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# Determining Manufacturing Qualities utilizing a Fuzzy-Based Approach

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**Abstract**
The Manufacturing qualities are integral factor within the manufacturing industries, for it not only determine survival but also efficient of an organization. Most of the implemented manufacturingapproaches in attaining qualities are subjective in nature. A fuzzy Based approach was adoptedin initiatingobjective processes. This paper demonstrates the practical application of fuzzy logic techniques in the obtaining qualities of manufacturing.

**Keywords:** Fuzzy Logic, Manufacturing Qualities, Fuzzy Set, Fuzzy Theory.

## INTRODUCTION

The term quality as applied to manufactured products may be defined as that characteristics or combination of characteristics which distinguishes one article from another, or the goods of one manufacturer from those of their competitors, or one grade of product from another when both are turned out by the same factory. Quality is dual: on the one hand it serves to identify the article and on the other, it is equivalent to the degree of perfection. It is not absolute and can only be judged or realized by comparison with some pre-determined standards. When such a standards have been specified, then the quality of the product can be described as "better or worse" or "higher or lower" than the established quality specifications. In other words, quality is a variable and, when the permissible limits of variability have been stated, quality can be adequately defined for all practical purposes.

Controlling and improving quality in term of "Quality Control" has become an integral component for any well-meaning organization (Neuman, 2006) harnessing business strategy for many organizations (manufacturers, distributor, transportation companies, financial services organizations, health care providers and government agencies). Quality is a competitive advantage. A business that can delight customers by improving and controlling quality can dominate its competitors (Basu, 2004). Quality can be defined as "the degree to which the design vulnerabilities do not adversely affect product performance (El-Haik and Roy, 2005).

Quality cannot also mean fitness for use. There are two general aspects of fitness for use (Basu, 2004):

a. **Quality of Design:** The variation in grade or level of quality of a particular good or services at a particular point in times is technically termed "Quality of Design" in which are intentional. These differences are the result of intentional design differences among the types of automobiles. These design differences include the types of materials used in construction, specifications on the components, reliability obtained through engineering development of engines and drive trains, and other accessories or equipment utilized.

b. **Quality of Conformance:** The quality of conformance is how well the product conforms to the specifications required by the design. Quality of conformance is influenced by a number of factors, including the choice of manufacturing processes, the training and supervision of the workforce, the types of process controls, tests, and inspection activities that are employed, the extent to which these procedures are followed, and the motivation of the workforce to achieve quality.

The main focal point of this research paper is geared toward initiating a Fuzzy-Based System (FBS) for determining quality delivered within the manufacturing sectors using these factors;

a. **Money:** Most important factor affecting the quality of a product is the money involved in the production itself. In the present day of tough and cut throat competition, companies are forced to invest a lot in maintaining the quality of products.

b. **Materials:** To turn out a high quality product, the raw materials involved in production process must be of high quality.

c. **Management:** Quality control and maintenance programmes should have the support from top management. If the management is quality conscious rather than merely quantity conscious, organisation can maintain adequate quality of products.

d. **People (Manpower):** People employed in production, in designing the products must have knowledge and experience in their respective areas.

e. **Market:** Market for the product must exist before quality of the product is emphasized by management. It is useless to talk about the quality when the market for the product is lacking. For example, there is no demand for woollen garments in the hot climates (e.g., Southern part of India).

f. **Machines,:**To maintain high standards of quality, companies are investing in new machines.

g. **Methods and Methodologies:** Following new procedures and methods are essential for Quality attainment with these industries.

## REVIEW OF RELATED WORKS

Muir (2006) focused on a quality movement in which his method included a Statistical Process Control (SPC) and problem-solving techniques that were very effective in gaining the necessary momentum to change the mentality of organization needing to produce high quality products and services. Deming developed his 14 points, to communicate to managers how to increase quality within an organization. In his research Deming believed that that 85 percent of all quality problems were the fault of management. In order to improve, management had to take the lead and put in place the necessary resources and systems. For example, consistent quality in incoming materials could not be expected when buyers were not given the necessary tools to understand quality requirements of those products and services. Buyers needed to fully understand how to assess the quality of all incoming products and services, understand the quality requirements, as well as be able to communicate these requirements to vendors. In a well-managed quality system, buyers should also be allowed to work closely with vendors and help them meet or exceed the required quality requirements.

The theory of fuzzy logic provides a mathematical strength to capture the uncertainties associated with human cognitive processes, such as thinking and reasoning. In standard set theory, an object does or does not belong to a set. There is no middle ground. In such bivalent systems, an object cannot belong to both its set and its compliment set or to neither of them. This principle preserves the structure of the logic and avoids the contradiction of object that both is and is not a thing at the same time (Zadeh, 1965). However, fuzzy logic is highly abstract and employs heuristic (experiment) requiring human experts to discover rules about data relationship (Angel and Rocio, 2011).

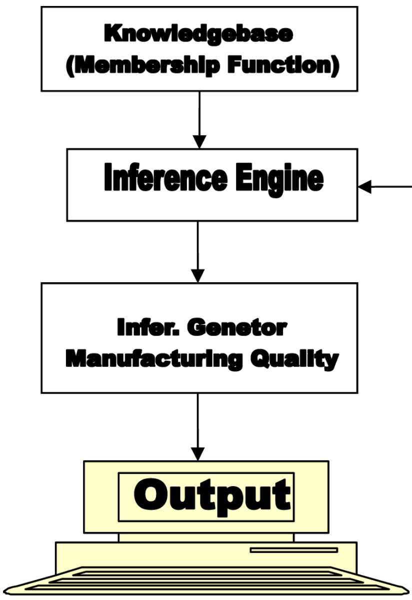
Fuzzy classification assumes the boundary between two neighbouring classes as a continuous, overlapping area within which an object has partial membership in each class (Kuang et al., 2011**).** Fuzzy logic highlights the significant of most applications in which categories have fuzzy boundaries, but also provides a simple representation of the potentially complex partition of the feature space. (Sun and Jang**,** 1993 and Ahmad, 2011) Conventional approaches of pattern classification involve clustering training samples and associating clusters to given categories. The complexity and limitations of previous mechanisms are largely due to the lack of an effective way of defining the boundaries among clusters. This problem becomes more intractable when the number of features used for classification increases (Christos and Dimitros, 2008).

## METHODOLOGY, RESULT AND DESIGN

From the review of Quality systems in the manufacturing industries, one can summarily say that most of the implemented approaches are subjective in nature and as a result an objective approach is necessary. In addition, proposing a Fuzzy-Based System (FBS) for determining manufacturing quality.

The proposed model is an architectural framework which enhances the fuzzy (inexact) information prevalent within the manufacturing industries with the aim of establishing a conclusive boundary point. Unlike the current approaches, in which success or failure are based on the wills and experiences of relevant personnel designing and administrating the approach in other to elicit relevant manufacturing qualities. This model is artificial intelligence based; therefore success and failure are not dependent on human intuitions, but success is closely linked within tuned-up approaches within the system components. Figure 3.1 presents our proposed soft-computing model.

**Figure 3.1:** Fuzzy- Base Model for Manufacturing Quality Assessment




Each of the components of the proposed system is discussed thus:

a. ***Knowledgebase:*** The linguistic variable (fuzzy set or criterias) for identifying a Maufacturing quality, the fuzzy-If-then rules and the supervised feed-forward learning paradigm resides in the knowledgebase of our proposed model.

b. The ***Inference Engine*** is the heart of the proposed model which combine the respective components to achieve the set-down objective or result of identifying a manufacturing quality.

c. ***Fuzzy Logic:*** the impreciseness (vagueness) associated with the criterias for identifying a particular peageant is resolved utilizing the rich facilities of fuzzy rules

d. ***The stationery system:*** the stationery system or mobile device in the proposed model provides the end-user with the generated result based on the interaction of this components.

The dataset presented in Table 1, residing within the knowledgebase of our proposed model was obtained through a research survey, utilizing questionnaires as the research tool for gathering data. The quantitative and qualitative questionnaires comprises of two segments. The first phase contains demographic information while the second phase comprises of manufacturing quality questions with the aim of eliciting relevant manufacturing questions. A total of fifty questionnaires were constructed and distributed to various patients spread across several manufacturing industries within Nigeria. All questionnaires administrated by the researchers were retrieved without mutilation.

**Table 1:** Data set showing pertaining to Manufacturing Quality

| Parameters or Fuzzy sets For Manufacturing Qualities | Codes | Membership Function for Manufacturing Qualities | | |
|---|---|---|---|---|
| | | Cluster 1 ($C_1$) | Cluster 2 ($C_2$) | Cluster 3 ($C_3$) |
| Money | R01 | 0.70 | 0.15 | 0.15 |
| Materials | R02 | 0.30 | 0.15 | 0.55 |
| Management | R03 | 0.20 | 0.65 | 0.15 |
| People (Man power) | R04 | 0.15 | 0.15 | 0.60 |
| Market | R05 | 0.30 | 0.60 | 0.10 |
| Machines | R06 | 0.20 | 0.10 | 0.70 |
| Method and Methodologies | R07 | 0.00 | 0.50 | 0.50 |

The generated results in table 2 were achieved utilizing the fuzzy membership function boundary of 0.53 for determining high degree membership function and low degree membership function.The fuzzy partition for each input feature consists of the parameters for assessing manufacturing qualities. The fuzzy rules that can be generated from the initial fuzzy partitions for the classification ofmanufacturing qualitiesare thus:

a. Low Manufacturing Qualities (Class: $C_1$)
b. ModerateManufacturing Qualities (Class: $C_2$)
c. High Manufacturing Qualities (Class: $C_3$)

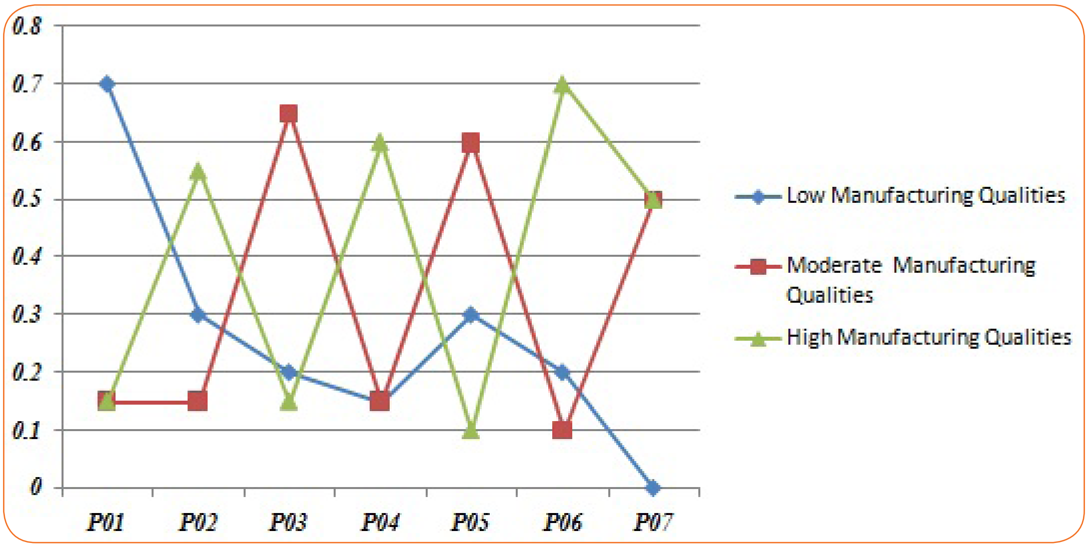
If the firm, company or industry is (F, C, I) experiences less than or equal to two (F,C, I $\leq$ 2) of the parameters for assessing manufacturing qualities *THEN* ($C_1$), if the firm, company or industry is (F, C, I) is experiences three (F, C, I = 3) of the parameters for assessing manufacturing qualities *THEN* ($C_2$) if the firm, company or industry is (F, C, I) is experiences four (F, C, I $\geq$ 4) or more of the parameters for assessing manufacturing qualities *THEN* ($C_3$).

**Table 2:** Data set showing pertaining to Manufacturing Quality

| Parameters or Fuzzy sets For Manufacturing Qualities | Codes | Membership Function for Manufacturing Qualities | | |
|---|---|---|---|---|
| | | Cluster 1 ($C_1$) | Cluster 2 ($C_2$) | Cluster 3 ($C_3$) |
| Money | R01 | 0.50 | 0.15 | 0.35 |
| Materials | R02 | 0.20 | 0.20 | 0.60 |
| Management | R03 | 0.10 | 0.80 | 0.10 |
| People (Manpower) | R04 | 0.20 | 0.10 | 0.70 |
| Market | R05 | 0.30 | 0.60 | 0.10 |
| Machines | R06 | 0.05 | 0.05 | 0.90 |
| Method and Methodologies | R07 | 0.00 | 0.50 | 0.50 |
| **Result** | | Low Manufacturing Qualities | Moderate Manufacturing Qualities | High Manufacturing Qualities |

Table 2 represents the degree of membership function for manufacturing qualities, for instance, R05 in cluster 1, we notice it has 0.30. In percentage, it can be represented as 30%, in cluster 2, 60%, and in in cluster 3, 10%. This means that the degree of membership function in ascertaining manufacturing quality in P05 matches **30% of Low Manufacturing Qualities, 60% of Moderate Manufacturing Qualities** and **10% of High Manufacturing Qualities.** The Fuzzy clustering graphical distribution shown Figure 2 depicts one criterion with high degree of membership function for **Low Manufacturing Qualities,** three criteria with high degree of membership function of **Moderate Manufacturing Qualities**, four criteria with high degree of membership function of **High Manufacturing Qualities**.

**Fig. 2:** Graphical Representation highlighting the Degree of Membership Function for manufacturing qualities




## CONCLUSIONS

This research paper has demonstrated the practical application of fuzzy logic in its application to determining manufacturing qualities. The proposed model which uses a set of fuzzified data set incorporated is more precise than the traditional system. The system designed is an interactive system which specifies varied ranges of manufacturing qualities.

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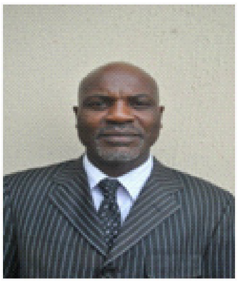

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