Breaking the Customer Code
A Model to Translate Customer Expectations into Specification Limits

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Abstract

Purpose – The aim of this paper is to develop a model to help service organizations to set the specification limits according to the customer expectations.

Design/methodology/approach - A review of relevant literature is used to develop a new integrated model with ideas from the Kano model, SERVQUAL, Taguchi loss function, Importance Performance Analysis (IPA) and a new model, "the Trade-Off Importance". A survey was carried out for 18 external customers and internal stakeholders of the Service Division of Siemens Industrial Turbomachinery AB in Finspong, Sweden.

Findings – The model has demonstrated its robustness and credibility to set the specification limits. Additionally it is a very powerful tool to set the strategic directions and for service quality measurement.

Research limitations – First, articles published on this subject are few and there is no similar model in the literature to confirm or compare results. The proposed model must be further validated in future research. Second, this study is applied in a single service division, with a relatively small sample. Ideal research should be conducted using multiple industries in order to ensure that the model is generalizable.

Originality/value – As far as we know, this paper is the first attempt to create a roadmap to set the specification limits in services. Researchers should find the proposed model to fill the research gap. From a managerial standpoint, the practical benefits in Siemens Industrial Turbomachinery AB, suggest a new way of communicating to customers. The model will also improve the target setting in the Six Sigma projects.

Keywords Customer satisfaction, Service industries, Six Sigma, Specification limits, Kano model, SPC

Paper type Research paper

Introduction

During the last 20 years, there has been steady growth not only in the service sector but also in the service content of most products (Nilsson, 2002). Today some 70% of the GNP is derived from the service sector in the US and most European countries (Bergman and Klefsjö, 2003). Research scholars suggest that firms now compete with services rather than goods (Rust, 1998; Grönroos, 2000; Vargo and Lusch, 2004). Harris and Harrington, (2000) claim that that the opportunity area for the twenty-first century is in the understanding and improvement of the service processes putting the customer in the centre of the issue. Phillips-Donaldson, (2005) in the article *"The Rock Stars of Quality"* states that the next breakthrough –and rock star (referring to the next guru in quality management)- is likely to come from the service sector.

The well-published financial benefits of Six Sigma in manufacturing are beginning to energize large scale application in services (Antony, 2006). Reported case studies of Six Sigma in services are scattered in a wide range of publications e.g. Cronemyr, (2007). Six Sigma is being used in banking, healthcare, accounting and finance, public utilities, shipping and transportation, airline industry, education (Antony, 2006).

An important part of the Six Sigma methodology is the calculation of number of defects in the process, i.e. points outside the specification limits. However, unlike goods quality, which can be measured objectively by number of defects, in service processes the setting up of specification limits is a complicated issue because it is marked by the use and expectations among the different customers. As Six Sigma was originally created for manufacturing, this crucial fact is not contemplated in the Six-Sigma roadmap Define- Measure-Analyze-Improve-Control (DMAIC).

Walter A. Shewhart viewed quality from two related perspectives: the objective and subjective side of quality (Shewhart, 1931). The first perspective views quality as an objective reality independent of the existence of man. In contrast, the subjective side of quality considers what we think, feel and sense as result of the objective quality.

Despite differences in expression, the two aspects of subjectivity and objectivity have revolved around since the time of Aristotle, (350BC) (Kano et al., 1984), and some popular models are widely used both by academics and practitioners, to link these two sides e.g. the Kano model, Quality Function Deployment, Puga-Leal and Pereira, (2007) model, classification through direct questions, Importance Performance Analysis, Kansei engineering, conjoint experiments. However, none of these approaches serve to successfully transform the customer expectations into specification limits in services.

This paper aims resolve this issue developing a roadmap to systematically set the specification limits in services linking the subjective side of quality with the objective side. To do so, one integrated model is presented, combining ideas from the Kano model, SERVQUAL, Taguchi loss function, Importance Performance Analysis (IPA) and a new model, the Trade-Off importance. The following section briefly reviews these five methods.

Kano model

Kano et al. (1984) developed a model to categorize the attributes of a product or service based on how well they are able to meet customer needs. The following are the popularly called Kano customer need categories.

- *Must-be requirements*: If these requirements are not fulfilled, the customer will be extremely dissatisfied. On the other hand, as the customer takes these requirements for granted, their fulfillment will not increase his satisfaction.
- *One-dimensional requirements*: With regard to these requirements, customer satisfaction is proportional to the level of fulfillment - the higher the level of fulfillment, the higher the customer’s satisfaction and vice versa.
- *Attractive requirements*: Also called Whoh! or delighters, these requirements are the product criteria which have the greatest influence on how satisfied a customer will be with a given product. Attractive

requirements are neither explicitly expressed nor expected by the customer. Fulfilling these requirements leads to more than proportional satisfaction. If they are not met, however, there is no feeling of dissatisfaction.

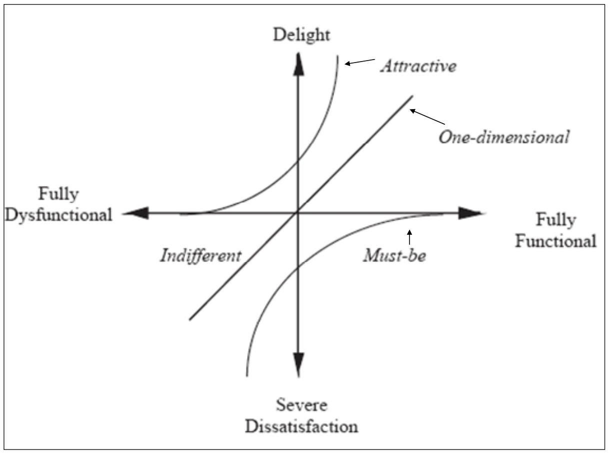

Figure 1.
Kano model of customer satisfaction.
Source: Pouliot, (1993)

SERVQUAL

In 1985, Parasuraman et al. developed the SERVQUAL instrument (refined in 1988, 1991 and again in 1994). The instrument consists of two sets of 22 statements: the first set aims to determine a customer's expectations of a service firm; while the second set seeks to ascertain the customer's perceptions of the firm's performance. The results of the survey are then used to identify positive and negative gaps in the firm's performance on five service quality dimensions. (Robison, 1999) According to Robison, 1999, there seems little doubt that in the past decade SERVQUAL has proven to be the most popular instrument for measuring service quality.

Berry and Parasuraman, (1991) defined the zone of tolerance as the range of service performance that a customer considers satisfactory. A performance below the tolerance zone will engender customer frustration and decrease customer loyalty. A performance level above the tolerance zone will pleasantly surprise customers and strengthen their loyalty. Several authors (e.g. Johnston, 1995**;** Cronin, 2003) consider that levels of service performance within the zone of tolerance are not perceived as different by customers. SERVQUAL 3-column format is capable of specifically indicating the position of the zone of tolerance.

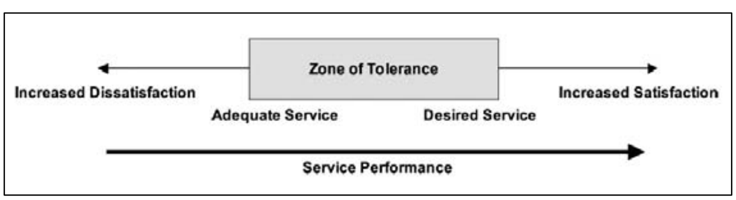

Figure 2. Variations within the zot are not perceived by the customers

Taguchi loss function

Taguchi changed the traditional view, that as long as a parameter lies within the specification limits, the financial loss is zero and as soon as a parameter has exceeded one of the tolerance limits, the financial loss is large. For Taguchi, every deviation from the target value means a loss which grows as the deviation increases (Bergman and Klefsjö, 2003). This view puts the customer at the centre of the issue (Lofthouse, 1999).

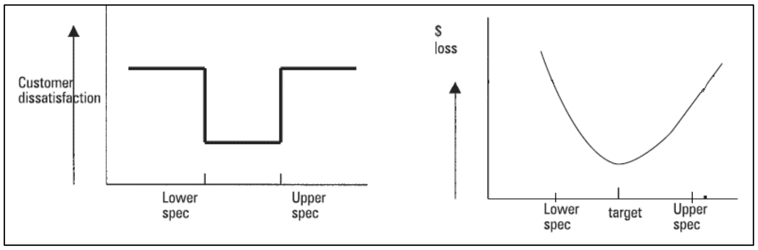

Figure 3. a)traditional view b) Taguchi loss function

For further details see Taguchi, (1987) or Phadke, (1989), for a short general overview with down-to-earth language see Lofthouse, (1999).

The Importance Performance Analysis (IPA)

The Importance Performance Analysis (IPA), introduced originally by Martilla and James (1977), and modified by Slack (1994), allows a company to identify which attributes of its products or services should be improved to become more competitive in the market. Typically, data coming from customer satisfaction surveys are used to build a matrix, where the importance is shown by the y-axis and the performance of the attribute by the x-axis. Although the IPA model of quality attributes has a simple structure, it can provide much useful information about a company's quality performance (Tontini and Silveria, 2007).

The Trade-Off Importance model

In the literature there is an agreement about the necessity of analyzing the relative importance of the attributes (e.g. Deming, 1986; Walker and Baker, 2000). When visiting your doctor, getting the proper diagnosis and treatment seems more essential than having a good selection of magazines available in the waiting room, though both may be necessary for a favorable experience (Walker and Baker, 2000). Customers may consider some features of a service as more necessary or essential to their experience than others.

The customer tends to consider everything important; we call it the "everything is important" problem. We developed a new approach for relative importance measurement, the Importance Trade-Off analysis. The basic idea of the model is that when explicit trade-offs between elements of the customer service mix are taken into account, different components of relatively importance emerge (Wetzels et al., 1995).

The customer is asked three pair wise questions of two attributes (see figure 4) and the questionnaire results are translated into one importance scale from 1 to 10 points. The trade off importance model is able of successfully measure the relative attribute importance.

If everything else would be the same **WHICH WOULD YOU PREFER?**

INSPECTION REPORT delivery time	0,5	1	MONTHS 1,5	2	2,5
	O	**O**	**O**	**O**	**O**
Spare part DELIVERY after the confirmed date	16	12	8 DAYS LATE	4	0

Figure 4. The new model: trade-off importance. One out of three trade-off questions

Model construction

In the literature there is an agreement about the limitations of using the methods explained previously alone and the need of an integrated approach (e.g. Tan and Pawitra, 2001; Puga-Leal and Pereira, 2007; Yang, 2003).

Witell and Löfgren (2007) made a literature review of 29 research articles; they found that the Kano model is often modified or used in combination with other methods.

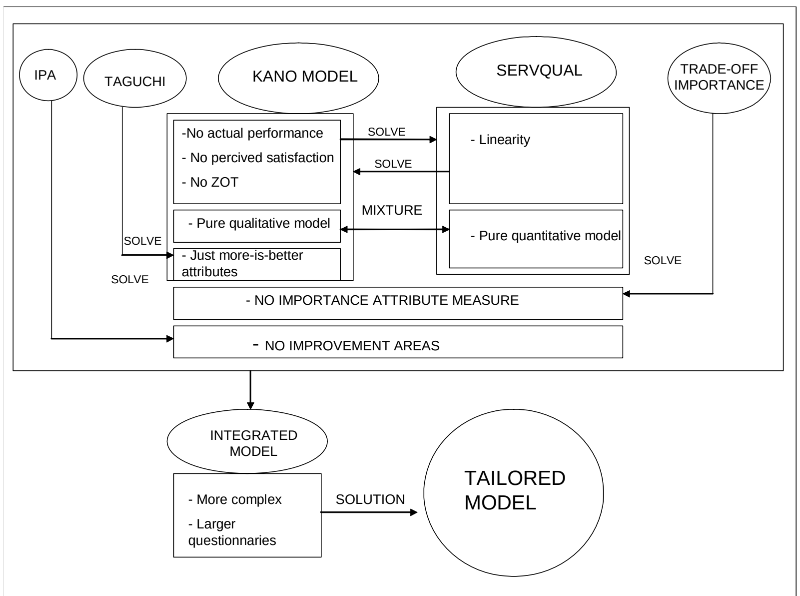

Figure 5. Problem analysis of the different models

Kano model modification and integration in SERVQUAL

The Kano model is a purely qualitative model, it does not inform about the actual situation in the curve, for example, one attribute is classified as "must be" but the model does not give any information whether the current performance is, for example, in the severe dissatisfaction area or in the neutrality area.

To solve this problem it is interesting to introduce the zone of tolerance concept into the Kano model. According to Pouliot, (2003), the "Must be" level is only a little above neutral because Must-be is only a weak statement of satisfaction, it is more a statement of lack of dissatisfaction, though certainly more positive than neutral. Symmetrically, "can live with" is not a strong statement of dissatisfaction, but its grudging acceptance is more negative than neutral.

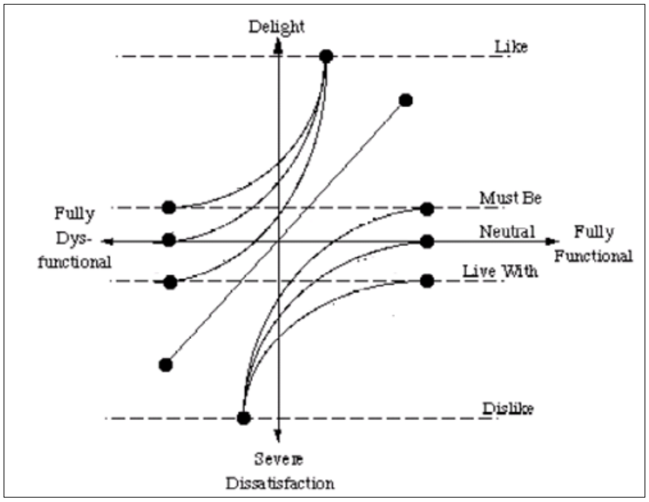

Figure 6.
Proposed lines, observe that there is not only one line for every classification. Source: (Pouliot, 1993)

Laveling the vertical levels of the Kano model with the wordings of the answers of the Kano questionnaire and integrating SERVQUAL into the Kano model, in the vertical axis, the area between "It must be like that" and "I can tolerate it" is the satisfactory service level where we can introduce the subjective zone of tolerance.

In the horizontal axis, we introduced the actual performance in, for example, days or months and the plot the box plot from historical data.

The satisfaction-performance lines allow to translate the subjective zone of tolerance to the objective zone of tolerance. It allows to know the percentage of the points of the service offered that fall into the satisfaction, dissatisfaction or delight area.

Despite SERVQUAL's wide use by academics and practitioners in various industries and in different countries, a number of studies have questioned its conceptual and operational bases, (e.g. Morrison, 2004, Lewis and Mitchell, 1990, Smith, 1995).

According to Tan and Pawitra (2001), three main areas for further improving SERVQUAL can be identified. First, SERVQUAL assumes that the relationship between customer satisfaction and service attribute is linear i.e. all the attributes are one-dimensional. This is not in line with the Kano ideas. In addition, SERVQUAL is recognized as a continuous improvement tool. There is however, no element for innovation. Third, SERVQUAL provides important information on the gaps between predicted service and perceived service but it is not able to address how the gaps can be closed.

Kano model can help address the innovation issue against SERVQUAL. Because attractive attributes are a source of customer delight, this is one area where efforts for improvement should be targeted (Tan and Pawitra, 2001). Introducing Kano model into SERVQUAL can counter the linearity problem.

Integrating and modifying SERVQUAL and Kano model, some problems have been addressed. However, there still are some more:

Kano model just considers more-is-better attribute: Taguchi, (1987) considered four categories of quality characteristics: higher-the-better (e.g. computer's performance), lower-the-better (e.g. waiting time in a queue), nominal-is-best (e.g. time schedules) and asymmetric.

The Kano model can be used just with more-is-better attributes. We developed a systematic approach to draw the four categories satisfaction-performance curves without the use of the Kano classification table.

The relative importance of the attributes is not analyzed: Kano model and SERVQUAL do not analyze the relative importance of the attributes. By integrating the new Trade-Off Importance model the information about the relative importance is obtained.

No improvement directions: Kano model and SERVQUAL do not have any strategic direction approach for guiding after the results. The Importance Performance Analysis, with information from the trade off importance model and SERVQUAL together with the Kano classification helps to guide to the improvement directions.

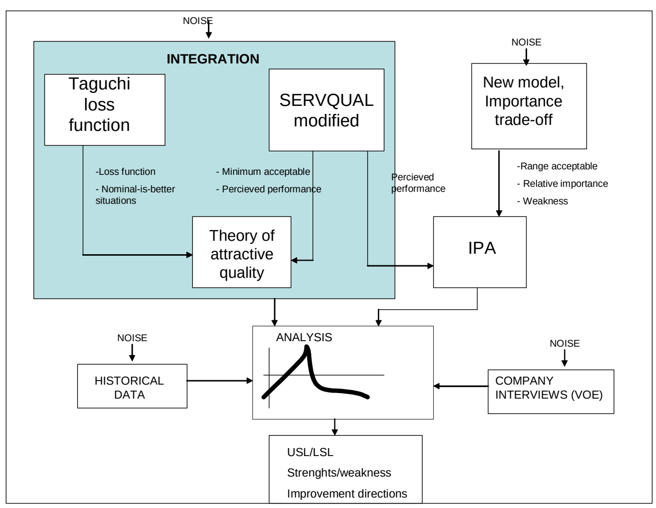

Figure 7.
Proposed model

Application in the Service Division, Siemens Industrial Turbomachinery AB (SIT)

Cronemyr, (2007) developed a model for process management that is being used in SIT AB. According to this approach the first step is mapping processes, second run Six Sigma projects and third go for the process control. Currently, phase 1 and 2 are running successfully, and Phase 3 is not used in the right way. Analysis and follow-up of Key Performance Indicators (KPIs) are performed with bar charts with monthly average values. The decisions are made according to the difference of this value and one target without taking into account the process variation. The process control charts were developed in a previous project.

The setting up of the specification limits based on the real customer needs will allow the company to use a SPC control loop in the "Six Sigma way".

Questionnaire design

Integrated approaches are normally time-consuming to answer and analyze, see for example, Yang, (2003); Tan and Pawitra, (2001). The most important constraint was that the questionnaire must take maximum 5 minutes to answer. It has three parts:

i- *Kano modified* questions for obtaining the satisfaction-performance lines, i.e. to link the subjective quality with the objective quality.

ii- *SERVQUAL modified*; the purpose is to measure internal and external customers' perceived performance and minimum service level.

iii- *Trade-Off Importance model* was designed to extract the customer relative importance of the different attributes.

Sample and data collection

We selected 9 internal stakeholders, the process owners of the different Key Performance Indicators (KPIs) and 9 external customers represented by people from finance and engineering at different companies and countries.

It is very important to have a high return rate. For example, (Yang, 2003), made a survey with an integrated approach, 1400 persons where mailed randomly, resulting in 150 valid questionnaires. In this situation the analysis of the questionnaires is useless because it does not represent the general opinion. Maybe, only the customers that are very satisfied or dissatisfied have answered.

Analysis

The model was applied for the six main KPIs in the service division; we will illustrate the analysis with an example (because of company confidentiality the real data have been somewhat manipulated). Inspection report delivery time is the time between the site job ends until the customer receives the inspection report.

In figure 8, the vertical axis represents the subjective side of quality, the customer perceptions of this attribute. The zone of tolerance is drawn between the "must be" and "I can tolerate it" line, in this zone the customers will not feel the variations. In the satisfaction area, the expectations are met, performance higher than the satisfaction area will lead to customer delight and lower to the ZOT will lead to dissatisfaction.

The horizontal axis represents the objective side of quality, the attribute actual performance represented in a box-plot gathered from historical data. The satisfaction-performance lines are drawn with a systematic roadmap based on the questionnaire answers of the customers. The satisfaction-performance line represents the customer satisfaction in function of the inspection report delivery time (in days). With the satisfaction-performance lines we can translate the subjective zone of tolerance to the objective ZOT.

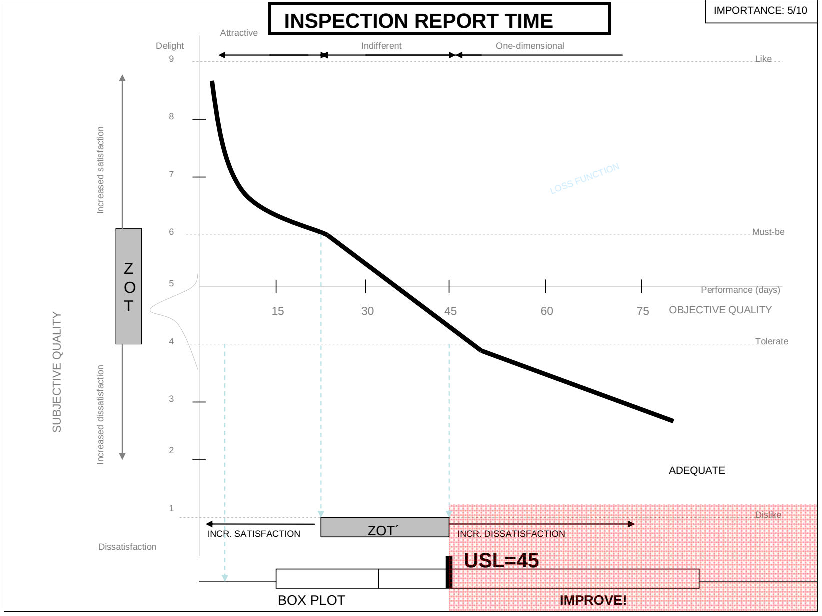

Figure 8.
Final graphic

In the graphic above there are three different areas:

Satisfaction area: Inspection reports between 20 and 45 days are in the indifferent area, the expectations are met the variations within this zone would have marginal effect in the customers' perceptions of the service.

Delight area: Inspections in less than 20 days is a delighter. This differentiates from the competitors.

Dissatisfaction area: Inspections in more than 45 days lead to external customer dissatisfaction; it is a bad performance in the process.

According to Bergman and Klefsjö, (2003), the quality of a product or service is its ability to satisfy, or preferably exceed, the needs and expectations of the customers. As long as the satisfaction-performance line is within the satisfaction and delight area, the organization is offering a high quality service. With more than 45 days of inspection report delivery time the customers start to be dissatisfied, The specification limit is marked in 45 days.

Capability analysis and target value

With the specification limits set by the customers, the real number of defects in the process can be calculated. To perform the capability analysis we assume that the distribution is normal. In services, where the human is the main player it is difficult to have normal distributions with 95% confidence level, it is needed to transform the data. Instead, we propose to calculate the percentage of conformance with specifications. There are tables to transform the yield into a sigma value.

Defining the quality loss as the customer dissatisfaction, by inverting the satisfaction-performance lines, the associated qualitative loss function can be drawn in the histogram. The loss function is very useful to understand that it is not just important to meet the specification limits. It is also important to center the distribution in the right area to maximize the customer satisfaction and minimize the associated cost.

This way of thinking was first introduced by Genichi Taguchi in the 1950s and early 1960s. Taguchi methods are claimed to have provided as much as 80 per cent of Japanese quality gains (Lofthouse, 1999).

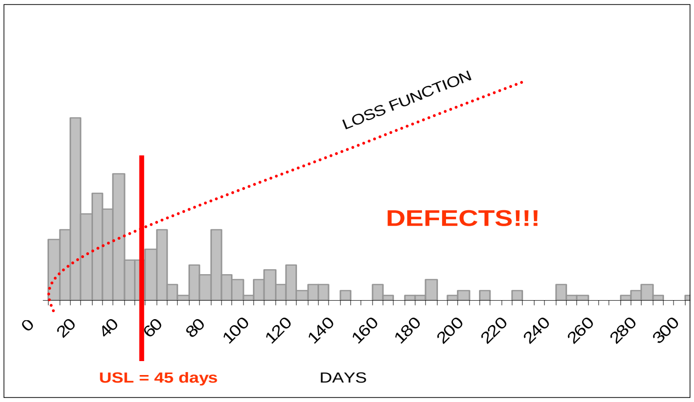

Figure 9.
Capability analysis

Improvement directions

The Importance Performance Analysis is a very simple, visual and useful tool. The vertical axis represents the attribute importance obtained from the "trade off importance model" and the horizontal axis the attribute perceived performance from SERVQUAL.

To enhance customer satisfaction, improvement efforts must be targeted in the attribute A. Improving attribute C will have a marginal effect in the customer service perception.

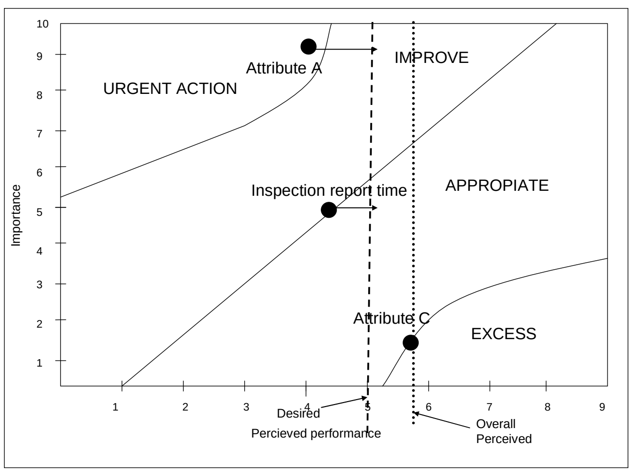

Figure 10.
IPA analysis

Practical implications

Every service organization uses the experience and Know-How for service excellence. However this does not give any real competitive advantage. Other organizations besides this experience they monitor the historical data to detect problems in the processes. The next step for the organizations is to listen to the customers, to link the experience with the historical data and with the customer expectations.

The Service Division, SIT AB, uses the experience, Know-How and the historical data in Six Sigma projects with very good results. It is currently between STAGE 1 and STAGE 2 of the proposed model (see figure 11).

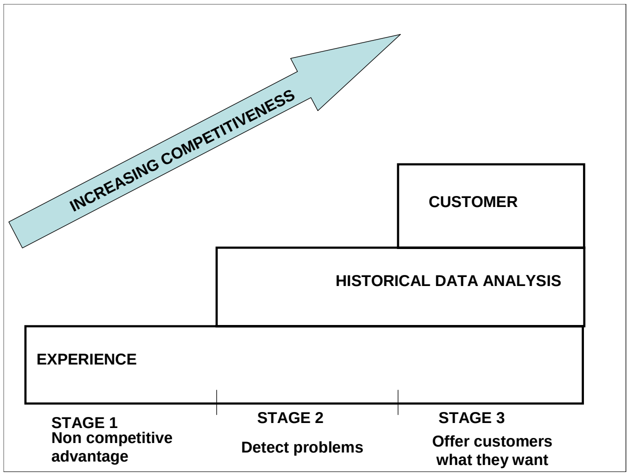

Figure 11. Proposed 3-Stage model for service excellence

But why does the organization hide the historical data in excel sheets with a lot of non relevant information. Why is only KPIs monitored? The historical data, well presented and interpreted can give extremely valuable information. The application of SPC would bring the company to STAGE 2, i.e. to detect problems in the process.

In this paper we have introduced a new way to communicate to customers. To know what they want, how they want it, what is really important for them and which are their perceptions about the service. The presented model links the three dimensions, experience, historical data and customer expectations and will allow the organization to go to STAGE 3 and offer the customers what they want.

Conclusions and recommendations

Today, firms compete with services rather than goods. Large service organizations are beginning to use Six Sigma as continuous improvement tool. An important part of the Six Sigma methodology is the calculation of number of defects in the process, i.e. points outside the specification limits. Unlike goods quality, which can be measured objectively by number of defects, in service goods the setting up of specification limits is a complicated issue because it is marked by the use and expectations among the different customers. As Six Sigma was originally created for manufacturing, this crucial fact is not contemplated in the Six-Sigma roadmap Define- Measure-Analyze-Improve-Control (DMAIC).

In this paper we presented a model to solve this issue and set the specification limits according to the customer expectations in services organizations. A review of relevant literature has been used to develop a new integrated model with ideas from Kano model, SERVQUAL, Taguchi loss function, Importance Performance Analysis (IPA) and a new model, the Trade-Off importance. A survey was carried out for 18 external and internal customers of the service division of Siemens Industrial Turbomachinery AB.

The output of the model is a chart that analyzes the most important KPIs in the Service Division from a general and objective perspective. The visual representation in the model of the Voice Of the Customer, the Voice Of the Data (VOD) and the Voice Of the Experience (VOE) creates value out of the data in one single graphic that cannot be attained through the use of either method alone. It makes this model a credible, robust and very powerful tool not just to set the specification limits but also, to set strategic directions, for a comprehensive service quality measurement and to improve the target setting in the Six Sigma projects.

The line that separates black (defect) and white (non-defect) in service processes is diffuse because is market by the customers. This paper is a contribution of a better understanding of what the customers think that is white, what the customers think that is black and which is the approximate line that separates black and white.

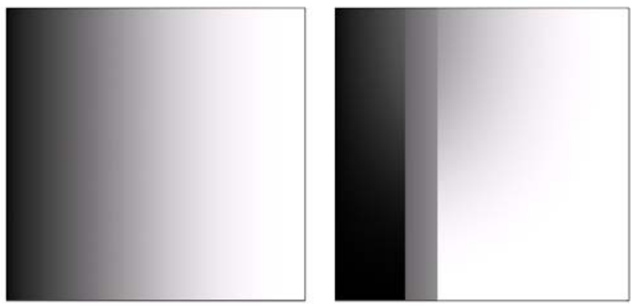

Figure 12

Managerial implications

This study is of interest for Siemens Industrial Turbomachinery AB managers. It will close the control loop and will allow the change of the traditional KPI bar charts for an SPC continuous health check. The real process sigma of the process can be calculated and the organization will use Six Sigma in its full potential.

The benefits in the SIT AB Service Division of the present study have a number of practical applications for service managers, mainly in organizations using Six Sigma or SPC policies.

Limitations and avenues for further research

This research has two main limitations, first, this is the first attempt to create a model to transform customer expectations into specification limits, there are a few articles published about this issue. We used for the first time the trade-off importance model and the Kano line drawing with more than 2 points. The proposed model must be further validated in future research.

Second, this study is applied in a single service division, with a relatively small sample. Ideal research should be conducted using multiple industries in order to ensure that the model is generalizable.

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