VALUE ENGINEERING ANALYSIS APPRAISAL FOR FARM MANAGEMENT: A CASE STUDY OF PISTACHIO FARMS

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ABSTRACT

Value engineering (VE) has been effectively applied in many different areas. The results have been very encouraging, and many companies accept VE not only as a tool to reduce costs, but also to improve the quality of their produce and streamline their systems. This paper attempts to highlight the application of VE in agriculture, as in pistachio tree farms in Iran. It is found that by implementing VE, unnecessary cultivation costs are lowered. Many of the other factors that lead to the inefficient use of resources could be resolved. In this study, the province of Yazd Iran was studied. Unfortunately there are cases of mismanagement and problems in agriculture management; and the problems must be resolved to make the system of pistachio growing more efficient. The prime objective of this paper is to introduce the concept of value engineering and highlight its application in pistachio farms. The results suggest that it is essential to use Indian Neem pesticide, because it is economically feasible and environmentally friendly to pistachio trees.

OPSOMMING

Waarde-Ingenieurswese (WI) word reeds doeltreffend toegepas op verskeie gebiede. Die resultate is sodanig bemoedigend dat maatskappye WI aanvaar as 'n hulpmiddel vir kosteverlaging sowel as vir die verbetering van kwaliteit van opbrengs en stroombelyning van prosesse. Die artikel poog om die toepassing van WI op die landbou van Iran na vore te bring. Dit toon dat onnodige verbouingskoste verlaag word met die implementering van WI. Talle ander faktore wat ook bydra tot ondoeltreffende gebruik van hulpbronne word ook deur WI aangespreek. Die Yazd-provinsie van Iran word in die artikel bestudeer. Ten einde die verbouingsproses van pistasieneute meer doeltreffend te maak moet wanbestuur en probleme van landboubestuur aangespreek word. Die hoofdoelwit van die artikel is om die konsep van WI bekend te stel en die toepassing daarvan op pistasieboerderye uit te lig. Die resultate dui op die gebruik van "Indian Neem" plaagbestrydingsmiddel aangesien dit ekonomies vatbaar en omgewingsvriendelik is.

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1. INTRODUCTION

The origin of value engineering (VE) can be traced back to the days of World War II, when there was a shortage of materials in the manufacturing sector due to increased consumption for war purposes [1]. Lawrence D. Miles, an electrical engineer who was then assigned to the purchasing department of General Electric (GE), began to find ways to alleviate the materials shortage in GE's production. He focused on the functions that a product was meant to perform, and experimented with alternatives to achieve the same functions without compromising quality. Although the main emphasis was not on cost reduction, this was a by-product. Initially named 'value analysis' by Miles, the programme was designed to improve value without sacrificing intended functions or purpose.

There were more than 130,000 hectares of pistachio tree farms in Iran in 2005 [2]. Pistachio is cultivated in the Middle East, the United States, and Mediterranean countries. There has been a dramatic increase in pistachio nut production in these countries over the past 20 years. Iran is one of the biggest producers and exporters of pistachio nuts. It produced more than 250,000 tons in 2003, and exported 115,335 tons to different countries in 2002 [3]. Their popularity has spread fast since Iran's early export of pistachios in the 1920s. Now the pistachio is one of the nation's most prized crops. Pistachio trees grow mainly in regions situated 500 to 2,200 meters above sea level with cold winters and hot summers. Pistachios are an excellent source of many nutrients essential for good health, including potassium, phosphorous, calcium, protein, vitamins, minerals, and amino acids [4].

Most of the farms are located in the provinces of Kerman, Yazd, Khorasan, and Semnan. In the past few years other provinces like Fars, Isfahan, and Markazi have paid attention to this world-famous agricultural product. Most of the farms are run by old and illiterate farmers who use traditional methods and have no knowledge of new systems that reduce costs and improve productivity. By implementing Value Analysis, performance would increase and costs would lower. Implementing this system should not affect the quality of the pistachio; so if this effort yielded an acceptable result, it would be beneficial for all farmers to follow and implement the new system on their farms.

2. BACKGROUND OF VALUE ENGINEERING

The value methodology was originally developed during World War II by United States industries, who – faced with shortages of critical war materials – substituted appropriate materials or systems that were available to maintain production and accomplish the required tasks. Larry Miles, an engineer at the General Electric Company, is generally credited with the development of the technique then known as 'value analysis'. In 1954 the United States Navy's Bureau of Ships adopted the concept to reduce costs during the design stage, and called it 'value engineering'. This was mainly because the relevant government documents then did not allow use of the term 'analysis', while those documents did contain the word 'engineering' [6]. The generic nature of VE makes it applicable to many types of projects, ranging from buildings to water treatment works. Moreover, it is suggested (later in this paper) that the prospects for implementing VE in the corporate and systemic contexts are good. In many ways, the inquiry into key functions furnished by a product or service system, and the search for alternative solutions beyond mere cost cutting, remain central to these different forms of implementation [2]. Nevertheless, the United States Department of Defense (DOD) accepted VE as a convenient way of obtaining the best practical value from its procurements, and adopted VE in contract clauses under the Armed Forces Procurement Regulations (AFPR) in 1961, permitting contractor incentives through sharing VE contract cost reductions [6].

The year 2007 marked 60 years of VM service. The past ten years have largely seen the debate over terminology resolved, aided by the publication of standards in many countries.

For the first four decades, North American thinking dominated development; over the past ten years, developments – principally in Europe, Australasia, and China (notably Hong Kong) – have seen divergent thought emerge [7].

3. TECHNIQUE OF VALUE ENGINEERING

Value engineering is a systematic effort to improve the value of a product, project, or system, and to optimise the life cycle cost. It is a process that identifies opportunities to remove unnecessary costs while ensuring that the quality, reliability, performance, and other critical factors meet the customer's expectations. Typically it is undertaken after the conceptual design stage, before detailed design and manufacture, with the goal of increasing the net value. However, value engineering can also be carried out at other stages of the product or project lifecycle [8]. It helps people to generate creative alternatives that secure essential functions at the greatest worth rather than cost [9]. Depending on their newness in the marketplace, innovations can be incremental or radical [10, 11, 12]. Radical innovation often requires developing an entirely new set of performance features [13, 14, 15].

Value engineering has two primary goals:
1- to deliver functions at the lowest cost;
2- to use group brainstorming and consensus to broaden the solution space and avoid narrow thinking.

Value can be improved by reducing the life cycle cost (LCC) and increasing customer worth or customer acceptance. The action of VE requires studies of the calculation of a product's LCC, where the focus is on the product's total cost. Teamwork is the key to successful value engineering. A multidisciplinary team composed of representatives of all stakeholders (client, designers, manufacturers, users, maintainers, etc.) plus specialists from different fields work together to identify improvements (increased value) [8].

Lawrence D. Miles, an electrical engineer in the purchasing department of General Electric (GE), started finding ways to alleviate the shortage of materials in GE's production. He focused on functions that a product was meant to perform, and experimented with alternatives to achieve the same functions without compromises in quality. Although the main emphasis was not on cost reduction, this emerged as a by-product. Initially named 'value analysis' by Miles himself, the programme was designed to improve value without deliberately sacrificing intended functions.

Many value engineering recommendations or decisions are born of necessity, and possibly involve the availability of equipment or material, or the physical limitations of time and topography (VE and least cost). Value engineering (VE) is a very powerful tool for promoting the competence of products and services in every industry. According to the VE standard of SAVE International, VE study can be divided into three parts: pre-study, study, and post-study. Prior to the VE study, various data such as project specification and cost information should be collected. A cost model should be worked out during the information phase. Through this process of collecting information, team members can clearly understand the whole project [17]. The technique of Function Analysis Structure Technology (FAST) is an important step in the creation of new ideas and innovation. Created ideas would then be evaluated in the evaluation phase.

Value engineering is one way to improve efficiency and seek the best balance between the cost, reliability, and performance of a product or service [18]. Value criteria come to the fore when choosing the appropriate alternative against a set of predetermined criteria – a value system [7]. In classical design the designer asks "What should the thing be like?". In value-based design the key question is "What is the mechanism? How should the thing work?" [19].

Lim et al. [20] demonstrated how value methodology could help to improve value, not focusing on making the product cheaper. VE enables team members to see the problem plainly, with fewer constraints, and also enables decision makers to review the goals of the project concisely [21]. Male et al. [22] studied the strategic phases of projects and the project value chain [23, 24, 25, 26 and 27], and also recognised a two-stage briefing process [25, 28]. They developed a function analysis system that was able to link strategic project-level function analysis through FAST diagramming with a function-clustering technique for value engineering. Kawabata [29] applied the VE method in-house to present proposals for value improvement, and thoroughly reviewed the functions of the proposals for value assurance. Smith [30] revealed that value engineering programmes experience variation because of mismanagement, lack of continuous value engineering training, improper selection of team members, improper use and development of final value engineering reports, and inappropriate timing of the studies performed.

Lee & Lo [17] described how a value engineering study could be performed and audited by a manufacturer, and how the audit team should be formed. They believed that a value engineering study was an effective programme to reduce the cost and upgrade the value of a hardware or software project. The mission of the VE team during the first VE workshop is to use the team members' collective knowledge and experience to:

- define 'what we know and what we need to know';
- develop recommendations to deliver the project according to the mission statement;
- develop recommendations to maximise the value of the solution [31].

4. RESEARCH METHODOLOGY

Two different methods were used in this work to assess value engineering: field study, and the implementation and analysis of different phases. The data was collected from all the provinces in Iran that were suited for pistachio farming. The proposed method includes some steps that are discussed. Brainstorming sessions were provided in order to obtain creative ideas. The results of these techniques are presented and their results discussed.

5. INFORMATION PHASE ABOUT PISTACHIO

Pistachio, one of the most popular nuts in the world, is cultivated in the Middle East, the United States, and Mediterranean countries. There has been a dramatic increase in the production of pistachio nuts in these countries over the past decade. Iran is one of the biggest producers and exporters of pistachio nuts: in 2003 it produced more than 250,000 tons, and in 2002 it exported 115,335 tons to various countries [32].

The pistachio's origin is still uncertain, but most experts agree that it probably originated in central Asia. Domestication occurred less than 2,000 years ago, and traders introduced them throughout the Middle East and the Mediterranean. Most pistachio production occurs in countries with a warm, arid climate. Iran, the United States, Turkey, Italy, and Syria are the principal pistachio production countries, and the nuts are grown mainly for export. Trees are also grown in Pakistan, Greece, India, and Australia. Due to their high nutritional value and their favourable taste, planting pistachio trees has become common in other parts of world [33]. Iran has 1,647,945 hectares of land, most of which is dry and unsuitable for regular agriculture. The quality of the water is also not good in most regions. Fortunately, the pistachio tree can adapt to the harsh conditions of the Iranian desert, with its salty water, poor soil, and hot summer climate. Pistachio trees can be grown in most parts of Iran, because of its weather, soil, and water. The pistachio is called 'green gold' because it is economically viable in many countries whose conditions favour its growth. It takes at least seven years for a tree to bear fruit, which is a long time for a farmer to wait; but its advantage is that it does not require much water. An old pistachio tree needs water only about four times a year, which is very good for regions with a shortage of water.

6. HARVESTED AREAS IN IRAN

Pistachios can be grown in the central desert of Iran, even with its adverse conditions such as shallow saline groundwater tables. The addition of water from shallow, saline groundwater to crop water use can be important in such conditions. Table 1 shows that 280,000 hectares of pistachio trees were cultivated in the year 2005, with about 80% of them in the province of Kerman. It also shows that the average Iranian output of pistachios is about one ton per hectare (300,000 / 280,000 = 1.07), which is very low compared with countries like the USA and Turkey. A solution needs to be found for this significant difference. Iran is the main pistachio-producing nation, but its output is very low and requires great effort. It should be noted that the pistachio output varies in different years because of both frost and drought, which are natural disasters; and there should be some way to resolve that problem too.

Province/City	Cultivated area (ha)	Output (tons)
Markazi	**1684**	**2500**
E. Azerbaijan	**63**	**127**
Ardebil	**1**	**0**
Kermanshah	**50**	**150**
Fars	**3550**	**773**
Kerman	**224243**	**250000**
Khorasan	**24943**	**15924**
Isfahan	**1243**	**3420**
Sistan Baluchestan	**1858**	**2585**
Zanjan	**65**	**702**
Semnan	**2931**	**8252**
Yazd	**15941**	**11490**
Hormozgan	**35**	**451**
Tehran	**804**	**103**
Qazwin	**2500**	**2403**
Jiroft-Kahnooj	**90**	**120**
Total	**280000**	**3000000**

Table 1: Harvested areas and production quantity of pistachio produced by different provinces of Iran (2005) [34]

7. PRODUCTION FOR PROVINCE OF YAZD

The Badami strain of pistachios is one of the most important crops in the arid regions of Iran, especially in the central desert. Here, pistachio trees (Pistacia vera L.) are grown in saline soils with shallow saline groundwater. The plant water uptake from this shallow saline groundwater is a potential source of water for pistachio growth [35]. Table 2 shows the statistics for Yazd province, which has had the greatest growth of land use for the cultivation of pistachio trees in the past few years. The amount of land with productive trees covers 10,789 hectares; but another 27,092 hectares should also be productive soon. The total production of pistachios in 2005 was 16,090 metric tons; in the years since it has increased rapidly.

Pistachio (brand)	Productive trees (ha)	Non-productive trees (ha)	Production (tons)
Owhadi	**1606**	**4186**	**2774**
Ahmad Aghaei	**2606**	**5525**	**2346**
Akbari	**1701**	**4173**	**2580**
Kale Ghoochi	**3872**	**9628**	**6435**
Others	**1004**	**1580**	**960**
Total	**10789**	**27092**	**16090**

Table 2: Pistachio production in province of Yazd for 2005 [16]

8. GLOBAL PRODUCTION

Global data indicate that Iran and the USA are the world's main producers of pistachio. In 2002 Iran produced about 300,000 tons, and the USA around 127,000 tons (Table 3); and between 1991 and 2002 they were the top two producers. Table 3 indicates that during the period studied in this paper, Iran's share as top producer ranged from 33% to 62%, and that of the USA as the second-largest producer ranged from 11% to 25%. Between 1991 and 2002 Iran's share as the world's largest pistachio producer increased more slowly than that of the USA. Data from this table show that the results of Iran's pistachio business are not satisfactory, because other countries did not have a tradition of pistachio farming. It should also be noted that Iranian pistachio was famous in ancient times too; but now other countries, like the USA and Turkey, have increasingly turned their attention to this field.

Year	Afghani-stan	China	Greece	Italy	Iran	Syria	Tunisia	Turkey	USA	Others	World
1991	2000	23000	4898	2400	182484	14400	620	64000	34930	721	399544
1992	2100	21500	4786	156	201632	20200	800	29000	66680	752	347606
1993	2200	24000	5573	1799	299332	13700	900	50000	68950	626	397080
1994	2300	25000	5351	240	195000	14925	900	40000	58500	656	343781
1995	2400	25000	5591	2200	238780	14500	1000	36000	67130	606	393107
1996	2500	28000	8892	100	260085	34324	1150	60000	47630	563	433094
1997	2600	30000	9137	5000	111916	29428	1200	70000	81900	657	341788
1998	4000	26000	8072	512	313957	35684	1200	35000	85280	642	510347
1999	2800	29000	6000	2649	131166	30133	1300	40000	55790	573	299411
2000	2800	22000	6500	2768	303957	39923	1300	75000	110220	1470	565938
2001	2600	26000	7500	2500	112432	37436	1300	30000	73030	1641	294439
2002	2800	26000	8500	2500	300000	39208	1300	40000	127010	1441	548759

Table 3: Global pistachio production by major producing countries (tons) [34]

9. PISTACHIO YIELD

Table 4 indicates that the average pistachio yield of the world was 12,642 kg/ha in 2002. Among the major producers, the United States topped the list in 2002 with 28,866 kg/ha. Next came Syria with 21,194 kg/ha; China with 17,333 kg/ha, Greece with 16,634 kg/ha, and Iran with 10,714 kg/ha. Iran's average pistachio yield during most of the years being studied was below the world average because of mismanagement; but drought was also a factor for some years. Iran's average pistachio yield in 2001 went as low as 4,008 kg/ha because of a serious country-wide drought; and other countries may have suffered similarly in that year. Still, Iran's numbers are unsatisfactory as the world's first producer of pistachio nuts; and an acceptable solution must be found.

10. PRESENT SYSTEM OF MANAGING PISTACHIO FARMS IN IRAN

Most of the farms have only a small portion of land. Their water sources are mainly wells of different depths, depending on the location of the land. They mostly use diesel pumps, although some of them have recently changed to electric pumps. Most farms are divided into smaller parts, each run by a different person. There is seldom enough cooperation between the farmers, and problems often arise between them. Because of the scarcity of water, its use has always been a problem; so everyone has only limited access to it. Problems also arise when mechanical or electrical failures take place. There is no unique or integrated management system to increase productivity and lower costs. Each person works independently of the others, and they seldom meet to find the best ways to deal with the problems. Sometimes they cooperate, but more often there are problems between them, along with a lack of trust. For example, some farmers may use insecticide at one time and

others at a different time. Most of them have no interest in cooperation and better management, and thus many other crises and problems arise.

Year	Afghani-stan	China	Greece	Italy	Iran	Syria	Tunisia	Turkey	USA	World
1991	7407	14024	12760	6536	11302	8471	188	21253	15497	11301
1992	7778	13110	11208	434	11748	9439	220	9227	29169	11157
1993	8148	14458	12357	5014	11359	10301	233	15252	29887	11752
1994	8519	15060	10702	686	9466	10223	237	11997	25140	9968
1995	8889	15060	11410	6286	10953	9692	257	10566	27512	11072
1996	9259	16867	17608	250	11213	13513	312	17152	18319	11637
1997	9630	17647	18093	12500	4529	16349	411	19337	30544	8859
1998	10000	14857	15827	1407	12102	17842	462	9405	30588	12704
1999	9333	19333	11742	7354	5115	15859	542	10614	19165	7602
2000	9100	18333	12715	7689	11064	21580	600	20633	36497	13904
2001	8900	17333	14677	6944	4008	20236	602	8608	23136	7048
2002	9333	17333	16614	6944	10714	21194	656	10000	28866	12642
AVG	16118	8558	13811	5170	9464	14558	386	13629	26193	10804

Table 4: Pistachio yield in major producer countries, 1991-2002 (kg/ha) [34]

11. CREATIVITY PHASE

This is the most important part of the job plan, in which the ideas are proposed for evaluation and consideration. All ideas need to be respected and considered, even if they look strange, unacceptable, or outrageous [5]. Everyone is free to suggest his/her own idea. All the members of the VE team have the same rights, and nobody can dictate to the group. It is better not to bring professional pistachio farmers into the group, because they might suggest ideas that the others would never have thought of for themselves. It is better to invite different people to discuss the problem. Specialists in the field should be invited too. A brainstorming team of people from different backgrounds can suggest various ideas for improving the system of pistachio farming in Iran. In this study, the best information is sought, and people with extra information can suggest ideas that are very useful.

12. STEPS TO A CREATIVE DISCUSSION

Iran faces two main challenges in producing and exporting agricultural products, particularly pistachios. The brainstorming team suggested various ideas, of which some of the most important and interesting set out below.

1. Hire a person with a degree in management for each farm.
2. Use Indian Neem insecticide, which is harmless to the environment and to the pistachio nut, in order to improve the quality of product.
3. Install security cameras in different locations on the farms.
4. Use a different irrigation system than flood watering, which is commonly used in Iran and wastes a great deal of water.
5. Train farmers to become familiar with new ideas, and educate them.
6. Arrange a trip for farmers to visit well-organised farms in other countries.
7. Encourage cooperation among farmers.
8. Solve the water shortage that faces agriculture.
9. Introduce new methods for combating insects.
10. Set up a training course for selected pistachio garden owners to improve multipurpose cooperatives for production, distribution, and export.
11. Require farmers to participate in management, and get the authorities to implement the proposal in order to improve the system of management.
12. Use quicker forms of transport, and establish modernised pistachio processing terminals.

13. Advertise Iranian pistachios in foreign markets.
14. Develop safe marketing management for the whole process, from farm to warehouse and export port.
15. Implement a smart farm system by using computers and controllers.
16. Ease government regulations.
17. Combat the corruption that is common in different sectors of government.
18. Seek increased investment by the government.
19. Change the habit of using old methods.
20. Accept new ideas rather than simply reject them.
21. Improve the quality of the soil.
22. Use new methods to harvest pistachio nuts, instead of picking them by hand.
23. Use different methods to combat frost, rather than ignoring it.
24. Use liquid fertilizers on leaves.
25. Invite agricultural professionals to visit farms regularly.

13. EVALUATION PHASE

In the evaluation phase, the objective is to evaluate the alternatives identified in the creativity phase. Impractical, useless, or impossible alternatives are eliminated, along with any that do not obviously meet the requirements established in the pre-study for the purpose of pistachio farming. The suggestions generated in the creative phase are grouped by what they have in common, and then each group is analysed according to the advantages and disadvantages that emerge. Groups then are evaluated for their importance to the project. Ranked according to the advantages and disadvantages of each, the alternatives are evaluated as a group and individually to determine which of them hold the greatest potential for improvement and so can be further developed in order to solve the problems of Iranian pistachio production. Information is gathered on each of the remaining alternatives to enable effective analysis of them. If every alternative is eliminated during the evaluation phase, then fresh ideas must be sought in the creative phase.

During the evaluation phase, some of the most important suggestions were chosen for further development. It should be noted that most of the suggestions arising in the creative phase were important; but the aim was to choose the best of them. Just one idea from each group is selected. From all the ideas that were generated, some of the more effective ones are listed in Table 5.

CREATIVE PHASE :
IDEAS:
1. Use liquid fertilizer on leaves. 2. Use Indian Neem insecticide which is harmless. 3. Use different irrigation system instead of flood watering. 4. Different methods to combat freezing. 5. Make farmers to participate and implement the proposals to improve management.

Table 5: Final ideas accepted for consideration

Only five suggestions were chosen from the many ideas raised in the brainstorming process. Each of these five proposals comes from a different group, and must be considered for taking forward into the development phase. In the creative phase the creative ideas are only noted, not evaluated. That is done in the evaluation phase and the decision phase. The criteria for evaluation are chosen in the evaluation phase, and each criterion is given a particular weight. The matrix below, devised in the evaluation phase, defines the scores / weights. The criteria that are considered more important are written down, and then the differences between them are noted. For example, in the first cell of the matrix, in comparing A and B, B is considered to be important; but A is also important. The difference in importance is regarded as major. So ‘A3’ is written in the first cell. Similarly, in the second cell (to the right of the first cell), A is seen as only slightly more important than C;

so 'A1' is entered there. In this way all the cells of the matrix are filled. These are only examples; and if the VE team feels that these need to be changed, they can do so.

EVALUATION PHASE:

Identify Criteria for Selection

Identity	Criteria	Score	Rank
A	Easy to implement	4	8
B	Manageable	2	9
C	Easy availability	0	10
D	Economically feasible	11	5
E	Satisfaction of farmers	9	6
F	Satisfaction of customers	18	2
G	Satisfaction of government	12	4
H	Productive	16	3
I	Friendly with environment	19	1
J	Easy to sell	6	7

Table 6: Identifying criteria for selection with rank and score

	B	C	D	E	F	G	H	I	J	SCORE
A	A3	A1	D2	E3	E3	G3	H3	I3	J2	4
B	B1	D1	E2	F2	G2	H2	I2	B1		2
C	D2	E1	F2	G2	H3	I3	J2			0
D	D1	F3	G3	D2	I3	D3				11
E	F3	G2	H2	I3	E3					9
F	F3	F2	I3	F3						18
G	H2	I1	J2							12
H	H2	H2								16
I	I1									19
J										6

Comparision	Pts
Major Difference	3
Medium Difference	2
Minor Difference	1
No Difference	0

Table 7: Scores for using in the decision matrix

The 10 criteria in Table 6 are labelled A to J for use in the decision matrix. The scores are derived from Table 7. Criterion I ("Friendly to environment") has the highest ranking with 19 points; the lowest-ranked criterion is C ("easy availability") with no points. In the evaluation phase, for the calculation of scores in the matrix, the scores for particular criteria are added up along each row as well as down each column. These scores are transferred to Table 6 in the evaluation phase. The ranking is done just to ensure that the prioritisation has been done properly. If all the team members agree that something is not particularly important, and yet it has been given a high rank, then it suggests that something went wrong somewhere in evaluating the criteria, and so corrections can be made.

14. DEVELOPMENT PHASE AND FINAL DECISION

The decision matrix in Table 8 below is the last step in choosing the best proposal. The total score can be seen in the last column on the right side, in which proposal 2, with the highest score of 443, was selected. Using Indian Neem insecticide on Iranian pistachio farms emerges as the best alternative to be implemented, based upon the VE analysis done for this purpose. The criteria and the ideas are copied into the decision matrix. The scores for each criterion are copied into the decision matrix, and become the weightings for each criterion. Now each of the ideas is evaluated against each of the criteria. The score of an idea against the criteria is calculated by multiplying the score for the criterion by the weight of the criterion: score of idea against criteria = (score in scale of 1-5) x (weight of the criterion).

Once this has been done, the total score for each idea can be calculated, by adding up the scores of that idea against each individual criterion. The idea that scores highest is the recommended idea. This idea is then examined to estimate the savings, with all relevant details, and taken to top management for approval and implementation.

15. IMPLEMENTATION PHASE

It should be noted that many people around the world still do not know about Indian Neem. But it is economically beneficial, and also does not harm the environment. By implementing this VE in Iranian pistachio farming, farmers would notice a major change in the long term, from which everyone would benefit.

16. DISCUSSION

The data for the harvested areas and the quantity of pistachio produced in the different provinces of Iran were collected for the year 2002, because the figures were available and accurate. Figures for global pistachio production by major producing countries were collected from 1991 to 2002. In addition, the pistachio yield (kg/ha) in major producer countries from 1991 to 2002 was collected. The brainstorming team suggested different ideas, from which the 25 most important and interesting ideas were selected for further analysis. Then the brainstorming team selected five different ideas for the evaluation phase. Ten criteria for selection, with rank and score, were identified. The scores for use in the decision matrix were calculated, and finally the decision matrix was developed. Surprisingly, the use of Indian Neem pesticide was selected as the best proposed idea for pistachio farming in Yazd province in Iran.

DECISION MATRIX:

V.E. Analysis for Pistachio farms / Desired Criteria	Easy to implement	Manageable	Easy availability	Economically feasible	Satisfaction of farmers	Satisfaction of customers	Satisfaction of government	Productive	Friendly with environment	Easy to sell	
Excellent =5 Very Good =4 Good =3 Fair =2 Poor =1											
Proposal / Weighting for Criteria	A	B	C	D	E	F	G	H	I	J	Total Score
	4	2	0	11	9	18	12	16	19	6	
1. Use fertilizers on leaves.	5	4	5	3	4	4	5	5	3	4	387
	20	8	0	33	36	72	60	80	54	24	
2. Use Indian Neem insecticide which is harmless.	4	4	1	4	4	5	5	4	5	5	443
	16	8	0	44	36	90	60	64	95	30	
3. Install cameras inside the farms.	3	4	4	4	5	1	3	4	4	3	321
	12	8	0	44	45	18	36	64	76	18	
4. Use different irrigation system.	2	3	4	4	3	3	4	3	4	3	329
	8	6	0	44	27	54	48	48	76	18	
5. Make farmers to participate and implement the proposals to improve their management.	1	3	3	4	3	4	5	4	5	4	396
	4	6	0	44	27	72	60	64	95	24	

Table 8: Decision matrix

17. CONCLUSION

This paper presents the extent to which value engineering principles and practices are being applied to pistachio farming in Iran. In general, there is a strong indication that the future prospects for the use of VE in Iranian agriculture are positive; but a number of obstacles remain. More effort is required to educate farmers on the various aspects of VE. The Iranian government should also pay greater attention to urging farmers to cooperate and accept new ideas to improve the management of pistachio farming. Based on the analysis done for implementing VE on pistachio farms, it was found that the best idea is to

use Indian Neem products like Neem pesticide, which is more effective than chemical pesticides. Although indigenous to India, many countries have done recent research into growing the Neem tree, from which a very valuable pesticide can be produced. The most important aspect of using Neem pesticide is that it does not harm the environment. Its use is also economically feasible in the long term.

18. REFERENCES

[1] Value Engineering Manual, 2004. Technical Session, Engineering Division, Division of Highways, West Virginia Department of Transportation.

[2] **Cheah, C.Y.J**. 2005. *Appraisal of value engineering in construction in South Asia*, International Journal of Project Management, 23, pp 151-158

[3] **Kashaninejad, M.** 2006. *Some physical properties of pistachio nut and its kernel*, Journal of Food Engineering, 72, pp 30–38

[4] http://economics.ca/2003/papers/0460

[5] **Mostafaeipour, A.** 2006. *Implementation of TRIZ and VE at the earthquake crisis management for non-standard houses*, International Conference on Problem Solving Strategies & Techniques. Tehran, Iran.

[6] **Witschey, W. & Wulff,** R. 1998. *How to ensure quality and cut costs with cultural institution value methodology: A case study of value engineering on an historic renovation project at the Science Museum of Virginia*, Museum Management and Curatorship, 17(1), pp 65–83

[7] **Male, S. & Kelly, J.** 2007. A re-appraisal of value methodologies in construction, SAVE (Society of American Value Engineering) International.

[8] Design methods fact sheet for value engineering (VE). 2001. The University of Queensland MECH4551, System Design Projects.

[9] **Shong Liew, I. S.** 2002. *Application of value engineering to geotechnical design for a factory structures on soft alluvial flood plain in Indonesia*, Geology and Geotechnical Engineering Consideration to Coastal Development, pp 1-6 (available at:www.gnpgeo.com.my/download/publication/**2002**_03.pdf).

[10] **Henderson, R.M. & Clark, K.B.** 1990. *Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms*, Administrative Science Quarterly, 35(1), pp 9–30

[11] **McDermott, C.M.** 1999. *Managing radical product development in large manufacturing firms: A longitudinal study*, Journal of Operations Management, 17 (6), pp 631–644

[12] **Hauser, J., Tellis, G.J. & Griffin, A.** 2006. *Research on innovation: A review and agenda for marketing science*, Marketing Science, 25(6), pp 687–717

[13] **Leifer, R., McDermott, C.M., O'Connor, G.C., Peters, L.S., Rice, M. & Veryzer, R.W.** 2000. Radical innovation: How mature companies can outsmart upstarts, Harvard Business School Press, Cambridge, MA, USA.

[14] **Zhou, K.Z., Yim, C.K. & Tse, D.K.** 2005. *The effects of strategic orientations on technology- and market-based breakthrough innovations*, Journal of Marketing, 69(2), pp 42–60

[15] **Lin, J., Chai, K.H., Brombacher , A.C. & Wong, Y.S.** 2009. *Optimal overlapping and functional interaction in product development,* European Journal of Operational Research, 196, pp 1158–1169

[16] **Younker D.** 2003. Value engineering: Analysis and methodology, New York: Marcel Dekker.

[17] **Lee, L.J.H. & Lo, C.Y.** 2004. *Audit system for better performance of value engineering study in a manufacturer*. SAVE International Conference.

[18] **Fong, S.W.** 1998. *Value engineering in Hong Kong: A powerful tool for a changing society*, Computers ind. Engng, 35(3), pp 627-630

[19] **Seni, D.A.** 2004. *Function analysis as a general design discipline*, SAVE International.

[20] **Lim, J.K., Lee, M.J. & Kim, S.I.** 2006. *Application of value analysis for BTL project in Korea*, SAVE International.

[21] **Shublaq, E.W.** 2004. *Introducing superimposed FAST in privatization decision making*, SAVE International.

[22] **Male, S., Gronqvist, M. & Kelly, J.** 2002. *Linking function analyzing techniques*, SAVE Journal.

[23] **Bell, K.** 1992. The strategic management of projects to enhance value for money for BAA PLC, PhD thesis, Heriot Watt University.

[24] **Graham, M.,** 2001. *The strategic phase of privately financed infrastructure projects*, PhD thesis, University of Leeds.

[25] **Male, S.P. & Kelly, J.R.** 1992. Value management as a strategic management tool, In Value and the Client, RICS.

[26] **Moussa, N.** 1992. *The application of lean manufacturing concepts to construction: A case study of airports as large, regular-procuring, private clients*, PhD thesis, University of Leeds.
[27] **Standing, N.** 1999. *Value engineering and the contractor*, PhD thesis, University of Leeds, 1999.
[28] **Latham, M.** 1994. Latham Report, Constructing the Team, HMSO.
[29] **Kawabata, A.** 2006. *VE application to the back face partition of crew's cabin in train cars: Application of VE to the crew compartment partition window*. SAVE International Conference.
[30] **Smith, K.L.** 1999. *Applying value analysis to a VE program*. AAHSTO VE Conference.
[31] **Riek, G.C.** 2004. *Value engineering – a key part of Halton Region's quality control program*, SAVE International.
[32] **Kashaninejad, M., Mortazavi, A., Safekordi, A. & Tabil, L.G.** 2006. *Some physical properties of pistachio (Pistacia vera L.) nut and its kernel*, Journal of Food Engineering 72, pp 30–38
[33] **Kashaninejad, M., Mortazavi, A., Safekordi, A. & Tabil, L.G.** 2007. *Thin-layer drying characteristics and modeling of pistachio nuts*, Journal of Food Engineering, 78, pp 98–108
[34] **Karim Koshteh, M.H.** Global pistachio production and marketing challenges, University of S&B, Iran.
[35] **Sepaskhah, A.R. & Karimi-Goghari, S.** 2005. *Shallow groundwater contribution to pistachio water use*. Journal of Agricultural Water Management, 72, pp 69–80