EMPLOYEE AWARENESS AND SATISFACTION ON QUALITY MANAGEMENT (SIX SIGMA) – FACTOR ANALYSIS

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ABSTRACT

In this era of intense competition, quality has become the key slogan in organizations as they strive for a competitive advantage in an atmosphere characterized by liberalization, globalization and knowledgeable customers. In these days of globalization and liberalization, organizations find it difficult to survive unless they have competitive advantage. Quality is a key component in achieving competitive advantage. The effective management of quality is the key to increased quality and enhanced competitive position in the current global market.

Keywords: Quality Management, Six-Sigma, Factor, Factor Loading, Eigen Value, communalities.

INTRODUCTION:

Quality Management has gained in popularity mainly because of increasing customer consciousness of quality and growing international competitive pressure with the increasing need to cater to the growing demands of the customers and to cope with intensifying competition. Quality Management has also proved to be effective in lowering manufacturing costs and improving productivity. It has been a well proven fact that poor product quality or service quality will increase the costs in almost all organizations. The empirical evidence suggests that, give services of high quality surpass the competition in benefits and in market penetration rate. Quality is a key component in achieving competitive advantage. The effective management of quality is the key to increased quality and enhanced competitive position in the current global market

STATEMENT OF THE PROBLEM

The results of a study that observed International Organization for Standardization (ISO) certified companies in India indicate that the perceived benefits related to quality of procedures come first. However, the real impact on the bottom line and cost reduction comes last.

By contrast, since the Six Sigma approach has a significant influence on the bottom line, American and Indian companies such as Motorola, General Electric, AlliedSignal and many of the hosiery industries in Tirupur have implemented this approach to improve their profits.

Lack of product quality as a consequence has led to widespread customer dissatisfaction. Poor quality is not a unique phenomenon restricted to the Hosiery products in India.

Substandard quality is a global problem. One of the studies (Harry, 1998) indicates that most of the American companies work near four sigma which means that for every million products, there are at least 6,210 defective parts or units. This means that the loss to these companies and to the national economy is 0.006 per million produced parts. This loss is represented by the cost of rework, repair, scrap and returned items.

OBJECTIVES OF THE STUDY

1. To analyse the factors influencing the implementation of quality management.

RESEARCH METHODOLOGY

Research is a process of defining and redefining problems formulating the different hypothesis with suggested solutions by collecting, summarizing, organizing and evaluating different data by thus reaching on solutions with careful testing.

DATA COLLECTION

Primary Data

In order to fulfill the objectives set, a sample study was undertaken by using a well-framed questionnaire that was duly filled by the respondents. Respondents with varying background were selected based on the important aspects of their occupation, education, age and area etc. They are working in both organized and unorganized sectors at Tirupur district.

Secondary Data

The primary data were supplemented by a spate of secondary sources of data. The secondary data pertaining to the study was gathered from the records published by the office of the ILO, labour association, SIHMA, TEA and Tirupur labour organization. Latest information was gathered from well-equipped libraries in Bangalore, Chennai and PSG Learning Resource Centre, Coimbatore and also from Internet web resources.

ANALYSIS AND INTREPRETATION

FACTOR ANALYSIS

Factor Analysis is used to study a complex product or service in order to identify the major characteristics or factors considered important by the respondent. The purpose of factor analysis is to determine the responses to several numbers of statements, which are significantly correlated. Factor analysis is applied to assess the significance of the factors that are responsible ensuring the practice of six sigma quality management.

TERMINOLOGY IN FACTOR ANALYSIS

1. Factor
2. Factor Loading
3. Eigen Values
4. Communalities
5. Total Variance explained
6. Factor Variance explained

FACTOR CHOSEN FOR THE ANALYSIS

The level of satisfaction perceived by the respondents in applying six sigma concept was studied by selecting major quality function deployment in hosiery units. The quality function deployment consist 23 factors. These 23 factors were chosen and classified in an orderly form, and f actor analysis was employed and the detailed analysis and discussions are done at various stages.

TABLE NO. 1 DESCRIPTIVE STATISTICS OF SELECTED VARIABLES

	Mean	**Std. Deviation**	**Analysis N**
Programme offering	3.08	1.157	1000
Program times	3.07	.936	1000
Maintenance staff	2.95	.914	1000
Fitness staff	2.73	1.073	1000
Training	2.32	1.249	1000
Facility size	2.68	1.266	1000
Instructions	3.03	1.147	1000
Amount/type of equipment	3.01	.951	1000
Staff schedule	2.84	1.009	1000
Facility hours	2.60	1.162	1000
Access control	2.72	1.257	1000
Fee structure	3.24	1.126	1000
Lighting	3.17	.966	1000
Internet access	2.91	1.073	1000
Clean locker room	2.59	1.242	1000
Atmosphere is very safe	2.69	1.079	1000
Friendly and courteous relationship	2.83	1.193	1000
Employing knowledgeable and professional staff	2.78	1.156	1000
Respond quickly to problems	2.68	1.196	1000
Easy to sign up for programs	2.79	1.366	1000
Value for money	3.10	1.269	1000
Targets	3.10	1.001	1000
Deployment	3.09	.865	1000

STATISTICS ASSOCIATED WITH FACTOR ANALYSIS

Bartlett's Test of Sphericity can be used to test the null hypothesis. To conclude that the variables are not correlated with the population. The test of Sphericity is based on the chi-square transformation of the determinant of the correlation matrix. A large value of test statistics will favour the rejection of null hypothesis.

KAISER-MEYER-OLKIN MEASURE OF SAMPLING ADEQUACY

This index compares the magnitude of the observed correlation co-efficient to the magnitude of partial correlation co-efficient. Instances of small values indicate that the

correlation between pairs of variables cannot be explained by other variables and hence factor analysis will not be appropriate.

EIGEN VALUES AND COMMUNALITIES

The factor's Eigen values or Latent route is the sum of the squares of its factor loading. It helps us to explain how well a given factor fits the data from all respondents for all factors. Communalities is the sum of square of a statements factor loading. i.e., it explains how much each variable is accounted for by the factors taken together.

FACTOR LOADING

Simple correlation between the variables and the factors were studied with the help of factor matrix contains the factor loading and the factors. The researcher has applied the factor analysis to assess the major attributes influencing to the level of satisfaction in applying six sigma concept in hosiery units.

A correlation matrix was constructed based on the ratings. The analytical process is based on the matrix of correlation between variables. Valuable insights can be gained from an examination of this matrix. If the factor analysis should be proper, the variables must be correlated. If the correlation between all the variables are small, factor analysis may not be appropriate. In this inter correlation matrix, the correlation between all the variables are in good fit, and the factor analysis may be appropriate. Keiser (1974) suggests that values of 0.9 are higher are great and values below 0.5 are unacceptable.

TABLE NO. 2

KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.668
Bartlett's Test of Sphericity	Approx. Chi-Square	3325.221
	Df	300
	Sig.	.000

The above table of Bartlett's test and Keiser-Meyer–Olkin measure of sampling adequacy are used to test the appropriateness of factor model. In our study, the KMO measure of sampling adequacy was 0.668, which is higher than the standard 0.5. Bartlett test is used to test the null hypothesis i.e., to find out the variables are not correlated. Since the appropriate chi-square value in applying six sigma in hosiery industry is 3325.221 which is significant at 1% level, the test leads to rejection of null hypothesis.

The value of KMO statistics is also high thus the factor analysis is considering an appropriate technique for analyzing the correlation matrix.

TABLE NO. 3 COMMUNALITIES

	Initial	**Extraction**
Programme offering	1.000	.617
Program times	1.000	.563
Maintenance staff	1.000	.528
Fitness staff	1.000	.611
Training	1.000	.605

Facility size	1.000	.674
Instructions	1.000	.679
Amount/type of equipment	1.000	.485
Staff schedule	1.000	.683
Facility hours	1.000	.518
Access control	1.000	.537
Fee structure	1.000	.573
Lighting	1.000	.703
Internet access	1.000	.734
Clean locker room	1.000	.500
Atmosphere is very safe	1.000	.750
Friendly and courteous relationship	1.000	.695
Employing knowledgeable and professional staff	1.000	.718
Respond quickly to problems	1.000	.689
Easy to sign up for programs	1.000	.636
Value for money	1.000	.660
Targets	1.000	.557
Deployment	1.000	.593

Extraction Method: Principal Component Analysis.

Table no 3 shows the communality values. Communality can be defined as the proportion of variance in any one of the original variables, which is captured by the extracted factors.

The history of the derived components is outline in the total variance explained in table no.4.35

TABLE NO. 4 TOTAL VARIANCE EXPLAINED

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.843	11.374	11.374	2.843	11.374	11.374	2.672	10.689	10.689
2	2.235	8.940	20.313	2.235	8.940	20.313	1.623	6.493	17.182
3	1.614	6.456	26.769	1.614	6.456	26.769	1.552	6.209	23.391
4	1.512	6.048	32.817	1.512	6.048	32.817	1.470	5.878	29.270
5	1.379	5.517	38.334	1.379	5.517	38.334	1.424	5.694	34.964
6	1.220	4.878	43.212	1.220	4.878	43.212	1.417	5.668	40.631
7	1.207	4.828	48.041	1.207	4.828	48.041	1.305	5.220	45.852
8	1.056	4.224	52.265	1.056	4.224	52.265	1.262	5.047	50.898
9	1.053	4.213	56.478	1.053	4.213	56.478	1.254	5.015	55.913
10	1.004	4.017	60.495	1.004	4.017	60.495	1.145	4.582	60.495
11	.961	3.842	64.337						
12	.944	3.774	68.112						
13	.853	3.413	71.524						
14	.796	3.186	74.710						

15	.766	3.064	77.774							
16	.745	2.979	80.753							
17	.706	2.823	83.576							
18	.649	2.595	86.172							
19	.622	2.486	88.658							
20	.586	2.344	91.002							
21	.568	2.274	93.276							
22	.494	1.975	95.251							
23	.468	1.870	97.122							

Extraction Method: Principal Component Analysis.

It is observed from table no.4 that the label Eigen values used to highlights that the Eigen value for a factor indicates total variance attributed to the factor. Factor 1, programme offerings 2.843 with 11.374 % likewise the second factor programme times for 2.235 with 8.940. The first three factors combined together account to 26.77% of total variance. Similarly, fourth factor shows 6.048% variation and fifth, sixth and seventh factor combined together account for 48.041%. Eighth factor showed the variance of 1.056 which accounts for 52.26% of total variance. The ninth factor showed the variance 1.053 with total percentage of 56.47% and the tenth factor showed the variance 1.004 and total value of 60.495% represents the combination of all these factors.

DETERMINATION OF FACTORS EIGEN'S VALUE

In this approach, only the factors with Eigen values greater than 1.0 are maintained, the other factors are not included in the model. Since there are ten factors possessing Eigen value which are greater than 1.0 i.e., out of 23 factors loaded in the factor analysis, only 10 factors said to be extracted from the total 23 factors.

TABLE NO. 5 COMPONENT MATRIX (a)

	Component									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Programme offering	.758	-.339	.056	.088	.071	-.048	.064	-.026	-.052	.050
Program times	.746	-.327	.041	.077	.056	-.060	.068	.016	.063	-.085
Maintenance staff	.740	-.316	.086	.044	.108	-.001	-.101	.034	-.054	.080
Fitness staff	.660	-.384	.117	.000	.078	.143	.011	.011	.080	-.079
Training	.317	.285	.061	-.126	-.202	.055	-.306	-.220	-.163	.092
Facility size	.220	.444	.018	-.004	.134	-.151	.008	-.147	-.289	.003
Instructions	.291	.440	-.090	-.297	.128	.211	-.020	.145	-.163	-.129
Amount/type of equipment	.093	.347	.567	.066	.076	-.270	.261	-.034	.039	-.031
Staff schedule	.062	.297	.546	.312	-.217	.005	.087	-.087	-.102	.226
Facility hours	.181	.330	.418	.181	-.249	.235	-.142	.080	-.073	-.173
Access control	.299	.348	-.400	-.103	-.292	-.014	.081	.323	.265	.234
Fee structure	.027	.342	-.005	.533	.172	.030	-.060	.085	.177	.103

Lighting	.057	.307	.014	.509	.266	.095	-.389	.213	.044	-.219
Internet access	.160	.333	.011	-.408	.384	-.108	.172	.074	-.150	.133
Clean locker room	.110	.251	-.098	-.021	.571	-.092	-.244	-.061	.167	.086
Atmosphere is very safe	-.029	.034	-.178	.176	.360	-.591	.187	-.017	.073	-.181
Friendly and courteous relationship	.087	.235	-.083	-.075	.302	.582	.113	-.170	.054	.111
Employing knowledgeable and professional staff	.042	.096	-.146	.460	-.045	.051	.629	.113	-.140	.056
Respond quickly to problems	.212	.190	-.331	.076	-.069	.151	.387	-.384	-.175	.071
Easy to sign up for programs	.328	.323	-.218	-.131	-.257	-.175	-.032	.570	-.185	.029
Value for money	-.227	-.322	.211	.074	.195	.280	.196	.416	.203	.293
Targets	.241	.184	-.002	-.051	-.386	-.185	.062	-.150	.462	-.275
Deployment	.202	.227	-.394	.229	-.089	.088	-.096	-.246	.404	.159

Extraction Method: Principal Component Analysis. a. 10 components extract

TABLE NO. 6 COMPONENT TRANSFORMATION MATRIX

Component	1	2	3	4	5	6	7	8	9	10
1	.874	.103	.167	.049	.271	.271	.077	.079	.179	.063
2	-.448	.381	.412	.327	.336	.391	.126	.086	.230	.188
3	.118	.784	-.069	.004	-.271	-.134	-.309	.189	-.350	.147
4	.080	.159	-.415	.700	-.171	-.094	.413	-.135	.091	-.266
5	.121	-.148	.717	.321	-.368	-.232	-.056	-.346	-.184	.020
6	.012	-.243	.118	.162	-.184	-.248	.232	.827	.027	.258
7	.008	.239	.067	-.401	.027	-.302	.725	-.245	-.024	.316
8	.013	-.056	-.035	.250	.725	-.522	-.143	-.031	-.326	.084
9	.017	.072	-.096	.052	-.077	-.398	-.328	-.153	.752	.350
10	-.024	.240	.288	-.212	.097	-.331	.044	.208	.278	-.756

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

TABLE NO. 7 ROTATED COMPONENT MATRIX(A)

	Component									
	1	2	3	4	5	6	7	8	9	10
Programme offering	**.834**	.034	.016	-.042	.036	.051	.088	-.031	.014	-.081

Program times	**.820**	.003	-.038	-.010	.059	.038	.041	-.085	.056	.065
Maintenance staff	**.811**	.004	.067	.028	.057	.045	-.054	.052	-.013	-.118
Fitness staff	**.777**	-.043	-.013	-.025	-.042	-.055	-.029	.101	.014	.117
Training	.007	**.711**	.121	.042	-.025	.062	.016	-.189	-.091	.186
Facility size	-.024	**.701**	-.105	.142	-.036	.064	.135	.215	-.031	-.132
Instructions	-.006	**.512**	.301	-.298	.016	-.166	-.353	.024	.283	-.025
Amount/type of equipment	.050	**.395**	-.143	.313	.107	.192	-.029	.385	-.095	.209
Staff schedule	.001	.115	**.657**	-.149	.183	.073	.005	-.118	-.114	.070
Facility hours	.037	-.058	**.530**	.314	-.104	.044	-.210	-.205	.177	-.055
Access control	-.004	-.098	**.474**	.111	-.195	-.084	.242	.391	.176	.170
Fee structure	.043	-.046	**.448**	.088	.321	.247	.037	.213	-.066	.271
Lighting	-.006	-.002	.025	**.818**	.032	.062	-.081	-.013	-.012	.034
Internet access	-.066	.200	.058	**.579**	.020	-.087	.155	-.070	.237	-.093
Clean locker room	.076	.000	.057	.058	**.835**	.136	.011	-.001	-.076	-.015
Atmosphere is very safe	.019	-.043	.089	-.029	**.673**	-.024	.098	.059	.475	.011
Friendly and courteous relationship	.007	.043	.021	.018	-.043	**-.792**	-.010	.118	-.116	-.042
Employing knowledgeable and professional staff	.112	.135	.110	.004	.104	**.476**	-.119	.320	.110	-.115
Respond quickly to problems	.003	.213	.333	.116	.099	**.426**	.145	-.064	-.063	-.048
Easy to sign up for programs	.011	.141	-.093	.105	.127	-.189	**.753**	-.145	-.009	.005
Value for money	.054	-.061	.150	-.148	-.052	.278	**.608**	.068	.226	-.008
Targets	-.003	-.004	.091	.115	-.032	.059	.078	-.765	.004	.007
Deployment	.036	-.115	.016	.193	.018	.118	.126	.036	**.696**	-.072

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 16 iterations.

The rotated component matrix indicates a clear separation. The table no.6 shows the first rotated factor F1, explaining 10.68 % of total variance reveals strong association between program offerings program times and maintenance of staff and fitness of staff have loading of 0.834, 0.820, 0.811 and 0.777 respectively. This suggested that factor 1 is a combination of these variables which are interpreted as “program schedule”. Now, for factor 2, the variable association between training, facility size, instruction and amount/type of equipment are caption as “quality directions” which have high loading of 0.701, 0.512, 0.395, 0.530 and 0.818 respectively. In factor 3, the variables such as staff schedule facility hours, access control and deployment were clubbed together and called as “Inspiring events” which have the loading of 0.657, 0.474, 0.696, 0.466 and

0.849 respectively. On the other hand, the strong variables such as clean locker room, friendly and courteous relationship, respond quickly to problems, and easy to sign up for programs were grouped together and called as "conducive work environment". These factors showed high loading of 0.835,0.792,0.426,0.753 and 0.608 respectively.

From the analysis, it is learned that out of 23 variables loaded in the factor analysis, only 10 factors are extracted which shows that the data reduction has been condensed to ten factors which gives high level of satisfaction to the hosiery entrepreneurs practicing six sigma concept. These ten variables are called highly influencing factors in applying six sigma concept.

FINDINGS & SUGGESTIONS

1. The quality function deployment practicing in hosiery industry was studied with the help of factor analysis. 23 factors were identified and various stages of factor analysis were done and finally it was observed that out of 23 factors, only 10 factors were extracted. These 10 factors are highly influencing in quality function deployment.

- The problems faced with the other factors were studied and found that dominance of middlemen and demanding commission was found as a major issue it is followed by hectic financial crises. Hence, it is suggested that hosiery entrepreneur association may get orders directly from the foreign buyers and same may be distributed to the registered members of the association

CONCLUSION

It is learned from the study that almost all the respondents are practicing six sigma concepts and producing world class quality by implementing latest ISO concepts including environmental focus. Whilst the sigma measure can well be used for general end communication and motivation purposes it should not be used in a technical sense. Technically, one is advised to aim for preferred value and minimize variation. For measured data where specification limits are concerned the use of the cp or pp family of standardized indices allow one to focus on the estimation of consequences at each limit, upper and lower. Being universal they also facilitate capability/performance comparisons between unlike process characteristics.

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