International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

THE SUPERVISORYPROPOSAL STUDY ON SEWING MACHINE DESIGN EXPANSION BASED ON THE QFD

[1]PATNAM SANTHI PRIYA, [2]T.NARESH KUMAR, [3]K.SRINIVASA RAO

[1&2]Asst.Professor, Department of Mechancial Engineering, Malla Reddy Engineering College (Autonomous), Maisammaguda(H), Gundlapochampally Village, Secunderabad, Telangana State – 500100

[3]Assoc.Professor, Department of Mechancial Engineering, Malla Reddy Engineering College (Autonomous), Maisammaguda(H), Gundlapochampally Village, Secunderabad, Telangana State - 500100

Abstract

The speed of the new product development insewing machine industry is slow. Due to the influence of thegeneral situation of sewing industry, time and funds,combined with the uncertainty of the development result,the enterprises find hard to make decision on how and whento develop their new products or improve old ones, thoughthey have eager and strong desire. To meet the verydemands, the article introduces the QFD, sets up the houseof quality, and ensures the best group of the improvementmeasures and contribution under the restriction of the cost.

INTRODUCTION

From the view of Life Cycle of Engineering Designtheory (LCED), modern Design starts on the voice ofCustomer and ends with the customer's use and reject.And one of the basic features of modern design is'Modern design is driven by customer'.[1] Many studiesagree that the early decision-making design, thoughsharing 8% cost of the whole, determines the effect of85% cost in the life cycle. Therefore, how to scientificallymake the decision in early stage of design is veryimportant.

The decision-making design has been studied in theAngle of Knowledge Reasoning by Ma Jun[2], in the viewof entropy method by Zhou Chaoyangetc[3]. But theirstudies both concentrate on evaluation and choice amongthe design cases, and have not involved the transformationof the VOC to the engineering technological target and theoperating specification reasonably and effectively. ZhaoDaozhi[4] has made study the decision-making design todecide which engineering method gives priority tomeeting the VOC at the constraints of time and cost. Butas the major subjects, the different customers' preference,purpose and focus were ignored in the weighing values ofcustomer's demands. QFD, used in the article, is a way to convert Voice ofCustomer (VOC) into Product Quality Characteristics(PQC), to determine the weightings of the each PQC, andto plan these items. [5]Currently, the new product development speed insewing machine industry is slow. Due to the generalsituation of sewing industry, time and funds, combinedwith the uncertainty to the development result,

theenterprises find hard to make decision on how and whento promote their new products, though they have eagerdesire.

In view of this atmosphere, the article introduces theQFD, setups the house of quality, and ensures the bestgroup of the improvement measures from all under therestriction of the cost.

Voice of Customer (VOC) methodology can be used to capture the customer needs – both current (stated needs) and latent (unstated needs). VOC methodology helps capture the needs of customer through stated verbatim comments (customer voices). It helps translate verbatim comments (customer voices) into customer needs to product/service output characteristics (customer requirements).

Sewing machine

A **sewing machine** is a machine used to sew fabric and other materials together with thread. Sewing machines were invented during the first Industrial Revolution to decrease the amount of manual sewing work performed in clothing companies. Since the invention of the first working sewing machine, generally considered to have been the work of Elias Howe, and Englishman Thomas Saint in 1790,[1] the sewing machine has greatly improved the efficiency and productivity of the clothing industry.

Home sewing machines are designed for one person to sew individual items while using a single stitch type at a time. In a modern sewing machine the fabric easily glides in and out of the machine without the inconvenience of needles and thimbles and other such tools used in hand sewing, automating the process of stitching and saving time. Early sewing machines were powered either by constantly turning a handle, or with a treadle mechanism; electrically-powered machines were later introduced.

Industrial sewing machines, by contrast to domestic machines, are larger, faster, and more varied in their size, cost, appearance, and task.

A model of the machine is exhibited in London at the Science Museum. The machine is made of wood and uses a barbed needle which passes downward through the cloth to grab the thread and pull it up to form a loop to be locked by the next loop. The first American lockstitch sewing machine was invented by Walter Hunt in 1832.[7] His machine used a needle with the eye and the point on the same end carrying the upper thread, and a falling shuttle carrying the lower thread. The curved needle moved through the fabric horizontally, leaving the loop as it withdrew. The shuttle passed through the loop, interlocking the thread. The feed was unreliable, requiring the machine to be stopped frequently and reset up. Hunt eventually lost interest in his machine and sold individual machines without bothering to patent his invention, and only patenting it at a late date of 1854. In 1842, John Greenough patented the first sewing machine in the United States. The British partners Newton and Archibold introduced the eye-pointed needle and the use of two pressing surfaces to keep the pieces of fabric in position, in 1841.

The first machine to combine all the disparate elements of the previous half-century of innovation into the modern sewing machine was the device built by

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English inventor John Fisher in 1844, a little earlier than the very similar machines built by Isaac Merritt Singer in 1851, and the lesser known Elias Howe, in 1845. However, due to the botched filing of Fisher's patent at the Patent Office, he did not receive due recognition for the modern sewing machine in the legal disputations of priority with Singer, and Singer reaped the benefits of the patent.

Proposed method

The Focuses on helping enterprises toselect suitable measure group to meet the requirement ofVOC under the cost restriction.Though the paper takes the example of sewingEnterprises, the research concept and methods can also beapplied to other industrial enterprises.

METHODOLOGY

SETTING UP THE SEWING MACHINE HOUSE OFQUALITY BASED ON THE ASI MODEL

GFD method mainly includes two models: ASI andGoal/QPC. In accordance with the characters of the sewing machine, the article takes the ASI model. The house of quality (HOQ) is the basis and tools of the ASImodel. The ASI model divides the VOC into four periodssuch as: product planning, parts planning, processplanning and production planning. A HOQ is builtaccording to each period.The study mainly focuses on the infant stage of the sewing machine development, so, the study is carried outbased on the further computation and construction of theproduct planning HOQ.

The brief HOQ of the sewing machine is shown asfollows:

Setting up the improved design house of qualityTake the example of certain sewing enterprise, theenterprise applies QFD method to setting up house of quality, when they plan to improve their products. HOQincludes 4 customer's requirements: Weak sewingapplicability (CR1), oil stain pollution to the sewingproducts (CR2), high power consumption (CR3), loudnoise and big vibration (CR4) and slow step of the productreform.(CR5), and 9 improvement measures are:improving cloth-feeding mechanism (EC1), improvingthread-picking mechanism (EC2), adopting hermetic fuelsupply (EC3), introducing oil-free technology into somemechanism, such as hook and picking thread bar (EC4),using servomotor (EC5), servomotor driving the up-axisdirectly (EC6), driving with synchronous belt (EC7), wholemachine simulation analysis and moving parts lightweight(EC8) and design outsourcing (EC9). The number ofselected typical customers is 4, that is:

According to these information, the sewingimprovement design House of Quality is built as figure.2.

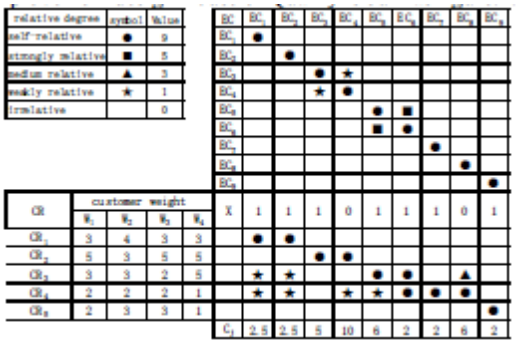

figure 2. the sewing improvement design House of Quality

The Autocorrelative matrix P, Relationship matrix Rand customer's requirement weighting matrix W list isshown as follows:

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$$P=\begin{bmatrix}1&0&0&0&0&0&0&0&0\\0&1&0&0&0&0&0&0&0\\0&0&1&0.1&0&0&0&0&0\\0&0&0.1&1&0&0&0&0&0\\0&0&0&0&1&0.56&0&0&0\\0&0&0&0&0.56&1&0&0&0\\0&0&0&0&0&0&1&0&0\\0&0&0&0&0&0&0&1&0\\0&0&0&0&0&0&0&0&1\end{bmatrix}$$

$$R=\begin{bmatrix}9&9&0&0&0&0&0&0&0\\0&0&9&9&0&0&0&0&0\\1&1&0&0&9&9&0&3&0\\1&1&0&1&1&9&9&9&0\\0&0&0&0&0&0&0&0&9\end{bmatrix}$$

$$W=\begin{bmatrix}3&4&3&3\\5&3&5&5\\3&3&2&5\\2&2&2&1\\2&3&3&1\end{bmatrix}$$

B. Solving the Optimized design decision-makingmodel

The X shows that, with the restriction of 250,000 Yuancost, improving cloth-feeding mechanism (EC1),hread-picking mechanism (EC2), adopting hermetic fuelsupply (EC3), using servomotor (EC5), servomotor drivingthe up-axis directly (EC6), driving with synchronous belt(EC7) and design outsourcing (EC9) can be all carried outto improve the sewing machine, and can maximize thesatisfaction level of the 4 typical customers.

V. CONCLUSION

The study mainly focuses on helping enterprises toselect suitable measure group to meet the requirement ofVOC under the cost restriction.Though the paper takes the example of sewing

Enterprises, the research concept and methods can also beapplied to other industrial enterprises.

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