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APPLICATION OF SYSTEMATIC INNOVATION IN TECHNOLOGY DEVELOPMENT (RCA AND TOPSIS MODELS PRESENTATIONTO DETERMINEPROBLEM SOLVING STRATEGIES)

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ABSTRACT

Technology development as one of the structural issues of technology management has been always seriously taken into consideration by organizations in order through the structures which promote technology to comprehend right changesin their various organizational structures. Progress and welfare of societies, economic booming, industries development, wealth creation and competitive advantage are all the result of technology application and its development. Given technology's structure dynamism, its transfer and development always require such factors as systematic innovationin order by logical and systematic approach of this science to provide suitable solutions for solving the existing fundamental conflicts in technological issues particularly technology development. For this purpose, in this research, through extensive study of technology development issues, conflicts tree of this problem is drawn and the existing conflicts are investigated and some strategies for solving the issue of technology development are offered. In the end, to prioritize the offered strategies, by considering the existing conflicts as the criterion and the recommended strategies as the option and using Shannon Entropydecision making technique, weight of each criterion is calculated and using TOPSIS technique problem solvingstrategies of technology development given the rootconflict are prioritized.

KEYWORDS

Technology development, Systematic innovation, Theory of invention problem solving, Root Conflict Analysis (RCA), TOPSIS decision making technique.

INTRODUCTION

Technology development has been able to positively affect key factors of national and international economies and level of citizens' welfare. Hence, today, we are witness that by introduction of modern technologies, micro and macrostructures of societies become involved in fundamental changes and feel the need for fitting contexts in order to achieve improvement in living standards and welfare. Technology as actual application of science and experience for resolvinghuman's need has had a strong role in countries' economic and industrial development and competitive advantage of enterprises (Dastjerdi*et al*., 2010). At the present time, importance of technology as the main growth and development lever is very evident. In addition, the competitive environment has made enterprises seek capabilities apart from financial abilities and technology offers them the opportunity to realize this. Technology global impact on society, trade and industry is unquestionable. Today, technology as the greatest comprehensive force which affects humans' life has been admitted by various social strata (Piquitoand Pretorius,2000) and has been able toplay a simple role in interaction between people, society and environment and to be defined as a key stimulus in evolutionary development of economy and society (Khalil,2000). Basically, the issues related to technology, its development andtransfer can be considered determinants of wealth creation and competitive advantage. This point in view of scientific circles is so important that Porter has acknowledged technology as one of the five competitive forces of industries. Therefore, it can be stated that this force as one of the key competition variables uses its capability to change competition through change of structure (Porter, 1988). Considering the aforesaid, we can find out about vital role of technology and its components in daily life but we should note that technology users accept technology when they are able to establish a proper relationship with presented values by technology. Therefore technology supplying firms increasing regard themselves bound to study fundamental issues in technology generation and more differing values relative to past technologies and technologies presented by their competitors. Further, organizations for development of the current technology consider themselves bound to careful study of issues, threats and changes in international markets. One of the important and key approaches of technology development and new products development can be the focus on innovation management. Systematic innovation as one of the effective solutions of technology development by its logical and systematic approaches is able to investigate various aspects of technology in order in its development process always the technologies to be provided which have more value and application relative to technology type. In fact, it can be said that systematic innovationin process of identification, profound and accurate etymology of technology development and resolving its problemsand obstacles, has the capability to recommend solutions which in addition to speeding up and facilitating the development process, seriously take innovative aspect of the solution into account. This point may have significant effect on technology value in development process. In addition, capability of this science can be investigated to the extent that today growing tendency of researches with centrality of systematic innovation in different areas such as chemical sciences, mathematics, art quality management, design and manufacturing systems of products and services, value engineering, management and technology increasingly have been taken into

consideration by researchers. In line with what was said earlier, it can be referred to the special focus on TRIZ functional areas in the last decades for resolving technological issues. TRIZ applicationformsthe main axis of prior studies in specification of technology roadmapping, study of enterprises' technological capabilities, technology forecasting, technology maturity, technology intelligence, offering new products in various industries using 40 inventive principles (www.Triz-journal.com). For example, Norrie (2007), has introduced TRIZ as a tool for study of current technologies and identifying potential offuture technologies at the time of composing technology road mapping. He used TRIZ approaches in 2 steps of the 7-step technology road mapping, i.e. specification of the systems requirements and discovery of various technologies. Souchkov (2007) based on modern TRIZ techniques, has evaluated technology. He introduced TRIZ procedures of technology valuation within a framework which shows the time and reason of using technology valuation methods. In addition, he believes technology valuation is not an accidental matter and requires special patterns. These special patterns will be used at micro and macro levels for technology valuation and finding out which phases of system evaluation have been performed.

Salimi*et al.* (2006) believe technology forecasting and future technologies determinationare among the requirements of industrial firms. In the world of today, mere use of mathematics is not effective in technology forecasting, therefore the knowledgebased on realities and experiences have been used next to mathematics. In their view, the numerous techniques used for technology forecasting are more like day dreaming, hence they tried to forecast technologybased on TRIZ and through this to discover relationships between these categories. Moehrleand Lessing (2004) using TRIZ technique investigated enterprises' technological capabilities. Analysis of enterprises'capabilities using this technique will provide useful information with regard to competitors which at the time of strategic decisions makings will be considered amongst the most valuable sources. According to Mann (2003), use of innovative systematic methodsallows more effective technology forecasting. From among a large number of invented methods, Mann considers TRIZ techniques a new step in forecasting of technology evolutionary course. Schuh (2003) regards technology the main factor in success of technology-oriented firms. To identify competitive technologies, technology managers needtechnology intelligence in order to forecast future path. To reach this goal, technology intelligence requires a variety of tools such as TRIZ methodology and the methods with TRIZ centrality mentioned by Schuh. Also, it can be referred to other done researches such as combination of TRIZ tools together with analysis of theirpotential states of failure and effects. Further, application of TRIZ tools in development of dynamic modeling, etc. Given the aforesaid, in this research, first, by extensive study in the areas related to technology the existing fundamental issues and conflicts are investigated in this environment. In the following, using Extended TRIZ approach and process of Root Conflict Analysis, positive and negative effects of each conflict are investigated and for resolving the existing conflicts new effective strategies are formulated. In the end, by application of multi-criteriondecision making techniques, degree and priority of the offered strategies have been determined.

REVIEW OF THEORETICAL BASES

TECHNOLOGY

Technology indisputably has been known the main basis of development which using its components including techno ware, human ware, info ware andorgan ware transforms inputs into presentable output in the market (NasirzadehandGholamzadeh, 1995). Importance of technology has root in its competitive nature (Pilkington, 2006). Hence, paying attention to technology management and development is regarded amongst the prerequisites of each system for planning and policy making at macro level, technology management as an interdisciplinary specialization has been able to integrate exact sciences, engineering, managerial science and methods and to emphasize on technology as the factor of wealth generation (Khalil, 2000). According to Liao (2005), technology management is the process of planning, leading, controlling and coordinating technological capabilities in order to realize organization's strategic and operational goals which continually involves management and employees in technological innovation process to increase productivity level, improve quality of personal living and work condition (Edsomwan, 1987). Technology management by creation and diffusion of technology realizes human's ceaseless efforts (Christiansen, 1987) and shows its effect more strongly by technology integration, evaluation, marketing, and commercialization (Liao, 2005). To present technology management is a systematic way, assessment indices such as forecasting of new technologies potential, use of long term programs for development of technological possibilities, and continuous study of future technologies have been specified (Morita and Flynn, 1997). Technology management, in the process of products and services differentiation, reduction of operational costs, creation of new business opportunities, plays its role the best as facilitating and supporting element of strategic changes (Floyd, 1997). Technology management has national, organizational and individual dimensions. In national dimension (macro level), basically it focuses on role of general policies in progress of science and technology, in organizational dimension (micro level), it helps creation and preservation of organizations' competitive ability, and in individual dimension, it increases individual's financial power (Khalil, 2000). Therefore, paying attention to various aspects of technology management ought to be the top priority of managerial programs. Failing to combine effective and efficient technologies, lack of necessary education for technology utilization, and technology detrimental environmental impact always threat technology management and its various aspects and by accurate identification of the respective areas, one can transforms them into opportunity and more and more benefit from them (Farahmand, 2004).

TECHNOLOGY DEVELOPMENT

Today, the process of societies development more than ever requires adoption of a concept of technology which in addition to comprehensiveness gives more importance and priority to its software aspects. Changes of technology concept from mechanical and hardware aspects to intellectual and software aspects is a sign of stepping in development path (NasirzadehandGholamzadeh, 1995). To institutionalize this, it is enough to make everyone sensitive to what has been so far assumed to be something unchangeable and to educate them and propagate the rational and logical way of doing these affairs.

From viewpoint of Platt and Wilson (1999), technology development is product of improvement and reinforcement of resources with the purpose of creating change and change management which constantly paves the way for various countries and industries in order to foster competitive capabilities and improve competitive advantages (Wang *et al.*, 2007). Technology development monitors all the efforts and activities which are made for promotion of technology level. These efforts may lead to creation of new technology or improve the existing technology. What seems necessary for technology development is a strategy which comprises a combination of technology transfer and its endogenous development because endogenous transfer and development of technology can be effectively complementary to each other (Abbaspur, 1897).

Technology development is the sign of human creativity (Khalil, 2000) the 4 main phases of which are as follows:

1. Determining technology strategies: technology strategy specifies the tasks should be done for improvement of new technologies.
2. Conceptualization: the thing which should be taken into account at this phase isnot deviating from the improvement and progression path. Eventually, at evolution and selection stage, the best concepts are chosen for development.
3. Optimization: to achieve flexibility and maturity in new technologies, optimization is a necessary action.
4. Selection and transfer: by study of various aspects of successful technologies, 4 criteria, superiority, constancy, maturity, and flexibility, are introduced based on which the selected technologies are transferred to other development programs (Clausing, 2001).

Ultimate goal of technology development is optimal resources development and improvement oftheir utilization which eventually results in increased productivity of activities and greater profitability of enterprises (Christiansen, 2000). Hence, the need for a correct planning, dynamic organization, procurement and training of specialized human force and effective control of activities is still felt. Technology in development path always faces some obstacles the growing course of which widens their technology gap (Shafiee, 1987). Paying attention to technology's 4 components based on a systematic view while knowing reciprocal effect between the components and their synergic effect in the whole, ignites the first and basic sparks of overcoming these obstacles and paves the way for technology comprehensive development (NasirzadehandGholamzadeh, 1995).

On this path, the focus on the effective factors on technology development including creativity and innovation as promotingas well as cooperation and interaction of educational and research, industrial and judicial systems with technology macro policies for technology development is an imperative (Salami andGudarzi, 2001).

RELATIONSHIP OF TECHNOLOGY DEVELOPMENT AND CREATIVITY ENGINEERING

Given the various existing methods for resolving technology issues and problems and its development and by changing methods and approaches of problem solving from the approach of reaction to problem to preventing occurrence of problem, creativity engineering as one of the most superior methods has been able to show its power in solving and affecting solution of various technological problems and other issues. Creativity engineering with its systematic approach has fundamentally changedthe 4 main phases of technology development particularly technology strategy (Clausing, 2001). The urgent need for creativity for giving direction to problem solving process, seeking the problems in the unknowns and the ability of using creative methods and patterns has caused the attention to be more and more concentrated on such issues as creativity engineering, Theory of invention problem solving, and creative thinking given their abilities such as adoption of new attitude based on evolution forms, ability of quick and effective analysis (Salimi*et al.*, 2005). Technological changes result in improvement of technology level. Therefore, technology development process oversees all the efforts and activities which take place for promotion of technology levelin a country, government or organization. These changes are based on new and innovative approaches which lead to generation of new technology, and improvement and development of the existing technology (Farahmand, 2004).

CREATIVITY ENGINEERING

Development process of science, technology and extensive information flow require systems and their components to comprehend the skills for facing problems and solving them for continuous survival and progress. Therefore, presence of an active spirit for this intellectually still body is a critical matter in order by continuation of time, innovativeness and adaptability to achieve its goals (Alvani, 2007). Researchers and psychologists such as Guilford in order to get out of mental stagnation recommend such skills as creative thinking, creativity principles, innovativeness and special techniques in order through which by understanding environment's changes and developments to face obstacles and problems and by creative approach to solve the problems. Therefore in a comprehensive definition, creativity is described as creation of something new and unique which in a suitable and useful way leads to a scientific, industrial or socialproblem solving(Pirkhaefi, 2008). In fact, principles of creativity and innovation involve a new and novel answer or concept but it should be noted that this novelty is in accordance with logical and objective principles. To solve this problem, Altshuller, after years study and investigation, introduced Creativity and Innovation Engineering Systematic Approach which in the following will be discussed.

CREATIVITY ENGINEERING AND THEORY OF INVENTION PROBLEM SOLVING

Cooperation of GenrichAltshuller with inventors in registration of inventions and analysis and examination of thousands patents led to presentation of a problem solving methodology based on systematic approach. This rational methodology later on was employed as an important and applied tool for solving technological issues, complex and simple problems (Mansurian, 2007). Step-by-step process, ideal solution, repeatability and having a structure for science of invention are among the first principles which Altshullertook notice of them in his studies and by further studies and by finding out about the role of technical conflicts in problem solvinghe invented the Matrix of Conflicts. TRIZ as a science emerging late in second half of the 19th century has gone through a variety of stages for evolution. Table (1) explains evolutionary process of this science.

TABLE 1: EVOLUTIONARY COURSE OF CREATIVITY AND INNOVATION ENGINEERING (1982-2008)

Year	Creativity and Innovation Engineering History
1982 to 1989	Development of TRIZ application in various aspects relative to art and mathematics (Murashkovsky, 1997; Tsourikov, 1991)
	Creating huge development by introducing ARIZ C85
	5-fold classification of Innovation Standard System based on article 76
	In addition to Physical Effects Data Base, other techniques developed as well (Salamatov, 1988)
	Design of TRIZ copy for children
	TRIZ Russian Association start-up
1990 to 1998	Altshuller published a book named Strategy of Creative Individual's Life (Pirkhaefi, 2008)
	Introduction of TRIZ software package in the US (www.ideation-triz.com)
	TRIZ Russian association was Known as TRIZ International Association in the world
	Upon Altshuller's death in 1998, TRIZ faced recession
1998 to 2008	Techniques before 1998 became famous as TRIZ
	Development of TRIZ application in various organizations (Zlotin*et al.*, 1999)
	The first software copy in traduced by Creax (www.creax.com)
	Attention to TRIZ managerial and business applications (Mann, 2004)
	Provision of new tools such as Root Conflict Analysis
	Combination of quality managerial and engineering models such as Quality Function Development

TRIZ lies within a range the beginning of which is a kind of creative world view or a comprehensive approach to sciences and technology and in the end of it the tools of creative problem solving and creativity and innovation techniques are placed. In fact, by a comprehensive definition the creativity engineering can be defined as a human-oriented science based on systematic methodology for creative problem solving. TRIZ is an algorithmic approach for creative solving of technical problems. TRIZ researches starts with this hypothesis: the universal principles of invention is a basis for creative innovation using advanced technologies, i.e. when these principles are defined, they can significantly help people's thinking in generation of processes based on innovation which act more forecasting (Zlotin*et al.*, 2001). Inprocess of problem solving, the best and most successful solution is obtained from selection of the most suitable principles by concentrating on details. Use of TRIZ results in generation of concepts to reduce negative effects and improvement in design, particularly strategy design in technology management and development. TRIZ functional areas in scientific activities generally can be classified into 6 areas of technology improvement and development, inventions registration and new inventions development, new products development, development of existing products, forecasting of short and long term periods, and finally research and scientific engineering.

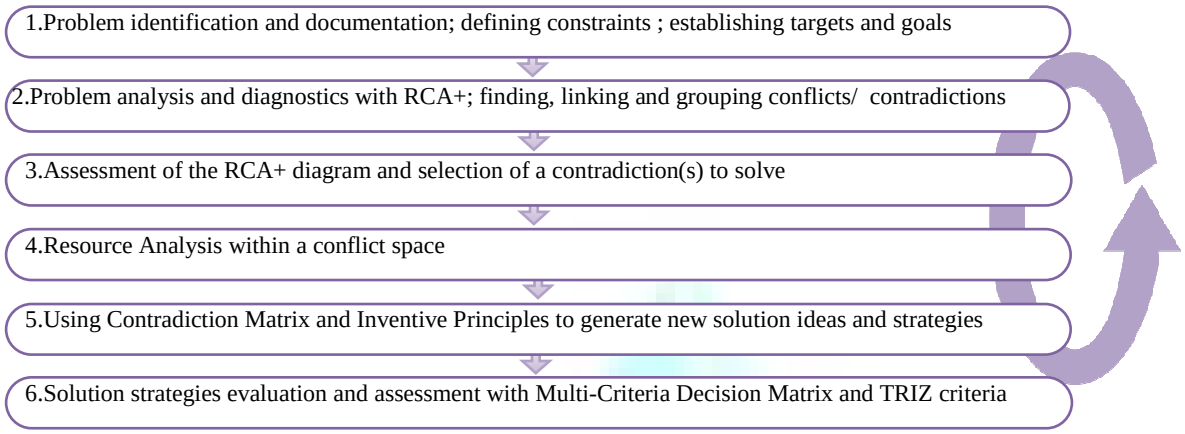
In actualperformance, technology improvement and existing product development are among the tasks which are done more frequently and following the presented technology performance, organizations try to use the best new technology parameters with the least cost for technology development.

EXTENDED TRIZ PROCESS

The main philosophy of TRIZ methodology relates to its essential role in solving complex and difficult problems. TRIZ, independent from the applied fields, is able to analyze and solve a variety of problems and issues arising from artificial systems such as social, commercial, cultural and particularly technological (Mann andDomb, 1999). In recent years, with continuous successes of research models, a new style of Theory of invention problem solving, Extended TRIZ, has been introduced which is a process oriented method.Extended TRIZ with its 6 main steps is used for analysis of managerial problems and issues, identification of conflicts origin and their radical causes, selection of problems to solve, offering novel ideas and strategies of problem solving, and assessment of final result. This approach always updates tools of novel problem solving for application in organization technological systems. In addition to standard tools of inventive problem solving, this process uses techniques of Root Conflict Analysis, Comparative Ranking Scorecard and Multi-Criterion Decision Making Matrix and for further improvement of the suggested solution does not sparethe modern principles and techniques. Extended TRIZ process is shown in figure (1). Each step in this process is gone through by techniques which systematically enter the process from the previous steps and the outputs are provided to enter the next stages. In

this cyclic process, the assumptions and decisions taken in previous phases, according to the feedback link presented in the figure, return to the intended stage and correction operation is done on them in order the next steps to be taken according to the standard (RuchtiandLivotov, 2001).

FIGURE 1: EXTENDED TRIZ PROCESS

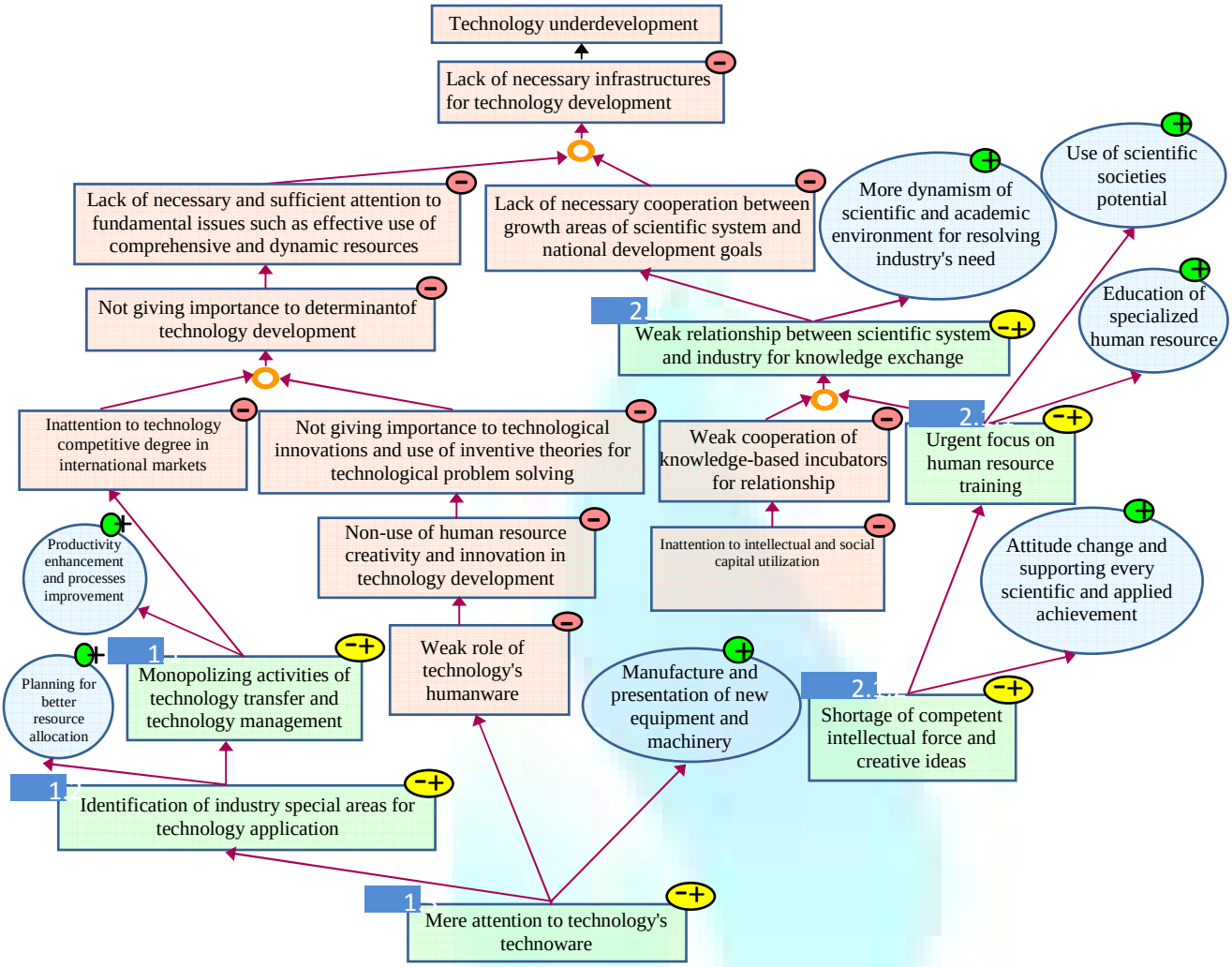


Source: Souchkov*et al.*, 2006

ROOT CONFLICT ANALYSIS

Root Conflict Analysis is an invented technique for analysis of issues and problems the main purpose of which is to extractconflicts from issues and presenting them as a tree structure. Diagram of Root Conflict Analysisis designed top-down and its starting point is from a negative result. The diagram goes through its course by presenting different reasons and effects arising from negative result and understanding that whether the stated reason isconflict, otherwise it moves to lower levels. One of the main advantages of diagram of Root Conflict Analysis is stopping at a level of the tree structure where the stated reason without a need for discovering any further reason has the greatest contribution to causing the problem (Souchkov, 2005). In the diagram in question, all the negative effects are shown with negative sign and all the positive effects with positive sign, and conflicts with positive and negative signs. Between the effects, always two types of relationships govern. "or" relationship appears when two or more causes lead to a particular effect which are represented in the figure as arrows of two or more different reasons towards one effect, and "and" relationship in which causes and effects state their effect together and without elimination of the other. The small orange circles present in the diagram, represent "and" relationship. Given presence of a large number of conflicts, analyzing all of them is not possible. Hence, three strategies for selection of conflicts are taken into consideration. By selection of the first conflict which lies at the highest level and the conflict at the lowest level or a combination of these two strategies, the stages of conflicts analysis starts. In the end, it can be stated that by resolving the conflicts which lie at upper levels of the diagram, we reach short term solutions and long term and radical solutions are identified through solving the conflicts at lower levels (Souchkov*et al.*, 2006). Given the abilities of Root Conflict Analysis as one of the modern tools of Theory of invention problem solving, to solve the issue of technology underdevelopment, experts' view on the fundamental principles of technology underdevelopment is used and given the prior research, the research's model in figure (2) is presented as the main pillar of this tool for solution and study in order through various processes, the best possible strategies to be discussed for resolving this problem.

FIGURE 2: DIAGRAM OF ROOT CONFLICT ANALYSIS TO SOLVE THE ISSUE OF TECHNOLOGY UNDERDEVELOPMENT



PROBLEM SOLVING WITH ROOT CONFLICT ANALYSIS APPROACH

Table of sub-treeconflicts provided in table (2), by studying causes of conflict, examines the closest positive and negative effect of each cause in order to facilitate continuation of the process course for conflictselection. It should be noted that in the tree model of problem solution, the conflicts which have no negative effect move forward to the extent that the benefit from their origin and its negative effect, i.e. negative effect of the main cause in fact is considered as the sub-tree's negative effect.

TABLE 2: STUDY OF SUB-TREECONFLICTS EFFECT

Conflict	Causes	Positive effects	Negative effects
1.1	Monopolization of technology transfer and management activities	Increase of productivity and process improvement	Inattention to competitive degree of technology in international markets
1.2	Identification of industry's special areas for technology application	Planning for better resource allocation	Inattention to competitive degree of technology in international markets
1.3	Mere attention to technology's techno ware	Manufacture and supply of new equipment and machinery	Weak role of technology's human ware
2.1	Weak relationship of national system of knowledge and industry for science exchange	More dynamism of scientific and academic environments for resolving industry's needs	Lack of necessary cooperation between growth areas of scientific system and national development goals
2.1.1	Urgent attention to issue of human resource education	Education of specialized human resource	Weak relationship of national system with industry for knowledge exchange
2.2.2	Shortage of competent intellectual force and creative ideas	Change of attitude and support of every scientific and applied achievement	Urgent attention to issue of human resource education

PRESENTING PROBLEM SOLVINGSTRATEGIES

In the following, based on the lowest conflict selection strategy, the conflict "mere attention to technology'stechno ware" has been selected as input. At this stage, to solve this conflict, it is necessary some strategies to be presented to which in table (3) is referred:

TABLE 3: PROBLEM SOLVINGSTRATEGIES

S1	Change of attitude to human resources from cost to asset
S2	Education of current human resources working in work places particularly education of creative thinking for offering innovative ideas
S3	Education and use of specialized forces for correct planning for identification of areas requiring technology transfer and development
S4	Talent management and improvement and retention of talent treasure
S5	Presentation of applied knowledge in universities and special attention to exact sciences and managerial issues as sub-branch sciences of technology management
S6	Improvement of human resource management programs
S7	Focus on fostering intellectual and social capitals
S8	Creating and safety valve to express opinions and welcoming scientific and feasible suggestions of work forces

MULTI-CRITERION DECISION MAKING TECHNIQUES APPLICATION FOR PRIORITIZATION OF PROBLEM SOLVING STRATEGIES

Given the solving process of the existing problem, in the final step, we only suffice with the problem solving strategies, but the essential point in identifying solution of each problem is making the respective strategies operational. Therefore, in this section, while specifying main strategies of the problem, for their ranking, first, Shannon Entropy for determining the indices' importance coefficient is used and withspecification of weight vector by this technique, by applying TOPSIS Technique the strategies' final ranking takes place. It should be noted that in this problem, given structure of the two introduced techniques, the existing conflictswhich have been examined in table (2) are presented as the problem's criteria and the presented strategies in table (3) are considered as decision making options.

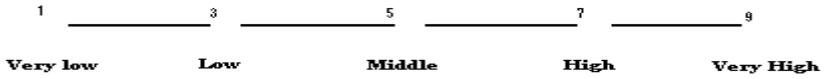
DETERMINING WEIGHT VECTOR AND TOPSIS APPLICATION TO FIND STRATEGIES PRIORITIES

By careful attention to the existing criteria in this issue, first, it is needed correct criteria to be used for resolving conflict between the criteria and for each criterion and strategy a symbol to be specified. Symbols of problem solving criteria and strategies are denoted by S in table (3) and by C in table (4), respectively.

TABLE 4: PROBLEM SOLVINGCRITERIA

$C1^-$	$C2^+$	$C3^-$	$C4^+$	$C5^+$	$C6^+$
Monopolizing technology transfer and management activities	Identifying industry's special areas for technology application	Mere attention to technology's techno ware	Weak relationship of national knowledge system and industry for exchange of science	Urgent attention to issue of human resource education	Shortage of competent intellectual force and creative ideas

Considering qualitative and quantitative nature of the introduced criteria, for solving the problem, the two following bi-polar scales are used to collect experts' opinions.



Entropy can be used as a suitable method for measuring weight of each introduced criterion. In this method, the wider the distribution in values of an index is, the more important that index will be. In theory of information, Entropy is an uncertainty criterion which is expressed by probability distribution. This distribution is defined by Shannon as follows:

$$Ei = S(P1, P2 \ldots . Pn) = -k \sum_{i=1}^{n} [pi * lnpi]$$

Entropy performing stages can be summarized as follows:

1. Calculation of P_{ij}
2. Calculation of the entropy valueE_j
3. Calculation of the uncertainty value d_i
4. Calculation of the weights W_j
5. Calculation of the adjusted weights W'_j

By performing the calculations related to entropy stages, the obtained vector from this method can be used in TOPSIS technique. The weights regarding the six studied criteria can be seen in table (5).

TABLE 5: CRITERIA WEIGHTS OBTAINED FROM SHANNON ENTROPY TECHNIQUE

W1	W2	W3	W4	W5	W6
0.13	0.158	0.198	0.15	0.157	0.207

TOPSIS

TOPSIS model was recommended by Hwang and Yoonin 1981. This model can be regarded as one of the best multi-indexdecision making models. In this method, M options are measured by N indices. This method is based on the concept that the selected option should have the shortest distance from the positive ideal solution and the longest distance from negative ideal solution and it is supposed that desirability of each index is steadily increasing or decreasing. 6 steps of this method are:

1. Quantifying and de-scaling decision making matrix
2. Obtaining weighted de-scaled matrix
3. Finding positive and negative ideal solution
4. Obtaining distance of each option from positive and negative ideal solution
5. Specifying relative proximity of an option to ideal solution
6. Options ranking

Table (6) shows experts' views on each option, given the criteria. This table is first de-scaled (by norm method) and then bymatrix multiplying of this table by the weight vector obtained from Shannon EntropyMethodin table (5), the weighted de-scaled matrix is calculated.

TABLE 6: DECISION MATRIX

	C_1^-	C_2^+	C_3^-	C_4^+	C_5^+	C_6^+
S_1	4	6	2	8	10	7
S_2	6	9	5	4	7	8
S_3	8	8	4	3	6	6
S_4	5	7	4	6	4	6
S_5	4	8	3	6	7	7
S_6	3	7	2	8	9	7
S_7	7	4	6	7	6	10
S_8	7	6	3	10	5	5

TABLE 7: WEIGHTED DE-SCALED MATRIX V = N * W_{n*n}

	C_1^-	C_2^+	C_3^-	C_4^+	C_5^+	C_6^+
S_1	0.032	0.047	0.036	0.061	0.079	0.071
S_2	0.048	0.07	0.091	0.03	0.055	0.081
S_3	0.064	0.063	0.072	0.023	0.047	0.061
S_4	0.04	0.055	0.072	0.046	0.031	0.061
S_5	0.032	0.063	0.054	0.046	0.055	0.071
S_6	0.024	0.055	0.036	0.061	0.071	0.071
S_7	0.055	0.031	0.109	0.054	0.047	0.102
S_8	0.055	0.047	0.054	0.077	0.039	0.051

In the next step, positive and negative ideals should be specified for each index. Obviously, for the index which has negative aspect, the most ideal positive answer is the smallest existing answer and the most ideal negative answer is the greatest existing answer.Positive and negative ideals for the present problem are defined as follows:

i^+={min v_{i1},max v_{i2}, min v_{i3}, max v_{i4}, max v_{i5}, max v_{i6}}

i^-={man v_{i1}, mix v_{i2}, man v_{i3}, mix v_{i4}, mix v_{i5}, mix v_{i6}}

After specification of the ideals, the distance from positive and negative ideals for all indices ought to be calculated the general formula of which is follows:

$d^+ = \sqrt{\sum_{j=1}^{m}(vij - v}$

$d^- = \sqrt{\sum_{j=1}^{m}(vij - v_{\cdot d}}$

Tables (8) and (9) represent positive and negative ideal distance for the eight answers.

TABLE 8: POSITIVE IDEAL DISTANCE

d^+1	d^+2	d^+3	d^+4	d^+5	d^+6	d^+7	d^+8
0.071	0.082	0.092	0.013	0.042	**0.038**	0.096	0.077

TABLE 9: NEGATIVE IDEAL DISTANCE

d^-1	d^-2	d^-3	d^-4	d^-5	d^-6	d^-7	d^-8
0.071	0.082	0.092	0.013	0.042	**0.038**	0.096	0.077

After performing all the above stages, degree of relative proximity of each criterion to ideal solution is to be calculated. For this purpose, the following formula is used:

$$CL_i = \frac{di^-}{d_i^- + d_i^+}$$

Finally, given the performed stages, strategies ranking according to TOPSIS method are specified in table (10).

TABLE 10: PRIORITIZATION OF PROBLEM SOLVING STRATEGIES

S4	Talent management and improvement and retention of talent treasure
S6	Improvement of human resource management programs
S5	Presentation of applied knowledge in universities and special attention to exact sciences and managerial issues as sub-branch sciences of technology management
S2	Education of current human resources working in work places particularly education of creative thinking for offering innovative ideas
S8	Creating and safety valve to express opinions and welcoming scientific and feasible suggestions of work forces
S7	Focus on fostering intellectual and social capitals
S3	Education and use of specialized forces for correct planning for identification of areas requiring technology transfer and development
S1	Change of attitude to human resources from cost to asset

CONCLUSION

In present time, pivotal role of technology in growth and development of countries is very evident and beyond any doubt so that without its careful management, a dynamic presence on the market will be impossible. The need for utilizing technology has created a situation in which planning for technology development is considered a key requirement. In development path, technology is always faced with some obstacles which create major challenges for managers and industry policy makers, therefore adopting fitting measures and integrated strategies are regarded prerequisites on this path. In this direction, in present article, using different tools and forward-looking approaches through analysis of status quo and study of future scenarios, technology development is investigated. Main obstacles of technology development are identifies through extensive studies and interview with experts and specialists in this field and using Theory of invention problem solving with Extended TRIZ approach the existing relationships between them are analyzed. Studies on Root Conflict Analysis process, have revealed inattention to human aspect of technology concept and mere emphasis on its technical dimension as the most important and profound obstacles of technology development. This obstacle has a high leading power so that for managing, controlling and solving it as the rootconflict, the formulated strategies which after determining weight vector of conflicts (criteria) using Shannon Entropy Decision Making method and profiting from experts' view are ranked in the framework of 8 strategies by TOPSIS method. It is noteworthy that the mentioned strategies by change of researchers' selected domain may be ranked differently. In addition, it is suggested that for future researches more attention to be paid to the conflicts modeling based on cause and effect approach and for eventual decision making, DEMATEL and Network Analysis Models to use.

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