Approach of Customer Requirement Analysis Based on Requirement Element and Improved HoQ in Product Configuration Design

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***Abstract*—Accurate acquisition and effective translation of customer requirements are two key links in product configuration design. In the paper, two concepts are introduced for customer requirement decomposition. One is the requirement element, and the other is the granularity of requirement element. Moreover, the controlling principle for granularity of requirement element is given and the method of requirement decomposition is proposed from the point of semantic meaning. This method means semantic segmentation, semantic translation, supplement or subdivision of human-machine-environment and semantic combination. Customer's customized requirements could be decomposed effectively according to the proposed method of requirement decomposition as well as by controlling the granularity of requirement element reasonably. On that basis, in customer requirement translation, improved house of quality (IHoQ) is constructed by combining the characteristics of requirement element and the demands of configuration design and using the thought of quality function development (QFD). So, a new approach of customer requirement analysis based on requirement element and IHoQ is put forward by integrating organically the technology of requirement decomposition and the tool of requirement translation. Accurate acquisition and effective translation for customer requirements could be realized by using this approach. Finally, the customized design of a money-binding machine is taken as an example to validate the effectivity of proposed method.**

***Index Terms*—configuration design; customer requirements; requirement element; improved house of quality**

I. Introduction

Product configuration design is an important technology to realize agile customized development. Customer requirements are the foundation and source in product configuration design. So, it must be analyzed firstly so as to realize accurate acquisition and effective translation for them. But for most of customers, their original requirements are maybe some fuzzy or general customized demands, and even some of them are contrary each other. So, these abstract customer's requirements need to be decomposed into some specific demands. On that basis, customer requirements are effectively translated into technical demands to guide configuration design. Research of requirement modeling always serves as a breakthrough point for requirement analysis. Now, some scholars have proposed many different methods of requirement modeling. For example, Guo et al [1] present a methodology for requirement analysis and downstream mapping in product life-cycle, based on a topology for product requirements modeling. Zheng et al [2] propose a modeling approach to product requirements for mass customization based on the existing product evolvement [2]. Concerning the whole implementation process of mass customization, Dai et al [3] put forward a methodology of modeling its general requirement. In addition, some other approaches of requirement modeling are put forward based on ontological knowledge from different points [4-6]. Yuan et al [7] propose a hierarchy model of customer demands, which divides the customer demands into four layers: overall performance parameters, functional parts, appearances and sales features. Although research directions of these modeling methods are maybe different, these methods all deal with requirement decomposition in some degree. From the point of modeling process, these methods focus on describing and mapping process of model, but for two problems could not be given the detailed discussion. One is how to decompose the fuzzy or abstract customer requirements into the specific and usable sub-requirements, and the other is how to control the scale of requirement decomposition. In the paper, two concepts on the

doi:10.4304/jsw.7.3.691-698

requirement element and the granularity of requirement element are introduced for customer requirement decomposition by analyzing the characteristics of customer requirements. Moreover, the control principle for granularity of requirements element is given and the method of requirement decomposition is proposed. As a result, the fuzzy or abstract customer requirements could be decomposed into the specific requirement elements by applying the proposed principle and method.

On that basis, the decomposed requirements must be translated into the practical technical demands so as to guide configuration design. Now, translation methods of customer requirements mainly adopt the axiomatic design or quality function development (QFD). For example, Huang et al [8] build a quality function deployment system based on the fuzzy measurement, and this system deploys four HoQs (house of quality) with the fuzzy measurement, fuzzy relationship matrix and fuzzy transition matrix. Clusters of functional requirements are identified based on fuzzy clustering analysis, and the mapping mechanism between the customer and functional domains is incarnated in association rules [9]. Yang et al [10] propose an integer planning model which translates the customer requirements into the technical characteristics with considerations of resource constraints. To solve the problems of fuzziness, imperfection, inconsistency and redundancy in HoQ's customer requirement's information, the analysis technology of customer requirement s based on rough set theory was presented [11]. Du et al [12] propose a new product development mode to adopt mass customization based on QFD, and HoQ tool is reconstruct. Chen et al present [13] a mapping method from customer needs to functional requirements based on QFD and association rule mining. In the paper, in order to translate adequately requirement elements into the various information of configuration design, a improve house of quality (IHoQ) is constructed by integrating characteristics of requirement element and using the thought of QFD. IHoQ deals with some addition and modification based on HoQ according to the demands of configuration design so as to realize the effective translation from requirement element into configuration information. So, a new approach of customer requirement analysis based on requirement element and IHoQ is put forward by integrating organically the technology of requirement decomposition and the tool of requirement translation. This approach could realize the accurate acquisition and effective translation of customer requirements in product configuration design.

II. Requirement Decomposition

In order to decompose effectively customer fuzzy and abstract customized requirements, two concepts on requirement element and granularity of requirement element are introduced in the paper. Requirement element means that it is the indivisible minimal information entity on the basis of expressing customer requirements definitely. Granularity of requirement element means the dividing scale of requirement element.

There are two important problems in the process of requirement decomposition. One is how to control the granularity of requirement element, and the other is how to decide requirement element. Aiming at two problems, controlling method for the granularity of requirement element and specific technique for requirement decomposition are put forward in the paper.

A. Controlling Method for the Granularity of Requirement Element

The granularity of requirement element relates to customer requirements. The granularity of requirement element reflects the scale of requirement entity. If the granularity of requirement element is too small, it maybe will lose the meanings of original customer requirements. But if the granularity of requirement element is too large, requirement element could not definitely express the meanings of customer requirements, accordingly it makes against the correct comprehension and translation of customer requirements for the designer. As a result, controlling principle for the granularity of requirement element is given, that is, the granularity of requirement element trends to the smaller scale on the base that requirement element should wholly express the meanings of original customer requirements. In the practical requirement decomposition, customer requirements should be decomposed into some requirement elements according to controlling method of the granularity of requirement element and integrating the characteristics of the actual product.

B. Operable Method of Requirement Decomposition

Four specific principles are put forward by analyzing customer requirement semantics, and they are as following.

(1) Principle of semantic segmentation

Customers use descriptive language to express their requirements, and these descriptions are usually general and fuzzy, but there often contains customer's actual expectation for product. From the point of semantic meaning, if these descriptive languages are segmented into some independent and whole information entities, the actual requirement meanings contained requirement expression could be fully explored. So, principle of semantic segmentation is as following.

Customer requirements are segmented into the smallest, whole and independent information entity according to the semantic descriptive language in requirement expression.

An instance on the principle of semantic segmentation is shown in Fig. 1.

(2) Principle of semantic translation

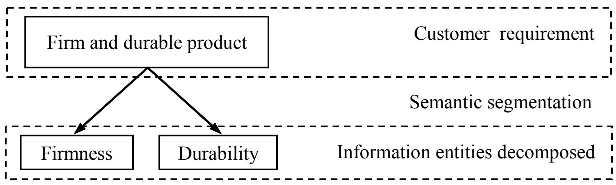


Figure 1. An instance on the principle of semantic segmentation.

The information entities segmented according principle of semantic segmentation could reflect customer's actual requirements. However their descriptive language is still customer's original expression, it is without strict word order so as not to be used conveniently by a designer. As a result, the expression of information entity must be translated into the designer's language. So, principle of semantic translation is as following.

Information entity decomposed should be translated into the design language according with the strict expression structure of word order.

An instance on the principle of semantic translation is shown in Fig. 2.

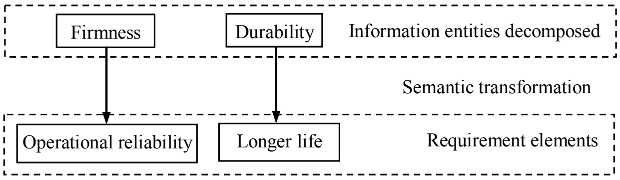


Figure 2. An instance on the principle of semantic translation.

(3) Principle of supplement or subdivision of human-machine-environment

In most conditions, product mainly affects three aspects, that is, human (user), machine and environment. As a result, designer should complement or subdivide customer requirements from the point of human, machine and environment, so that requirement elements could more exactly accord customer mind. So, principle of supplement or subdivision of human-machine-environment is as following.

Designer should supply or subdivide customer requirements from three aspects of human, machine and environment so that requirement elements could accurately accord with customer psychology.

An instance on the principle of supplement or subdivision of human-machine-environment is shown in Fig. 3.

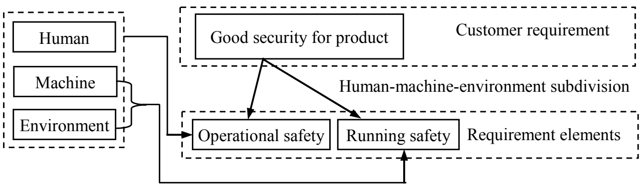


Figure 3. An instance on the principle of subdivision of human-machine-environment.

(4) Principle of semantic combination

The expression of original customer requirements maybe contains some semantic overlapped information, that is, some requirement descriptions seemingly are different, but in fact some requirement express the same information or one requirement expression has contained another meaning, after you analyze them from the point of semantic meaning. As a result, these same requirement elements must be combined in order to sure them independent each other. So, the principle of semantic combination is as following.

Overlapping or inclusive semantic description should be incorporated in requirement expression so that the final requirement elements are independent each other.

An instance on the principle of semantic combination is shown in Fig. 4.

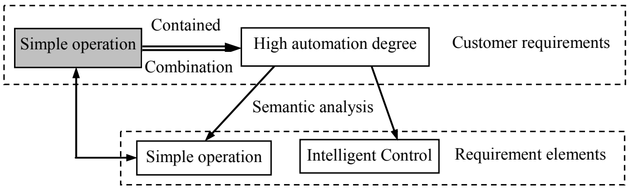


Figure 4. An instance on the principle of semantic combination.

If customer requirements are decomposed according with above-mentioned four principles, not only requirement elements could completely express the original customer requirements, but also there would be no the overlapping or inclusive requirement information each other.

III. Requirement Translation

A. *Improved HoQ*

Quality function development is a methodology for product development and has been widely applied to different product developments. House of quality takes as a core tool of QFD, and its establishment is a key in the application of QFD method. QFD method has certain adaptabilities for product configuration design. But, because the development of configuration design has its own characteristics, traditional HoQ has some limitations in the transformation process of customer requirements for configuration design. So, an improved HoQ is put forward by integrating characteristics of requirement element and the demands of configuration design, and the structure of IHoQ is shown in Fig. 5. The aim of improving the traditional HoQ lies in the sufficient transformation from customer requirements into the specific information of configuration design. The specific content and implication of every section in IHoQ is as following.

The first section of IHoQ is requirement elements, their weights and expected values. Among which, the weight of requirement element could be obtained by calculating the important level of requirement element. The expected value of requirement element is an added item, and it expresses customer's expection for the target value of customized requirement, and every requirement element corresponds to an expected value. This section will provide basis for subsequent solving of configuration instance.

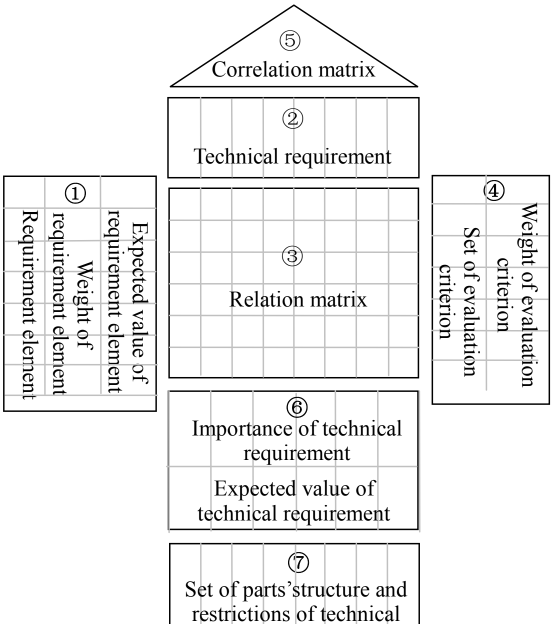
The second section of IHoQ is technical requirements, and every of them is decided by designer according to customer requirements and product's characteristics. Technical requirements relate to customer requirements, and they take effect on the choice of parts' structures and the whole process of configuration design.

The third and fifth section of IHoQ reserves the structure and content of traditional HoQ.

The fourth section of IHoQ is the set of evaluation indexes and the corresponding weight values for configuration scheme. The evaluation indexs of configuration scheme should be determined according to customer requirements. Determining the importance of evaluation index needs to consider weight values of customer requirements.

The sixth section of IHoQ is the weights of technical requirements and the corresponding target values. The weights of technical requirements are the core of requirement translation in configuration design. The results of requirement translation provide the base for configuration reasoning. The target values of technical requirements express the possible expected values, and these values provide the base for subsequent solving of configuration instance.

The seventh section of IHoQ is the set of parts' structures and the constraints of technical requirements. This section is an added content and corresponds to the second section of IHoQ, and it provides the base for the choice of parts' structures and solving of configuration instance.



Modified section:①④⑥; Added section:⑦

Figure 5. The structure of IHoQ.

B. Approach of Customer Requirement Analysis Based on Requirement Element and IhoQ

The proposed method of requirement decomposition and IHoQ tool are complementary each other. Requirement element is the information source of IHoQ and provides specific input for it. Requirement elements could be translated into the needed specific information including technical requirements, set of parts' structures and set of evaluation indexes and so on by using IHoQ tool. So, a new approach of customer requirement analysis based on requirement element and IHoQ is put forward, and its analysis process is shown in Fig. 6. This approach could realize the accurate acquisition and effective translation of customer requirements.

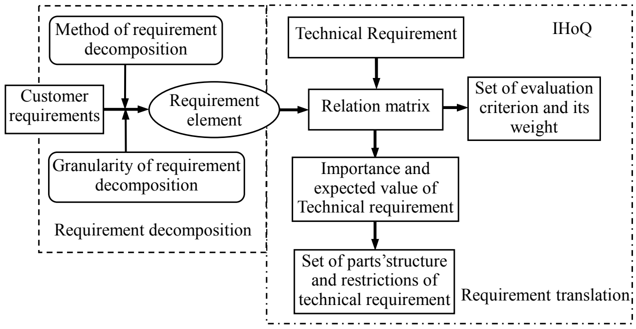


Figure 6. Analysis process of proposed approach.

C. The Process of Requirement Translation

Determining the weights of customer requirements and that of technical requirements are the two crucial links by using IHoQ in the process of requirement translation.

1. Determining the Weights of Customer Requirements

For the weights of customer requirements, the method of criteria weighting matrix [14] is adopted to determine in the paper. This method is similar to the thought of AHP (analytic hierarchy process), but it is simpler and more visual than AHP. It is more suitable for determining the weights of many requirement elements. The calculation procedures are as following.

(1) Decomposing customer requirements

The original customer requirements are decomposed step by step into requirement elements and are respectively noted as R_1, R_2, ⋯, R_n.

(2) Constructing requirement weighting matrix

Requirement weighting matrix is established by comparing requirement element one to one. The relative importance of requirement element is marked with 1-4 scores, and 1, 2, 3 and 4 score respectively means equal importance, weak importance, more importance and distinct importance. Vector of requirement element is marked as $R=(R_1,R_2,\cdots,R_n)$. Requirement weighting matrix is marked as R_ω.

$$R_\omega = R \bullet R^{-1} \tag{1}$$

$$R_\omega = \begin{bmatrix} R_1 \\ R_2 \\ \vdots \\ R_n \end{bmatrix} \bullet \begin{bmatrix} R_1 & R_2 & \cdots & R_n \end{bmatrix} = \begin{bmatrix} R_1R_1 & R_1R_2 & \cdots & R_1R_n \\ R_2R_1 & R_2R_2 & \cdots & R_2R_n \\ \vdots & \vdots & \cdots & \vdots \\ R_nR_1 & R_nR_2 & \cdots & R_nR_n \end{bmatrix} \tag{2}$$

Because it is a symmetric matrix, R_ω could be simplified as upper triangular matrix and is as following.

$$R_\omega = \begin{bmatrix} R_1R_1 & R_1R_2 & R_1R_3 & \cdots & R_1R_n \\ & R_2R_2 & R_2R_3 & \cdots & R_2R_n \\ & & R_3R_3 & \cdots & R_3R_n \\ & & & \cdots & \vdots \\ & & & & R_nR_n \end{bmatrix} \tag{3}$$

In order to express definitely the relative importance between requirement elements and easy calculation, Equation (3) will be simplified as following.

1) If two different requirement elements noted respectively as R_i and R_j have the same importance, they will be marked as R_i-R_j in (3).

2) The items located diagonal line of (3) could be fully marked as "1", because they are self-comprasion.

3) Except above-mentioned two situations, other items of (3) will be marked as "R_m-k（m=1,2,⋯,n）,（k=1,2,3,4）", and among which R_m notes more important requirement element by comparing the importance between R_i and R_j, and k notes the score of R_m.

(3) Calculating absolute weight of any requirement element

Absolute weight of any requirement element is noted as $A\omega_{R_i}$ and calculated as following.

$$A\omega_{R_i} = Row(\omega_{R_i}) + Column(\omega_{R_i}) \tag{4}$$

In (4), $Row(\omega_R)$ denotes sum of weight of row vector for R_i, and $Column(\omega_R)$ denotes sum of weight of column vector for R_i. But the weight located diagonal line only calculates one time in row vector or column vector for R_i. So, absolute weight of any requirement element equals the sum of weight of row vector adding that of column vector.

(4) Calculating relative weight of any requirement element

Relative weight of any requirement element could be calculated as following.

$$R\omega_{R_i} = 10 \cdot (A\omega_{R_i} / A\omega_{R\max}) \tag{5}$$

In (5), $A\omega_{Rmax}$ denotes the maximum of absolute weight of requirement element. For convenience, the maximum of relative weight of requirement element sets "10".

2. Determining the Weights of Technical Requirements

The weights of technical requirements could be calculated as following.

(1) Determining the relevance between customer requirements and technical requirements

There maybe have three kinds of corresponding relationship between customer requirements and technical requirements [15]. Firstly, one-to-one relationship, that is, for a customer requirement, there only exists a unique technical requirement corresponding it. Secondly, one-to-many relationship, that is, for a customer requirement, there maybe exists many technical requirement corresponding it. Thirdly, many-to-one relationship, for many customer requirements, there mainly exists a technical requirement corresponding them. In order to express quantificationally the relevance between customer requirements and technical requirements, the evaluating scores of them are given, that is, "0 (no correlation)", "1 (weak correlation)", "3 (medium correlation)" and "9 (strong correlation)".

(2) Calculating absolute weight of technical requirement

Absolute weight of any technical requirement is noted as $A\omega_{D_i}$ and calculated as following.

$$A\omega_{D_i} = \sum_{j=1}^{n} (R\omega_{R_j} \bullet S_{R_j D_i}) \tag{6}$$

In (6), $R\omega_{R_j}$ denotes the relative weight of any requirement element, and $S_{R_j D_i}$ denotes the score of relevance between any requirement element marked as R_j and a technical requirement marked as D_i.

(3) Calculating relative weight of technical requirement

Relative weight of any technical requirement could be calculated as following.

$$R\omega_{D_i} = 9 \cdot (A\omega_{D_i} / A\omega_{D\max}) \tag{7}$$

In (7), $A\omega_{Rmax}$ denotes the maximum of absolute weight of technical requirement. For convenience, the maximum of relative weight of technical requirement sets "9".

IV. Example of Application

In this paper, a money-binding machine is taken as the example to discuss the proposed approach of customer requirement analysis based on requirement element and IHoQ.

(1) Requirement decomposition

Customer customizes a money-binding machine for a bank, and it is the gross customized requirement. Usually, when customer customizes a money-binding machine, he will propose some specific customized requirements, for example, binding ¥0.1-¥100 money quickly and tightly, good security, firmness and durability, energy-saved and environment protected, simple operation, small size and light weigh, fine appearance, moderate cost and high automation degree. It shows from these customized requirements that the original customer requirements are usually fuzzy or general and even overlapping in semantics. So, these original customized requirements must be decomposed firstly in the process of configuration design. Customer's customized requirements should be decomposed according to the proposed method of requirement decomposition as well as by controlling the granularity of requirement element reasonably. Requirement elements decomposed are shown in Table I.

(2) Determining the weights of requirement elements

The weights of requirement elements for a money-binding machine could be obtained by using the method of criteria weighting matrix, and their results are shown in Table II, among which, any requirement element is marked as R_i (i=1,2,⋯,17).

(3) Requirement translation

Customer requirements will be translated into all kinds of specific configuration demands, such as technical requirements, weights of technical requirements, set of parts' structures and so on. Customer requirements of a money-binding machine are translated by using IHoQ tool, and the result of requirement translation is shown in

Table III. In which, the fifth section and the fourth section of IHoQ are not given, because the two sections could not affect the result of requirement translation. It shows from the result of Table 3 that requirement elements are exactly translated into the needed configuration demands to guide the whole design process.

V. Conclusions

In the paper, requirement element and granularity of requirement element are introduced for customer requirements decomposition, and the controlling principle for granularity of requirement element is given and the method of requirement decomposition is proposed. In requirement translation, an improve HoQ is constructed by integrating the characteristics of requirement element and the demands of configuration design and applying QFD thought. On that basis, a new approach of customer requirement analysis based on requirement element and IHoQ is put forward by integrating organically the technology of requirement decomposition and the tool of requirement translation, and it is applied to the customized design of a money-binding machine. Some conclusions are:

1) The proposed method of requirement decomposition means semantic segmentation, semantic translation, supplement or subdivision of human-machine-environment and semantic combination. The fuzzy and abstract customer requirements could be decomposed into some clear and specific requirement elements according to this method as well as by controlling the granularity of requirement element reasonably so as to realize the accurate acquisition of customer requirements.

2) IHoQ could fully play the function of customer requirements and realize the effective translation from customer requirements to the specific configuration demands.

3) The approach of customer requirement analysis based on requirement element and IHoQ could realize the accurate acquirement and the effective translation for customer requirements in configuration design so as to achieve the agile customized development.

TABLE I.
Decomposition Table of Requirement of a Money-Binding Machine

Gross requirement	Sub-requirement	Decomposition principle		Requirement element	Decomposition principle	Requirement element
Money-binding machine for bank	Binding ¥0.1-¥100 money quickly and tightly	Semantic segmentation and semantic transformation	Controlling the granularity of requirement element	Binding adjustability	Semantic combination	Binding adjustability
				Binding tightly		Binding tightly
				High binding efficiency		High binding efficiency
	Good security	Human-machine-environment subdivision		Operational safety		Operational safety
				Running safety		Running safety
	Firmness and durability	Semantic segmentation and semantic transformation		Operational reliability		Operational reliability
				Longer life		Longer life
	Energy-saved and environment protected	Semantic segmentation, semantic transformation and human-machine-environment subdivision		Little energy consumption		Little energy consumption
				Low noise		Low noise
				Small pollution		Small pollution
	Simple operation	Semantic transformation		Simple operation*		Simple operation
	Small size and light weigh	Semantic segmentation, semantic transformation and human-machine-environment subdivision		Convenient carrying		Convenient carrying
				Compact structure		Compact structure
				Light weigh		Light weigh
	Fine appearance	Semantic transformation		Fine appearance		Fine appearance
	Moderate cost	Semantic transformation		Moderate cost		Moderate cost
	High automation degree	Semantic transformation and human-machine-environment subdivision		Simple operation*		Intelligent Control
				Intelligent Control		

TABLE III.
WEIGHTS OF REQUIREMENT ELEMENTS OF A MONEY-BINDING MACHINE

		Binding adjustability	Binding tightly	High binding	Operational safety	Running safety	Operational reliability	Longer life	energy consumption	Low noise	Small pollution	Simple operation	Convenient carrying	Compact structure	Light weigh	Fine appearance	Moderate cost	Intelligent Control
		R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**R15**	**R16**	**R17**
Binding adjustability	**R1**	1	R1-R2	R1-R3	R1-R4	R1-2	R1-2	R1-2	R1-4	R1-3	R1-3	R1-2	R1-4	R1-3	R1-4	R1-3	R1-4	R1-3
Binding tightly	**R2**		1	R2-R3	R2-R4	R2-2	R2-2	R2-2	R2-4	R2-3	R2-3	R2-2	R2-4	R2-3	R2-4	R2-3	R2-4	R2-3
High binding efficiency	**R3**			1	R3-R4	R3-R5	R3-2	R3-2	R3-3	R3-2	R3-2	R3-2	R3-4	R3-3	R3-4	R3-2	R3-3	R3-2
Operational safety	**R4**				1	R4-R5	R4-R6	R4-2	R4-3	R4-2	R4-2	R4-2	R4-4	R4-3	R4-4	R4-3	R4-4	R4-3
Running safety	**R5**					1	R5-R6	R5-2	R5-3	R5-2	R5-2	R5-2	R5-3	R5-2	R5-3	R5-3	R5-3	R5-2
Operational reliability	**R6**						1	R6-R7	R6-3	R6-2	R6-2	R6-2	R6-3	R6-2	R6-3	R6-3	R6-3	R6-2
Longer life	**R7**							1	R7-3	R7-R9	R7- R10	R11-2	R7-2	R7-2	R7-2	R7-2	R7-R16	R17-2
Little energy consumption	**R8**								1	R9-2	R10-3	R11-2	R8-2	R8-R13	R8-R14	R15-2	R8-R16	R17-3
Low noise	**R9**									1	R10-2	R9- R11	R9-3	R9-2	R9-2	R9-2	R9-2	R9-2
Small pollution	**R10**										1	R10-2	R10-3	R10-3	R10-2	R10-2	R10-2	R10-2
Simple operation	**R11**											1	R11-2	R11-3	R11-3	R11-2	R11-2	R11- R17
Convenient carrying	**R12**												1	R12-R13	R12-R14	R15-2	R12-R16	R17-3
Compact structure	**R13**													1	R13-R14	R13-R15	R13-2	R17-3
Light weigh	**R14**														1	R15-2	R14-R16	R17-2
Fine appearance	**R15**															1	R15-2	R17-2
Moderate cost	**R16**																1	R17-2
Intelligent Control	**R17**																	1
Absolute weight	$A\omega_{R_i}$	43	43	37	37	31	29	18	6	18	23	19	4	7	5	10	5	19
Relative Weight	$R\omega_{R_i}$	10	10	8.6	8.6	7.2	6.7	4.2	1.4	4.2	5.3	4.4	0.9	1.6	1.2	2.3	1.2	4.4

TABLE III.
IHOQ OF A MONEY-BINDING MACHINE

Technical Requirement			Mode of sending money	Binding mode	Binding speed	Packing force	Operational mode	Scale of binding money	Control system	Outline dimension	Design Life	Rated voltage	Rated power	Machine Weight
Requirement Element	**Weight**	**Expected value of requirement element**												
Binding adjustability	10	￥0.1-￥100	0	0	0	0	0	9	0	0	0	0	0	0
Binding tightly	10		0	9	0	9	0	0	0	0	0	0	0	0
High binding efficiency	8.6	≤35s/bundle	9	3	9	0	0	0	3	0	0	0	0	0
Operational safety	8.6		3	0	3	3	3	0	0	3	0	1	0	1
Running safety	7.2		0	0	1	0	3	0	0	0	0	0	0	0
Operational reliability	6.7		0	0	3	0	1	3	0	0	1	0	0	0
Longer life	4.2	≥3 years	0	0	0	0	0	0	0	0	9	0	0	0
Little energy consumption	1.4		1	0	3	3	0	0	0	0	0	1	9	0
Low noise	4.2	≤70dB	0	0	3	0	0	0	0	0	0	0	3	0
Small pollution	5.3	Without dirt such as oil stains	0	3	0	0	0	0	0	0	0	0	0	0
Simple operation	4.4	Fully automatic mode	9	0	0	0	3	0	3	0	0	0	0	0
Convenient carrying	0.9	Table type	0	0	0	0	0	0	0	3	0	0	0	9
Compact structure	1.6	≤0.7W×0.7D×1.5Hm	3	3	1	3	1	3	1	9	0	0	0	3
Light weigh	1.2	≤130kg	3	0	0	3	0	3	0	3	0	0	0	9
Fine appearance	2.3	Tanya hue and handsome outline	0	0	0	0	3	0	0	3	0	0	0	0
Moderate cost	1.2		9	3	3	0	0	0	3	0	3	0	0	0
Intelligent Control	4.4		9	0	3	0	9	0	9	1	0	0	0	1
Absolute weight of technical requirement			203	140.1	165.7	128.4	115.4	118.5	83.8	57.8	48.1	10	25.2	36.7
Relative weight of technical requirement			9	6.2	7.3	5.7	5.1	5.3	3.7	2.6	2.1	0.4	1.1	1.6
Expected value of technical requirement			Automatic	Bonding Mode of double cross five points	≤ 30s/bundle	6000N~ 15000N	Control panel	￥0.1~ ￥100	Single Chip Microcomputer	≤0.6W× 0.5D× 1.3Hm	≥3 years	220v	600W	≤120kg
Set of parts'structure and restrictions of technical requirement			Structure of sending money	Bonding and shearing structure	Structure of walking belt	Packing structure	Control panel	Structure of adjusting money	Control system	*Translate into the restrictions of technical requirement*				

ACKNOWLEDGMENT

This work is supported by the Funds for Liaoning Association of Social Sciences in China No. 2010lslktxxjc-01, and the Fundamental Research Funds for the Central Universities in China No. 2009JC17.

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