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A Survey on the Application and Role of Value Engineering in Pars Simin Chemical manufacturing company (the manufacturing unit of Pars Simin white plastic paints)

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Abstract

In the present era of global economies all organizations are performing in the area of commercial and economic competition. Besides, customers' needs and expectations have also increases with the spread of technologies. These factors affect, directly, organizations' profitability and survival. The need to decrease costs and possessing a proper design for different products, having correctly understood the real needs of customers, has increasingly became significant and is considered as a key factor in achieving success. The present paper performs value engineering technique to specify and analyze the function of various components in Pars Simin's plastic (non-oil) paints. It, then, determines the significance percentage of functions, analyzes costs and evaluates value indicator to reduce time and costs in order to try to improve and modify each function with the low value indicator. Finally, the providence developed in each produced patch is presented.

Keywords: Value engineering, cost analysis, time and costs reduction, products' proper design

Introduction

Value engineering is a technique or managerial method to increase value, profitability and target-orienting. The considered phenomenon here can be small part of a small product or a magnificent project or even a human behavior or reaction. Value engineering has a higher and more positive effect on those phenomena which have particular features such as high costs, huge number of components, complicated system and components, etc. Value engineering is a functionalistic approach which identifies functions of a system, product or service and their related costs. It is a creative though that uses approved techniques to detect lower-cost alternatives for specific functions and to improve the plan.

Problem Definition

Value engineering is a systematic and approved approach to achieve favorable functions of a system and production of a service or product with the lowest costs so that no harm threats the quality, reliability, performance and safety of mentioned factors because of cost minimization. Through an organized, challenging and analytical process to benefit the organization the value engineering procedure integrates the value system.

Teamwork is the essence of value engineering so that the success of all processes in value engineering depends on the success of its team.

Value engineering is an organized attempt made to investigate and analyze all activities in a plan and is considered as on of the most effective and important economic methods in the area of engineering tasks. The present paper tries to perform value engineering technique and consequently to reduce production time and costs of a product. It aims to answer following question in order to apply the value engineering technique in Pars Simin Chemicals Manufacturing Company (PSCMC):

1. Does the Value Engineering (VE) technique in the company, on the considered unit, result in a reduction in production costs of a product?
2. Does the Value Engineering (VE) technique in the company, on the considered unit, result in a reduction in production time of a product?

Some Reasons for Unnecessary Costs

- Lack of enough time
- Lack of full knowledge
- Lack of value measurement
- Lack of costs identification
- Honest but wrong beliefs
- Lack of communications
- Weak human relationships
- Fear of shame
- Current approaches and habits
- Current traditions
- Having haste to finish the project

Curriculum of Value Engineering

Components and various parts of value engineering are its curriculum the aim of which is to improve the value indicator in the project considered. Based on a definition by SAVE (international society of value engineering) VE curriculum is "an organized approach to study value". The curriculum has a specified beginning and end and is performed in three stages: preliminary study (pre-study), study of value, and complementary study (post-study). An effective attempt of VE must include all stages and phases of the curriculum. Omission of only one phase hampers the process of achieving goals. The precision and attention allocated to each phase is different in various projects.

Research Methodology

The present paper uses a method proposed by SAVE. Based on this model, the procedures include three steps:

1. Preliminary studies
2. Studies of value
3. Complementary studies

Interview was employed in this research as the data gathering tool. The task's scope id determined and the value team is identified. Team's members investigate related information. After the investigations are done, value workshops are held to perform the process of studying the value.

Data Analysis

The Preliminary Studies Step

All required data, especially technical and cost data, are determined in this step to provide for performing stages of value studies. Besides, customers' needs and evaluation criteria are identified. Selecting the team's members instructional workshops are held in which members get familiar with the VE.

Based on collected data, building plastic (non-oil) paints are the most produced product (215 tones per year). Consequently it is possible to have higher providence in these. Thus, the white plastic paint of Pars Simin was selected to perform the VE on (by consulting experts and specialists in the company). Team members (experts of producing white plastic paint) are shown in Table 1. Also, in this step, evaluation criteria are specified which are obtained by interview from specialists (respecting customers' needs and reports by painters). The most important of these criteria include: quality, coverage, price, persistency, freshness and beauty, Brushing, uniformity and the final concentration.

Table 1. Characteristics of VE team members

Characteristics of the leader and members of VE team in PSCMC	
The value facilitator's name	characteristics
Seyed Mohammad No' Pasand Asil, PhD	Supervisor Professor in Guilan University
Esmaeil Ramzanpour. PhD	Supervisor Professor in Guilan University
Seyedeh Sogol Seyed Sa'adat	MA Student of MBA
Team members	Characteristics
Seyed Jalal-e-Din Seyed Sa'adat	Employee and Commercial Manager
Engineer Karim Hoseini Ali Abadi	Research and Development Manager and Quality Management Expert
Keyvan Bashar Doust	Laband Quality Management Expert
Faraz Ghotbi	Quality Assurance Manager
Seyed Sattar Seyed Sa'adat	Lab Expert

Value Study

This step is performed after methodology's preliminary steps and is considered as the main and the most important part of VE. Based on the standard VE methodology of SAVE, VE is composed of six consecutive phases which include: information, function analysis, creativity, evaluation, development and presentation. This methodology follows a structures and integrated thought process. All activities in the present paper were performed in a stepwise manner in six steps which are mentioned below.

Data Collection Phase

This phase aims to complement the data set provided in the previous step. Here, all data related to the product are gathered. Then, costs of the finished price of white plastic paint are identified. Pareto chart was used to determine the study range. Pareto rule (or the eighty – twenty rule) shows that 20% of materials involve 80% of costs.

Table 2. The table of collective percentage of number and costs

order	Ingredients	Collective percentage of Kilo	Collective percentage of costs
1	Tylose	0.004	0.03
2	Aluminum Silicate	0.02	0.05
3	Antifreeze	0.03	0.07
4	Paint thinner	0.05	0.07
5	Talk	0.10	0.08
6	Water	0.31	0.08
7	Titan	0.51	0.71
8	Resin	0.72	0.90
9	Calcium Carbonate	0.99	0.92
10	Other	1.00	1.00

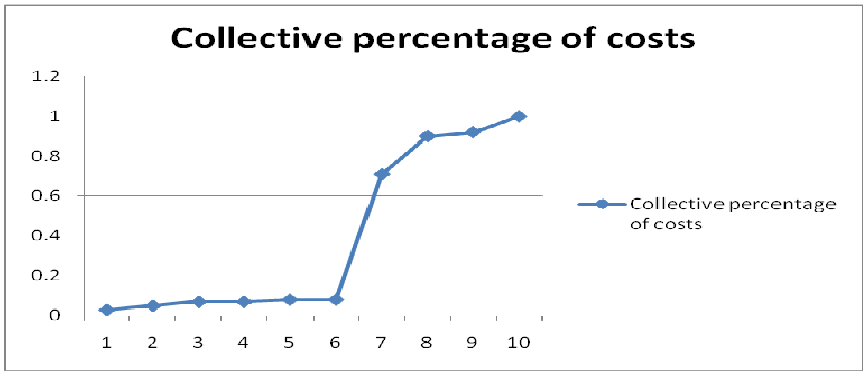

Figure 1. Pareto chart of Pars Simin's white plastic paint

Function Analysis Phase

This step is the heart of value methodology and is considered as the main factor which distinguishes value methodology from improvement ones. In this step a product and its ingredients' functions are identified first and then classified into two groups. The functions are defined by the VE team as two words, i.e. a noun and a verb. Having identified and classified the functions the technical FAST chart is depicted. This chart helps in understanding relationships between a product's functions and preparing thoughts for creativity. The FAST chart specifies relationships between all determined functions. This method clarifies functions logically and consecutively and shows their related relationship, dependence and priorities. It is used to transfer the highest amount of main information in the lowest available space. A product's functions are organized regularly in this chart. Having depicted the FAST chart the value indicator (which is a criterion to measure the value) is determined by the following formula:

Value indicator = function's importance percentage / percentage of costs

The duad weighting technique was also used to calculate the importance of each function. Moreover, the VE team determined matrices of costs percentage allocated to each function in order to determine their costs percentage.

Table 3. Product's function

Order	Material	Function	Function type		
			Primary	Secondary	
1	Water	Diluter		√	
2	Anti-foam	Foam formation preventing		√	
3		Bacteria growth prevention		√	
4	Benzoate Sodium	Erosion prevention		√	
5	Hexametaphosphate Sodium	Paint conditioner		√	
6	Tylose	Paint concentrator		√	
7	Texapone	Brush Improving		√	
8	Tycshan	Creation of a white expression		√	
9	Carbonate Calcium	Paint filler		√	
10	Talk Silicate Aluminum	Cost lowering		√	
11	Talk	Resistance against washing		√	
12	Silicate Aluminum	Paint persistency		√	
13		Forming a layer of paint		√	
14	Resin	Creating adherence		√	
15	Antifreeze	Lowers the freezing point		√	
16	Ammonium	Regulated pH		√	
17	Pain Thinner	Wets margins and edges		√	
18	Anti-mildew	Prevents formation of mildew		√	
19	Plastic Bin	Product packaging		√	
20	Shring Label	Product protection		√	
21		Creates beauty	√		Output
22	Paint	Protects the surface	√		Output
	Welter in Water				Input

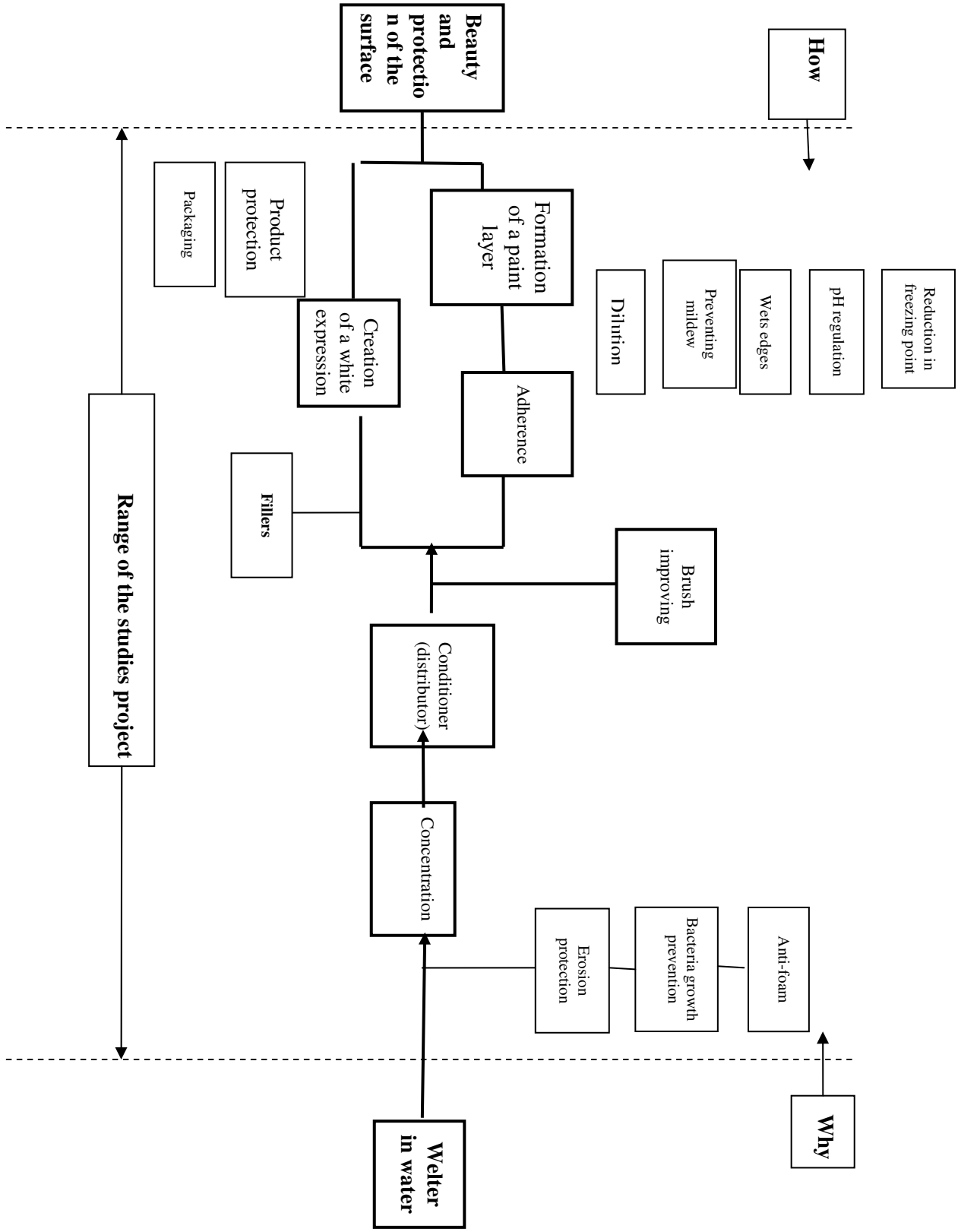

Figure 2. The technical FAST chart of white plastic of Pars Simin

Table 4. Importance percentage of each function

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	sum	percentage
Diluter A	A6	A7	A7	A6	A8	A8	A5	A6	A6	A7	A7	A4	A4	A7	A8	A8	A7	A8	A7	126	6.63
	B4	C3	D3	E4	F2	G2	H5	I4	J4	K3	L3	M6	N6	O3	P2	Q2	R3	S2	T3		
Foam formation preventing B	B6	B6	B4	B8	B6	B4	B5	B5	B6	B6	B3	B3	B6	B7	B7	B6	B6	B6			
	C4	D4	E6	F2	G4	H6	I5	J5	K4	L4	M7	N7	O4	P3	Q3	R4	S4	T4		104	5.47
Bacteria growth prevention C	C5	C4	C8	C6	C3	C4	C4	C4	C4	C2	C2	C5	C6	C6	C6	C7	C6				
	D5	E6	F2	G4	H7	I6	J6	K6	L6	M8	N8	O5	P4	Q4	R4	S3	T4			89	4.68
Erosion prevention D	D4	D8	D6	D3	D4	D4	D4	D4	D2	D2	D5	D6	D6	D6	D6	D6					
	E6	F2	G4	H7	I6	J6	K6	L6	M8	N8	O5	P4	Q4	R4	S4	T4				88	4.63
Paint conditioner E	E8	E7	E4	E6	E6	E6	E6	E2	E2	E6	E7	E7	E6	E7	E7						
	F2	G3	H6	I4	J4	K4	L4	M8	N8	O4	P3	Q3	R4	S3	T3					109	5.74
Paint concentrator F	F5	F1	F3	F3	F3	F3	F1	F1	F4	F5	F5	F4	F8	F7							
	G5	H9	I7	J7	K7	L7	M9	N9	O6	P5	Q5	R6	S2	T3						63	3.32
Improving brushing G	G2	G3	G3	G4	G4	G2	G2	G4	G5	G5	G4	G7	G4								
	H8	I7	J7	K6	L6	M8	N8	O6	P5	Q5	R6	S3	T6							71	3.74
Creation of a white expression H	H6	H6	H7	H7	H4	H4	H7	H8	H8	H7	H9	H7									
	I4	J4	K3	L3	M6	N6	O3	P2	Q2	R3	S1	T3								128	6.74
Paint filler I	I5	I6	I6	I3	I3	I6	I7	I7	I6	I8	I6										
	J5	K4	L4	M7	N7	O4	P3	Q3	R4	S2	T4									106	5.58
Cost lowering J	J6	J6	J3	J3	J6	J7	J7	J6	J8	J6											
	K4	L4	M7	N7	O4	P3	Q3	R4	S2	T4										106	5.58
Resistance against washing K	K5	K3	K3	K6	K7	K7	K6	K8	K5												
	L5	M7	N7	O4	P3	Q3	R4	S2	T5											97	5.11
Paint persistency L	L3	L3	L6	L7	L7	L6	L8	L5													
	M7	N7	O4	P3	Q3	R4	S2	T5												97	5.11
Forming a layer of paint M	M5	M9	M9	M9	M9	M9	M8														
	N5	O1	P1	Q1	R1	S1	T2													146	7.68
Creating adherence N	N9	N9	N9	N9	N9	N8															
	O1	P1	Q1	R1	S1	T2														146	7.68
Lowers the freezing point O	O6	O7	O5	O8	O6																
	P4	Q3	R5	S2	T4															86	4.53
Regulated pH P	P5	P4	P8	P4																	
	Q5	R6	S2	T6																67	3.53
Wets margins and edges Q	Q3	Q8	Q4																		
	R7	S2	T6																	65	3.42
Prevents formation of mildew R	R8	R6																			
	S2	T4																		84	4.42
Product packaging S	S4																				
	T6																			43	2.26
Product protection T																				79	4.15

Total scores for each comparison = 10

Table 5. The cost allocated to each function

Ingredients	Total Cost (Rial)		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Diluter	40000	40000	40000																			
foam formation preventing	71600	71600		71600																		
Bacteria growth prevention	52400	52400			52400																	
Erosion Prevention	78600	78600				78600																
Paint Conditioner	121625	121625					121625															
Paint Concentrater	1360000	1360000						1360000														
Brush Improving	26250	26250							26250													
Creation of a white expression	2440000	2440000								2440000												
Paint filler	525000	525000									141750											
Cost lowering	1097250	1097250									184500	369000	61500									
Resistance against washing	61500	61500										330750										
Paint persistency	66250	66250									198750	397500		66250								
Forming a layer of paint	2660000	2660000													2660000							
Creating adherence	4940000	4940000													4940000							
Lowers the freezing point	517500	517500															517500					
Regulated pH	7700	7700															7700					
Wets margins and edges	51000	51000																	51000			
Prevents formation of mildew	59000	59000																		59000		
Product packaging	1202800	388000																			388000	
Product protection	1629600	1629600																			698400	1629600
		116400																			116400	
Cost Percentage	38968075		0.1	0.18	0.13	0.2	0.31	3.49	0.07	62.62	1.35	2.81	0.16	0.17	6.83	12.7	1.33	0.02	0.13	0.15	3.08	4.18

Table 6. The value indicator of each function

		Importance Percentage	Cost percentage	value index
Diluter	A	6.63	0.1	66.30
foam formation preventing	B	5.47	0.18	30.38
Bacteria growth prevention	C	4.68	0.13	36.00
Erosion Prevention	D	4.63	0.2	23.15
Paint Conditioner	E	5.74	0.31	18.52
Paint Concentrater	F	3.32	3.49	0.95
Brush Improving	G	3.74	0.07	53.43
Creation of a white expression	H	6.74	62.2	0.11
Paint filler	I	5.58	1.35	4.13
Cost lowering	J	5.58	2.81	1.99
Resistance against washing	K	5.11	0.16	31.94
Paint persistency	L	5.11	0.17	30.06
Forming a layer of paint	M	7.68	6.83	1.12
Creating adherence	N	7.68	12.7	0.60
Lowers the freezing point	O	4.53	1.33	3.41
Regulated pH	P	3.53	0.02	176.00
Wets margins and edges	Q	3.42	0.13	26.31
Prevents formation of mildew	R	4.42	0.15	29.47
Product packaging	S	2.26	3.08	0.73
Product protection	T	4.15	4.18	0.98

Having determined the value indicator for all functions those functions whose value indicator is lower than 1 are transferred to the next step to be investigated and analyzed. In this chart, those functions are selected for improvement and transfer to the next step which are paced above the 45^{o} line. The results are shown in the following value chart.

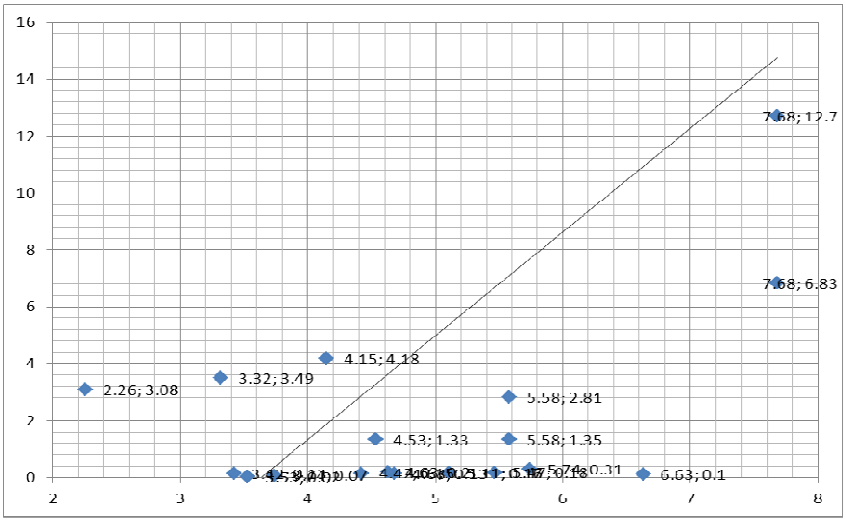

Figure 3. The value chart of white plastic paint of Pas Simin

Creativity Phase

The creativity phase in VE aims to develop the most possible ideas regardless of their quality. Brainstorm sessions were held in this stage and each team member recorded new ideas about selected functions of the previous stage.

Evaluation Phase

The purpose of this phase is to identify and select the best ideas for more developments. Here, of ideas invented in the creativity phase impractical and irrelative ones were omitted and best items were selected to develop in the next step to improve the product's value.

Table 7. Suggested Ideas of the VE team

Number	Function	Suggested Idea
1	Creation of the white expression	Reduction of Titan to 250 K and adding 150K of Litipone
2		Reduction of Titan to 150 K and adding 150K of Litipone and 100K Calcium Carbonate
3		Reduction of Titan to 50 K and adding 100K of Litipone and 250K Calcium Carbonate
4		Using Titan with a different trademark (Chinese)
5		Omission of Titan
6		Replacing Titan with Litipone
7		Replacing Titan with Calcium Carbonate
8	Creating Adherence	Reduction of Resin to 300K and of Titan to 250K, adding 50K of Litipone and 200K of Carbonate Calcium
9		Reduction of Resin to 250K and of Titan to 150K, adding 150K of Litipone and 250K of Carbonate Calcium
10		Using acrylic resin instead of PVA Resin
11		Using 400K of Titan, reducing Resin to 300K and adding 100K carbonate calcium
12		Replacing Resin with Starch
13		Using different kinds of Resin
14	Paint's concentration	Omission of Tylose and replacing it with CMC
15		Reduction of Tylose to 4K and adding 4K of CMC
16		Using lower-cost brands
17		Reduction of Tylose to 4K and adding 4K of carbonate calcium
18	Product packaging	Replacing poly ethylene with card sheet in the bottom of the shiring
19		Replacing P.E with P.P
20		Omission of shiring and distribution of single paint cans
21	Protection of products	Using Iron caldrons instead of steel ones
22		Making shelves in the warehouse to increase the space and avoiding constructing more indoor spaces

Improvement and Development Phase

The development phase aims to investigate strategies and options which are considered as a practical solution in the evaluation phase. Here, costs and providences for each idea were precisely calculated. Then, respecting determined criteria in pre-study stage, these ideas are compared and their priority of performance is specified through numerical analysis of criteria (by duad comparison). And example of numerical analysis worksheet on the function of "creation of a white expression" is shown below.

It is important to note that time is measured since it is, in the improvement and development phase, among the most important factors. Besides, VE technique did not reduce the time in any of considered steps.

Guidance of evaluating Citeria: equal 1, slightly more important 3, more improtant 5, very more important 7

Scoring the options: Bad 1, Weak 2, Average 3, Good 4, Very Good 5, Perfect 6

	Evaluation Citeria										
A	Quality		A								
B	Coverage		A 5	B							
C	Price		A 5	C 3	C						
D	Persistency		D 3	D 5	D 3	D					
E	Freshness and Beauty		A 5	B 3	C 3	D 5	E				
F	Brushing		A 5	B 5	C 5	D 5	E 3	F			
G	Uniformity		A 7	B 7	C 7	D 7	E 5	F 3	G		
H	Final Concentration		A 7	B 7	C 7	D 7	E 5	F 3	G-H	H	
	Citeria's total score		34	22	25	35	13	6	1	1	
	Ranking		2	4	3	1	5	6	7	7	Total Rank
1	Reduction of Titan to 250 K and adding 150 K of Litipone	criterion weight	136	88	100	210	52	30	6	5	627
		score of citeria	4	4	4	6	4	5	6	5	
2	Reduction of Titan to 150 K and adding 150K of Litipone and 100K Calcium Carbonate	criterion weight	102	66	125	210	39	20	6	4	572
		score of citeria	3	3	5	6	3	4	6	4	
3	Reduction of Titan to 50 K and adding 100K of Litipone and 250K Calcium Carbonate	criterion weight	48	44	150	210	26	20	6	4	508
		score of citeria	2	2	6	6	2	4	6	4	
4	Using Titan with a different trademark (Chinese)	criterion weight	136	88	25	210	110	30	6	6	611
		score of citeria	4	4	1	6	5	6	6	6	

Figure 4. The worksheet of numerical analysis through dual comparison

Presentation Phase

This phase aims to come to an agreement and create commitment for the designer and employee of the project to perform suggestions. The VE team of Pars Simin, in this step, presented the selected set of suggestions to the manager of the company, in agreement with all team members and respecting their priorities and developed changes and providences. The manager confirmed and accepted all suggestions.

Table 8. Results of VE project in Pars simin

Providence	Plan Costs (Rials)	Selected options by the VE team
7875000	16825000	Reduction of Titan to 250 K and adding 150K of Litipone
1810000	5790000	Reduction of Resin to 300K and adding 100K carbonate calcium
240000	1120000	Using lower-cost brands instead of Tylose
9925000		The total providence in each caldron
25580		Providence in one gallon of paint
516100000		The total providence per 52 caldrons per year

Table 9. Providence in warehousing and product protection

1125000000	125000000	Making shelves in the warehouse to increase the space and avoiding constructing more indoor spaces in 500m

Conclusion

Value Engineering is an organized attempt which aims to investigate and analyze all activities performed in a plan and is known as one of the most efficient and important economic methods in the area of

engineering tasks. Thus, the present paper described this technique in a stepwise and applied manner. Some results of this research are presented bellow.

1. In the present paper VE identifies, removes or modifies every factor causing unnecessary costs in the process of white plastic paint production, without any harm to main and basic functions of the system since the VE curriculum is based on stable improvement of design and performance.
2. VE methodology is considered with a systematic look at the product and decreases costs of producing white plastic paint while respecting customers' needs (this cost reduction is calculated to be 9925000 for each caldron, i.e. 25580 Rials providence in each gallon of paint. The company produces 52 caldrons per year the providence of which is about 516100000 Rials. Besides a 1125000000 Rials providence is seen in warehousing).
3. The VE technique was stable and unchanged throughout the production of white plastic paint in Pars Simin Company. Before the execution of VE, the production time of this product was about 1:30 to 1:45 hours which did not change even after using VE.

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