Development of a Model for Quality to Enhance Organisational Learning

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Abstract: This paper describes the development of a Total Quality Management model in manufacturing environment. Based on literature review, critical factors and their dimensions for the success of quality improvement are identified. A modelling framework is proposed and some preliminary outputs are presented as to show the potential of the model when completed.

1. INTRODUCTION

In the quality literature, a number of studies emphasised the linkages between adoption of quality management policies and organisational performance. Majority of those studies, however, used statistical analysis, such as discriminant analysis and factor analysis, in establishing the links. Undoubtedly, those studies failed to provide insight into how adoption of a particular quality policy influenced operational and business performance, and enhance organisational learning.

Further more, statistical modelling exercises usually consider very simplistic view of quality issues. The major performance measures used in the literature are customer satisfaction, rejection, scrap rate and rework. Very little has been reported on how customer satisfaction, reject, scrap and rework rates are influenced by other variables such as process improvement, product improvement, training programs, worker's attitudes, reporting of quality cost data, management support, etc.

This paper takes a broader view of quality issues and analyses the relationships between quality management practices and organisational performance from a systems perspective. At first, a survey of quality dimensions (TQM dimensions) and performance measurement dimensions are presented. Based on these dimensions, a categorisation of quality models is provided.

Next, using a system dynamics based quality model the paper presents an evaluation of quality strategies. How and to what extent a particular strategy influences an individual performance measure is highlighted. The model also evaluates causal relationships between various quality strategies and business and operational performances. Finally, a discussion on the utility of the model in organisational learning is presented.

2. FACTORS IN TQM

Needless to say, the majority of the businesses are interested in product quality due to its potential to market share expansion, lower costs of production/operations, improvement on productivity and ultimately increase in profitability. There is a sequential flow of actions and influences. Hence, it is necessary to understand the cause-effect mechanisms in the quality system. The causes can be stated as the critical TQM factors and the effects are the effectiveness of the critical TQM factors. A number of empirical studies in the TQM literature dealt with (a) the identification of critical TQM factors and its relationships between individual factors, and (b) relationship of critical TQM factors with operational and business performance.

A major drawback of traditional quality studies is that these studies do not consider the dynamic nature of TQM. The dynamic view means how quality policy interacts and hence influences operational and business performance over a long time horizon. Statistical analysis such as discriminant analysis, factor analysis, and structure equation modelling (SEM) fails to generate dynamic scenarios.

3. SURVEY OF DIMENSIONS OF CRITICAL TQM FACTORS AND PERFORMANCE MEASURES

It is necessary to understand what are the reliable and valid critical TQM factors, and how these factors influence operational and business performances. The most commonly used critical TQM factors cited in the literature are top management support, customer focus, supplier's quality management, design quality management, benchmarking, quality data reporting, usage of quality control tools, employee involvement, employee empowerment, quality related training, product quality, and supplier's performance. Each of these critical factors has more than one dimension.

For example, quality data reporting has several dimensions, such as the availability of cost of quality data; availability and timeliness of the data; extent of quality data collected by the service/support areas of the division; extent to which quality data are used for tools to manage quality; extent to which quality data are available to hourly employees; extent to which quality data are available to managers and supervisors; the extent to which quality data are used to evaluate supervisor and managerial performance; and the extent to which quality data are used to evaluate supervisor and managerial performance (Saraph, Bensons and Schroeder,1989).

The most common manufacturing and business performance indicators cited in the literature are product service quality, operational quality, financial quality, public responsibilities, and employee satisfaction and customer satisfaction. Each of these measures has several dimensions. Each of these performance measures has several dimensions.

4. THEORY OF QUALITY-PERFORMANCE RELATIONSHIP

The three popular models of quality-performance relationships are: Deming's chain reaction model (Deming,1982); cost saving model (Garvin, 1984); and award criteria relationship model (Malcom Baldrige Award, USA). A large amount publications are available in relation to these three models.

Deming's chain reaction model assumes that improvement in productivity and business performance stems from the impacts of 'quality' on reductions in waste of materials, labour hours, and machine hours. Such reduction result in lower unit manufacturing costs, improved productivity and greater profits. Figure 1 shows quality improves (a) productivity, productivity reduce internal costs and hence improves profits, (b) customer satisfaction, customer satisfaction improves market share and hence increase profits, and (c) productivity, reduce internal costs, reduce external prices and increase market share, and hence increase in profits of the firm.

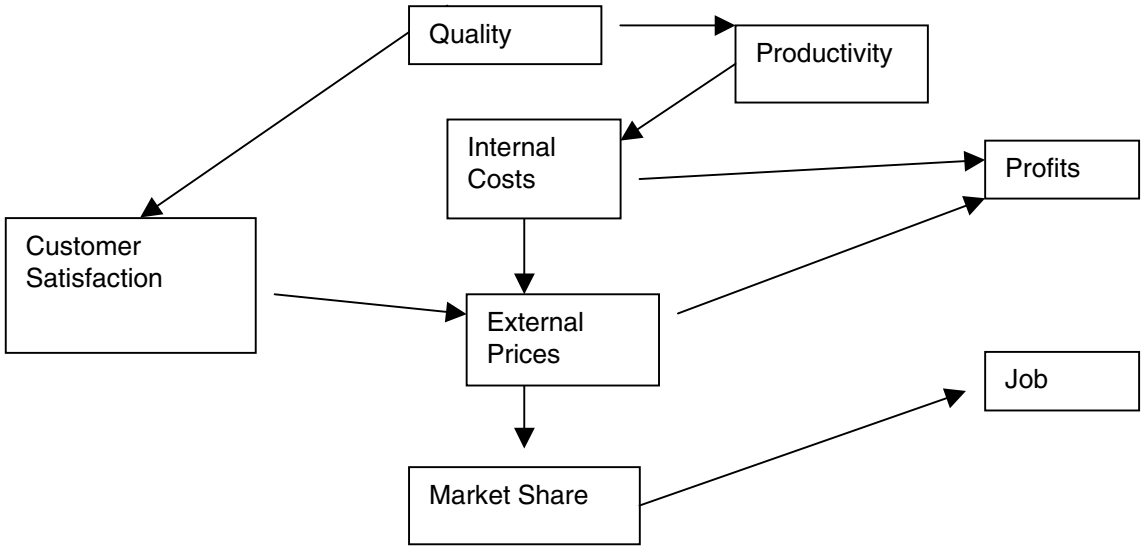


Figure 1: The Deming's Chain Reaction Model (Source: Deming, 1982)

Garvin's cost saving model shows (in Figure 2) that improved reliability or conformance of product leads to:

- Improved productivity, reduce manufacturing costs and hence increase in productivity;
- Lower rework and scraps costs, reduce manufacturing costs and hence increased profit; and
- Lower warranty cost and product liability costs, reduce lower service costs and hence increased profit.

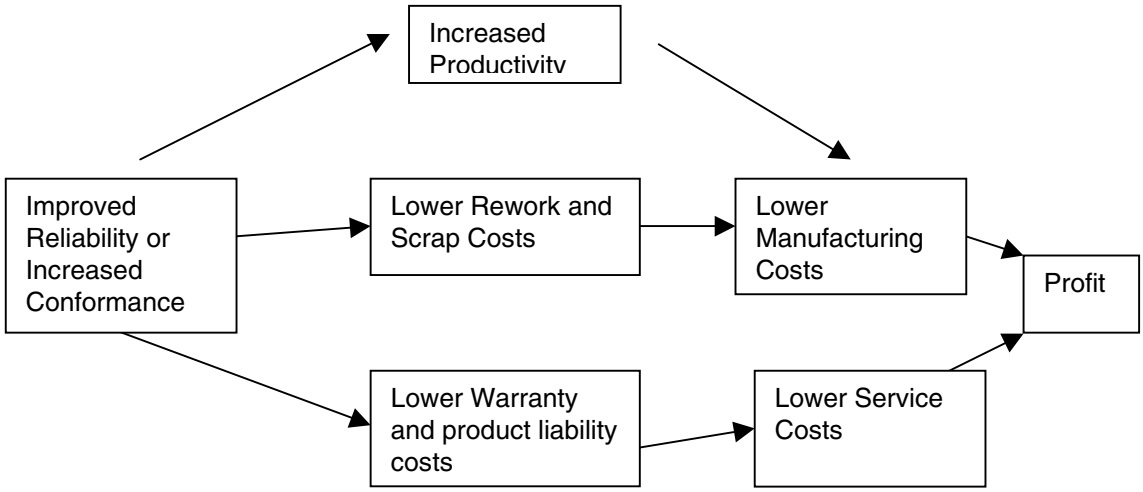


Figure 2: The Cost Saving Model (Source: Garvin, 1983)

Figure 3 shows the relationship between drivers, enablers and categories relating to quality as envisaged in award criteria relationship model. Australian Quality Award-AQA (1995) is based on Malcom Baldrige Award.

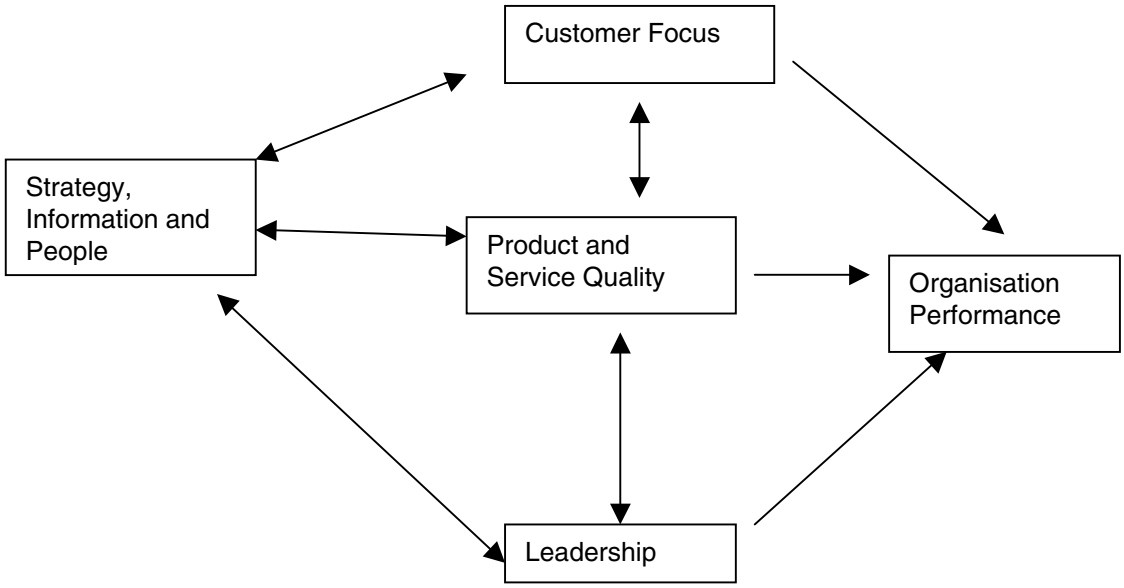


Figure 3: Award Criteria Relationship Model (Source: Australian Quality Awards Assessment Criteria, 1995)

5. FINDINGS OF QUALITY-PERFORMANCE EMPIRICAL STUDIES

One of the earlier studies (Buzell and Gale, 1987) partly related to TQM effectiveness can be found in marketing literature for PIMS (Profit and Impact of Marketing Strategy) study. PIMS study inspired further research in quality. This study found that:

- strong positive relationship exists between quality and market share,
- high product quality is associated with increase in cumulative production with later reductions in manufacturing cost due to learning curve effects,
- strong positive correlation exists between quality and financial measures of profitability such a return-on-investment, and
- quality improvements enhances financial measures of profitability through reductions in cost and improvement in market share (Buzell and Gale, 1987).

Empirical studies conducted by Sarapah, Benson & Schroeder (1989), Sluti (1992), Ahire, Golhar, & Waller (1996), Anderson, Rungtusanntham, Schroeder & Devraj (1995), Flynn, Schroeder & Sakakibara (1995), Sjoblom (1995), Black & Porter (1996), Forker et al (1996), Adam, Jr (1994), and Grandzol and Gershon (1997) show interesting insights into quality theory. The studies conclude that only implementation of critical TQM factors in an organisation may not bring higher efficiency unless the leadership for quality, employee empowerment, employee motivation and culture in the organisation is submissive to TQM initiative. A number of empirical studies show that critical TQM factors have a positive influence on operational and business performance. But, the empirical studies failed to provide detailed mechanism of how

adoption of particular quality policy influenced operational and business performance. Following are the drawbacks of the above mentioned empirical studies:

- Studies lag in establishing the direct relationship to one or more specific performance measures and subsequent impact of the performance measures at aggregate level,
- Studies lack in adopting system concept, and
- Studies are constrained with the use of appropriate analytical tools, such as discriminant analysis, factor analysis and Structure Equation Modeling (SEM). The researchers seem to agree that it is difficult to interpret the results from these analytical tool, specifically SEM.

Sjoblom (1995) suggested one of the keys finding that in order to implement TQM, a system approach should be taken. None of the component alone is sufficient, but a total approach involving. Both technical tools and management leadership factor is necessary. Hence, it can be concluded that defines TQM as a system approach that considers every interaction between the various elements of the critical factors of TQM in an organisation, and where the overall effectiveness of the system is higher than sum of the subsystem. The system, as defined here is the inter-related set of quality policies, process, technology, human resources needed to achieve the quality transformation. Thus, although the quality literature acknowledges the dynamic relationship among the TQM principles (Mandel, Howell and Sohal, 1997).

6. A CONCEPTUAL FRAMEWORK FOR QUALITY-PERFORMANCE MODEL

A quality-performance model for dynamic situations is suggested in this paper. The framework takes a broader view of quality issues and analyses the relationships of dimensions of critical TQM factors with operational and business performance.

As stated in the literature, in order to gain effectiveness of TQM it is necessary to secure stronger support from the top management. Garvin's (1984) study concludes that top management commitment to product quality planning and quality control of shopfloor is a must. In the same vein, Modaress and Ansari (1989) found that due to lack of top management participation in quality programs, there is a slow implementation of quality control techniques in design and manufacturing supportive areas and lack of mathematical skills.

Hence, in developing the proposed dynamic quality-performance model, the top management support is considered to be the prime mover. The model as shown in Figure 4 shows how critical TQM factors are influenced by the top management support and ultimately lead to continuous improvement.

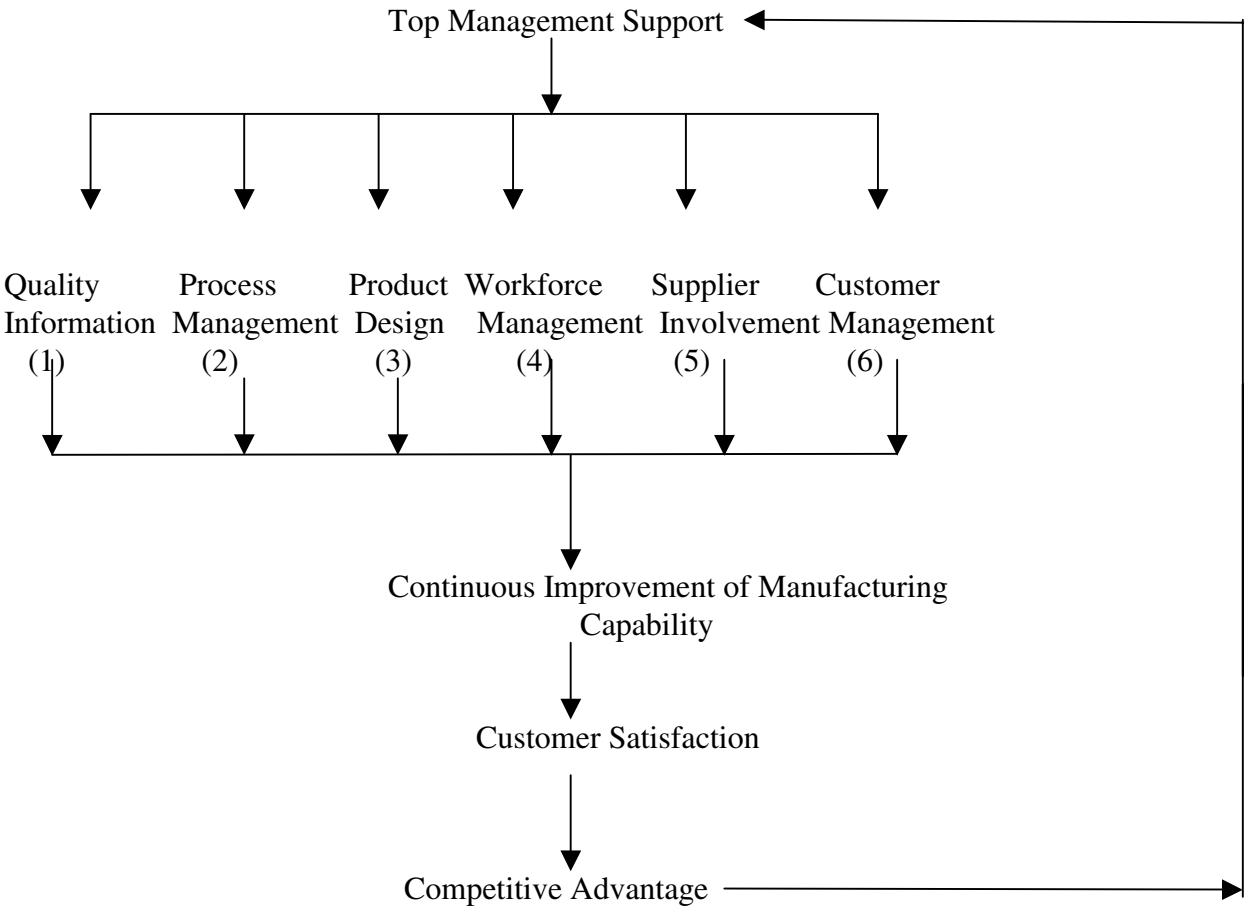
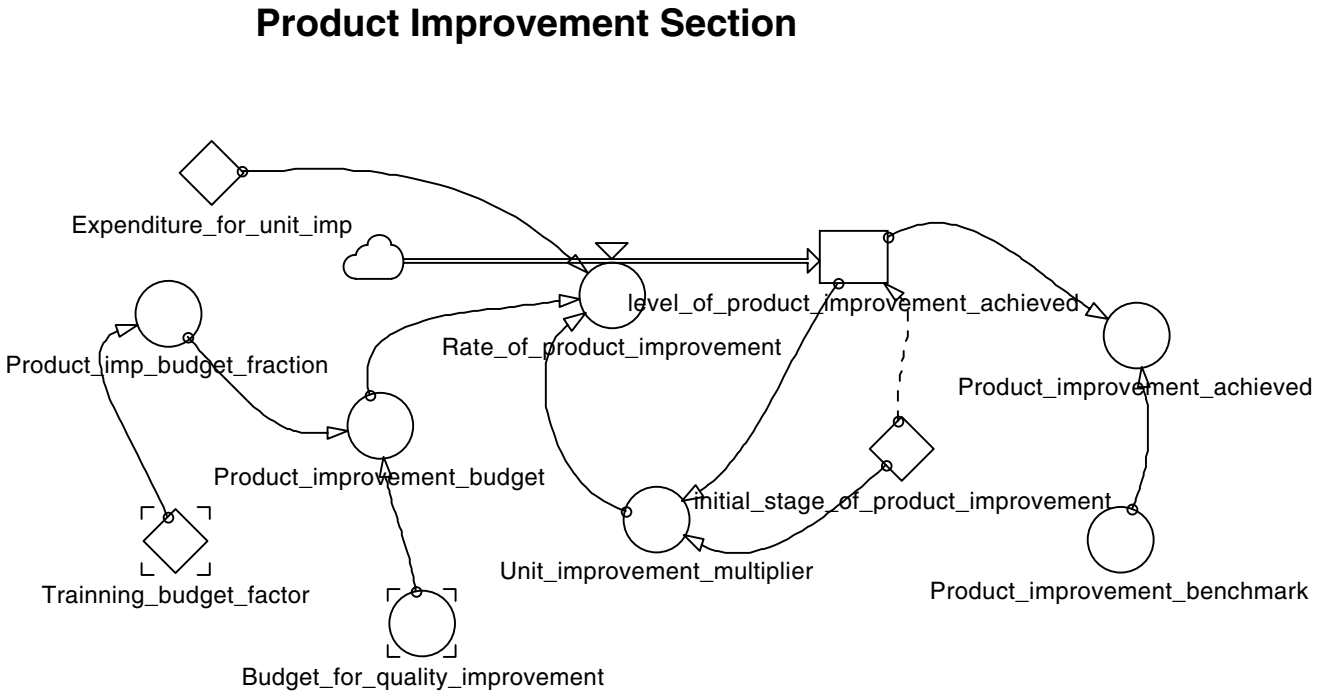


Figure 4: Effect of Quality Management Practices on Competitive Advantage
Source: (Flynn, Schroder and Sakakibara, 1994*)*

The model as shown in Figure 4 is under development. The six major sub-sectors of the model (quality information, process management, product design, workforce improvement, supplier involvement and customer management) are being developed individually. The individual models will be tested and integrated to generate the overall behaviour of the quality system.

Figure 5 shows the Powersim model of product and process improvement management process. The mechanisms incorporated in Figure 5 are indicative of the ideas being considered in the modelling process. Obviously, these models will go through revisions before a final decision is taken of the overall model.



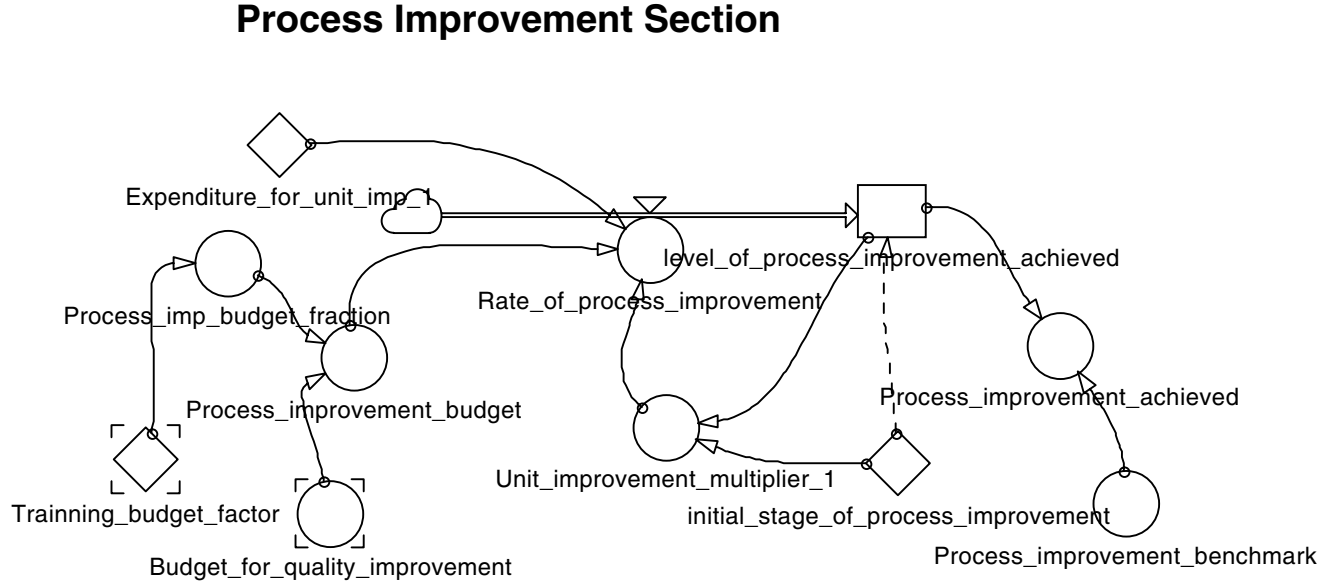


Figure 5: Mechanisms considered in product and process improvement.

The overall model will be converted to a flight simulator. The control page of the flight simulator will contain a number of policy control variables. Figure 6 shows the anticipated layout of the control page.

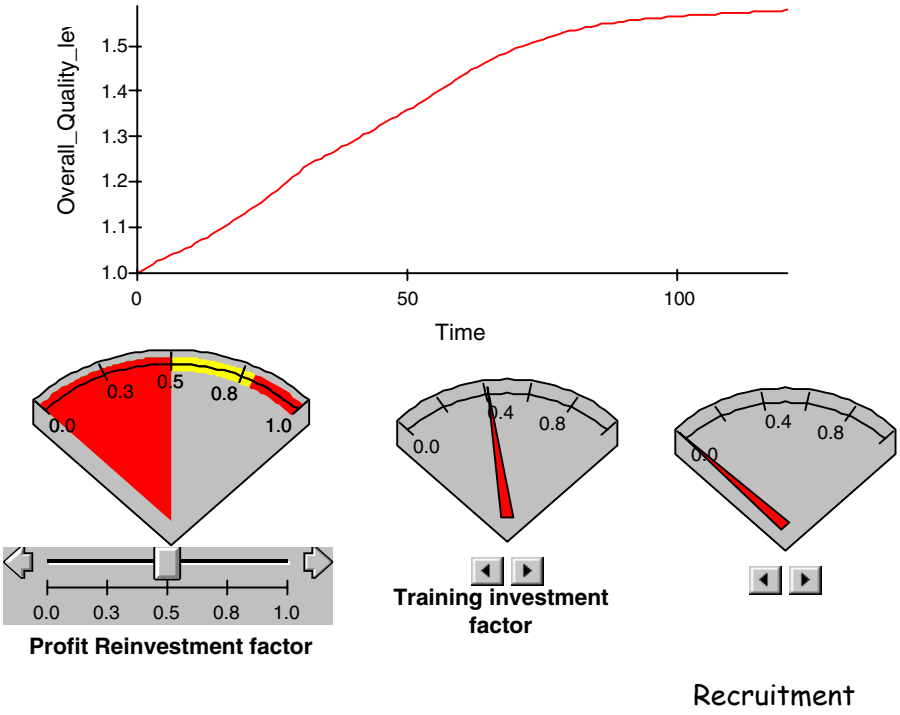


Figure 6: Flight Simulator Control Page.

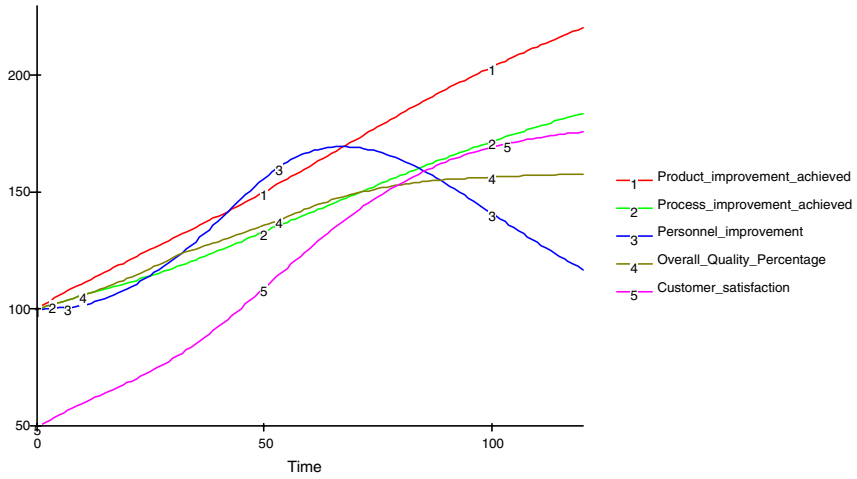


Figure 7: Various Components of Quality Outputs

Figure 7 shows the components of overall quality measurement and their plausible behaviour over time. The control page of the flight simulator will provide proper navigational instructions to direct to various graphical outputs.

The proposed dynamic quality-performance model will be used to answer some of the following questions:

- Through which mechanism(s) the critical TQM factor leads to overall behaviour of quality in an organization?
- How interaction of top management support (leadership for quality) and technical system improves operational and business performance?
- Through which detailed mechanism suppliers improves quality of product and hence business performance?
- Through which mechanism customer satisfaction links to operational and business performance?

7. MODEL CONTRIBUTION TO ORGANISATIONAL LEARNING

Understanding of this quality model and its implementation will lead to learning in organisations. The model will enhance learning through-

- openness to new ideas. Quality in the organisation will be looked in totality.
- commitment from senior management. Managers will become transparent on the process or mechanisms of interactions and, therefore, most likely to get committed to quality improvement process.

The model can be an instrument in the unlearning process, which is the first step in becoming a learning organisation. Unlearning involves breaking with current behaviours/and or mental modes, while learning can either lead to whole new ways of understanding and acting or build on those that exist.

8. CONCLUSION

There are a number of qualitative models to study TQM in manufacturing organisation. While they are useful in identifying the critical factors for the success of TQM, they seriously lack in explaining the internal mechanisms, which generate the observed behaviour. This study attempts to illustrate the internal mechanisms.

The main focus of this work is to develop an aggregate level TQM model and then convert it to a flight simulator type model. The flight simulator model will be very useful to quality managers to try and observe the consequences of their intended policies.

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