2	1/4	1/4	1/3	1/4	1/3	1/3	1	1/4	1/4	1/3	1/3	2	0.022
ST1	3	1/2	4	1/2	3	3	2	1/2	2	4	1	1/2	3	3	4	0.092
ST2	3	2	3	1	3	3	2	1/3	2	4	2	1	3	4	5	0.114
WT1	1/2	1/3	2	1/3	1/2	1/3	1/3	1/4	1/3	3	1/3	1/3	1	1/2	3	0.031
WT2	1	1/3	3	1/4	1/2	1/3	1/3	1/4	1/3	3	1/3	1/4	2	1	3	0.035
WT3	1/3	1/4	1	1/5	1/4	1/4	1/4	1/5	1/4	1/2	1/4	1/5	3	1/3	1	0.017
CR = 0.085																

Table 97: Pairwise Comparison Matrix for Alternatives on W9

W9	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	2	1/2	1/4	3	1/3	2	3	1/4	3	1/4	1/4	1/4	2	3	0.044
SO2	1/2	1	1/2	1/3	2	1/3	2	2	1/3	3	1/4	1/4	1/4	2	3	0.039
SO3	2	2	1	1/4	3	1/3	3	3	1/5	3	1/3	1/4	1/4	2	3	0.051
SO4	4	3	4	1	4	3	3	4	2	5	1	1/2	1/2	3	4	0.115
SO5	1/3	1/2	1/3	1/4	1	1/3	1/2	1	1/4	2	1/4	1/5	1/5	1/2	2	0.023
WO1	3	3	3	1/3	3	1	2	3	1/2	4	1/3	1/4	1/4	3	4	0.070
WO2	1/2	1/2	1/3	1/3	2	1/2	1	2	1/4	3	1/3	1/4	1/4	2	3	0.036
WO3	1/3	1/2	1/3	1/4	1	1/3	1/2	1	1/4	2	1/4	1/5	1/5	1/2	1	0.022
WO4	4	3	5	1/2	4	2	4	4	1	5	1/2	1/3	1/3	4	4	0.101
WO5	1/3	1/3	1/3	1/5	1/2	1/4	1/3	1/2	1/5	1	1/5	1/5	1/5	1/3	1	0.017
ST1	4	4	3	1	4	1/3	3	4	2	5	1	1/2	1/2	3	4	0.114
ST2	4	4	4	2	5	4	4	5	3	5	2	1	1	4	4	0.159
WT1	4	4	4	2	5	4	4	5	3	5	2	1	1	4	4	0.159
WT2	1/2	1/2	1/2	1/3	2	1/3	1/2	2	1/4	3	1/3	1/4	1/4	1	2	0.031
WT3	1/3	1/3	1/3	1/4	1/2	1/4	1/3	1	1/4	1	1/4	1/4	1/4	1/2	1	0.020
CR = 0.044																

Table 98: Pairwise Comparison Matrix for Alternatives on W10

W10	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/3	2	1/2	1/4	1/2	1/4	1/3	1/2	1/3	1/3	1/3	1/2	1/2	1/3	0.025
SO2	3	1	3	2	1/3	3	1/3	2	3	2	1/2	1/3	3	2	1/2	0.071
SO3	1/2	1/3	1	1/3	1/5	1/2	1/5	1/3	1/2	1/3	1/4	1/5	1/2	1/2	1/4	0.019
SO4	2	1/2	3	1	1/4	1	1/4	1/2	2	1/2	1/3	1/3	2	1	1/3	0.039
SO5	4	3	5	4	1	3	1	3	3	2	3	1	3	3	2	0.136
WO1	2	1/3	2	1	1/3	1	1/3	1/2	1	1/2	1/3	1/3	1	1	1/3	0.035
WO2	4	3	5	4	1	3	1	3	3	2	3	1	3	3	2	0.136
WO3	3	1/2	3	2	1/3	2	1/3	1	2	2	1/3	1/3	3	2	1/3	0.059
WO4	2	1/3	2	1/2	1/3	1	1/3	1/2	1	1/2	1/3	1/3	1	1	1/3	0.033
WO5	3	1/2	3	2	1/2	2	1/2	1/2	2	1	1/2	1/3	3	2	1/2	0.058
ST1	3	2	4	3	1/3	3	1/3	3	3	2	1	1/2	3	3	1/2	0.090
ST2	3	3	5	3	1	3	1	3	3	3	2	1	3	3	2	0.130
WT1	2	1/3	2	1/2	1/3	1	1/3	1/3	1	1/3	1/3	1/3	1	1/2	1/3	0.031
WT2	2	1/2	2	1	1/3	1	1/3	1/2	1	1/2	1/3	1/3	2	1	1/3	0.037
WT3	3	2	4	3	1/2	3	1/2	3	3	2	2	1/2	3	3	1	0.101
CR = 0.032																

Table 99: Pairwise Comparison Matrix for Alternatives on W11

W11	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/2	1/3	1/3	1	1/2	1/2	1/2	1/2	3	1/4	1/3	1/2	1	2	0.033
SO2	2	1	1/3	1/2	2	2	1	2	2	4	1/4	1/3	1/2	3	3	0.061
SO3	3	3	1	2	3	3	3	2	3	4	1/3	1/2	2	3	3	0.110
SO4	3	2	1/2	1	3	3	3	2	2	4	1/4	1/2	2	3	3	0.093
SO5	1	1/2	1/3	1/3	1	1/2	1/2	1/2	1/2	3	1/4	1/3	1/2	2	2	0.035
WO1	2	1/2	1/3	1/3	2	1	1/2	1	1	4	1/4	1/3	1/3	2	3	0.045
WO2	2	1	1/3	1/3	2	2	1	2	2	4	1/3	1/3	1/2	3	3	0.061
WO3	2	1/2	1/2	1/2	2	1	1/2	1	1	4	1/4	1/3	1/2	2	3	0.048
WO4	2	1/2	1/3	1/2	2	1	1/2	1	1	4	1/4	1/3	1/2	2	3	0.047
WO5	1/3	1/4	1/4	1/4	1/3	1/4	1/4	1/4	1/4	1	1/5	1/5	1/3	1	1	0.019
ST1	4	4	3	4	4	4	3	4	4	5	1	3	3	4	5	0.195
ST2	3	3	2	2	3	3	3	3	3	5	1/3	1	2	3	4	0.127
WT1	2	2	1/2	1/2	2	3	2	2	2	3	1/3	1/2	1	3	3	0.077
WT2	1	1/3	1/3	1/3	1/2	1/2	1/3	1/2	1/2	1	1/4	1/3	1/3	1	1	0.026
WT3	1/2	1/3	1/3	1/4	1/2	1/3	1/3	1/3	1/3	1	1/5	1/4	1/3	1	1	0.022
CR = 0.036																

Table 100: Pairwise Comparison Matrix for Alternatives on O1

O1	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/3	3	2	1/4	1/4	1/4	3	1/5	1/2	1/2	2	2	3	3	0.045
SO2	3	1	4	4	1/3	1/2	1/4	3	1/4	3	3	3	3	3	4	0.085
SO3	1/3	1/4	1	1/3	1/4	1/4	1/4	2	1/5	1/3	1/3	1/3	1/2	2	3	0.025
SO4	1/2	1/4	3	1	1/4	1/4	1/4	3	1/4	1/3	1/2	1	2	3	3	0.038
SO5	4	3	4	4	1	2	1/3	3	1/3	3	3	4	3	4	5	0.119
WO1	4	2	4	4	1/2	1	1/3	3	1/3	3	3	4	3	4	5	0.104
WO2	4	4	4	4	3	3	1	4	1/2	3	3	4	3	5	5	0.156
WO3	1/3	1/3	1/2	1/3	1/3	1/3	1/4	1	1/4	1/3	1/3	1/3	1/2	1	2	0.023
WO4	5	4	5	4	3	3	2	4	1	3	4	4	4	5	6	0.182
WO5	2	1/3	3	3	1/3	1/3	1/3	3	1/3	1	2	3	3	3	3	0.064
ST1	2	1/3	3	2	1/3	1/3	1/3	3	1/4	1/2	1	2	2	3	3	0.051
ST2	1/2	1/3	3	1	1/4	1/4	1/4	3	1/4	1/3	1/2	1	2	3	3	0.039
WT1	1/2	1/3	2	1/2	1/3	1/3	1/3	2	1/4	1/33	1/2	1/2	1	2	3	0.032
WT2	1/3	1/3	1/2	1/3	1/4	1/4	1/5	1	1/5	1/3	1/3	1/3	1/2	1	2	0.020
WT3	1/3	1/4	1/3	1/3	1/5	1/5	1/5	1/2	1/6	1/3	1/3	1/3	1/3	1/2	1	0.016
CR = 0.062																

Table 101: Pairwise Comparison Matrix for Alternatives on O2

O2	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/3	2	3	3	1/5	1/3	1/3	1/2	4	1/2	1/4	3	3	4	0.055
SO2	3	1	3	4	4	1	2	1	3	5	2	1/3	4	3	5	0.114
SO3	1/2	1/3	1	3	2	1/3	1/3	1/3	1/2	4	1/3	1/4	3	3	4	0.047
SO4	1/3	1/4	1/3	1	1/2	1/4	1/4	1/4	1/3	3	1/4	1/5	2	2	4	0.030
SO5	1/3	1/4	1/2	2	1	1/4	1/3	1/4	1/3	4	1/3	1/4	2	3	4	0.037
WO1	3	1	3	4	4	1	2	1	2	5	2	1/2	4	3	5	0.112
WO2	3	1/2	3	4	3	1/2	1	1/2	2	5	2	1/3	3	3	5	0.090
WO3	3	1	3	4	4	1	2	1	3	5	2	1/2	4	3	5	0.116
WO4	2	1/3	2	3	3	1/2	1/2	1/3	1	5	1/2	1/3	3	3	5	0.065
WO5	1/4	1/5	1/4	1/3	1/4	1/5	1/5	1/5	1/5	1	1/5	1/5	1/3	1/3	1/2	0.015
ST1	2	1/2	3	4	3	1/2	1/2	1/2	2	5	1	1/3	3	3	5	0.079
ST2	4	3	4	5	4	2	3	2	3	5	3	1	4	4	5	0.170
WT1	1/3	1/4	1/3	1/2	1/2	1/4	1/3	1/4	1/3	3	1/3	1/4	1	2	3	0.027
WT2	1/3	1/3	1/3	1/2	1/3	1/3	1/3	1/3	1/3	3	1/3	1/4	1/2	1	2	0.025
WT3	1/4	1/5	1/4	1/4	1/4	1/5	1/5	1/5	1/5	2	1/5	1/5	1/3	1/2	1	0.016
CR = 0.051																

Table 102: Pairwise Comparison Matrix for Alternatives on O3

O3	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1	5	1/2	3	1/2	1	3	2	5	1	5	2	4	5	0.098
SO2	1	1	5	1/2	4	1	2	4	3	5	2	5	2	4	5	0.120
SO3	1/5	1/5	1	1/5	1/3	5	1/4	1/2	1/3	4	1/4	2	1/4	1	3	0.058
SO4	2	2	5	1	4	1	2	4	3	5	2	5	2	4	5	0.137
SO5	1/3	1/4	3	1/4	1	1/4	1/3	3	1/2	4	1/3	3	1/2	3	4	0.049
WO1	2	1	5	1	4	1	3	4	3	5	2	5	2	4	5	0.119
WO2	1	1/2	4	1/2	3	1/3	1	3	2	5	1	5	2	4	5	0.090
WO3	1/3	1/4	2	1/4	1/3	1/4	1/3	1	1/3	4	1/3	3	1/3	3	4	0.038
WO4	1/2	1/3	3	1/3	2	1/3	1/2	3	1	4	1/2	3	1	3	4	0.060
WO5	1/5	1/5	1/4	1/5	1/4	1/5	1/5	1/4	1/4	1	1/5	1/3	1/5	1/3	1/2	0.013
ST1	1	1/2	4	1/2	3	1/2	1	3	2	5	1	4	2	4	5	0.090
ST2	1/5	1/5	1/2	1/5	1/3	1/5	1/5	1/3	1/3	3	1/4	1	1/3	1	2	0.020
WT1	1/2	1/2	4	1/2	2	1/2	1/2	3	1	5	1/2	3	1	3	5	0.069
WT2	1/4	1/4	1	1/4	1/3	1/4	1/4	1/3	1/3	3	1/4	1	1/3	1	3	0.025
WT3	1/5	1/5	1/3	1/5	1/4	1/5	1/5	1/4	1/4	2	1/5	1/2	1/5	1/3	1	0.015
CR = 0.105																

Table 103: Pairwise Comparison Matrix for Alternatives on O4

O4	SO1	SO2	SO5	WO1	WO2	WO4	WO5	WT2	Local Priorities
SO1	1	5	4	3	5	2	5	5	0.293
SO2	1/5	1	1/3	1/4	1	1/5	4	4	0.060
SO5	1/4	3	1	1/4	3	1/4	4	5	0.101
WO1	1/3	4	4	1	5	1/3	5	5	0.178
WO2	1/5	1	1/3	1/5	1	1/5	4	4	0.059
WO4	1/2	5	4	3	5	1	5	5	0.249
WO5	1/5	1/4	1/4	1/2	1/4	1/5	1	2	0.032
WT2	1/5	1/4	1/5	1/5	1/4	1/5	1/2	1	0.027
CR = 0.117									

Table 104: Pairwise Comparison Matrix for Alternatives on O5

O5	SO1	SO2	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	Local Priorities
SO1	1	3	3	1/3	1/2	3	4	1/3	5	4	4	5	4	0.115
SO2	1/3	1	2	1/4	1/3	3	4	1/4	5	4	3	4	4	0.084
SO4	1/3	1/2	1	1/4	1/4	3	3	1/4	5	4	2	4	4	0.069
SO5	3	4	4	1	2	4	5	2	6	5	4	5	5	0.194
WO1	2	3	4	1/2	1	3	4	1	6	5	4	5	5	0.146
WO2	1/3	1/3	1/3	1/4	1/3	1	2	1/4	4	4	1/3	3	4	0.047
WO3	1/4	1/4	1/3	1/5	1/4	1/2	1	1/5	4	3	1/3	3	3	0.036
WO4	3	4	4	1/2	1	4	5	1	6	5	4	5	5	0.166
WO5	1/5	1/5	1/5	1/6	1/6	1/4	1/4	1/6	1	1/3	1/5	1/4	1/3	0.014
ST1	1/4	1/4	1/4	1/5	1/5	1/4	1/3	1/5	3	1	1/4	1/3	2	0.022
ST2	1/4	1/3	1/2	1/4	1/4	3	3	1/4	5	4	1	3	4	0.059
WT1	1/5	1/4	1/4	1/5	1/5	1/3	1/3	1/5	4	3	1/3	1	3	0.029
WT2	1/4	1/4	1/4	1/5	1/5	1/4	1/3	1/5	3	1/2	1/4	1/3	1	0.020
CR = 0.082														

Table 105: Pairwise Comparison Matrix for Alternatives on O6

O6	SO2	SO4	SO5	WO1	WO2	WO4	WO5	ST1	ST2	WT1	WT2	Local Priorities
SO2	1	1/3	3	1/4	3	1/5	1/5	1/4	4	1/4	1/4	0.038
SO4	3	1	4	1/4	3	1/5	1/5	1/3	4	1/3	1/4	0.053
SO5	1/3	1/4	1	1/4	1/2	1/4	1/5	1/4	3	1/4	1/4	0.026
WO1	4	4	4	1	4	1/2	1/3	4	5	4	3	0.156
WO2	1/3	1/3	2	1/4	1	1/5	1/5	1/4	3	1/4	1/4	0.028
WO4	5	5	4	2	5	1	1/2	4	5	4	3	0.188
WO5	5	5	5	3	5	2	1	4	5	4	3	0.227
ST1	4	3	4	1/4	4	1/4	1/4	1	4	2	1/3	0.080
ST2	1/4	1/4	1/3	1/5	1/3	1/5	1/5	1/4	1	1/4	1/5	0.019
WT1	4	3	4	1/4	4	1/4	1/4	1/2	4	1	1/3	0.070
WT2	4	4	4	1/3	4	1/3	1/3	1/3	5	3	1	0.114
CR = 0.086												

Table 106: Pairwise Comparison Matrix for Alternatives on O7

O7	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/3	3	1/4	1/3	1/4	1/4	1/6	2	4	1/4	1/2	1/5	3	3	0.030
SO2	3	1	3	1/4	1/3	1/3	1/4	1/5	3	4	1/4	3	1/4	3	4	0.044
SO3	1/3	1/3	1	1/5	1/4	1/4	1/5	1/5	1/2	3	1/4	1/3	1/5	2	3	0.021
SO4	4	4	5	1	4	3	1/3	1/3	4	5	3	5	1/3	4	5	0.109
SO5	3	3	4	1/4	1	1/3	1/4	1/4	3	4	1/4	4	1/4	4	5	0.057
WO1	4	3	4	1/3	3	1	1/3	1/4	3	5	1/2	4	1/4	4	5	0.071
WO2	4	4	5	3	4	3	1	1/3	4	6	3	5	1/2	5	6	0.132
WO3	6	5	5	3	4	4	3	1	5	7	4	5	3	5	6	0.195
WO4	1/2	1/3	2	1/4	1/3	1/3	1/4	1/5	1	4	1/4	1/2	1/4	3	3	0.027
WO5	1/4	1/4	1/3	1/5	1/4	1/5	1/6	1/7	1/4	1	1/5	1/4	1/6	1/3	1/2	0.012
ST1	4	4	4	1/3	4	2	1/3	1/4	4	5	1	5	1/3	4	5	0.088
ST2	2	1/3	3	1/5	1/4	1/4	1/5	1/5	2	4	1/5	1	1/5	3	3	0.032
WT1	5	4	5	3	4	4	2	1/3	4	6	3	5	1	5	5	0.149
WT2	1/3	1/3	1/2	1/4	1/4	1/4	1/5	1/5	1/3	3	1/4	1/3	1/5	1	2	0.019
WT3	1/3	1/4	1/3	1/5	1/5	1/5	1/6	1/6	1/3	2	1/5	1/3	1/5	1/2	1	0.014
CR = 0.088																

Table 107: Pairwise Comparison Matrix for Alternatives on T1

T1	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/3	3	2	4	1/3	1	2	1/2	5	1/4	1/4	1/3	3	4	0.052
SO2	3	1	4	3	5	2	3	3	3	6	1/3	1/3	3	4	4	0.116
SO3	1/3	1/4	1	1/3	2	1/4	1/3	1/3	1/4	3	1/5	1/5	1/4	1/3	1/2	0.020
SO4	1/2	1/3	3	1	4	1/3	1/2	2	1/3	5	1/4	1/4	1/3	3	4	0.046
SO5	1/4	1/5	1/2	1/4	1	1/5	1/4	1/3	1/5	3	1/5	1/5	1/5	1/3	1/3	0.017
WO1	3	1/2	4	3	5	1	3	3	3	6	1/3	1/3	2	4	4	0.101
WO2	1	1/3	3	2	4	1/3	1	3	1/2	5	1/4	1/4	1/3	3	4	0.054
WO3	1/2	1/3	3	1/2	3	1/3	1/3	1	1/3	4	1/4	1/4	1/3	2	3	0.036
WO4	2	1/3	4	3	5	1/33	2	3	1	5	1/4	1/4	1/2	3	4	0.069
WO5	1/5	1/6	1/3	1/5	1/3	1/6	1/5	1/4	1/5	1	1/6	1/6	1/5	1/4	1/4	0.012
ST1	4	3	5	4	5	3	4	4	4	6	1	1	3	4	5	0.168
ST2	4	3	5	4	5	3	4	4	4	6	1	1	3	4	5	0.168
WT1	3	1/3	4	3	5	1/2	3	33	2	5	1/3	1/3	1	4	4	0.087
WT2	1/3	1/4	3	1/3	3	1/4	1/3	1/2	1/3	4	1/4	1/4	1/4	1	3	0.031
WT3	1/4	1/4	2	1/4	3	1/4	1/4	1/3	1/4	4	1/5	1/5	1/4	1/3	1	0.023
CR = 0.106																

Table 108: Pairwise Comparison Matrix for Alternatives on T2

T2	SO1	SO2	SO3	SO4	SO5	WO1	WO2	WO3	WO4	WO5	ST1	ST2	WT1	WT2	WT3	Local Priorities
SO1	1	1/2	3	3	2	1/3	1/3	1/3	1/4	4	1/3	1/4	3	4	4	0.049
SO2	2	1	4	4	3	1/2	1/3	1/2	1/4	4	1/2	1/4	3	4	4	0.062
SO3	1/3	1/4	1	1/2	1/3	1/5	1/5	1/5	1/5	4	1/5	1/5	1/3	2	3	0.023
SO4	1/3	1/4	2	1	1/3	1/5	1/5	1/5	1/5	4	1/5	1/5	1/2	3	4	0.027
SO5	1/2	1/3	3	3	1	1/4	1/5	1/4	1/5	4	1/4	1/5	2	4	4	0.039
WO1	3	2	5	5	4	1	1/2	1	1/3	5	1	1/3	4	5	5	0.091
WO2	3	3	5	5	5	2	1	2	1/2	5	2	1/2	4	5	5	0.120
WO3	3	2	5	5	4	1	1/2	1	1/3	5	1	1/3	4	5	5	0.091
WO4	4	4	5	5	5	3	2	3	1	6	3	1	4	5	6	0.163
WO5	1/4	1/4	1/4	1/4	1/4	1/5	1/5	1/5	1/6	1	1/5	1/6	1/4	1/3	1/2	0.013
ST1	3	2	5	5	4	1	1/2	1	1/3	5	1	1/3	4	5	5	0.091
ST2	4	4	5	5	5	3	2	3	1	6	3	1	4	5	6	0.163
WT1	1/3	1/3	3	2	1/2	1/4	1/4	1/4	1/4	4	1/4	1/4	1	3	4	0.034
WT2	1/4	1/4	1/2	1/3	1/4	1/5	1/5	1/5	1/5	3	1/5	1/5	1/3	1	2	0.018
WT3	1/4	1/4	1/3	1/4	1/4	1/5	1/5	1/5	1/6	2	1/5	1/6	1/4	1/2	1	0.015
CR = 0.064																

Appendix V.A: Survey Form on the Transportation Time of Pakistan (Logistics and Shipping Companies)

Structured Survey
Transportation Times & Costs Survey (Logistics Companies)
(Port of Origin: Karachi)

Instructions to Complete the Survey: Please write your inputs in the area shaded blue for the following sections 1 to 7.

Detail of the Person Filling the Survey Form	
Name	
Designation	
Company	
Contact	Email: Phone:
Date	

Detail of the Company	
Name	
Location	
Types of Products1 Transported	
Types of Services2 Offered	
Freight Movement Locations3	
Contact	Email: Phone:
Explanation: 1: Types of products can be bulk, fluids, fresh products, etc. 2: Time based offers, quantity offers, product insurance, etc. 3: Locations include, inside Pakistan and offshore destinations.	

Europe				
Sr. No.	Destination Port	Travelling Times	Travelling Costs (40 Feet Container)	Travelling Costs (20 Feet Container)

America				
Sr. No.	Destination Port	Travelling Times	Travelling Costs (40 Feet Container)	Travelling Costs (20 Feet Container)

Asia				
Sr. No.	Destination Port	Travelling Times	Travelling Costs (40 Feet Container)	Travelling Costs (20 Feet Container)

Far East				
Sr. No.	Destination Port	Travelling Times	Travelling Costs (40 Feet Container)	Travelling Costs (20 Feet Container)

Africa				
Sr. No.	Destination Port	Travelling Times	Travelling Costs (40 Feet Container)	Travelling Costs (20 Feet Container)

In-Country Transportation Times and Costs (Main Industrial Locations to Karachi Port)			
Origins	Travelling Times	Cost (40 Feet Container)	Cost (20 Feet Container)
Karachi			
Nooriabad			
Hyderabad			
Mirpur Khas			
Nawabshah			
Khairpur			
Sukkar			
Rahim Yar Khan			
Bahawalpur			
Multan			
Faisalabad			
Lahore			
Rawalpindi			
Sargodha			
Kohat			
Peshawar			
Dera Ismail Khan			
Quetta			
Sibi			
Gawadar			
Muzafarabad			

Appendix V.B: Survey Results on the Transportation Time of Pakistan

Table 128: Inland Transportation Time from Industrial Locations to Karachi Port

Region	Industrial Locations	Transportation Times
Baluchistan	Hub	01
	Quetta; Gawadar	02
Kashmir and Northern Areas		02-03
Khyber Phakhtunkha	Peshawar; Mardan; Swabi; Kohat	02
Sindh	Karachi; Hyderabad; Dadu; Jamshoro; Nawabshah; Sukkar; Sanghar; Khairpur	01
Punjab	Rahim Yar Khan; Bhawalpur; Mulatn; Muzaffargarh; Lahore; Faisalabad; Rawalpindi; Sialkot; Gujrat	02

Table 129: Off Shore Transportation Time to Main Export Destinations of Pakistan

	Destinations	Time in days
Europe	United Kingdom (Felixstowe Port)	19-20
	Germany	22-23
	France	28-30
	Italy	21-22
	Norway	34-35
	Portugal	34-35
Far East	Australia	34-35
	New Zealand	N/A
	Indonesia	N/A
	Malaysia	16-17
	Japan	24-25
	Vietnam	21-22
Africa	South Africa	24-25
	Algeria	24-25
	Egypt	18-20
	Libya	18-20
	Morocco	N/A
	Tunisia	29-30
Middle East and South Asia	Saudi Arabia	10-11
	India (Bombay)	2-3
	Bangladesh	18-20