PERCEPTUAL MAPPING OF VARIOUS TQM TECHNIQUES

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ABSTRACT

As a result of keen global competition in many business sectors, the number of various TQM techniques has proliferated over the last decade. Each of these quality techniques has its own unique characteristics and application. The paper aims to portray the positioning of some of the more popular TQM techniques as perceived by a group of students pursuing Master degrees and a few senior members of the Hong Kong Quality Management Association. The term TQM is used loosely to refer to many commonly practised quality improvement techniques and tools. The Multidimensional Scaling (MDS) technique was used to analyse the underlying discerning criteria adopted by the respondents. Both 2-dimensional and 3-dimensional mappings were employed. The interpretation of the dimensions sheds light on how people measure and compare the different kinds of quality tools. The finding would be useful to quality-
promoters to understand how the different popular TQM techniques are perceived by the people.

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Measuring Mental Perception

When asked what do they think of various quality techniques, individuals would use their subjective reference criteria to make their judgement. These criteria exist in the minds of people and do not have an independent, objective existence. One way to construct objective scales which can correspond a person's internal mental "scales" is by using Multidimensional Scaling (MDS). This study helps establish some subconscious dimensions that people use in comparing and viewing various quality techniques.

Multidimensional Scaling technique (MDS)

This statistical technique has its origins in psychometrics and it can be used in a wide variety of fields to analyse distance-like (proximities) data called dissimilarity data. MDS depicts the structure of a set of items from data that approximate the distance between pairs of the items. Each item is represented by a point in a multidimensional space. Two similar items are represented by two points that are close together and two dissimilar items are located by two points that are far apart. Usually the space is a two- or three- dimensional Euclidean space.

The Euclidean distance d_{ij} between points i and j is defined as:

$$d_{ij} = [\Sigma(x_{ia} - x_{ja})^2]^{1/2}$$

where x_{ia} specifies the co-ordinate of point *i* on dimension *a*.

MDS can construct a map of the locations of items relative to each other from similarity or dissimilarity data. Analogy can be drawn to the problem faced by a surveyor who, after measuring a set of places, needs to draw a map showing the relative positions of those places.

From a geographical map, one can easily prepare a table of distances. However the reverse process of constructing a map from a table of distances would be extremely difficult if not impossible without a suitable tool. MDS can be employed to analyse these "dissimilarity" data to build the map. This distance example uses interval data for one symmetric matrix. This is termed Classical MDS (one matrix, Euclidean model).

Dissimilarity matrix of people's perception would be inaccurate on interval basis. At best people can rank the dissimilarity among the various items under study. The rank ordering of the dissimilarity are ordinal data. Hence the MDS model is nonmetric.

MDS can be extended to more than one matrix of dissimilarity to enable analysis of more than one case (i.e. subject who provides the dissimilarity data) possible. This Replicated MDS applies the Euclidean distance model to several dissimilarity matrices simultaneously.

Sampling of Respondents

The present study is based on ordinal (i.e. the rank ordering of dissimilarities among the various TQM techniques) data obtained from 39 respondents. Three respondents are from the Hong Kong Quality Management Association (the President, the Hon. Secretary, and the Hon. Adviser). The remaining 36 respondents were selected as a convenient sample. They are part-time MBA students with many years of working experience. A mini lecture on the various TQM techniques was given to them prior to their completing the dissimilarity matrix table. While the sample so selected is biased it would however represent the general views of a group of educated and matured business practitioners.

The TQM tools selected for the study

The choice of the twelve TQM (or more appropriately "quality") tools were initially selected based on the author's own personal experience and modified after discussion with the President of the HKQMA. These twelve quality techniques were by no means exhaustive, but should be common enough to be understood by the respondents who were asked to rank order the dissimilarities among all possible pairings of the techniques. To facilitate the rank ordering exercise, a specially designed matrix table was given to each respondent. They were asked to rank the quality techniques row by row by giving a dissimilarity score of '1' for the most similar technique with the one which was being compared. The next most similar technique was given a score of '2". This continued until the most dissimilar technique was scored with a score of '11'. The exercise took about 15 minutes. The result was a square asymmetric matrix table with zeros along the diagonal, from each respondent. Although theoretically the matrix should be symmetric, but in reality they were asymmetric because human minds are extremely dynamic in comparing items in pairs.

The twelve TQM techniques selected were scrambled to achieve randomness during comparison. The notations used in the respective perceptual maps were:

f_s	Five Ss (Structurize, Systemize, Sanitize, Standardize, Scrutinize)
coq	Costs of Quality (i.e. Prevention, Appraisal, Failure costs)
iso	International Standardisation Organization (ISO9000 Certification Scheme)
qfd	Quality Function Deployment (i.e. the House of Quality)
jit	Just In Time
cs	Customer Service Programmes
spc	Statistical Process Control
bm	Benchmarking
tqm	Total Quality Management (or Total Quality Control)
tm	Taguchi Methods
qcc	Quality Control Circles
bpr	Business Process Reengineering

Results of the Replicated MDS Analysis

The two dimensional spatial map of the respondents' perception vividly depicts how people view the various TQM techniques. The horizontal axis (dimension 1) can be easily interpreted as "whole organization oriented" (i.e. cs, iso, qfd, coq, tqm, bm, & bpr) on the left hand side of the map; and "production oriented" (spc, jit, tm, qcc, & f_s) on the right hand side. It is more difficult to label the vertical axis (dimension 2). But dimension 2 can be broadly described as "overall improvement" (bpr, tqm, coq, tm spc, & qfd) on the lower half of the map; and "setting standards" (bm, f_s, jit, iso, & cs) on the upper part of the diagram.

FIG

It is useful also to analyse the data on a three-dimensional basis. This can provide a better understanding of the complex mental comparison processes by different individuals. The

dimensions so analysed will provide useful insightful understanding of the key criteria that people use to discern various quality techniques. Knowing these criteria would enable quality promoters to communicate and sell the respective techniques to the relevant parties. If the perception is not appropriate, then some market positioning of the techniques may be necessary.

It is obviously more complex to analyse and interpret the three dimensions of the perceptual mapping. The three-dimensional cube is depicted with the three positive axes located at the centre. This 3-D diagram provides a general picture of the relative locations of the twelve different quality techniques. The 3-D cube would then be rotated to reduce to a two dimensional squares; i.e. one looking from the front end, another looking from the side, and the third from the top of the cube. This is analogous to X-raying the cube to determine the locations more precisely.

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From the three "compressed" two-dimensional maps redrawn from the 3-D cube, a matrix table summarizing the key characteristics of the various TQM techniques can be constructed.

LEGEND: VVV Strong vv Medium v Weak ~ Negligible	**X+** Whole Organization Oriented	**X-** Production Oriented	**Y+** Setting Standard	**Y-** Overall Improvement	**Z+** Applicable for large organizations	**Z-** Applicable for organizations of any size
ISO	vv		v		v	
COQ	v			~	vv	
BPR	~	~		vv	vv	
SPC		vvv		~	~	
5S		~	vv		v	
JIT		v	v		v	
BM		~	vv			v
TQM	~			vv		~
QFD	vv			v		v
CS	vvv		~	~		v
TM		vv		v		vv
QCC		v	~	~		vv

The three dimensions can be described as:

Whole Organization Oriented vs Production Oriented (along the X axis)
Setting Standards vs Overall Improvement (along the Y axis)
Applicable for large Organization vs Applicable for Organizations of any size (along the Z axis)

Conclusion

The paper presents a powerful and yet interesting approach to analyse the perception of people towards the various TQM techniques. The description of the axes provides some

hints how people subconsciously compare and discern different TQM techniques. The same technique can be applied to employees of an organization practising various TQM programmes (or indeed any programmes and /or activities). The way how they perceive the various initiatives would be interesting for the management of the company. With this knowledge the management can check if the various improvement initiatives have been appropriately perceived by the employees. MDS can have many applications in understanding the perception of people in a more objective and scientific manner.

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