CHAPTER 2

LITERATURE REVIEW

2.1 STUDIES ON PERFORMANCE MANAGEMENT

Performance Measurement has evolved through four different phases since the early 1980’s. During the initial stage, the focus is only on traditional financial performance measures such as profit, return on investment, return on sales, price variances, sales per employee, profit per unit production and productivity. Of these performance measures, productivity has been considered as the primary indicator of performance (Ghalayini et al 1997). Traditional performance measures, developed from costing and accounting systems, have been criticized for encouraging short termism (Hayes and Garvin 1982), lacking strategic focus (Skinner 1974), encouraging local optimization (Fry and Cox 1989), encouraging minimization of variance rather than continuous improvement (Lynch and Cross 1991), not being externally focused (Kaplan and Norton 1992) and even for destroying the competitiveness of the manufacturing industries (Hayes and Abernathy 1980). Many enhancements such as lead time reductions, customer service and quality improvements are ignored. During this phase, companies implemented new technologies and new production management philosophies to be competitive in the market. The implementation of these changes have revealed that traditional performance measures have many limitations and the development of new performance measurement systems is required for the success (Ghalayini et al 1997).
During the second stage, numerous frameworks have been developed in order to overcome these criticisms. The literature of new measurement methods evolved in two main streams. One of these streams focuses on developing better financial tools that overcome the limitations of traditional financial performance measures. The second research stream stresses the importance of nonfinancial performance measures. The frameworks developed in this stream integrate nonfinancial and financial performance measures with a process approach, giving greater importance to measures such as customer satisfaction, employee satisfaction and defect rates. The newly developed performance measurement frameworks and various dimensions used to measure the performance are listed in Table 2.1. These models help organizations to define a set of measures which reflect their objectives and measure the performance appropriately.

<table>
<thead>
<tr>
<th>Framework</th>
<th>Researchers</th>
<th>Dimensions of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sink and Tuttle model</td>
<td>Sink and Tuttle</td>
<td>Effectiveness, efficiency, quality, productivity, quality of work life, innovation and profitability.</td>
</tr>
<tr>
<td></td>
<td>(1989)</td>
<td></td>
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<tr>
<td>Performance measurement matrix</td>
<td>Keegan et al</td>
<td>Cost, non-cost, internal environment, external environment</td>
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<tr>
<td></td>
<td>(1989)</td>
<td></td>
</tr>
<tr>
<td>Results and determinants framework</td>
<td>Fitzgerald et al</td>
<td>Results (financial performance, competitiveness); determinants (quality, flexibility, resource utilization, innovation)</td>
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<td></td>
<td>(1991)</td>
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</tbody>
</table>
Table 2.1 (Continued)

<table>
<thead>
<tr>
<th>Framework</th>
<th>Researchers</th>
<th>Dimensions of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance measurement system models</td>
<td>Lockamy (1991)</td>
<td>Cost, quality, lead time, delivery</td>
</tr>
<tr>
<td>Balanced scorecard</td>
<td>Kaplan and Norton (1992)</td>
<td>Financial, internal business, customer perspective, innovation and learning</td>
</tr>
<tr>
<td>EFQM model</td>
<td>European Foundation for Quality Management (1999)</td>
<td>Enablers, results</td>
</tr>
<tr>
<td>An integral performance measurement framework</td>
<td>Rouse and Putterill (2003)</td>
<td>Structure, processes, input, output, outcome and potentially others</td>
</tr>
</tbody>
</table>
These new performance measurement frameworks have answered the question “what types of measures should a company use?” but they did not provide specific advice to a company implementing a performance measurement system (Bourne et al 2000).

The third stage of evolution pertains to the development of various Performance Measurement Systems (PMS). To overcome the previous limitations associated with performance measurement frameworks, various integrated PMS have been developed. A PMS should (Dixon et al 1990; Bond 1999; Tangen 2004):

- support strategic objectives;
- have a limited number of performance measures and should convey information through these few and simple set of measures;
- provide an early warning detection system indicating what has happened;
- diagnose reasons for the current situation (often requiring explosion of aggregate performance measures into greater detail);
- guard against sub-optimization;
- indicate what remedial action should be undertaken;
- be easily accessible.

In comparison to PM frameworks, there are very few PMS in existence that have been academically developed (Folan and Browne 2005). Most of the PM systems developed in companies are a collection of best practices that have been grafted onto various PM frameworks. The three
academic PMS, which are being representative of the available PMS’ literature, are as follows: the balanced scorecard PMS (Kaplan and Norton 1992); Business Process Reengineering (BPR) PMS (Bradley 1996) and Medori and Steeple’s PMS (Medori and Steeple 2000). Moreover, according to Toni and Tonchia (2001), the main models of PMS can be referred under any of the following five typologies:

1. PMSs that are strictly hierarchical (or strictly vertical), characterized by cost and non-cost performance on different levels of aggregation, until they ultimately become economical.

2. PMSs that are balanced scorecard, where several separate performance measures, which correspond to diverse perspectives (financial, customer, etc.), are considered independently.

3. PMSs that can be called frustum, where there is a synthesis of low-level measures into more aggregated indicators, but without the scope of translating non-cost performance into financial performance.

4. PMSs that distinguish between internal/external performances.

5. PMSs that are related to the value chain.

PMS has been developed and used to identify poor performance and improvement areas, but fail to incorporate redesign of measures based on feedback from operations (Amaratunga and Baldry 2002). Performance measurement is merely the practical and technical exercise within the much wider “performance management” practice.
The fourth stage of evolution deals with the paradigm shift from performance measurement to performance management. The importance of looking beyond performance measurement and into performance management is supported by several authors (Otley 1999; Schmitz and Platts 2004; Folan and Browne 2005; Busi and Bititci 2006; Radnor and Barnes 2007). Performance Management can be defined as the use of performance measurement information to effect positive change in organizational culture, systems and processes, by helping to set agreed-upon performance goals, allocating and prioritizing resources, informing managers to either confirm or change current policy or programme directions to meet these goals, and sharing results of performance in pursuing those goals (Amaratunga and Baldry 2002). Figure 2.1 suggests the paradigm shift that has occurred in PM process. From mere financial recommendations, the PM process has evolved into performance management at present (Folan and Browne 2005).

*Figure 2.1 Evolutionary process of PM*
A performance management model would include the following key elements:

- a structured methodology to design the performance measurement system;
- a structured management-process for using performance measurement information to help make decisions, set performance goals, allocate resources, inform management, and report success (Amaratunga and Baldry 2002);
- a set of requirement specifications of the necessary electronic tools for data gathering, processing and analysis (Waggoner et al 1999);
- theoretical guidelines on how to manage through measures. Performance management systems are used to apply the information and knowledge arising from performance measurement systems (Adair et al 2003); and
- a review process to ensure that measures are constantly updated to reflect changes in strategy and/or market conditions (Waggoner et al 1999).

In a world of increasing global competition, the low wage economies of the developing world and the need for transparency and accountability pose a significant challenge to operations managers in both the manufacturing and service sectors. Measurement is the starting point for improving operational performance. The challenge is in measuring the right things and using those measures as the basis for managing performance improvement. Performance measurement and performance reporting without
performance management can be merely counter-productive (Radnor and Barnes 2007).

2.2 STUDIES ON SERVICE QUALITY MEASUREMENT

During the past few decades, service quality has become a major area of attention to practitioners, managers and researchers owing to its strong impact on business performance, lower costs, customer satisfaction, customer loyalty and profitability (Seth et al 2005). There has been a continued research on the definition, modeling, measurement, data collection procedure, data analysis etc., issues of service quality, leading to development of sound base for the researchers.

Seth et al (2005) have critically appraised 19 different service quality models and identified issues for future research based on the critical analysis of literature. The 19 models include:

1. Technical and functional quality model (Gronroos 1984),
2. GAP model (Parasuraman et al 1985),
3. Attribute service quality model (Haywood-Farmer, 1988),
4. Synthesized model of service quality (Brogowicz et al 1990),
5. Performance only model (Cronin and Taylor 1992),
6. Ideal value model of service quality (Mattsson 1992),
7. Evaluated performance and normed quality model (Teas 1993),
8. Information Technology (IT) alignment model (Berkley and Gupta 1994),
9. Attribute and overall affect model (Dabholkar 1996),
10. Model of perceived service quality and satisfaction (Spreng and Mackoy 1996),

11. Pivotal, Core and Peripheral (PCP) attribute model (Philip and Hazlett 1997),

12. Retail service quality and perceived value model (Sweeney et al 1997),

13. Service quality, customer value and customer satisfaction model (Oh 1999),

14. Antecedents and mediator model (Dabholkar et al 2000),

15. Internal service quality model (Frost and Kumar 2000),

16. Internal service quality DEA model (Soteriou and Stavrinides 2000),

17. Internet banking model (Broderick and Vachirapornpuk 2002),

18. IT-based model (Zhu et al 2002) and

19. Model of e-service quality (Santos 2003).

Seth et al (2005) reviewed these 19 service quality models and highlighted various issues, debates, strengths and weaknesses pertaining to these models. It was observed that the models focus on only one link (i.e. either marketer to consumer or front-line staff to supporting staff). However, Caruana and Pitt 1997; Reynoso and Moores 1995 have continuously pointed out the positive correlation of internal service quality (considering all the processes and operations associated in delivery of product or service) with business performance and the service quality delivered to the customer (including the distribution, marketing and other support functions).
The study points out that the key ingredients to service quality improvements are:

- clear market and customer focus
- motivated staff
- clear understanding of concepts of service quality and factors affecting the same
- effective measurement and feedback system
- effective implementation system
- efficient customer care system.

Among the various tools used for service quality measurement, SERVQUAL (Parasurman et al 1985) has been widely used by researchers. However, it is often criticized for considering the consumers’ expectations (Cronin and Taylor 1992; 1994). Other limitations of SERVQUAL lie in the measuring time and scale of service quality, according to Henug et al (2000).

Fuzzy logic (Zadeh 1965) is a precise logic of imprecision and approximate reasoning. Fuzzy logic can be viewed as an attempt at formalization/mechanization of two remarkable human capabilities. First, the capability to converse, reason and make rational decisions in an environment of imprecision, uncertainty, incompleteness of information, conflicting information, partiality of truth and partiality of possibility – in short, in an environment of imperfect information. And second, the capability to perform a wide variety of physical and mental tasks without any measurements and any computations (Zadeh 2008). Measurement of the perceived service quality is implemented usually through surveys with questionnaires (by phone, mail or in person). Hence, the subject of service quality is burdened by
fuzzy terms or buzzwords (e.g. attitude, taste, atmosphere), and customers may fill out the questionnaire subjectively based on their unique experience. To reflect the subjectivity and imprecision in the survey, the assessment made by the respondents can be represented as fuzzy sets (Yeh and Kuo 2003).

2.3 STUDIES ON TOOLS FOR PERFORMANCE MANAGEMENT

The literature pertaining to supporting tools used for Performance management like AHP, FAHP, EBG model, DEA, FQFD and FFMEA are reviewed in the following sections.

2.3.1 AHP and Fuzzy AHP

Analytical Hierarchy Process (AHP) is a multi criteria decision-making tool that has been used in almost all the applications related with decision-making (Saaty 1980). The usability of AHP in solving multiple criteria problems can be appreciated with its diverse applications in various fields: logistics, manufacturing, government, higher education, business, environment, military, agriculture, health-care, marketing, industry, service, sports, and tourism (Vaidya and Kumar 2006; Ho 2008).

The purpose of AHP is to capture the expert’s knowledge through pair wise comparison matrix. Over the years, there have been several criticisms related to the AHP’s reflection of human thinking style and its inability to accommodate uncertainty in the decision making process (Ayag and Ozdemir 2006; Haq and Kannan 2006; Jaganathan et al 2007). Therefore, fuzzy AHP, a fuzzy extension of AHP, is developed to solve the hierarchical fuzzy problems. Buyukozkan et al (2004) have compared the fuzzy AHP methods in literature based upon the important differences in their theoretical
structures and also provided the advantages and disadvantages of each method.

A few fuzzy AHP applications used by various researchers are: army operations (Cheng et al 1999), air-line service quality measurement (Tsaura et al 2002), catering service comparisons (Kahraman et al 2004), machine tool evaluation (Ayag and Ozdemir 2006), website evaluation (Bilsel et al 2006), supplier selection (Kahraman et al 2003; Haq and Kannan 2006; Chan and Kumar 2007), optimum maintenance strategies (Wang et al 2007), and manufacturing technology evaluation (Jaganathan et al 2007).

2.3.2 Data Envelopment Analysis (DEA)

Data envelopment analysis (DEA) is an analytical procedure for measuring the relative efficiency of Decision Making Units (DMUs) that perform the same type of functions and have identical goals and objectives (Charnes et al 1978). Using ‘i’ inputs, let the ‘N’ DMUs produce ‘j’ outputs and the resulting output–input structure of DMUs be as shown in Table 2.2. Let the $m^{th}$ DMU produce outputs $Y_{mj}$ using $X_{mi}$ inputs.

<table>
<thead>
<tr>
<th>DMUs</th>
<th>Output 1</th>
<th>...</th>
<th>Output j</th>
<th>Input 1</th>
<th>...</th>
<th>Input i</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMU 1</td>
<td>$Y_{11}$</td>
<td>...</td>
<td>$Y_{1j}$</td>
<td>$X_{11}$</td>
<td>...</td>
<td>$X_{1i}$</td>
</tr>
<tr>
<td>DMU 2</td>
<td>$Y_{21}$</td>
<td>...</td>
<td>$Y_{2j}$</td>
<td>$X_{21}$</td>
<td>...</td>
<td>$X_{2i}$</td>
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<tr>
<td>DMU N</td>
<td>$Y_{N1}$</td>
<td>...</td>
<td>$Y_{Nj}$</td>
<td>$X_{N1}$</td>
<td>...</td>
<td>$X_{Ni}$</td>
</tr>
</tbody>
</table>
The objective of the DEA exercise is to identify the DMU that produces the largest amounts of outputs by consuming the least amounts of inputs. This DMU (or DMUs) is considered to have an efficiency score equal to one. The efficiencies of other inefficient DMUs are obtained relative to the efficient DMUs, and are assigned efficiency scores between zero and one. The efficiency scores are computed using mathematical programming.

Four basic DEA models (models 1-4) presented below belong to CCR (Charnes, Cooper, Rhodes) version (Ramanathan 2006). These models can be used to calculate the DEA efficiency score of the $m^{th}$ DMU. The optimal objective function values of models 1 and 3, when solved, represent the efficiency score of the $m^{th}$ DMU. This DMU is relatively efficient if and only if their optimal objective function value equals unity. The optimal objective function values of models 2 and 4 represent the reciprocal of efficiency scores. Models (1-4) assume constant returns to scale (CRS) which is said to prevail when an increase of all inputs by 1% leads to an increase of all outputs by 1%. Models 1 and 3 are said to be input-oriented as the objective is to produce the observed outputs with a minimum input level. Models 2 and 4 are said to be output-oriented.

In all these models, decision variables are the values of the multipliers (elements of matrices $U$ and $V$ for Model 1, $U'$ and $V'$ for Model 2, $\lambda$ for Model 3, and $\mu$ for Model 4). Scalars $\sigma$ and $\Phi$ are also decision variables for models 3 and 4. The subscript “m” denotes the DMU for which efficiency computations are made. $X$ and $Y$ are the matrices of inputs and outputs, respectively, for all the DMUs, while $X_m$ and $Y_m$ are the matrices of inputs and outputs, respectively, for the $m^{th}$ DMU.
Model 1
Max \[ Z = V_m^T Y_m \]
\[ U, V \]
Such that
\[ U_m^T X_m = 1, \]
\[ V_m^T Y - U_m^T X \leq 0, \]
\[ V_m^T, U_m^T \geq 0 \]

Model 2
Min \[ Z' = U'_m^T X_m \]
\[ U', V' \]
Such that
\[ V'_m^T Y_m = 1, \]
\[ V'_m^T Y - U'_m^T X \leq 0, \]
\[ V'_m^T, U'_m^T \geq 0 \]

Model 3
Min \[ \Theta_m \]
\[ \Theta, \lambda \]
Such that
\[ Y \lambda \geq Y_m, \]
\[ X \lambda \leq \Theta_m X_m, \]
\[ \lambda \geq 0: \Theta_m \text{ free} \]

Model 4
Max \[ \phi_m \]
\[ \phi, \mu \]
Such that
\[ Y \mu \geq \phi_m Y_m, \]
\[ X \mu \leq X_m, \]
\[ \mu \geq 0: \phi_m \text{ free} \]

In order to obtain true performance frontier, a proper DMU number is required (Zhang and Bartels 1998). Due to inadequate number of degrees of freedom, an insufficient number of DMUs for a DEA model would tend to rate all DMUs 100% efficient. A rule of thumb for maintaining an adequate number of degrees of freedom when using DEA is to obtain at least two DMUs for each input or output measure (Bowlin 1987). Adequate care should be taken in selecting input/output measures and the list of DMUs.
Numerous researchers have used DEA for various applications: bank efficiency evaluation (Soteriou and Stavrinides 1997), hospital efficiency evaluation (Al-Shammari 1999), distribution center efficiency (Ross and Droge 2002), army maintenance shop evaluation (Sun 2004), manufacturing efficiency evaluation (Leachman et al 2005; Sofianopoulou 2006), supplier selection (Talluri et al 2006; Ramanathan 2007) and flexible manufacturing system selection (Shang and Sueyoshi 1995; Liu 2008).

The combined AHP–DEA approach has received less attention among the researchers. Only a few studies have focused on the applications of this approach. The application areas are government agency location selection, manufacturing facility layout selection and government performance evaluation (Ho 2008).

2.3.3 Extended Brown-Gibson (EBG) Model

The Brown–Gibson model (Brown and Gibson 1972) was developed for evaluating alternative plant locations using certain objective and subjective factors. This quantitative model helped in selecting the best location from a given set of alternatives. Punniyamoorthy and Aravindan (2002); Punniyamoorthy and Vijaya Ragavan (2003) used the modified Brown–Gibson model for justification of technology selection in a manufacturing system. This Extended Brown–Gibson (EBG) model has been used to assist in the strategic decision-making process considering both objective and subjective factors influencing the decision and addresses both time and cost dimensions in its objective factor measure.
2.3.4 **Fuzzy Failure Mode and Effect Analysis (FFMEA)**

The Failure mode and effects analysis (FMEA) is a technique used for defining, identifying and removing known and/or potential failures, problems, errors and so forth from the system, design, process, and/or service before they reach the customer (Stamatis 1995). FMEA identifies the potential failure modes and prioritizes the failure causes. The FMEA team decides the effect of each failure mode through Risk Priority Number (RPN) which is the product of the occurrence (O), severity (S) and detection (D) of a failure. However, in reality, the risk factors O, S and D are difficult to be precisely estimated. The crisp RPNs have been considerably criticized for the following reasons by various researchers (Braglia et al 2003; Pillay and Wang 2003; Bowles 2004):

i. Various combinations of O, S and D may produce exactly the same value of RPN, but their hidden risk implications may be totally different.

ii. While considering a practical application of FMEA, the relative importance among O, S and D cannot be treated equally.

iii. The three factors are difficult to be precisely estimated. Much information in FMEA can be expressed in a linguistic way such as Likely, Important or Very high and so on.

Most of the applications using fuzzy FMEA use if-then rules for prioritizing the failure modes (Xu et al 2002; Garcia et al 2005; Tay and Lim 2006; Guimaraes and Lapa 2007 and Chin et al 2008). A vast amount of knowledge and expertise is required in order to build huge if-then rules. Hence, in order to avoid building a big if–then rule base, Wang et al (2008)
used fuzzy weighted geometric mean (FWGM) for risk evaluation and prioritization of failure modes in FMEA.

2.3.5 Fuzzy Quality Function Deployment (FQFD)

Quality function deployment (QFD) is a planning and problem-solving tool that is used for translating customer requirements (CRs) into design characteristics (DCs) of a product / service (Hauser and Clausing 1988). QFD is a customer-oriented quality management and product development technique originally used for hard products, but its ideas are by no means inapplicable to soft services. Indeed, it was gradually introduced into the service sector to design and develop quality services. The wide acceptability of the QFD technique can be shown from its reported applications in various service areas such as accounting, administration, banking, contracting, engineering services, food distribution, government services, hotels, on-line bookshops, mortgage, professional services, public sectors, real estate appraisal, retail, technical library and information services, wholesale and in particular, healthcare (Chan and Wu 2002).

The QFD process finally yields a systematic and graphical diagram called House of Quality (HoQ) which highlights the DCs in terms of their influence on CRs. A typical HoQ contains information on “what to do” (CRs), “how to do” (DCs), correlation matrix between CRs and DCs, a correlation matrix among DCs and competitors benchmarking data. When the important critical customer needs are concentrated properly, then the results from QFD process will be very effective (Karsak 2004). Using crisp values for assessing the importance of customer needs, degree of relationship between customer needs and design requirements, and degree of relationship among the design requirements have been criticized by several authors (Karsak 2004; Bevilacqua et al 2006; Kwong et al 2007). The imprecise design information
can be represented effectively by linguistic variables and triangular fuzzy numbers. Using fuzzy set theory, the value of a linguistic variable can be quantified and extended to mathematical operations (Chen and Weng 2003).

Only very few studies related to combining QFD and FMEA for an improvement process exist in the literature. A methodology for investigating the interaction between QFD and FMEA by cross-functional and multi-disciplined teamwork has been proposed by Ginn et al (1998). A customer-focused methodology for the built-in reliability to maximize customers’ satisfaction based on the constrained resources by combining the FMEA and QFD has been developed by Tan (2003). However, their studies are only limited to descriptive analyses for obtaining the quality and resource benefits. The methods to carry out the aggregation of QFD and FMEA are not mentioned, and the uncertainty at the product design stage is not considered, either. Chen and Ko (2009) integrated fuzzy FMEA into the existing fuzzy QFD approach for determining the achievement levels of design requirements and part characteristics in order to maximize the customers’ satisfaction.

2.4 STUDIES ON AUTOMOBILE SERVICE INDUSTRY

Numerous works from automotive manufacturing industry have been reported in operations management literature. However, works related to automotive service industry are rarely found in the literature (Brito et al 2007). Automotive service industry includes vehicle servicing, repairing and breakdown and recovery services. Literature related to service attributes and the service quality measurement in car service industry can be gained from previous studies on car maintenance services. Starting with 42 attributes, Bouman and Wiele (1992) evaluated the service quality of the Dutch car service industry and concluded that three attributes namely kindness,
tangibles and faith can be used in a car service industry against the SERVQUAL instrument's five dimensions.

Chen and Ting (2002) have conducted a study in automobile repair shops using grey relationship analysis and proved that service quality and customer satisfaction are two different constructs in the minds of the consumers. Ten influencing factors proposed by Parasuraman et al (1985) have been used to measure the service quality of repair shops. Behara et al (2002) used neural network for effective service quality measurement in an auto-dealership network at Thailand using the following 36 parameters:

1. Waiting before appointment
2. Replacement car during maintenance
3. Replacement car during repair
4. Friendly personnel
5. Correct problem analysis
6. Fast reaction to complaints
7. Estimate before maintenance/repair
8. Convenient location from home
9. Convenient location from work
10. Dealer always ready for customer
11. Available for customer to contact
12. Personal treatment
13. Work done right the first time
14. Small problems are solved without payment
15. Fast treatment of guarantees
16. Tries to keep the bill low
17. Keeps appointments
18. Direct help in case of an emergency
19. Advice when customer takes car back
21. Dealer tries to “live” problem of customer
22. Service mentioned by customer is carried out
23. Sufficient parking space
24. Spare parts immediately available
25. State of car (chair/mirror) unchanged
26. Car treated carefully
27. Dealer must make clear what has been repaired
28. Bill is clear and correct
29. Technical equipment is modern
30. Car ready as promised
31. Dealer reminds when guarantee has ended
32. Car cleaned after maintenance/repair
33. Work done is clearly indicated on bill
34. Cost estimates are equal to the bill
35. Reception area is clean
36. Garage area is clean

Using neural network approach, different definitions of service quality are modeled and analyzed. It is concluded that perception-only model of service quality is more accurate than perception-minus-expectation model in predicting service quality.
Brito et al (2007) used 30 service attributes to evaluate the Brazilian customers’ preference in choosing a branded dealer or an independent garage for providing maintenance service and these attributes are as follows:

1. Ability to absorb non-estimated costs generated by internal problems or failures
2. Ability to anticipate problems
3. Accuracy and correctness of invoice and receipt
4. Adequate opening hours
5. Attendants’ cooperation and quick response
6. Attendants’ trustworthiness
7. Attention to modifications demanded by the customer
8. Attention to service details
9. Employees’ discretion
10. Employees’ willingness to get to know customers
11. Employees’ appearance
12. Employees’ courtesy and politeness
13. Employees’ knowledge and experience
14. General equipment condition
15. General site condition
16. Getting it right first time
17. Giving the customer individual and personal attention
18. Image of being reliable
19. Keeping promises
20. Keeping to agreed schedule
21. Keeping to original forecasted price
22. Mechanics’ trustworthiness
23. Organization’s climate and environment
24. Prompt price change communication
25. Value for money service
26. Willingness to adapt to customer schedule
27. Willingness to adopt specific solutions
28. Willingness to explain service development
29. Willingness to negotiate
30. Willingness to solve the customer’s problems

The results showed that the branded dealers’ service operation is relatively weak when compared to independent garages. Among the 30 service attributes, customers preferred branded dealers only for better equipment condition while they preferred independent garages for three service attributes namely value for money, adherence to forecast prices and mechanical reliability. SERVQUAL has been used as a tool to collect the customer preference.

All these studies used either SERVQUAL instrument or Likert scale survey questionnaire to collect the data regarding perceived service quality. The statistical analysis of the results gained from the Likert scale survey using traditional methods is cumbersome. Moreover, the subjective assessment of the service process using SERVQUAL or SERVPERF instruments is intrinsically imprecise and ambiguous (Williams and Zigli 1987). To reflect the subjectivity and imprecision in the survey, the assessment made by the respondents can be represented as fuzzy sets (Yeh and Kuo 2003). Liou and Chen (2006) proposed a conceptual model to assess
the perceived service quality in a family-owned copy shop using fuzzy set theory and customers' vague linguistic terms. It is proven that the fuzzy linguistic assessment of service quality is much closer to human thinking than methods based on crisp numbers (Benitez et al. 2007).

2.5 CONCLUSIONS FROM THE LITERATURE REVIEW

The above presented extensive literature review in the field of Performance Management and its supporting tools revealed the following:

i) Most of the researchers have concentrated on manufacturing performance while service performance measurement is still a relatively new topic for research.

ii) The available literature related to performance frameworks show what to measure, but give little guidance when it comes to the question of how to measure it.

iii) Majority of the service organisations still uses production measures as performance dimensions. A multi-dimensional analysis with cost, time and service quality as performance measures in the service sector is rarely found in the literature.

iv) The quantity and quality dimensions of service offering cannot be treated in isolation. Hence, both the quantity and quality aspects must be considered together to provide a joint impact on the total performance of the service firm.

v) From the very few studies in service performance management, the interaction of tools like AHP, FAHP, fuzzy logic, EBG model, DEA, FQFD and FFMEA is rarely found.
vi) The perceived service quality can be measured precisely with fuzzy set theory using customers' vague linguistic terms. It is evident that the fuzzy linguistic assessment of service quality is much closer to human thinking than methods based on crisp numbers.

vii) An integrated approach to the performance management process in auto repair shops is rarely found in the literature.

From the literature, it is evident that, a multidimensional analysis in service organizations is non-existent. Hence, this provides a research agenda for the development of a new methodology to measure and improve the service performance. Based on the conclusions from literature review, the following research objectives are framed:

(i) To develop an integrated closed loop service performance management model using various techniques like FAHP, fuzzy logic, EBG, DEA, FFMEA and FQFD.

(ii) To use cost and time as the quantitative dimensions and service quality as the qualitative dimension in the service performance management process.

(iii) To illustrate the developed models with case studies from automobile repair shops.

The above objectives have been the basis for the present research work. Various models developed in order to meet the research objectives are explained in the following chapters.