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Experimental Designing about R&D Risk Based Quality Function Deployment

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Abstract: R&D is one of essential factors of technological innovation system. Here a new R&D project risk management frame is proposed. This framework effectively unifies quality function deployment (QFD) with risk management, and then we design evaluation experiment. The goal is that the participants can positively appraise the risk management frame in subjective feeling and experience appraisal as so on. Therefore, supporting such hypothesis: the platform coming from the predetermined risk management frame can specifically influent the policy-making execution.
Key words: research and development (R&D); R&D project; risk management; QFD

1. INTRODUCTION

R&D ability immediately influences technology advancement, thus influences national industrialization advancement, economic development stamina and international competitiveness. Our country Enterprise was in abundance has enlarged investment to the R&D in recent years, especially in High-tech enterprises. But contrasting with the high investment, the R&D investment's success ratio was actually low. And one of important reasons is the relative lag's R&D investment management of the risk project was not already suitable fast development of the R&D investment with high-tech characteristic. In R&D risk management frame, risk essential factors can be lawyerly decomposed to R&D each staged upon using the QFD method through the relational matrix. Through customer competitiveness analysis and technical competitiveness analysis, flooding the massive judgment analysis in the process, this causes early decision-making in the performance history to be more careful and objective ◦ Therefore the R&D source management may be realized. The following risk which caused from designing can be avoided as a result. At the same time, QFD also stresses the expert participation and the group cooperation. This enables the benefit counterparts sensate and understand the risk and the uncertainty in the R&D process .This might give the choice process which need certain technical knowledge or throwing to the customer formerly to the experts to solve. Not only this breaks barrier between functional departments, but promotes exchange and cooperation between departments. This is also advantageous in realizing the R&D “parallel” design process, thus reduces even eliminates the adverse consequences and

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accident causing communicate impetration.

2. FACTORS ANALYSES BETWEEN QFD METHOD AND R&D RISK MANAGEMENT

2.1 Primary meaning of QFD

Quality function deployment (QFD) is a method that transforms the customer request as the project objective and the main quality assurance depending on product promoting to improve design quality satisfied customers. QFD is regarded as transforming the customer request as “quality character”. This can promote design quality of terminal products. Through systematically adjusting relations between the user's needs and the quality characters, starting from each part of service quality, each part and each process quality improvement is realized. Guinta(Akao, Y. & Mazur, G., 2003) thought that QFD is an effective tool which helps R&D organizations to research and develop high- grade products by small costs and provide a more effective service. The numerous scholars also believed that using QFD, not only can effectively listen to the customers’ opinions, understand the customers’ demand, but may also determine how to use the existing condition to meet the customer need by logic reasoning system. King, B (Guinta, L. & Praizler, N. 1993). thought that QFD is one designing products and service system based on the customer requests .It involves all producers or the suppliers. Sullivan (King, B. 1987) pointed that QFD suitably transforms customers’ request as specification of product development and each production stage .In brief, all QFD management theories take the customers as the center and pay great attention to use one system effective method.

The QFD process is completed through a series of graphs and matrices. The shapes of these matrices and graphs are very likely as a series of houses, therefore is called vividly “house of quality, HOQ”. It is the core that actuates entire QFD process. Usually HOQ is shown in Figure 1. It is composed of the following several generalized matrix parts: WHATS matrix, expressing what demanded; HOWS matrix, expressing how to do in view of the demands; co relational dependence matrix, indicating co relational dependence between WHATS; HOWS reciprocity matrix, indicating relations of HOWS in various projects; appraisal matrix, indicating appraisal situation to organizations or technical costs in HOWS; competitive either the feasible appraisal matrix, using to feasibility analysis comparisons about competitive powers .After establishing HOQ, the output item of - HOWS item are obtained through qualitative and quantitative analysis, namely the transformation has completed from” demand anything” to “how to do”.

2.2 QFD method and R&D project risk management

One of biggest merits of QFD is that we the effective plan and the prevention in the product early time design stage can be made in the product design, thus this can avoid doing over and the duplicated work in the later R&D period. The product plan matrix is the core of QFD. It uses the matrix to launch the way to carry on the appraisal separately the similar products in the market from customer's angle and technology angle. It is composed of the customers’ demand, the technical demand, market competition ability, technology competitive ability and so on. These are the essential factors of R&D risk management. The risk management frame based QFD provide one effective method to the R&D project's benefit counterparts to manage the risk and the uncertainty of the R&D project The risk management frame's execution platform has certain inflections for executing and understanding the policy-making .Through the QFD implementation and the movement, enhance consciousness that R&D face the customers’ demand directly. It has the inestimable function to enterprise's development.

3. THE EXPERIMENTAL DESIGN BASED ON QFD PROMOTION- VERSION SOFTWARE PLATFORM

We do an experimental design-- research and develop a section of new traveling wave electric motor. This is cooperative project between in Jiangsu chunsheng supersonic electrical machinery Limited company and of Aeronautics and Astronautics Precise Actuation Research Institute of Nanjing University. The experiment mainly launches in 3 teams. There are 4 people each group. The experiment goal is to examine the validity of R&D risk management frame. It specifically focuses on the customer value formation during R&D process, and establishes the risk matrix to carry on the analysis.

3.1 Experiment advancement

The appraisal experiment of risk management frame in QFD promotion- version software platform mainly be carried on by t three group of student team, whose serial number is #100, #200 and #300, and each group has 4 students. There will be the different risks in the R&D project's different periods of traveling wave electric motor. We may determinate different risk assessment indicator system according to the different stage of the project. This can manifest the dynamic of risk assessment. The risk factor analysis is that to determine the risk types and the scope of a project. Namely, which risk existences .These risk factors are listed one by one to take as the object of the risk assessment. In different stages, because the depth that we do the project technical design, plan and environment inquiry of traveling wave electric motor's is different, it is not same to understanding the risk degree. This must gradually experience a process from shallow to deep. Some scholars have conducted the researches about related appraisal indicator systems. But because each person has the different goal, angle and method, the risk assessment indicator system is infinitely varied. Here, R&D project risk factors of traveling wave electric motor are divided into external environment factor, the project internal factor, the enterprise ability factor, the market factor and the management factor.

The risk categories of each risk assessment matrix may be divided into 5 big risk categories: technological risk, support risk, plan risk, exterior risk and legal risk. the sorting category given by three teams is quite as follows in table 1.

It taked each team to build the risk assessment matrix, computation customer demand quantity as well as the calculated risk category quantity policy-making time, it is showed in table 2

3.2 Risk and policy-making decomposition

Through decomposing the customers' demand, thus "the customer satisfied to the traveling wave electric motor" will be transformed into "the customers' demand" which can analysis the relation matrix. The customers' demands are: Reliability, low cost manufacture, product life, high effective and accuracy, use convenience, and so on. Using the inquiring survey importance judgment and the redundant frequency importance judgment let the customers evaluate the important by the fifth-order section to definite customers' demand importance.

Analyses on market competitiveness. In the customers' angle, emphasizing satisfying customers, we evaluate products of Chunsheng and the other competitor's product. Mainly providing how much degree suppliers satisfy customers' demand. The market competitiveness appraisal similarly carries on grading by the fifth-order section to the customer demand.

We use "length" express the customers' demand importance .This value is bigger, showing that this demand has a more important value to the customers. Otherwise, the importance is lower. We hypothesis product characteristic point (i.e. marketing key) and the goal quality according to that the customers

request the importance degree and analysis result compared with other company comparatives'. If importance of Chunsheng's products is higher than others', and its lever similarly is higher, Chengsheng Company may directly use this as the products' characteristic in the marketing strategy. If importance of Chunsheng's products is higher than others', but its lever is lower, at least, the goal quality hypothesis same level with others' and this kind of project cannot become the product characteristic point. If importance of Chunsheng's products is higher than others', but its lever is lower and others' are lower too, Chunsheng can hypothesis their products'' goal quality higher than others', therefore, this project may become the marketing key (i.e. product characteristic point). Take these ideas as foundation to hypothesis products' goal quality. Now if we could distinguish the types of demand projects, charm nature quantity, expectation quality or natural quality, then this will help to hypothesis the product characteristic point. After the goal quality and this company quality level are determined, we may obtain the level enhancement rate Ri. (Formula 1)

$$\text{level enhancement rate } R_i = \frac{\text{goal quality}}{\text{company quality level}} \qquad (1)$$

Here, the absolute importance W_{ai} is obtained through the customer demand importance K_i, the level enhancement rate R_i and the product characteristic point S_i by accumulating. (Formula 2)

$$W_{ai} = K_i \times R_i \times S_i \qquad (2)$$

The relative importance is equals the absolute importance and transforms the percentage (Formula 3)

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$$W_i = \left(W_{ai} / \sum W_{ai}\right) \times 100\% \qquad (3)$$

4. CONCLUSION

R&D project risk management frame based on QFD is that the student team makes the appraisal to traveling wave supersonic electric motor research and development project. This frame is based on the DOS system, realizing QFD computer software package. The software's merits are: good user interface, conforming QFD operational order, and operating to obtain very specialized result. The goal is to appraise the validity and robustness of the predetermined risk management frame and to realize the examination of policy-making execution and the decision-making in the different platform. All these results support such hypothesis: comes from the entire operation platforms from the predetermined risk management frame can specifically influent the policy-making execution.

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FIGURE AND TABLES

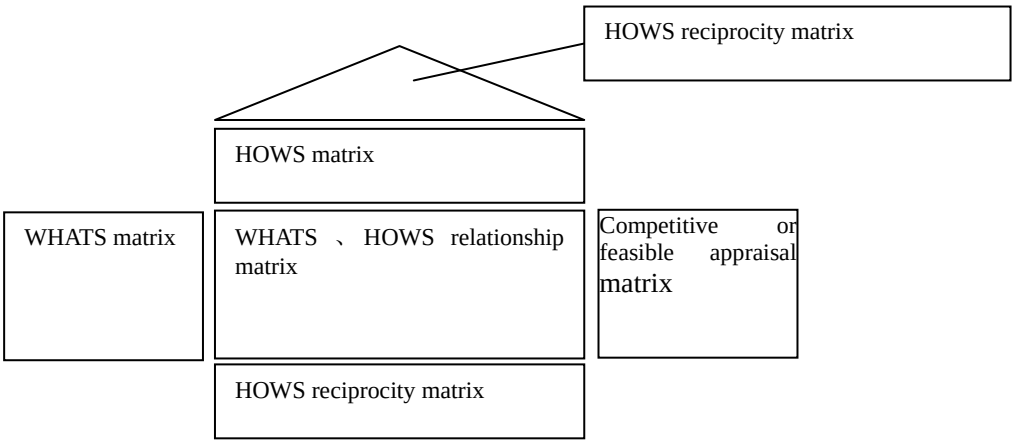

Figure 1: The fundamental mode of QFD matrix

Table 1: Risk category sorting given by #100、#200 and #300

Risk category sorting	**#100**	**#200**	**#300**
1	Risk from exterior	Risk from exterior	Technological risks
2	Technological risks	Technological risks	Risk from exterior
3	Risk from support	Risk from support	Risk from support
4	Plan risk	Plan risk	Risk from law
5	Risk from law	Risk from law	Plan risk

Table 2: Time Summarize of the policy-making execution useing QFD

	Average value	#100	#200	#300
time（seconds）	40.7	37	45	40
Quantity of customers' demand	10	13	7	10
Quantity of risk categories	8	10	8	7