MOFD: A MODEL FOR SYNERGIZING TPM AND QFD

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MOFD: A MODEL FOR SYNERGIZING TPM AND QFD

4.1. Introduction

While ascertaining the absence of any model linking TPM and QFD in both literature and practising arena, two methodologies of linking these two principles were examined. One methodology proposes that QFD can be introduced into TPM principles. The other methodology proposes the reverse, in the sense that TPM can be introduced into QFD projects. In both of these methodologies, there is likelihood that these two principles do not get linked, appropriately to evolve synergic benefits. To overcome this possibility, this research work was started by designing the MQFD model exclusively for linking these two principles. The conceptual features of MQFD model are described in this chapter. Next, its implementation procedure is enumerated and described by adopting a hypothetical case study.

4.2. Use of QFD for TPM

Both QFD and TPM have widely been in existence during last three decades (Akao and Mazur, 2003, Nakajima, 1993, Chan et al., 2005). Though their objectives are about the quality improvement aspects, their perceptions and orientations are focused on attaining different objectives. In order to nourish their synergic benefits, it became necessary to examine the use of QFD for TPM. This aspect is depicted in Figure 4.1. As hinted, the objectives of QFD are largely on meeting the external customers’ requirements through the involvement of managerial employees, whereas the objectives of TPM are mainly concentrated upon the enhancement of operators’ capabilities towards enhancing maintenance quality of equipment. These differing objectives will lead to the division between managerial staff and the operators. If QFD is properly integrated with TPM programme, then those differing objectives can be focused towards the unified direction of achieving continuous maintenance quality improvement. However this would be a challenging task. Because, QFD professionals have not so far applied it for improving equipment’s maintenance quality. Likewise TPM professionals have not been orienting towards continuous maintenance quality improvement of products produced by the organizations.
### Objectives of QFD

1. To translate customer's vague languages into technically understandable languages.
2. To enable the percolation of customer's voice into practical arena.
3. To facilitate the customer's voice to obtain exactly what he/she wants.

(Sahney et al., 2004)

### Objectives of TPM

1. To achieve zero breakdowns.
2. To achieve zero defects.
3. To achieve improved throughputs.

### Objectives of QFD and TPM

To gather both internal and external customer's perceptions in achieving zero break downs, zero defects and improved throughout and translate them into practically implementable and viable propositions.

### Benefits of QFD

1. Development of team work and participation culture.
2. Systematic development of documentation connecting all functional requirements.
3. Reduced field problems.
4. Lesser design changes.
5. Identification of strengths and weaknesses of products with reference to competitors products.

(Lokamy and Khurana, 1995)

### Benefits of TPM

1. Cultivating sense of ownership of equipment among the operators.
2. Development of cross functional teams to improve individual employee and employer performance.
3. Increase the life of equipment and plant.
4. Identification of reasons for equipment failures.
5. Increase in motivation level of employees.

(Eti. et al., 2004)

### Synergic Benefits of QFD for TPM

Development of teams consisting of not only operators but also managers who are concerned with equipment effectiveness for providing tangible and intangible gains that would be received by both internal and external customers.

### Figure 4.1. Use of QFD for TPM

Hence the task of integrating QFD and TPM has to be carried out with precautions because of their inherent divergent objectives. This finding necessitated the development of MQFD model exclusively to integrate QFD and TPM principles.
4.3. MQFD model

The conceptual features of the MQFD model are shown in Figure 4.2. As shown, the performance of a company will be heard through the voice of customers. Those voices of customers are used to develop the HoQ (Chein and Su, 2003). This process has to be accomplished by MQFD team. The outputs of HoQ, which are in the form of technical languages (Rahim and Baksh, 2003), are submitted to the top management for making strategic decisions. This step is necessitated because researchers have established the need for applying strategic approach in both QFD (Lu and Kuei, 1995) and TPM (Murthy et al, 2002, Hunt and Xavier, 2003) projects for ensuring their success.

The technical languages which are concerned with enhancing maintenance quality are strategically directed by the top management towards eight TPM pillars. The TPM characteristics imbibed through the development of eight pillars are fed into the production system. Here, their implementation is focused towards increasing the values of the maintenance quality parameters, namely OEE, MTBF, MTTR, performance quality, availability and MDT.

The outputs from production system are required to be reflected in the form of business values namely improved maintenance quality, increased profit, upgraded core competence, (Miyake and Enkawa, 1999) and enhanced goodwill (Ahmed et al, 2005). The rationale behind measuring these business oriented outputs is that, maintenance is established a business function and hence any maintenance model is required to show performance in the form of the above business metrics (Zhu et al., 2002, Eti et al, 2004). All the quantified values of outputs are used for developing another HoQ and comparing with set targets. At this point, the next cycle begins.

The MQFD model implementation would be a never-ending continuous improvement process. A unique feature of the MQFD model is that it is not necessary to change or dismantle the process of developing house of quality and TPM projects, which might be already in practice in the company concerned. Thus, the MQFD model enables the tactical marriage between QFD and TPM.
Figure 4.2. MQFD Model
4.4. Implementation aspects of MQFD

In order to illustrate the implementation aspects of MQFD, a hypothetical case study is presented here. For this purpose a company manufacturing sanitary paper products is considered. The products of this company are facial tissues, pocket tissues, lady napkins and diapers. The steps that are to be carried out to apply MQFD model are presented below. These steps have been developed as an analogy to those followed in TPM and QFD implementation case studies like those reported by Eti. et.al (2004), Ireland and Dale (2001), Chin et.al, (2001) and Pun et.al (2000). The rationale behind developing each step is also appraised.

4.4.1 Step 1.

MQFD experts deliver seminar to the top management personnel who subsequently agree to implement MQFD in the company.

4.4.1.1 Rationale

The vitality of top management support and commitment for the successful implementation of both TPM and QFD models have been well established by the researchers (Emiliani, 2005, Kaye, and Andersen, 1999, Cooke, 2000, Kathawala and Motwani, 1994). The core requirement of the above seminar is to convince the top management about the potential value of implementing MQFD and to gain their commitment and ownership to it. Similar emphasis is made in Chan et.al (2005) while enumerating the twelve steps of a TPM implementation programme.

4.4.2. Step 2.

The MQFD experts and top management personnel undergo brainstorming sessions on MQFD implementation. At the end of these sessions, they decide to apply MQFD in the production process of diapers because its sales volume is the highest of all the other three products produced.

4.4.2.2. Rationale

The rationale of this step is that top management personnel are cautious while embarking any new programme. At the same time, they will be attracted to the
models, which will lead to sales and revenue increase. Same approach has been reported by Ghobadian and Terry (1995) while describing the implementation of QFD in a company by name Alitalia. Similar step is envisaged under the name ‘focus group brainstorming’ in Pun et.al (2000) and Chin et.al (2001).

4.4.3. Step 3.

MQFD team consisting of eight members is formed. The constitutional structure of this team is given below.

I  Works manager
II Engineer “A”
III Engineer “B”
IV Foreman “A”
V  Foreman “B”
VI Quality controller
VII Factory Accountant
VIII Marketing Manager

4.4.3.1 Rationale

The individual knowledge will be too narrow and self centered for adoption in real time environments. A team effort is required to make better decisions (van der Wall, and Lynn, 2002). When members from different departments join, practically compatible continuous improvement results will emerge (Chan, et al, 2005). The synergic combination of multi-disciplinary efforts will lead to very valuable decisions (Ollero, et al., 2002). Quite interestingly the formation of team is envisaged while implementing both TPM and QFD principles (Ireland and Dale, 2001, Rahim. and Baksh, 2003, Tsang and Chan, 2000). Hence the team shown above is formed while implementing MQFD which has to be done with care (Balthazard and Gargeya 1995).

4.4.4. Step 4.

Top management permits the MQFD team to meet once in a week in the training hall.
4.4.4.1. Rationale

After formation of MQFD team, the management shall support its effective functioning by providing the required resources. One among them is the management’s willingness to allot a certain time during the working hours for convening MQFD meetings. In order to fulfill this requirement, while implementing MQFD, the management shall gesture by earmarking one or two hours in a week for MQFD members’ meeting. Similar appraisal has been made by Bamber et.al (1999) who has cited time allocation as one of the factors effecting successful implementation of TPM.

4.4.5. Step 5

MQFD experts conduct a half-a-day seminar to both management and employees.

4.4.5.1. Rationale

When MQFD gains momentum, a section of management and employees may feel skeptic about its fruitful results. This feeling may emerge in the form of resistance to change. In order to mitigate these reverberations on MQFD, a seminar explaining its features and expected benefits to be reaped by the company is required to be conducted. Similar observations have been reported by Ireland and Dale (2001). Also, a step like the one said above has been suggested with regard to the implementation of TPM in a company in Tsang and Chan (2000).


MQFD team identifies the following four customer languages.

Customer language 1: “Eva tape (used for tying diapers on babies) is getting peeled off.”

Customer language 2: “Other companies are making T shaped diapers. Diapers produced by our company are X shaped which are difficult to handle”.
Customer language 3: “Packing of diapers produced by competitor companies are tri-fold which are attractive after packing whereas diapers produced by our company are bi-fold”.

Customer language 4: “The diapers produced by the competitor companies last longer”.

4.4.6.1. Rationale

Identifying customer language is a difficult exercise. The different sources and channels are to be tactically tapped and traced to gather customer languages. MQFD team has to adopt suitable methodologies to identify the above customer languages. For this purpose the MQFD team may refer to the methodologies reported in article like Chin et al. (2001), Kumar and Midha (2001), Ghobadian and Terry (1995) and Pun et al. (2000).

4.4.7. Step 7.

MQFD team ranks the customer languages according to their importance and decides to choose the ‘customer language 1’ for subsequent consideration.

4.4.7.1. Rationale

Prioritisation has been an accepted practice in several fields. For example Juran and Gryna (1997), recommend the use of Parato analysis to identify vital few quality problems. Likewise, the field of inventory management uses ABC analysis to prioritise the materials as A, B and C categories (Zomerdijk, and Vries, 2003). Hence, MQFD implementation would be more result oriented if customer languages are ranked and considered according to their priorities. However, the choosing of appropriate metrics and scales for ranking customer languages would be a challenging task.

4.4.8. Step 8.

MQFD team conducts brainstorming sessions and develops HoQ. This stage progresses through the following steps (Besterfield, et al., 2004) by conducting the eight brainstorming sessions in succession.
Brainstorming session I: Customer language is subjected to discussions. Finally the customer requirements (whats) are listed.

Brainstorming session II: The technical features of fulfilling customers’ requirements are subjected to discussions. Finally the technical descriptors with respect to the customer requirements are listed.

Brainstorming session III: The relationships between customer requirements and technical descriptors are discussed. Finally the relationship matrix between customer requirements and technical descriptors is developed.

Brainstorming session IV: The technical descriptors are subjected to discussion for establishing relationships among themselves. Finally, the interrelationship matrix between technical descriptors is developed.

Brainstorming session V: The competitors’ status with reference to customer requirements is discussed. Finally, the competitive assessments are quantified using numerical values.

Brainstorming session VI: The customer requirements are subjected to discussions for establishing their priorities. Finally, the customer requirements are prioritized using numerical values.

Brainstorming session VII: The technical descriptors are subjected to discussions for establishing their priorities. Finally, the technical descriptors are prioritized using numerical values.

Brainstorming session VIII: All the outcomes of Brainstorming session I -VII are subjected to discussions from the holistic point of view. Finally these outcomes are entered into the HoQ matrix.

4.4.8.1. Rationale

The need of conducting brainstorming sessions in attaining maintenance strategies is established in research (Madu, 2000). This exercise results in systematic conversion of customer languages (requirements) into technical languages (descriptors). In addition to that, HoQ matrix shows a clear picture.
of the ranking, relationships among customer and technical languages. In addition to that, correlation among technical languages, if any is revealed. Hence the above step utilizing these features is a core aspect of MQFD programme.


The highest ranked technical language brought out of HoQ is as follows. "It is found that oil used at the cutter knife flows over the tape while cutting. It causes it to get peeled off. Use of oil is to be avoided by installing artificial chiller unit".

4.4.9.1. Rationale

Vital few problems damage the systems to the maximum possible extent. Hence solving of vital few problems would overcome major malfunctioning of the systems (Logothetis, 1997). Therefore when technical language with highest priority is chosen, it would lead to solving of major deficiencies and trading off minor deficiencies (Besterfield, et al., 2004).

4.4.10. Step 10

MQFD team submits the results to the top management personnel.

4.4.10.1. Rationale

The continuous support and leadership of management are prerequisites for the successful laying of foundation of any programme in an organization. In order to sustain its development, the management's sustained involvement is vital. Hence it is essential that MQFD team reports to the top management about the progress of MQFD. Similar thrust is made by Bamber et.al (1999) for the successful implementation of TPM.

4.4.11. Step 11

The top management personnel along with MQFD experts conclude that the results reported by the MQFD team are to be fed into the TPM pillars. Table
4.1 shows the action taken in this regard. The technical languages drawn from HoQ will have to be positioned to enhance maintenance quality. This task is made possible by passing through the TPM eight pillars.

**Table 4.1. Action to be taken to construct eight TPM pillars**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Autonomous Maintenance</strong></td>
<td>The operators running diaper machine are informed about the</td>
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<tr>
<td>(Jishu-Hozen-Pillar 1)</td>
<td>suggestions of MQFD team and are trained to maintain the</td>
</tr>
<tr>
<td></td>
<td>artificial chiller unit on their own. The operators develop</td>
</tr>
<tr>
<td></td>
<td>confidence to maintain artificial chiller unit.</td>
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<tr>
<td><strong>Individual Improvement</strong></td>
<td>MQFD team members analyse different losses that emanate due</td>
</tr>
<tr>
<td>(Kobetsu Kaizen-Pillar 2)</td>
<td>to maintenance failure of artificial chiller unit and ranked</td>
</tr>
<tr>
<td></td>
<td>the losses using risk priority numbers (R.P.N). The factors</td>
</tr>
<tr>
<td></td>
<td>considered are severity, occurrence, and detection.</td>
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<tr>
<td><strong>Planned Maintenance</strong></td>
<td>MQFD team identifies the maintenance requirements and their</td>
</tr>
<tr>
<td>(Pillar 3)</td>
<td>frequencies. MQFD team conducts one-point lessons to the</td>
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<td></td>
<td>operators who are required to run artificial chiller unit. At</td>
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<tr>
<td></td>
<td>the end, MQFD team presents the operators with a timetable on</td>
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<td></td>
<td>planned maintenance of artificial chiller unit and a small</td>
</tr>
<tr>
<td></td>
<td>sized maintenance diary with dates and check-lists containing</td>
</tr>
<tr>
<td></td>
<td>the planned maintenance operations to be carried out.</td>
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<tr>
<td><strong>Quality Maintenance</strong></td>
<td>MQFD team conducts one point lesson on entering data on</td>
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<tr>
<td>(Pillar 4)</td>
<td>defects. MQFD team sets up a system to monitor defects on the</td>
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<td></td>
<td>basis of any duration. For this purpose, MQFD trains the</td>
</tr>
<tr>
<td></td>
<td>operators to enter the data while operating the artificial</td>
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<tr>
<td></td>
<td>chiller unit in maintenance diary and presents it to the</td>
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<td></td>
<td>MQFD experts. MQFD team members decide to conduct Why-Why</td>
</tr>
<tr>
<td></td>
<td>analysis, poke yoke and kaizen. MQFD members decide to orient</td>
</tr>
<tr>
<td></td>
<td>towards zero defects.</td>
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Table Contd......
Office TPM (Pillar 5)
MQFD team prepares a software for personnel working in office to compute incentives for the operators who are operating artificial chiller unit. The use of this software by the office personnel ensures that the incentive computation is straightforward and free from errors.

Education and Training (Pillar 6)
MQFD team designs and develops curriculum for providing education and training on artificial chiller unit. MQFD team prepares the list of operators and supervisors who are required to participate in these programmes and the benefits they are required to gain.

Safety, Health and Environment (Pillar 7)
MQFD members go to the work place to demonstrate to the operators who are working on the artificial chiller unit about the safety, health and environment measures that are required to be taken care of. MQFD members conduct make drill exercise to check the preparedness of operators working on artificial chiller unit towards safety, health and environmental aspects.

Initial Control (Development Management-Pillar 8)
MQFD team develops the rules for rewarding the operators based upon the MTBF, OEE, MTTR, MDT, performance quality, and availability of artificial chiller unit. A reward system for calculating the tangible and intangible values of the incentives based upon the above parameters concerning the artificial chiller unit is developed. This motivates that the operators of the diaper machine to run artificial chiller unit without any resistance.

4.4.11.1. Rationale

As mentioned earlier, one of the approaches of enhancing maintenance quality is through the development of TPM pillars (Ahmed, et al, 2005, Ireland and Dale, 2001). Hence this step is necessitated. Action taken by each pillar is presented in Table 4.1.
4.4.12. Step 12

The construction of eight TPM pillars is completed. The results are directed towards the operation of the production system. In this regard, MQFD team computes the six TPM parameters namely OEE, MTBF, MTTR, performance quality, MDT and availability.

4.4.12.1. Rationale

Many authors have claimed that OEE is the most effective measure of maintenance quality (Chan, et al., 2005), However organizations would be in need of viewing maintenance quality from different perspectives (Ahmed, et al, 2005, Juran, and Gryna, 1997, Blanchard, 1997). This is made possible by measuring the other parameters cited above. For example, the company’s perspective of maintenance quality is viewed by seeing the down time of equipments and products. This is made possible by referring to MDT.

4.4.13. Step 13

The overall results indicate 60% increase in organisational performance. MQFD members compare this result with the set target. They find that the target set is 70%.

4.4.13.1. Rationale

There is every chance that the maintenance quality of a company may be improved at the cost of its business performance. The ultimate objective of MQFD shall be the achievement of core competence. Hence, after implementing MQFD cycle, it is essential to ultimately measure its contributions towards its business success. Researchers have cited the importance of ensuring the integrity of TPM benefits with business performance (Ahmed, et al, 2005, Seth and Tripathi, 2005). Though MQFD cycle results in business performance improvement, its level has to be checked with the that of the target. This will enable the company to reap of ultimate benefits of implementing MQFD.
4.4.14. Step 14

MQFD members conduct brainstorming sessions among themselves and conclude that the performance quality is to be improved. Subsequently they evaluate the tactical suggestions and ideas emerged during these brainstorming sessions.

4.4.14.1. Rationale

Continuous improvement is a hallmark of TPM (Blanchard, 1997). But before embarking on the next cycle of MQFD, brainstorming sessions are to be conducted among its team members. These brainstorming sessions will lead to the revealing of the effective way of promoting the next cycle of MQFD.

4.4.15. Step 15

Tactical suggestions of MQFD team members are submitted to the top management for taking strategic decisions. The strategic decisions lead to the approval of implementing the tactical suggestions.

4.4.15.1. Rationale

The findings and results of MQFD will have to be used for company's sustained and continuous improvement. Hence, strategic decisions are required to be made for implementing the outcomes of MQFD. Since management holds the key, the task of making strategic decisions in this direction has been accomplished by the management (Madu, 2000).

4.4.16. Step 16

The tactical suggestions are implemented. The overall maintenance quality reaches the set target of 70%.

4.4.16.1. Rationale

Since the suggestions have to yield value and results (Ireland and Dale, 2001), they have to be tactic. As the title itself hints, tactic suggestions lead to the attainment of set targets.
4.4.17. Step 17

On observing the favorable impact of MQFD, management revises the target for attaining maintenance quality as 80%. In this background, the MQFD members prepare themselves to work along with quality engineers to proceed towards the conduct of next cycle of MQFD, which begins by the construction of new HoQ. Thus MQFD leads to overall maintenance quality improvement with a particular reference to the voice of customers.

4.4.17.1. Rationale

It is necessary to revise the targets for facilitating the company to achieve global competitiveness (Chan, et al., 2005). Since, customers’ views are changing from time to time, it is necessary to update the HoQ and carry out the subsequent steps. Now MQFD has to spread across the organization. Hence quality engineers and other competent personnel are also included in the MQFD implementation cycle. Thus MQFD is set to aid the company to achieve core competence through the threshold of enhancing maintenance quality.

4.5. Conclusion

In this chapter, the conceptual and implementation features of MQFD model have been presented. This model has been designed by the author by linking QFD’s HoQ with TPM principles. In order to configure this model for fitting it in practical situations, the author has integrated maintenance quality with the business performance parameters namely profit, core competence and goodwill with the MQFD model. In order to direct the MQFD program along the streams of management’s mission and policies, the provision for making the strategic decisions has been included. The author has presented a hypothetical case study, which illustrates MQFD’s implementation steps. The MQFD model and its implementation aspects were the foundations of this research work. The subsequent activities carried out during this research work on these foundations are presented in the following chapters of this thesis.