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SIX SIGMA IN SERVICE: INSIGHTS FROM HOSPITALITY INDUSTRY

N. Pai Bhale[1], P. K. Srividhya[2], V. Mariappan[3], M. Sony[4], V. Belokar[5]

[1,2]Department of Mechanical Engineering,

Periyar Maniammai University, Vallam, Thanjavour, (India)

[3]Department of Mechanical Engineering,

Agnel Institute of Technology and Design, Assagao, Goa: (India),

[4]Engineer, Electricity Department, Panaji, Goa, (India),

[5]Department of Mechanical Engineering, Goa College of Engineering, Farmagudi, Goa, (India)

ABSTRACT

Six Sigma, as a technique has been applied, widely and successfully in the manufacturing sector. However its application in the service sector has been limited due to various reasons mainly attributed to intangibility. This paper presents study carried out in a large popular star hotel industry based in Goa, India. A real life stepwise case study is presented by integrating Discrete Event Simulation and Taguchi methods along with Six Sigma methodology. The results highlight how Six Sigma can play a key role in improving the service quality in hospitality industry. The paper presents the Front Office Modeling, Data collection and analysis to represent the existing system and its randomness. It employs Simulation which is much needed tool for the experimentation, especially in service segments. Statistical quality control charts and Taguchi Methodology are also applied to identify and set robustness in the process.

Keywords: Six Sigma Management, Service Process Management, Taguchi Methodology, Hospitality Industry, Process Capability

I. INTRODUCTION

Increasing globalization has resulted in a fiercely competitive environment and elevated levels of customer expectations**.** The service industry is one of the four main industrial categories of a developed economy. Service Sector of Indian Economy contributes to around 55 percent of India's GDP. This sector plays a leading role in the economy of India, and contributes to around 68.6 percent of the overall average growth in GDP between 2002-03 and 2006-07. Within the service sector, the hospitality industry constitutes 15.68%. In 2006-07 the Hospitality Industry registered a growth of 12%. Earlier being profitable was considered a good enough yardstick for

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performance. However the focus has been shifted now to maximizing returns from every possible avenue. To achieve this, various techniques were developed in the field of Quality Management like Six Sigma Management, TQM etc. Six Sigma is a problem solving methodology initiated to build robust processes at various stages in all areas of operation including marketing and sales, accounts, purchase, manufacturing, service and others to achieve 3.4 defects per million opportunities (DPMO).

II. PROBLEM ON HAND

Six Sigma, as a technique has been applied, widely and successfully in the manufacturing sectors and it is a well accepted engineering and management technique. However, its application in the service sector has been limited due to certain apprehensions. The most obvious reason why service companies keep away from Six Sigma is because they perceive it as a manufacturing tool. Service organizations feel that because they are involved with a large amount of human work force wherein witnessing any measurable defects is difficult. Recent surveys have shown that service companies that have invested in Six Sigma are all saving millions of dollars for every project.

The fear of metrics is another obstacle that stands in the way of the service sector and Six Sigma. As the quality characteristics are intangible there is a scarcity of meaningful data. Hence, leading indicators have to be devised in order to give tangibility to service and accordingly data are to be collected. Secondly, several hotels and resorts are skeptical about revealing data and letting people from the outside know about their internal processes. To study a system, it is sometimes required to experiment with the system itself. The objective of many system studies is to predict how a system will perform before being put into operation. There is a high level of interaction between the system and the customer which rules out the possibility of experimentation to be used for the improvement of the process. Experimentation requires trying out various possibilities to achieve the best possible performance from the system. This however, leaves the possibility that the customer might be exposed to an inferior quality of service as a part of experimentation and its implication, which could prove detrimental to the organization as a whole.

III. LITERATURE REVIEW

After initial success in manufacturing organizations, Six-Sigma has gradually gained widespread application in service organizations, including hotels and lodging. Although the hotel industry has an increased interest in Six-Sigma implementation and many hotels have yielded tangible benefits from this approach, the literature is limited. Moreover, the relationship between Six-Sigma implementation and its performance improvement outcomes is a rarely examined subject in the hospitality context. Therefore, this study attempts to assess the effectiveness of Six-Sigma and examine its impacts on various performance measures of upscale hotels in Egypt, seeking for what values and benefits it brings to improve the overall performance. To achieve this objective, the researcher surveyed 123 upscale hotels in Egypt. It is illustrated that Six-Sigma is a relatively new approach within the Egyptian hotel industry. The findings indicated that Six-Sigma implementation is positively and significantly associated with the operational and competitive performance of the surveyed hotels [1].

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The paper presents factors, influencing the success of business models used in the hospitality industry. The main results of the research showed that the success of the business, acting in the hospitality, grounded on the customer value creation, innovations implemented in the processes of the service delivery, and relationships with other partners in the sector, as well as customer [2].

Uses of Lean and Six Sigma have been limited in hospitality despite the documented success of Starwood Hotels implementing it company-wide in 2001. Research suggests that Lean and Six Sigma processes can be beneficial in improving many departments within a hotel to include house-keeping, food production, and transportation. The lack of implementation and reluctance towards Lean and Six Sigma is due to the daunting task of changing the culture of the organization and the resource costs associated with training and setting up infrastructure [3].

The hotel and tourism industry, which showed continuous growth in recent years, now looks ahead to economic turbulences and general difficult times. The industry applies successfully for many years modern methods and instruments to optimize productivity and efficiency and to increase the quality of services even further. This research aims to show practical experiences of the application of Lean Management methods in the hospitality sector and to make a statement about their suitability and the possible potential for optimization. The work refers to a case study in a hotel company, where several Lean methods have been implemented successfully [4].

The fact that the maintenance plans have been made well is an important issue in the prevention of the losses due to breakdowns within an enterprise. All management activities concerning the practices including such issues as the determination of maintenance priorities as well as preparation and supervision of maintenance plans are carried out with maintenance management. This study described the implementation of maintenance management and lean manufacturing techniques at the maintenance workshop in order to eliminate the losses due to breakdowns and to enhance productivity at an enterprise which produced dairy products [5].

While managerial barriers involve resistance to change and unleashed Six Sigma business strategy, technical problems are related to lack of data acquisition and analysis regarding DPMO processes and parameters [6]. It is a research carried out on the status of six sigma methodology in service organizations in India. It is reported certain difficulties, implementation issues of six sigma in service organization through their exploratory research. The authors also commented that the tangibility is the main culprit for six sigma management to penetrate service organization [7].

IV. SERVICE PROCESS MODELING

As the hospitality industry is too vast to model completely, only one process was selected and modeled. On brain storming the front office was taken up. There are two important sub-processes that take place in the front office which are delineated in following sections.

4.1 Check – in Process

The check-in process modeling starts with the arrival of the guest at the hotel entrance/lobby. The path of the guest from the point of pick-up by the hotel transport to the hotel lobby presents difficulties in tracking as there are several

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factors influencing the process. Factors such as traffic delays and other such occurrences are out of our control and present a difficulty in modeling and hence simulate. Upon the arrival of the guest, the guest is garlanded by the Guest Relation Executives (GREs). In a parallel flow, the luggage of the guest is extracted from the vehicle by the bell boys and taken to the luggage bay. Upon garlanding, the guest is either escorted to the seating area by the GREs or the guest could decide to go up to the front desk himself/herself. If the guest decides to go the seating area, the GREs take the necessary documents from the guest like passport etc for processing and also inform the front desk to start processing the forms for signing by the guest. If the guest him/herself goes upto the front desk, he/she hands over the documents to the front desk. In this case also, the front desk processes the documents and starts preparing the forms. After the guest has handed over the documents, the GRE suggest the guest to proceed to the seating area again. After the guest has been seated, the GRE instructs the bar to prepare the welcome drinks. The information passed on to the bar is the number of guests, and where they have been seated. In case, the guest is still at the front desk, same is passed on to the bar. The bar prepares the drinks and serves them to the guests. Quickness in serving the drinks is an important factor here. The drinks are usually prepared beforehand and are dispensed from a dispensing machine. The processing of the forms is completed by the front desk and kept ready. The GRE, when done attending to new arrivals (if any) collects the forms and takes it to the guest. The guest signs the forms. The GRE also clarifies any queries that the guest might have. When all the formalities are completed, the GRE escorts the guest to the luggage bay where the guest identifies his/her luggage. The guest is then escorted by the bellboy to his/her room.

4.2 Check - out Process

On the day the guest is supposed to checkout, the front office calls the guest in his/her room to find out the tentative time the guest will check out. The check-out process starts with the arrival of guest at the front desk. The luggage of the guest is brought to the luggage bay by the bellboy. The guest approaches the front desk and gives his details. The front desk prints out and hands over the total bill of the guest to him. The guest checks the contents of the bill and makes the payment. The front office then puts the bill in an envelope and hands it over to the customer. If the customer is a prepaid customer, then his bill will consist of the various expenditures that he/she incurred during the stay such as restaurant, transport, etc. If the customer has communicated the need of transport, then he/she waits for the transport to arrive. Upon arrival of the vehicle, the luggage is loaded on the vehicle by the bell boy. The flowchart for the process is given in Appendix Exhibit 2

V. DATA ANALYSIS

From the breakup of the check-in process into the sub processes and their respective times obtained, the modeling of check-in process has been attempted. With the data for the various sub-processes, the distribution that each sub-process follows has been obtained using software called Minitab. After carrying out the data analysis using Minitab software on various characteristics, the results obtained are shown in Table 1.

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VI. PROCESS IMPROVEMENT

Six Sigma methodologies improve any existing business process by constantly reviewing & re-tuning the process. The DMAIC methodology should be used when a product or process is in existence, but it is not meeting customer specification or is not performing adequately. As the entire hotel industry process is vast and difficult to model, it was finally arrived on brain storming with the experts that front office which carries a lot of impact and the interaction with the customer and the facilitator is quite high.

Table 1: Data analysis on Check-in process

Sl. No	Attribute	Distribution with AD statistic	Parameter
1	Inter arrival time for check-in	Weibull: [AD:0.608, P-value:0.108]	Shape =1.109, scale = 1169
2	Garlanding time	Exponential: [AD:0.71 P-value:0.196]	Mean = 9.071
3	Time to seat	Normal: [AD:0.121 P-value:0.983]	Mean = 33.08, Std.dev = 9.87
4	Form processing time	Weibull: [AD:0.254 P-value > 0.5]	Shape =1.346, Scale=199.4
5	Bag identification time	Weibull: [AD:0.334 P-value > 0.5]	Shape=1.234, Scale=42.29

The main two functions of the front office were identified as the Check-in process and the Check-out process and both the processes were investigated. The Check-out process was broken down into many sub-processes. The probability plots were obtained and hence the best distribution fit was decided. Among all the sub-processes, the "Time to Seat" process was found to follow normal distribution due to which fortunately the six sigma format can very well fit.

6.1 Statistical Process Control (SPC)

Table 5: Grouped data for control chart

Sub-group No.	X				Sample mean $\overline{X}$	Sample range (R)
	X1	X2	X3	X4		
1	20	40	32	-	30.667	20
2	39	45	33	-	39.667	12
3	30	23	37	-	30.000	17
4	35	42	29	15	30.250	27
Mean					$\overline{\overline{X}}$ =32.646	$\overline{R}$ =19

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At the outset it can be said that the process is off-centered owing to the fact that mean of sample means (32.646) from SPC is not the same as that of population mean (33.08), the process is off-centered.

- $\overline{X}$ chart: n=3

  A2=1.02 (for n = 3)

  UCL= μ + A2*R bar = 52.026 (1)

  LCL= μ – A2*R bar = 13.266 (2)

- R chart: n=3

  D4=2.57

  D3=0

  UCL= D4*R bar = 48.83 (3)

  LCL= D3*R bar = 0 (4)

The control chart has its Probability of Type I error as 0.27% with the power of the test for the common shift of μ + 1.5 σ, as 0.2374

6.2 Process Capability Analysis

Since the process is off-centered, C_{Pk} = min ($C_{PL,}$ C_{PU}) (5)

$C_{PL} = (\overline{\overline{X}} - LSL)/3\sigma = 0.3207$ (6)

$C_{PU} = (USL - \overline{\overline{X}})/3\sigma = 0.3333$ (7)

C_{Pk} = min[0.3207, 0.3333] = 0.3207 (8)

6.3 Taguchi Methodology

Taguchi methods are not of great importance to the service industry. Firstly, many of the methodologies used by Taguchi are inferior to more traditional statistical methodologies. Secondly, there are some inherent differences between manufacturing goods and rendering services, the main one being the interaction with the customer during the process. Because of the involvement of the customer in service operations, experimentation is not a viable option in new service development. Experimentation requires the making of products that have differing levels of quality.

In a manufacturing setup, these experimental products are not sold and hence the customer is not exposed to inferior products. In service operations, however, the customer is required to be part of the experiment and thus the customer is subjected to less than ideal results. In some cases, the results may be detrimental. One quantitative technique that Taguchi makes little mention of, but can play a vital role in improving service quality, is computer simulation. Simulation allows developers of new services to build quality into their products without subjecting their customers to experiments. Care must be taken to ensure that the simulation models and corresponding analysis are consistent with the principles of Taguchi. In order to conduct the experiments, the simulation program developed in the previous chapter is used.

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The seating process, which was found to follow normal distribution (on analysis for best-fitting distribution), is considered as the critical process. However, it is modeled as 3-parameter Weibull distribution in the simulation program owing to inherent limitation of the software. Hence, the critical factors of the process are found to be β (shape parameter), θ (scale parameter) and δ (location parameter). From the data analysis phase, three levels are assigned to each parameter/factor. As there are three factors at three levels each, the number of experiments to be conducted is 27 as recommended by Taguchi, and hence Orthogonal Array L-27 is selected.

It must be noted that care must be taken to ensure adequate number of responses for each experiment. Ex.: four responses for the interaction of a1, b1 and c1, and so on. This is done by specifying a range for each level of β (shape parameter) and dividing this range into four parts. Ex.: a1 takes values of 1, 1.25, 1.5 and 1.75. By inputting values, of the different factors at different levels, into the simulation program, 27 experiments with 4 responses each are conducted (as explained earlier). The output obtained is the average time taken to complete the seating process which is shown in the Table 6. On using the values obtained above in Minitab, Taguchi design was carried out and two graphs were generated, viz: main effects plot for SN ratios and main effects plot for means (main effects plot of standard deviation can also be obtained). In doing so, care must be taken to select the option 'smaller is the better' in each case, as our aim is to minimize the time taken for the seating process. The order in which values are input in Minitab must match the order specified while selecting the options of the Taguchi design (i.e.: run order, number of experiments, interactions, storage, etc.).

Table 5: Factors and Levels chosen for Taguchi design

Factor	Factor a	Factor b	Factor c
Weibull parameters	β (shape)	θ (scale)	δ (location)
Level 1	a1= 1-2	b1= 36.56	c1= 0
Level 2	a2= 2-3	b2= 37.5	c2= 1.071
Level 3	a3= 3-4.5	b3= 38.77	c3= 2.143

VII. RESULTS AND DISCUSSION

Our first and the foremost aim is to reduce the variability (in other words standard deviation) as well as to minimize the seating time. Ideally, the level having the lowest S/N ratio and the lowest mean for each factor give us the optimum level of that factor for smaller the better case. However, in the case of factor 'A' the level which gives minimum mean also has highest S/N ratio. Thus it leaves us with two choices level 1 or 3. However, level 1 gives highest mean hence we go in medium gain and choose level 3. Similar exercise can be carried out for factors 'B' and 'C'. Thus, after observing the two graphs, we find that the optimum level for 'A' is A3, for 'B' is B1 and for 'C' is C1. The corresponding values for each level are shown in the Table 7. Since factor A varies over a range an analysis was carried out to find which response of experiment A3B1C1 gives minimum standard deviation. The following table depicts the mean and standard deviation of all the responses.

Hence from Table 8 it is evident that for β=4.5 we get minimum value of standard deviation thus β=4.5 is chosen as optimum value for β. Now we recalculate process capability using the optimum values of the parameters/factors

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obtained above. β=4 in Weibull distribution is representative of a normal process. Since β=4.5 is close to β=4, hence process capability analysis can be carried out in a similar manner to normal distribution.

$C_{Pk} = \min(C_{PL}, C_{PU})$

$C_{PL} = (\overline{\overline{X}} - LSL)/3\sigma = 0.406$

$C_{PU} = (USL - \overline{\overline{X}})/3\sigma = 0.3828$

$C_{Pk} = \min(0.406, 0.3828) = 0.3828$

Table 6: Summary responses of designed experiment

Experiment	For a1= 1	For a1 = 1.25	For a1 = 1.5	For a1 = 1.75
a1b1c1	36.32	33.905	32.909	32.445
a1b1c2	37.384	34.985	33.992	33.54
a1b1c3	38.469	36.032	35.066	34.594
a1b2c1	37.284	34.774	33.766	33.296
a1b2c2	38.332	35.842	34.832	34.371
a1b2c3	39.408	36.89	35.897	35.42
a1b3c1	38.521	35.94	34.877	34.442
a1b3c2	39.592	36.99	35.949	35.483
a1b3c3	40.712	38.066	37.006	36.542
a2	For a2= 2	For a2= 2.25	For a2 = 2.5	For a2= 2.75
a2b1c1	32.302	32.392	32.347	32.449
a2b1c2	33.381	33.361	33.422	33.522
a2b1c3	34.445	34.437	34.495	34.6
a2b2c1	33.129	33.127	33.192	33.288
a2b2c2	34.207	34.202	34.262	34.35
a2b2c3	35.177	35.16	35.234	35.341
a2b3c1	34.261	34.254	34.323	34.415
a2b3c2	35.388	35.299	35.395	35.498
a2b3c3	36.31	36.296	36.362	36.471
a3	For a3=3	For a3=3.5	For a3=4	For a3=4.5
a3b1c1	32.573	32.837	33.078	33.31
a3b1c2	33.645	33.897	34.147	34.38
a3b1c3	34.716	34.963	35.204	35.45
a3b2c1	33.409	33.672	33.93	34.167
a3b2c2	34.487	34.735	34.985	35.235
a3b2c3	35.559	35.813	36.058	36.304

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a3b3c1	34.54	34.81	35.066	35.312
a3b3c2	35.619	35.88	36.141	36.382
a3b3c3	36.679	36.957	37.21	37.452

Table 7: Optimum values for β, θ and δ

	Factor a = β	Factor b= θ	Factor c= δ
Optimum level & value	A3= 3- 4.5	B1= 36.56	C1= 0

Table 8: Mean and Standard Deviation of the Responses

Variation of Factor A (β)	β = 3	β = 3.5	β = 4	β = 4.5
Standard deviation	11.86	10.486	9.29	8.34
Mean	32.573	32.837	33.078	33.31

Similarly, the procedures mentioned above should be carried out for all the other processes in order to obtain optimum values of the parameters/factors affecting each process. This ensures that the system's performance is at an optimum level.

VIII. CONCLUSION

Service sector has by and large missed the six sigma revolution that has benefited the traditional industry over the years. With this very objective in mind, this project was conceived. The major limitation in applying six sigma methodology to the service sector is the underlying intangibility of output that governs almost all the process in the service industry. There are many reasons for this. The main reason is that a majority of the processes involve a large amount of human interaction between the servers and the customer and the satisfaction of the customer to a large extent depends on the how the interaction between him and the server went. All other factors seem secondary in comparison. Through this research, we have identified "leading indicators" for various processes that bring tangibility to the process in such a way that it also takes care of that the "behavior" of the server is taken care of e.g. timeliness of service makes the process tangible and also is a good measure of the "behavior" of the server. This has been our biggest gain.

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