The Use of Taguchi Method in Improving the Quality of Product

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ABSTRACT:

The design of successful system depends on various qualities, it is an important requirement to pass up and carry out any activity by the decision maker. In many different cases, the aim would never be achieved because of incorrect use of data, or improper use of statistical tools of data analysis. This would consequently lead to incorrect decisions and mistaken predictions. Then must have information systems about the quality of data, in order to take the suitable decisions and predictions. The multidimensional system may possibly be checking up medical, productive, design systems in specific engineering field. Thus, must also be a paradigm to product monitor and identify the standards correctly. This may be workable in abnormal distribution systems, for instance; in check up system, the abnormal standard to identify the product satisfaction is almost used. In medicine on the other hand, the abnormal standard identify the disease intensity is almost used. Hence, tests the water (H_2O) that taken into consideration in this paper. This was done through varieties analysis using Taguchi Method, that was a modern tool to the evaluation of abnormal case it depends on Mahalanobios Distance.

Key Word: Water, Taguchi Method, Mahalanobios Distance.

HOW TO CITE THIS ARTICLE

Dr. Faris Ghanim Ahmed, “The Use of Taguchi Method in Improving the Quality of Product”, International Journal of Enhanced Research in Science, Technology & Engineering, ISSN: 2319-7463, Vol. 7 Issue 2, February-2018.

INTRODUCTION

After II war, the Japanese cooperation's were striving for survival with a very limited resource. Taguchi (engineer) was highly influential figure to stay the managing role of the government. Taguchi sought to manage the crisis, he favored for the government existence despite the difficult situations. The industrial revolution by Taguchi in Japan depended on a large scale of cost saving[1]. He demonstrated that largely external effects and noises affected all manufacturing operations. He also identified the suitable methods of noising causes that the products were exposed.

Taguchi's thought were drawn upon widely by the successful manufacturing companies worldwide. This is because successful results to create productive operations in less cost than before. Taguchi's method can be defined a system of cost monitoring according to the qualitative engineering that may help to apply the strategies instead of using the modern techniques[2]. One of these methods is upstream and shape floor quality engineering.

The Upstream method follows (Limited Space) (Shop-Floor Quality Engineering) in an efficient way to reduce the varieties and finding suitable and profitable designs for the product in the market. The shop-floor quality engineering provides the user with multi-dimensional methods. It depends on the reduction of cost product monitoring with higher efficiency and real time control. Upstream method, in general, is an applicable method, that may improve the quality cost and time saving[3].

Most of the formulaic applications of Taguchi's method were subjected to two aspects;

1. Improvement of product.
2. Improvement of product operation.

The extra profits of this technique can possibly be taken from Robustness of the general applicable technique in all Robustness; the technique is currently depended by some pioneering companies' world. Taguchi's method is also used to the internet central, practical manufacturing monitor; this is possibly active more process that is profitable. On a statistical level, Taguchi's method can be regarded as purely developed statistical methods to monitor the quality of products. In addition to the bio-technique, marketing and advertisements statisticians took the ideas of Taguchi in the field of design up grate and differences analysis[4]. Taguchi's methods are regarded as statistically used methods in different aspects, especially in health, engineering, industrial product[5]. In 1991, (Resit, Edwin) subsumed a general preview about the Taguchi's method and applications to improve the quality of product in reduced costs. Kevin[6] explained the Taguchi's method of production design in the same year. It was an experience of minimizing the expected value of best difference of the classical cases.

The current research aims to view the Taguchi's methods to improve the quality of product. It also aims to design a successful system a different characteristics. This is actually an important requirement to carry out any activity of decision maker and apply it on normal and abnormal distribution. This method is fulfilled through the application on data representing H_2O.

The study analyzed and tested the compound of H_2O by varieties analysis (Taguchi's methods). It is regarded as a robust method depends on Mahalanobios distance. The latter is usually used to make evaluations to the abnormal case.

Theoretical Part:

There were many differences about the methodology of Taguchi's ideas. Their differences were almost broken down vastly during 1990s. The apple of discord was directed towards the Taguchi's main methods of statistics rather than the philosophical implications of excellent and robust design.

Taguchi's philosophy was demonstrated as a global standard to design experiments for robustness and upstream, in a product, or design process. The philosophy of Taguchi's method may promoted the theoretical background of Japanese standards know as the best quality should lead to the reduced cost.

The general view in USA, on the other hand, states that robustness is relative to the robust improvement with a high cost. Taguchi's philosophy and Japanese views may seek to move the robustness towards the upstream. These methods help engineers to design the quality of operations. Many scholars,(George Box), (Soren Bisgaad) and (Conrad Fung) noted the following: the exclusive aim of robustness today is to design a quality for each product and treat to follow up the processes to the find product.

This robustness is regarded as a very important element for creativity in statistically designed experiments.

❖ **Taguchi's Definitions of Quality:**

The classical definition of quality is "the computability of options", this definition was broadened by (Joseph M. Juran, 1904 to 1974). The American Surveillance Convention (ASC) came with new definition in 1983. (Juran 1983) sees that "quality is the quality of use, or group of merits and qualities of certain product, or the service that may affect the ability to meet the requirements".

Another the definition for quality submitted by Taguchi, he stated the losses relative to the product "quality is the cause of losses of certain product in the society, except that losses by core functions". Accordingly, losses should be classified into two parts: (1) losses caused by the product change, (2) losses caused by product side-effects.

Taguchi mentioned that any product or service cam possibly be regarded as good quality. It could perform the required function without change in the nature of that predictor service. The damages caused by harmful side effects are little, they constitute the resulted loss of using cost"; as energy, time and money.

Statistically, Taguchi's project refers to three main contributions:

1. Taguchi's function of loss.
2. Philosophy of non-relative quality surveillance.
3. Creativity in design expensive.

Taguchi used function of loss, global statistical theory[7]; it is summarized that the function of loss my treat design treatments. Taguchi translated Fisher's methods through adaptation of medium results of any operation. Actually, Fisher submitted his ideas to the programmers. In agriculture, for instance, programmers should make comparisons between agricultural crops under treatment and other types of crops.

These experiences may sought to improve quality and the agricultural product, this could be in the field of design experiment.

Taguchi realized that the excellent engineering should be based on understanding costs in different cases. In classical industrial engineering, costs may be increased by the number of materials that can out of technical specifications of number. Taguchi's confirmed that producers should broaden their visions through interest in short-term costs. Any material manufactured in specific way, may lead to some losses for customers or some difficulties in the connection with other parts or the need to rebuilt in the margins of security. These externalities (losses) may be dropped out by producers, and they be more important them other social costs. Such externalities (losses) may prevent markets to work efficiently.

Taguchi fried to find some suitable methods to represent these ideas statistically. Hence, he specified three cases[8], they are:

1. Maximum bookmaker, for instance the agricultural crops.
2. Minimum bookmaker, for instance, radiations of Carbone dioxide.
3. Minimum difference of goal, for instance, the connection between two parts of the operation. The results of agricultural crops and Carbone dioxide.

Both cases represent the externalities of Monotonic in the third one. On this basis, Taguchi attributed the error of externality[9] to the:

1. The analogue representation in the expansion of Tylor series.
2. The total externalities are measured according to the current differences as an extra difference for the random variable.
3. The main function of square error of loss are more uses in statistics.

Thus Taguchi recognized that the best chance to remove differences in product design and the process of manufacturing, is to develop the engineering strategy that may help in various contexts. The stages of this strategy are[10]:

1. **System Design:** this is specifically within the visual level, may include creativity.

2. **Parameters Design:** it is necessary to formulate the design of the classical engineering. Taguchi's view was focusing on the excitant option to the required values to the system. In many conditions, it is possible to choose the parameters of model of reducing the effects on industrial performance. This is because of accumulated environment damages (Robustification).

3. **System Load Design:** within the completion of system successfully, the system load design has an essential effect on performance (reduction and difference in critical cases).

❖ **Taguchi's Method:**

It is represented in a group of items; They are the following:

✓ **Quality:** Any engineering design can possibly yield the model function when the input load application can be changed into the required results[11].

- Inputs = the used energy.
- Outputs = the requirements of time.

✓ **The Mean Idea of Customer's Requirements:**

- High quality measurement to limit all non-random errors.
- The best externalities (losses) = social externalities that may specify the model externality.
- The externality can be (increase $\pm$) on this basis, the resources of expenditures would be identified.
- The expenditures to improve quality through the diagram (1)[12].

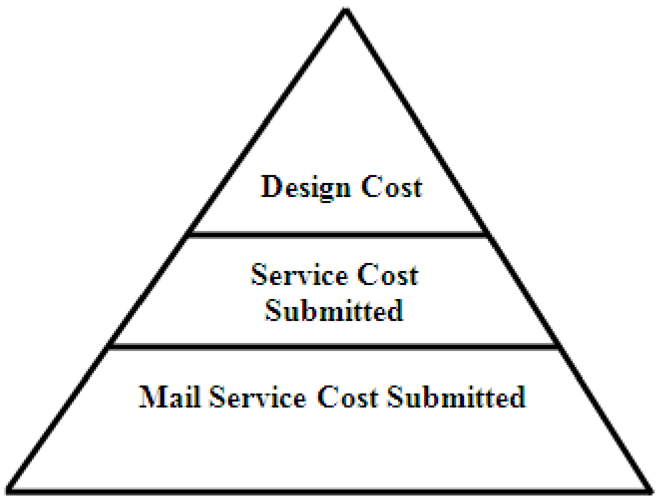

Diagram (1)
The paramedic of the required funds to improve quality

- ✓ **Customer's Satisfaction:** it can be measure through methods services and the following:
  - Customer's desire to the service.
  - No. of complains (1-10 score).
  - No. of services submitted to the customer's.
  - The situation of user.
- ✓ **Design:** Taguchi's method includes the following design:
  - Ordered no order devices.
  - Knowing the required workers for product.
  - Policies and procedures in work operations.
  - The applications of Taguchi's method.
- ✓ **The Concepts of Method Externalities:** The deviation from the product operation may lead to losses (externalities).
  - Less than aim.
  - Larger than aim.
  - Both.
- ✓ **The Function of Model Externalities (Losses)[13]:**

- Specify the loss, this can be measured through the following: $L(y) = k\,(y - m)^2$ that is: *L(y)* represent the loss, and *K* represent a constant it is value is the value of the cost divided by the Tolerance, i.e. $K = Cons. = \frac{Cost\,to\,Correct}{Tolerance}$ and *Y* represent the loss value we need, and *m* represent the Mean Value.

❖ **Taguchi's Experience[14]:**

It include Foster ideas, they are the following:

- Duties of work management, This can be realized through:
  - ∗ Work problems recognition.
  - ∗ Creative thinking.
  - ∗ Design contribution.
- Specify the easiest and best works. This can be realized through:
  - ∗ Work design.
  - ∗ Carry out the formulated design.
  - ∗ Analysis of result.

* Work can formation in results success through the following steps[15]:

1. **Problem:** Specify the manager's duties and works, improve the product.
2. **Creative thinking:** This can be realized through:
   * Emergency variables recognition in service.
   * Truth and open to all peoples with product privacy.
   * Factors identification.
3. **Test the planning policy and the selected technical design,** by the following:
   * The use of creative thinking to use the skillful design.
   * The administration should understand this part to evaluate the required resources.
4. **Test for work design and work stages,** this is:
   * Use of ANOVA, it requires that the manager should understand the instruction of use.
   * Designers for the easiest design. It has to reassure the administration to his ability to carry out the design.
5. **Analysis:** this is through:
   * The best factors that facilitate to reach target.
   * The rate of minimization, to enable control the differences of product.
6. **Certification of test and experiment:** through:
   * Start the new system based on the results of the experiment.
   * Testing the truthfulness of results.

Application Part:

In this part, Taguchi's method has been applied on the chemical compounds of H_2O taken from Sulaimani Health Directorate Department of Health Prevention[16]. The sample was taken from different remote areas in Sulaimani Governorate. The sample include 12 variables according to the (Table 1):

Table (1): The Chemical Component of Water (H_2O)

No.	Component	Cod
1	pH	X_1
2	Electrical Conductivity (EC)	X_2
3	Total Dissolved Solid (TDS)	X_3
4	Sodium (Na)	X_4
5	Potassium (K)	X_5
6	Total Hardness (TH)	X_6
7	Chloride (Cl)	X_7
8	Calcium (Ca)	X_8
9	Calcium Hardness	X_9
10	Magnesium (Mg)	X_{10}
11	Alkalinity	X_{11}
12	Nitrate (Ni)	X_{12}

The sample is content the Normal and Abnormal group, as the following:

1. The sample size for the normal group is 25 according to the (Table 2), that accept by the result of the chemical laboratory test. This result is called the (Healthy Data).
2. The sample size for the abnormal group is 25 according to the (Table 3), that reject by the result of the chemical laboratory test:

Table (2): The Normal Group Component Sample for the Water

Sample No.	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
1	7.68	783	501	8.9	1	370	31.8	3.2	8	88	222	47
2	7.51	514	329	23.7	1	290	37.6	10	24	65	275	16
3	7.49	380	243	6.2	0.2	270	237	8	20	61	209	23
4	7.56	333	213	7.9	0.1	240	46.8	37	92	36	272	22
5	7	555	355	15.3	0.8	360	57	8	20	82	206	39
6	7.87	343	219	21.5	1.2	200	31	23	57	34	224	22
7	7.99	475	304	14.9	1.2	80	56	8	20	14	290	1
8	7.68	345	220	4.5	0.7	190	32	26	65	30	252	8
9	7.38	509	325	11.6	0.7	330	50	36	92	57	231	8
10	7.3	285	195	13.4	1.1	190	55	24	60	31	204	29
11	7.4	446	285	7.5	0.4	260	49	33	84	42	223	40
12	7.3	307	196	7.3	0.5	200	32	22	49	36	264	6
13	6.8	608	389	23.3	2.2	320	61	54	136	44	292	50
14	7.2	367	234	4	0.7	210	25	19	48	32	228	10
15	7.4	464	296	5	1.3	340	54	25	64	67	269	4
16	7.49	424	271	26.6	1.1	220	41	25	64	37	211	2
17	7.2	569	364	6.3	0.9	320	63	22	56	64	280	19
18	7.9	433	277	5	0.6	300	6	28	72	55	205	12
19	7.04	521	333	1.9	0.8	280	10	19	48	56	297	23
20	7.28	535	342	4.8	0.5	330	15	16	40	70	271	3
21	7.09	873	558	31.5	0.6	480	22	22	56	103	293	37
22	6.91	546	349	20.2	1.4	340	20	41	104	57	218	14
23	6.9	715	457	35.7	0.9	340	17	12	32	74	284	15
24	7.47	405	634	45.3	1.4	400	11	51	128	66	235	21
25	8.03	277	434	19.2	1.6	300	12	32	80	53	225	13

Table (3): The Abnormal Group Component Sample for the Water

Sample No.	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
1	7.58	1070	685	95.3	1.4	390	312	6.4	16	91	163	46
2	6.78	869	200	76.6	3.3	550	142	8	20	129	170	25
3	8.9	480	307	125	1.3	150	96	40	101	112	172	9
4	8.71	380	243	150	4.6	100	21.3	12	32	16	253	10
5	7.3	1614	1032	263	5.4	220	390	35	88	32	262	46
6	7.4	445	284	154	14.7	310	56	33	84	55	199	38
7	6.09	1016	650	131	2.4	360	296	40	109	62	112	39
8	7.5	869	556	28.2	3.6	400	118	55	145	63	394	35
9	6.8	1643	1045	231	3.1	240	362	49	122	29	307	46
10	6.8	1212	775	38.4	2.6	310	64	112	280	17	292	47
11	8.18	1174	751	216	2.9	90	103	12	32	14	378	8
12	6.4	742	474	12.3	12.1	320	144	54	136	44	215	46
13	8.77	873	558	176	4.1	40	284	16	40	59	180	32
14	7.4	1059	677	200	2.1	80	193	6.4	16	14	378	2
15	6.5	1136	727	15.7	0.4	480	124	41	104	93	355	42
16	6.8	870	690	97.1	1.5	370	310	13	15	87	160	47
17	7.6	510	210	76.8	3.5	540	140	18	21	90	175	28
18	8.9	420	317	123	1.6	160	100	35	103	23	176	19
19	8.7	1615	245	145	4.4	110	123	34	78	56	254	15
20	7.3	450	1025	256	5.7	230	379	35	88	67	263	42
21	7.4	1016	285	145	14.1	320	156	34	85	64	199	35
22	6.1	871	660	130	2.7	370	310	41	106	65	112	37
23	7.6	1645	557	29	3.8	410	123	56	156	39	394	33
24	6.9	1235	1054	24	3.7	246	356	51	123	34	307	43
25	6.8	753	778	39	2.8	330	178	55	290	15	293	48

The Principle Steps For Use Taguchi Method:

The first step defined the variables and draw the sample, after that calculated the descriptive measures such that: Arithmetic Mean, Standard Deviation for the variables studied and the second step is to calculate the Standardized Normalized Values for it, as the follows:

First Step: Define the sample for Normal and Abnormal Group components of water, as in the above (Table 2 and 3).

Second Step: Find the Standardized Normalized Values for the sample of Normal and Abnormal Group components of water, as in the bellow (Table 4 and 5).

Table (4): The Standardized Normalized Values of Normal Group

Sample No.	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9	Z_{10}	Z_{11}	Z_{12}
1	0.84	2.01	1.49	-0.53	0.18	1.01	-0.25	-1.61	-1.60	1.63	-0.77	1.96
2	0.34	0.22	-0.04	0.78	0.18	0.04	-0.12	-1.09	-1.12	0.52	0.85	-0.24
3	0.23	-0.67	-0.79	-0.77	-1.55	-0.20	4.39	-1.24	-1.24	0.33	-1.17	0.26
4	0.49	-0.98	-1.06	-0.62	-1.76	-0.56	0.09	0.99	0.95	-0.87	0.76	0.19
5	-1.16	0.49	0.20	0.04	-0.26	0.88	0.32	-1.24	-1.24	1.34	-1.26	1.39
6	1.40	-0.91	-1.01	0.59	0.61	-1.03	-0.27	-0.09	-0.11	-0.97	-0.71	0.19
7	1.75	-0.04	-0.26	0.00	0.61	-2.47	0.30	-1.24	-1.24	-1.93	1.31	-1.30
8	0.84	-0.90	-1.00	-0.92	-0.47	-1.15	-0.25	0.14	0.13	-1.16	0.15	-0.80
9	-0.04	0.19	-0.07	-0.29	-0.47	0.52	0.16	0.91	0.95	0.14	-0.50	-0.81
10	-0.28	-1.30	-1.22	-0.13	0.40	-1.15	0.27	-0.01	-0.02	-1.11	-1.32	0.68
11	0.02	-0.23	-0.42	-0.65	-1.12	-0.32	0.14	0.68	0.71	-0.59	-0.74	1.46
12	-0.28	-1.15	-1.21	-0.67	-0.90	-1.04	-0.25	-0.17	-0.36	-0.87	0.52	-0.95
13	-1.75	0.85	0.50	0.75	2.78	0.40	0.41	2.29	2.29	-0.49	1.37	2.17
14	-0.57	-0.75	-0.87	-0.96	-0.47	-0.92	-0.41	-0.40	-.39	-1.07	-0.59	-0.66
15	0.02	-0.11	-0.33	-0.87	0.83	0.64	0.25	0.06	0.10	0.62	0.67	-1.09
16	0.28	-0.38	-0.55	1.04	0.40	-0.80	-0.04	0.06	0.10	-0.83	-1.11	-1.23
17	-0.57	0.59	0.28	-0.76	-0.04	0.40	0.46	-0.17	-0.15	0.47	1.01	-0.03
18	1.48	-0.32	-0.49	-0.87	-0.68	0.16	-0.84	0.29	0.34	0.04	-1.29	-0.52
19	-1.04	0.27	0.00	-1.15	-0.25	-0.08	-0.74	-0.40	-.39	0.09	1.53	0.26
20	-0.34	0.36	0.08	0.90	-0.90	0.52	-0.63	-0.63	-0.64	0.76	0.73	-1.16
21	-0.90	2.63	1.99	1.47	-0.68	2.32	-0.47	-0.17	-0.15	2.35	1.40	1.25
22	-1.42	0.44	0.14	0.47	1.05	0.64	-0.52	1.29	1.31	0.14	-0.89	-0.38
23	-1.45	1.56	1.10	1.85	-0.03	0.64	-0.59	-0.94	-0.87	0.95	1.13	-0.31
24	0.22	-0.50	2.66	2.70	1.05	1.36	-0.72	2.06	2.04	0.57	-0.37	0.12
25	1.87	-1.35	0.89	0.38	1.48	0.16	-0.70	0.60	0.59	-0.06	-0.68	-0.46

Table (5): The Standardized Normalized Values of Abnormal Group

Sample No.	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9	Z_{10}	Z_{11}	Z_{12}
1	0.20	0.28	0.34	-0.31	-0.78	0.74	1.03	-1.27	-1.11	1.12	-0.95	0.93
2	-0.73	-0.23	-1.41	-0.56	-0.27	1.86	-0.47	-1.21	-1.05	0.29	-0.87	-0.54
3	1.74	-1.21	-1.02	0.08	-0.80	-0.95	-0.87	0.19	0.08	1.77	-0.85	-1.65
4	1.51	-1.46	-1.26	0.41	0.08	-1.30	-1.53	-1.03	-0.89	-1.20	0.07	-1.58
5	-0.13	1.66	1.59	1.88	0.29	-0.46	1.72	-0.03	-0.11	-0.70	0.18	0.93
6	-0.01	-1.30	-1.17	0.46	2.77	0.18	-1.23	-0.12	-0.16	0.01	-0.54	0.34
7	-1.53	0.15	0.21	0.16	-0.51	0.53	0.89	0.19	0.19	0.22	-1.54	0.44
8	0.11	-0.23	-0.13	-1.19	-0.19	0.81	-0.68	0.84	0.69	0.25	1.68	0.16
9	-0.71	1.73	1.63	1.47	-0.32	-0.32	1.47	0.58	0.37	-0.80	0.69	0.93
10	-0.71	0.64	0.66	-1.06	-0.46	0.18	-1.16	3.32	2.57	-1.17	0.52	1.00
11	0.90	0.55	0.58	1.27	-0.38	-1.37	-0.81	-1.04	-0.89	-1.26	1.51	-1.72
12	-1.17	-0.55	-0.42	-1.40	2.07	0.25	-0.45	0.80	0.56	-0.33	-0.36	0.93
13	1.58	-0.22	-0.12	0.75	-0.06	-1.72	0.78	-0.86	-0.77	0.13	-0.76	-0.05
14	-0.01	0.25	0.31	1.06	-0.59	-1.44	-0.02	-1.28	-1.11	-1.26	1.5	-2.14
15	-1.05	0.45	0.49	-1.35	-1.04	1.37	-0.63	0.23	0.12	1.18	1.24	0.65
16	-0.71	-0.22	0.36	-0.29	-0.75	0.60	1.01	-0.99	-1.12	0.99	-0.99	1.00
17	0.22	-1.14	-1.37	-0.55	-0.22	1.79	-0.49	-0.77	-1.04	1.09	-0.82	-0.33
18	1.73	-1.36	-0.99	0.05	-0.72	-0.88	-0.84	-0.03	0.13	-0.98	-0.81	-0.96
19	1.50	1.66	-1.25	0.34	0.02	-1.23	-0.64	-0.07	-0.25	0.04	0.09	-1.24
20	-0.13	-1.29	1.56	1.79	0.37	-0.39	1.62	-0.03	-0.11	0.38	0.19	0.65
21	-0.01	0.15	-1.10	0.34	2.61	0.25	-0.35	-0.07	-0.15	0.28	-0.54	0.16
22	-1.52	-0.22	0.25	0.14	-0.43	0.60	1.01	0.23	0.15	0.32	-1.54	0.30
23	0.22	1.74	-0.12	-1.18	-0.14	0.88	-0.64	0.89	0.84	-0.89	1.68	0.02
24	-0.59	0.70	1.67	-1.25	-0.16	-0.27	1.42	0.67	0.38	-0.64	0.69	0.72
25	-0.71	-0.52	0.67	-1.05	-0.42	0.32	-0.15	0.84	2.71	-1.23	0.53	1.07

Third Step: Find the Correlation Coefficients for the two samples, Standardized Normalized Values for the sample of Normal and Abnormal Group components of water, as in the bellow (Table 6 and 7).

Table (6): The Correlation Coefficients of the Standardized Normalized Values for the Normal Group

Sample No.	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9	Z_{10}	Z_{11}	Z_{12}
Z_1	1											
Z_2	-0.46	1										
Z_3	-0.19	0.65	1									
Z_4	-0.15	0.29	0.65	1								
Z_5	-0.08	0.08	0.36	0.47	1							
Z_6	-0.44	0.67	0.77	0.37	0.09	1						
Z_7	0.01	-0.14	-0.28	-0.22	-0.25	-0.15	1					
Z_8	-0.15	-0.23	0.15	0.29	0.41	0.17	-0.24	1				
Z_9	-0.16	-0.21	0.16	0.29	0.41	0.19	-0.24	0.99	1			
Z_{10}	-0.35	0.75	0.71	0.26	-0.07	0.92	-0.04	-0.22	-0.20	1		
Z_{11}	-0.29	0.39	0.21	0.07	0.08	0.08	-0.20	-0.02	-0.02	0.09	1	
Z_{12}	-0.33	0.43	0.35	0.15	0.14	0.41	0.14	0.09	0.09	0.38	-0.06	1

Table (7): The Correlation Coefficients of the Standardized Normalized Values for the Abnormal Group

Sample No.	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9	Z_{10}	Z_{11}	Z_{12}
Z_1	1											
Z_2	-0.21	1										
Z_3	-0.44	0.45	1									
Z_4	0.29	0.06	0.22	1								
Z_5	-0.06	-0.16	-0.28	0.09	1							
Z_6	-0.63	-0.02	-0.10	-0.59	-0.01	1						
Z_7	-0.39	0.32	0.72	0.38	-0.17	-0.01	1					
Z_8	-0.32	0.24	0.29	-0.41	0.06	0.15	-0.13	1				
Z_9	-0.31	0.16	0.30	-0.24	0.01	0.13	-0.13	0.91	1			
Z_{10}	-0.09	-0.23	-0.35	-0.21	-0.09	0.56	0.07	-0.31	-0.40	1		
Z_{11}	0.05	0.43	0.37	-0.08	-0.12	-0.16	-0.20	0.26	0.28	-0.49	1	
Z_{12}	-0.67	0.20	0.52	-0.28	0.17	0.51	0.51	0.46	0.45	0.08	-0.13	1

We can see the differences between the values of the correlation coefficients, some of them are strong correlation and some is unsuccessful correlation, the reason is depend with the natural chemical component and the effected between them. About any result if the correlations are strong or not, we cannot be ignored because it is the true relations between the true components of water.

Table (8): The Analysis of Variance Table and Duncan test for the Standardized Normalized Values of Normal Group Components of Water Sample

Source of Var.	d.f.	S.S.	M.S.	F	P-value
Factor	11	7218162	656197	165.65	0.000
Error	288	1140863	3961		
Total	299	8359025			

Variable	Duncan Test
Z1	A
Z2	B
Z3	C
Z4	A
Z5	A
Z6	D
Z7	A
Z8	A
Z9	A
Z10	A
Z11	E
Z12	A

From the above table we can see the significant and non-significant variation between the standardized normalized values of normal group components of water sample.

Table (9):The Analysis of Variance Table and Duncan test for the Standardized Normalized Values of Abnormal Group Components of Water Sample

Source of Var.	d.f.	S.S.	M.S.	F	P-value
Factor	11	0.210	0.019	0.02	1.000
Error	288	283.825	0.986		
Total	299	284.035			

Variable	Duncun Test
Z1	A
Z2	A
Z3	A
Z4	A
Z5	A
Z6	A
Z7	A
Z8	A
Z9	A
Z10	A
Z11	A
Z12	A

From the above table we can see the non-significant variation between the standardized normalized values of abnormal group components of water sample.

From table (8 and 9) we can see how can effected the normal and abnormal components of water.

CONCLUSIONS

We can conclusion the following from use the Taguchi method in improving the quality of product.

1. To improving the quality of product must be start with a good system use the all available data and required from the experiment.
2. Test the results continually and association of it.
3. Work to find the best improving to the quality of product from the early and continually test for the product steps.
4. Recourse with consultant that special experience to select the best available ways or best experiments, and knowhow can be application the proportions of the consultant.
5. Define the best success ways that used in the international companies that attained excellence in field of specialization products or employment.
6. The goodness quality is the main characteristic that cares it.

Recommendation

Recommend the researcher necessary follow-up the Taguchi protocol at design any product or preferment employ or establishment trading company that work to preferment good employ or product that high goodness quality.

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