Strategic Planning for the Textile and Clothing Supply Chain

Deedar Hussain, Manuel Figueiredo, Anabela Tereso, and Fernando Ferreira

Abstract—The expansion of textile and clothing production to Asian regions has both, increased competition and created a need for integration with the global supply chain. Strategies are being designed to improve competitiveness and responsiveness of the chains by increasing the diversification of products and value addition. This study formulates and examines the potential of such strategies and their implementation for textile and clothing chains originating from Pakistan. The strategies were developed based on a SWOT analysis followed by their prioritization through Saaty´s AHP and ANP. This work extends the previously developed phase of strategic planning to the implementation phase. Here we analyse the strategic plans using the Simple Additive Weighting (SAW) method and taking into account relevant factors such as cost, time and implementability.

Index Terms— Implementation Phase of Strategic Planning, Textile and Clothing Supply Chain, Simple Additive Weighting

I. INTRODUCTION

THE expansion of textile and clothing chain in the Asian region has increased competition and consequently the need for improving integration in the chain. Strategies are being designed to improve competitiveness and responsiveness of the chains with increasing diversification of products. This study examines the potential of different strategies formulated by experts focusing on Pakistan´s case.

The supply chains in textile and clothing are driven by the big brands and retailers that have tremendous power in determining price, quality, delivery, and labor conditions for suppliers and producers down the chain. They are segmented 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 labor-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. During the last couple of decades, the major competing supply chains in textile and clothing are routed from China, India, Pakistan and Turkey and some others are emerging like Brazil and Bangladesh because of the low-cost production strategies.

The study on the strategic planning for the above system is based on developing the understanding of the different parts of the problem at required level of detail and then creating a holistic view through combining those parts. It covers the studies on the system and its environment, future target scenarios, strategic planning and implementation. Therefore it advances through the main phases of environment and system analysis, development and analysis of strategic plans and their implementation, and finally the monitoring and readjustment phases.

We address here mainly the implementation phase of the developed plans which were analyzed for their importance to the system targets by using different analytical tools. The planning situation is focused on the textile and clothing chains in a developing country and the system is the country itself.

In the following sections, the completed studies on the system and its environment analysis are presented firstly and then the implementation phase is discussed. Later, the methodology is described and the results are discussed and finally the conclusions are presented.

II. SYSTEM ENVIRONMENT AND STRATEGIC PLANNING

The general environment of the textile and clothing was studied and the development status of the chain entities was established through a literature review and discussions with chain experts. A Planning-link was introduced in the strategic planning process to establish the relationship of the chain entities and their development status to the targeted opportunities. It helped to devise relevant strategies for the system. These strategies were analyzed later for their importance to the target opportunities and thus the priorities were created for those plans. The prioritization process established the rating and importance of the plans which is useful in their implementation phase and also for the allocation of the limited resources of the system to achieve the objectives in shortest possible time. The previous studies on the analysis of the system and its environment and strategic planning and its evaluation are covered in [1]

Deedar Hussain is with NED University of Engineering and Technology, Karachi 75270, Sind, Pakistan. He is a PhD student at the Algoritmi Research Center, Department of Production and Systems, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal (phone: +351-253-111712; fax: +351-253-604741; e-mail: deedar_agha@hotmail.com).

Manuel Figueiredo is with Algoritmi Research Center. He is an Assistant Professor at Department of Production and Systems, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal (e-mail: mcf@ dps.uminho.pt).

Anabela Tereso is with CIT, Research Center for Industry and Technology Management. She is an Assistant Professor at the Department of Production and Systems, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal (e-mail: anabelat@dps.uminho.pt).

Fernando Ferreira is with 2C2T, Research Center for Textile Science and Technology. He is an Associate Professor at Department of Textile Engineering, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal (e-mail: fnunes@ det.uminho.pt).

and [2] and are described in the following paragraphs.

The strategic planning was started with the analysis of the environment which was followed by the strategy development phase. The environment analysis was linked with the strategy development phase through Planning-link. These are presented in the table 1 and 2 and figure 1.

TABLE 1
SWOT MATRIX FOR THE TEXTILE AND CLOTHING SUPPLY CHAINS

Internal Factors	
Strengths	**Weaknesses**
S1 - Indigenous cotton crop S2 - Low wages/labor costs S3 - Strong investment in textiles & made-ups S4 - Skills in ICT S5 - Skills in chemistry (for textile & clothing chemical industry)	W1 - Limited base of non cotton fibers W2 - Weak ginning sector W3 - Lower cotton yield (per acre) W4 - Low application & usage of ICT W5 - Non competitive behavior of entrepreneurs W6 - Skills (technical, marketing & management) W7 - Distance to (current) markets W8 - Underdeveloped logistics W9 - Weak market awareness (market´s dynamics, buyer´s needs, competitor´s strengths and weaknesses); because of weak ultimate-customer link W10 - Input´s costs and continuity W11 - Low Foreign Direct Investment (FDI)
External Factors	
Opportunities	**Threats**
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	T1 - Political instability T2 - Regional competitors

The internal and external environment was developed through SWOT analysis and the status of development for the entities was established as presented in table1 and figure1. The planning-link describes the relationship of internal factors to external opportunities (figure1). Based on the environment study and the factors relationship, the strategic plans were developed as presented in table 2.
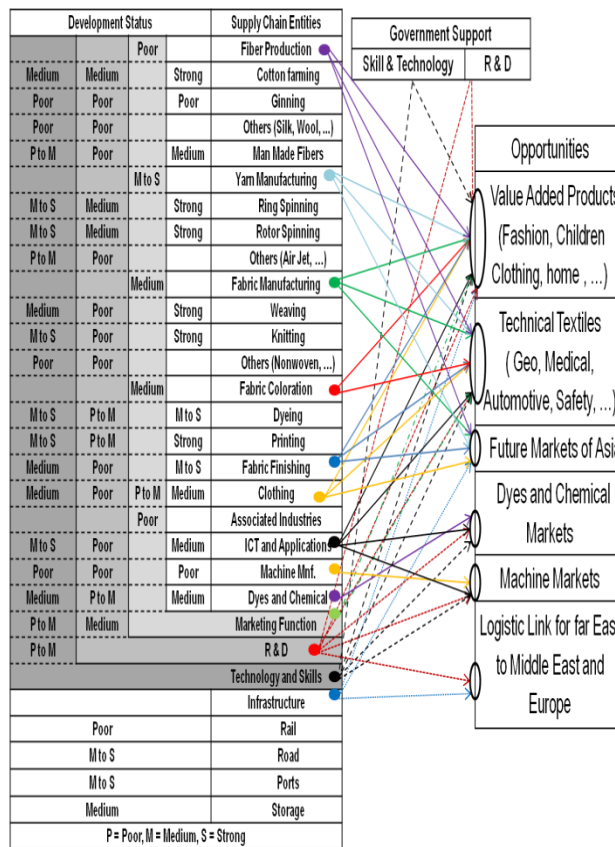

Fig.1. Planning-Link for the Strategic Planning of Textile and Clothing Supply Chains

TABLE 2
STRATEGIC PLANS FOR THE TEXTILE AND CLOTHING SUPPLY CHAINS

SO Strategy	WO Strategy
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
ST Strategy	**WT Strategy**
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

Analysis on the effectiveness of the developed strategic plans was conducted through the Analytical Hierarchy Process (AHP) and Analytical Network Process (ANP) developed by Saaty. Reference [3] and [4] discuss AHP and ANP in more detail and the analysis on the strategic plans can be found in [1]. The importance of the strategies and their ranking in relation to targeted opportunities is presented in table 3.

TABLE 3
IMPORTANCE AND RANKING OF STRATEGIES IN THE STRATEGY
DEVELOPMENT PHASE

STRATEGY	IMPORTANCE
WO4: Developing Effective Linkage between Industry, Academia and R&D Institutes	.144
WO1: Skill Development Programs	.123
ST2: Establishing Down Stream Facilities in Stable, Near to Market and Competing Regions	.084
WO2: Expanding Non-cotton Fibre Base	.082
SO2: Establishing Industrial Parks with Common Facilities of Design & Development Centres, ICT Application Centres & Effluent Treatment Plants etc	.080
SO1: Diversification of Product Range	.075
ST1: Development of Market Access Strategies	.073
SO4: Establishing Downstream Facilities in Competing Regions	.067
SO5: Improving Domestic Chemical Industry	.062
WO3: Improving Logistics	.050
WT1: Work in Close Collaboration with Competitors	.049
WT2: Development and Implementation of Long-term & Coordinated Policies	.040
WO5: Developing Domestic Engineering Industry	.029
SO3: Applying Export Incentives	.025
WT3: Introduction of Industry Relief Packages	.017

III. IMPLEMENTATION PHASE OF THE STRATEGIC PLANNING

The questions raised by the implementation phase are of different nature. They require the utilization of appropriate criteria related to the effective implementation of the plans. Important aspects at this stage are the limited resources available and the implementation time. It is also necessary to establish the dependency of the strategies and how they can be scheduled within those constraints.

In this section, we describe the new criteria which are useful in this phase, the methodology utilized and finally we will discuss the results and present the conclusions for the implementation phase.

Simple Additive Weighting (SAW)

The Simple Additive Weighting (SAW) model is a multicriteria method based on the Multi-Attribute Utility Theory (MAUT) devised by Keeney and Raiffa [5]. The SAW method is probably one of the best known and most widely used Multiple Attribute Decision Making method [6]. 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.

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

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.

A. Methodology

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 in the next section.

B. Criteria for Implementation Phase

Cost

Cost is one of the crucial criteria which are considered in the implementation phase. The objective for the cost criteria is to estimate and/or compare the magnitude of the financial resources required by the various strategies. The cost is classified into three general intensity levels and values were assigned according to those intensities. Strategies requiring lower financial resources are favored relatively to higher cost strategies in the prioritization process. Values for the cost criterion are presented in table 4.

TABLE 4
COST SCALE

Intensity	Value
Low Cost	1
Medium Cost	2
High Cost	3

Time

Time is another important criterion which is normally considered in the implementation phase of the strategic planning. Again, the time parameter is also addressed with general intensity levels and values were also assigned accordingly. The objective of the analysis was to prioritize the developed strategies according to the shortest times. Values for the time criterion are presented in table 5.

TABLE 5
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 study the ability of implementation for the developed strategies as some of them involve more players and their interaction making their implementation more complex. Here the implementability of the strategies is thought in terms of their dependency on those players and the development status of the chain in focus. Under this criterion, the objective is to favor the strategies which have less dependency on the commitment required. The values for the implementability criteria are presented in table 6.

TABLE 6
SCALE FOR IMPLEMENTABILITY
(BASED ON COMMITMENT OF PLAYERS INVOLVED)

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

C. Characteristics of the Strategies

The characteristics of the strategies were established from the values assigned by experts who are familiar to the process and with the previous studies on system analysis, strategy development and evaluation. The values assigned to strategies under new criteria are presented in table 7.

TABLE 7
VALUES OF CRITERIA FOR STRATEGIES

STRATEGY	CRITERIA VALUES FOR IMPLEMENTATION PHASE		
	COST (WEIGHT = 0.5)	TIME (WEIGHT = 0.3)	IMPLEMENTABILITY (WEIGHT = 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

The ranking of the strategies was determined using the Simple Additive Weighting (SAW) method, described above. The weights assigned to each criterion were also included in table 7. The results obtained are discussed in the next section.

IV. RESULTS

The results of the prioritization process with the SAW method are presented in the table 8 and Fig. 2. The ranking of the alternatives under the previous strategic planning phase is also presented for comparison.

TABLE 8
RANKING OF STRATEGIES IN THE IMPLEMENTATION AND EVALUATION PHASES

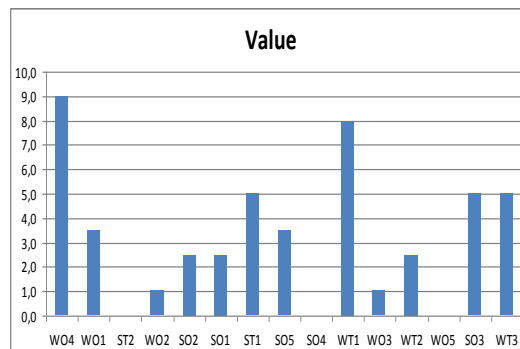| ALTERNATIVE	IMPLEMENTATION PHASE		STRATEGY EVALUATION PHASE	
	VALUE	RANKING	VALUE	RANKING
WO4	9,0	1	.144	1
WT1	8,0	2	.049	11
ST1	5,0	3	.073	7
SO3	5,0	3	.025	14
WT3	5,0	3	.017	15
WO1	3,5	4	.123	2
SO5	3,5	4	.062	9
SO2	2,5	5	.080	5
SO1	2,5	5	.075	6
WT2	2,5	5	.040	12
WO2	1,0	6	.082	4
WO3	1,0	6	.050	10
ST2	0,0	7	.084	3
SO4	0,0	7	.067	8
WO5	0,0	7	.029	13

Fig. 2. Importance Values for Strategies in Implementation Phase

Depending upon the priority value, the strategies are grouped into four categories ranging from the highest to the lowest utility function value. These groups are discussed further in the following paragraphs and presented in tables 9 to 12.

Top Ranked Strategies (with value clearly above 5)

TABLE 9
IMPORTANCE VALUES AND RANKING FOR STRATEGIES IN THE STRATEGY IMPLEMENTATION PHASE

RANK	VALUE	STRATEGIES
1	9,0	WO4: DEVELOPING EFFECTIVE LINKAGE BETWEEN INDUSTRY, ACADEMIA AND R&D INSTITUTES
2	8,0	WT1: WORK IN CLOSE COLLABORATION WITH COMPETITORS

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 are initiation and accomplishment of the desired results. The former needs low resources and higher commitment whereas the later needs much more time and commitment. In this study, the initiation part of the implementation phase is the main focus. The initiation phase can be regarded as short term whereas the result realization part can be regarded as medium-to-long term.

Medium Ranked Strategies (with values around 5)

TABLE 10
IMPORTANCE VALUES AND RANKING FOR STRATEGIES IN THE STRATEGY IMPLEMENTATION PHASE

RANK	VALUE	STRATEGIES
3	5,0	ST1: DEVELOPMENT OF MARKET ACCESS STRATEGIES
4	5,0	SO3: APPLYING EXPORT INCENTIVES
5	5,0	WT3: INTRODUCTION OF INDUSTRY RELIEF PACKAGES

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 utilization of resources whereas the strategy ST1 covers external aspects and it is more difficult to implement although it needs less resources. Strategies SO3 and WT3 are short-to-medium term strategies which are focused to improve the present environment for the industrial activity in order to direct the products to value added segments.

Low Ranked Strategies (with values clearly below 5 but greater than 1)

TABLE 11
IMPORTANCE VALUES AND RANKING FOR STRATEGIES IN THE STRATEGY
IMPLEMENTATION PHASE

RANK	VALUE	STRATEGIES
6	3,5	WO1: SKILL DEVELOPMENT PROGRAMS
7	3,5	SO5: IMPROVING DOMESTIC CHEMICAL INDUSTRY
8	2,5	SO2: ESTABLISHING INDUSTRIAL PARKS WITH COMMON FACILITIES OF DESIGN & DEVELOPMENT CENTERS, ICT APPLICATION CENTERS & EFFLUENT TREATMENT PLANTS ETC
9	2,5	SO1: DIVERSIFICATION OF PRODUCT RANGE
10	2,5	WT2: DEVELOPMENT AND IMPLEMENTATION OF LONG-TERM & COORDINATED POLICIES

In this group, most of the strategies are focused on the development of infrastructure and skills. The segments of the system which are in focus are at different levels of development, as shown in figure 1, so they need different amounts of resources. Similarly, the time to initiate and get results can be different depending upon their level of development. Strategies WO1 and SO2 are already in implementation and in general most of them can be implemented in medium-to-long term plans.

Very Low Ranked Strategies (with values 1 or below)

TABLE 12
IMPORTANCE VALUES AND RANKING FOR STRATEGIES IN THE STRATEGY
IMPLEMENTATION PHASE

RANK	VALUE	STRATEGIES
11	1,0	WO2: EXPANDING NON-COTTON FIBER BASE
12	1,0	WO3: IMPROVING LOGISTICS
13	0,0	ST2: ESTABLISHING DOWN STREAM FACILITIES IN STABLE, NEAR TO MARKET AND COMPETING REGIONS
14	0,0	SO4: ESTABLISHING DOWNSTREAM FACILITIES IN COMPETING REGIONS
15	0,0	WO5: DEVELOPING DOMESTIC ENGINEERING INDUSTRY

The strategies in this group are the ones which need higher level of resources because of their scope and their present level of development. In this group of strategies many players from different segments of the system are involved increasing the difficulty of implementation. The strategies under this group are more general in nature and they also affect other segments of industrial and business activities apart from textile and clothing. The resources utilized for them can be fetched from the general development plans in the country.

It will be useful to see the dependency of some strategies on others to create effective implementation plans. Strategy "SO1: Diversification of Product Range" for example depends upon many other strategies like "WO2: Expanding Non-cotton Fiber Base", "WO1: Skill Development Programs" and "ST2: Establishing Down Stream Facilities in Stable, Near-to-Market and Competing Regions". The study of such dependencies for scheduling the strategic plans with resource restrictions may be a relevant future research.

Sensitivity Analysis

A sensitivity analysis was performed to see the effect of changes in the values of the weights assigned to each criterion on the ranking of strategies. These weights were taken as 0.5, 0.3 and 0.2 for cost, time and implementability, respectively. Changing these weights to more or less 50%, the ranking is stable for most of the strategies. Thus, no

major changes are observed within this range of weights for cost, time and implementability. This is shown in figures 3 to 5.
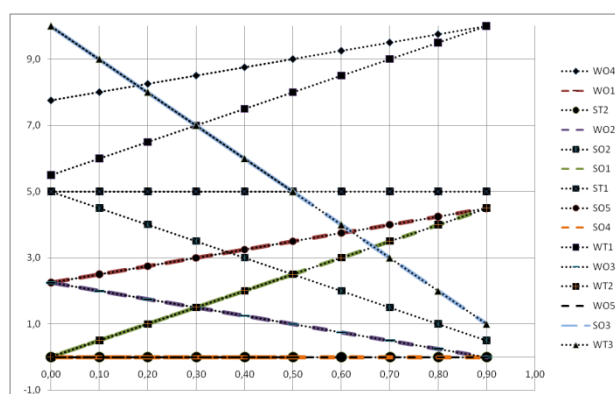

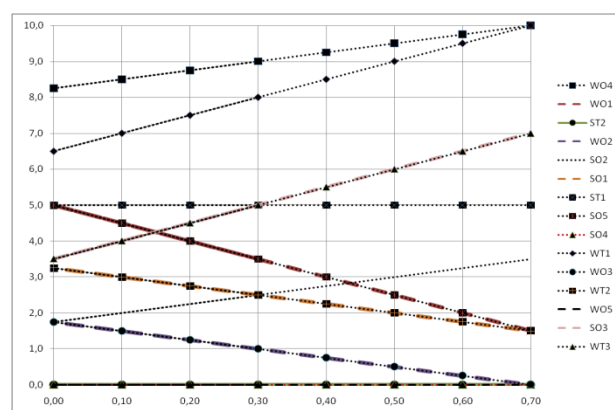Fig. 3. Sensitivity Analysis of Criteria Factors (Cost)

Fig. 4. Sensitivity Analysis of Criteria Factors (Time)
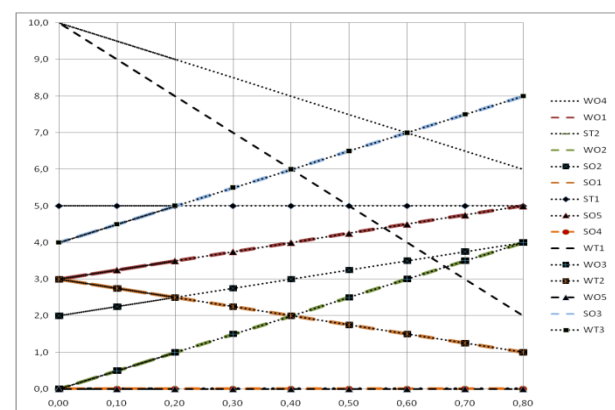

Fig. 5. Sensitivity Analysis of Criteria Factors (Implementability)

V. CONCLUSION

On the basis of the analysis performed concerning the implementation phase of the strategic planning, short, medium and long term strategies were identified. These strategies can be scheduled according to the availability of resources and their dependency.

It is interesting to emphasize that the ranking obtained in the previous phase of strategic planning can be best utilized for resource allocation while the results obtained here and the dependency of the strategies can be best utilized for their scheduling.

The directions identified for future research can provide further insight for an efficient implementation of the strategies.

REFERENCES

[1] Hussain, D., Figueiredo, M., Tereso A., Ferreira, F., 2010, A Study of Textile & Clothing Supply Chain in Pakistan, 2nd International Conference on Engineering Optimization, 6 - 9 September 2010, IST, Lisbon, Portugal, ISBN:978-989-96264-3-0.

[2] Hussain, D., Figueiredo, M., Tereso A., Ferreira, F., 2011, Textile and Clothing Supply Chain: Use of Planning-Link in the Strategic Planning Process, X Congreso Galego de Estatística e Investigación de Operacións, Pontevedra, 3–4–5 de novembro de 2011.

[3] Saaty, T. L. and Vergas, L. G. (2006) Decision Making with Analytical Network Process, Springer.

[4] Saaty, T. L. and Sodenkamp M., 2008, Making decisions in hierarchic and network systems, Int. J. Applied Decision Sciences, Vol. 1, No. 1, 2008. pp. 24-79.

[5] Keeney, R. L. and Raiffa, H., Decisions with Multiple Objectives: Preferences and Value Tradeoffs, Wiley, New York. Cambridge Univ. Press, New York (1993).

[6] Rogers, Martin (2001) Engineering Project Appraisal, Blackwell Science.