Overview of Comprehensive Information Quality Management under Mass Customization

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Abstract—**Mass customization is a mode of production for a single customer or a large number or varieties of products in the market. It is based on the mass production of the cost and speed. But due to the presence of the customer diversification and personalized order, make mass customization information quality management more complex and difficult. This paper outlines the necessity of information management under mass customization, and puts forward the concept, basic theory and recursive formula of the total information quality management.**

Keywords—Mass Customization, The Total Information Quality Management, The recurrence formula

I. INTRODUCTION

With the continuous development of diversified markets, Mass Customization has not satisfied the original mass customization, and the demand for personalized customers also has greatly increased the difficulty of mass customization. This has made the original information quality management model extremely challenging. This has made the original information management model suffer extremely challenging. First of all, China's mass customization started late, and many companies have not yet established a CRM system, resulting in a long-term lack of customer data; Secondly, the ever-changing market has led to a shortened information demand cycle for mass customization, and the information update speed far exceeds the original information reserve; Finally, it is difficult for Chinese enterprises to effectively play the role of mass customization under the constantly changing and dynamic market changes. The piecemeal experience cannot adapt to the current level of productivity.

Based on the current large-scale customization of current data, poor information, and broken experience, this paper summarizes the experience of predecessors and summarizes the concept and basic theory of the total information quality management. And according to the comprehensive information quality management, a recurrence formula is proposed to solve the main problems of mass customization in China.

II. BASIC THEORY

A. Mass Customization

The idea of mass customization was first proposed by Alvin Toffler in 1970 [1].In 1993, B Joseph Pine II officially proposed the concept of mass customization for the first time: providing customized personalized products and services at the cost and time of mass production [2].After later, Jiao J X [3], Hart C W [4], et al. also proposed concepts. Chinese scholars Shao Xiaofeng [5], Zhang Ping[6] also made further research. Professor Qi Guo-ning[7] of Chinese scholars believes that, mass customization is a kind of "under the guidance of system thinking, using the overall optimization point of view, making full use of the various resources available to enterprises, in standard technology, modern design methods, information technology, and the support of advanced manufacturing technology, according to the individual needs of customers, the production methods of customized products and services are provided at low cost, high quality and high efficiency in mass production." The core of mass customization is to convert all or part of the product's custom production problems into mass production, and to customize any number of products for individual customers or small batch multi-variety markets with the cost and speed of large-scale production [8].

B. Quality Control

Quality is the key to satisfying customer needs in the mass customization production. Juran once said: The future 21st century will be "the century of quality". He believes that quality is "applicability". Feigenbaum argues that quality is "an integrated product and service characteristics that satisfies customer expectations through products and services in all markets, engineering, manufacturing and maintenance". P.B.Crosby believes that "quality is in line with the requirements." In addition, the world-famous quality masters Kaoru Ishikawa [9], Deming [10], and Genichi Taguchi [11] have all explained the definition of quality. However, on a global scale, the specific quality standard currently implemented is ISO9000:2000, in which quality is defined as the degree to which a set of inherent characteristic meets the requirements [12].

At present, there is no uniform definition of quality management. In a way, scholars at home and abroad have

different requirements on quality management. Table 1 briefly summarizes the theories, advantages and limitations of several quality management scholars at home and abroad.

Quality management under mass customization is generally manifested as customer satisfaction, design quality and information quality management in the manufacturing process. And quality management runs through the whole process of mass customization.

TABLE I. COMPARISON OF QUALITY MANAGEMENT SCHOLARS' THEORY AND ADVANTAGES AND DISADVANTAGES

scholar	theory	advantage	limitation
Juran	Juran Ttrilogy	universal	Basics
Kaoru Ishikawa	PDCA	Objectify Standardization	not include human creativity.
Feigenbaum	Quality Control Circle (QCC)	Bottom-up Step by step	Strong geographical limitations Manpower required
P.B. Crosby	Total quality management (TQM)	From top to bottom Strong professionalism	Poor initiative Long cycle
Genichi Taguchi	Zero Defect	Strong initiative Request quantification	Ignore customer needs
Zhang Gong-xu	Quality Loss Function	Quantitative quality Management and loss	Based on Deming and P.B. Crosby
Kaoru Ishikawa	The two kinds of quality Multivariate diagnosis	Multi-process production highly targeted	Not universal

C. Information Quality Management

The quality of information not only represents the usefulness of information, but also determines the degree of product completion and user satisfaction in production. High-quality information comes not only from information system design, information analysis and information resource management, but also from correct understanding of information quality, judgment of information value and effective control and guarantee of information transmission process [13].

In 1991, Richard Y. Wang opened a comprehensive data quality management course at MIT Sloan College, which laid the foundation for theoretical research on information quality. Over the past 20 years, information quality management tools have become increasingly mature, product defect defense capabilities have also been increased, and information quality research has never been interrupted. Figure 1 shows the number of CNKI journals on the subject of information quality management in the past decade.

Fig. 1. Number of journals on information quality management in CNKI

III. THE TOTAL INFORMATION QUALITY MANAGEMENT

Based on the previous studies on information quality management and TQM, this paper proposes the concept of the total information quality management, including the hierarchical relationship of the total information quality management. This paper holds that total information quality management (TQM) is an activity that aims at satisfying the requirements of information users and guarantees the integrity and accuracy of information by developing information quality, maintaining information quality, improving information quality and guaranteeing information quality. The comprehensiveness of comprehensive information quality management means that the entire process of the management system must participate in management. It is the management of four aspects: symbol, data, information and knowledge, including the whole process of information from the beginning to the contact. Total information quality management (TQM) is based on the exploration of information quality management, and It is also summarized from the definition of symbol, data, information and knowledge in the four stages of information expression and its quality significance.

At present, there is no accurate answer to the definition and relationship between symbols, data, information, knowledge. Table 2 summarizes the research and summary of scholars at home and abroad. In general, information is symbol and data, so data is the specific form of information, information is the logical meaning of data, and knowledge is the information that becomes objective laws. It can be considered that there is a hierarchical relationship between the four.

TABLE II. DEFINITION AND RELATIONSHIP OF SYMBOL, DATA AND INFORMATION KNOW

	Definition 1	Definition 2	Relations
Symbolic	Symbols are perceptions that are considered to carry meaning [16]	It is everything that conveys the exact concept of a thing in some way [14-15]	The original message does not mean anything until it is unprocessed.
Data	Data are often seen as simple facts [17]	It is the result of observation, the logical induction of objective things, the raw material used to express objective things [18]	Carrier of information
Information	Information is knowledge through processed data or programming [19]	For the direct or indirect expression of the way things exist or their inherent state, , the information is uncertain, and the data is not.	Information is a symbol that has been interpreted and is meaningful data.
Knowledge	It's a result of knowledge.[20]	Answer to a question under specific conditions [21]	the correct information

At the same time, there are hierarchical relations among symbol quality, data quality and information quality. Firstly, there is no definition of symbol quality at present. This paper argues that symbol quality is the accuracy of data use process and belongs to the category of data quantity. Secondly,

Richard y. Wang et al. [17] believe that data quality is determined by a series of parameters from data consistency, accuracy to correlation. Strong et al. [22] believe that data quality means "data is suitable for use". Fan Wen-fei et al [23] believe that data quality management is the five core issues, namely data consistency, data repeatability, data accuracy, data timeliness and information integrity; Su Qiang[24] believes that data quality is the basis of information quality. Data quality belongs to the category of information quantity. Thirdly, for the difference between information quality and data quality, Strong, Fan Wen-fei, Stuart E. Madnick, and Richard Wang believe that there is no clear boundary between information quality and data quality. Scholar Su Qiang [23] believes that there is an inclusive relationships between information quality and data quality. Chinese scholar Song Li-rong [25] believes that there is a difference between data quality and information quality, and high-quality data is not equal to high-quality information. This paper holds that there is a subordinate relationship between information quality and data quality, and that the level of data quality determines the level of information quality. The views of various types are shown in Table III.

TABLE III. VARIOUS VIEWS ON DATA QUALITY, INFORMATION QUALITY, AND KNOWLEDGE QUALITY

	Data quality	information quality	knowledge quality
Definition 1	The extent to which the data is suitable for use [17]	Degree of satisfaction with the use of information users [28]	In the context of knowledge market, knowledge quality is the degree to which knowledge characteristics perceived by knowledge evaluators meet expectations [30]
Definition 2	The degree to meet specific user expectations [26]	Information should conform to the specification [21]	The degree to which knowledge conforms to objective logic
Definition 3	It is determined by a series of parameters from the consistency, accuracy and relevance of the data [27].	Information quality = quality of information content + quality of information collection + quality of information expression + quality of information utility [29]	The extent to which requirements are met in terms of improving productivity, influencing social life, saving trial and error costs, and adding value to knowledge [32]
Relationship	Data quality is the basis of information quality	Data quality exists in information quality	

Similarly, information quality also belongs to the category of knowledge quantity. Therefore, the total information quality management believes that there is a hierarchical relationship between symbol quality, data quality and information quality. The hierarchical relationship mode is shown in Figure 2.
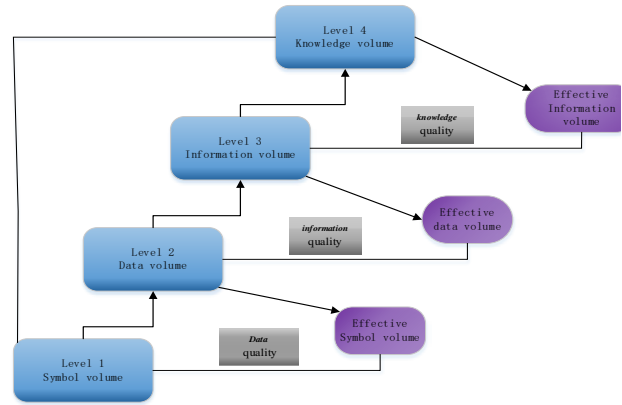

Fig. 2. Comprehensive information quality management hierarchy

The data quality, information quality and knowledge quality of total information quality management can be optimized for the problems of few data, poor information and broken experience under mass customization. And through the research of comprehensive information quality management, taking information quality as the core, the whole process and multi-level management of information quality, reducing information loss and improving information accuracy, thereby improving the satisfaction of information users.

IV. THE RECURRENCE FORMULA

A. Date quality equation

Suppose D: $\{d_1, d_2, d_3...d_n\}$ is the set of data events D, $d'_1, d'_2, d'_3...d'_n$ is the symbol unit d, and $D' \in \{d'_1, d'_2, d'_3...d'_n,\}$ is the valid symbol event in the D event, $D' \in D$, then the data quality DQ is shown in Equation (1).

$$DQ = \sum_{i=1}^{n} \frac{D'(d'_i)}{D(d_i)}, \quad i = 1, 2, ...n \quad (1)$$

B. Information quality equation

Suppose I: $\{i_1, i_2, i_3...i_n\}$ is the set of data events I, $i'_1, i'_2, i'_3...i'_n$ is the symbol unit I, and $I' \in \{i'_1, i'_2, i'_3...i'_n\}$ is the valid symbol event in the I event, $I' \in I$, then the data quality IQ is shown in Equation (2).

$$IQ = \sum_{i=1}^{n} \frac{I'(i'_i)}{I(i_i)}, \quad i = 1, 2, ...n \quad (2)$$

C. Knowledge quality equation

Suppose K: $\{k_1, k_2, k_3...k_n\}$ is the set of data events K, $k'_1, k'_2, ...k'_n$ is the symbol unit k, and $K' \in \{k'_1, k'_2, k'_3...k'_n\}$ is the valid symbol event in the K event, $K' \in K$, then the data quality KQ is shown in Equation (3).

$$KQ = \sum_{i=1}^{n} \frac{K'(k'_i)}{K(k_i)}, \quad i = 1, 2, ...n \quad (3)$$

V. Summary

Firstly, this paper summarizes the problems existing in mass customization production, summarizes and overview of information quality management, puts forward the concept and basic theory of total information quality management, and lists recursive formulas. In the process of information quality management, domestic and foreign scholars have already had a wealth of views, but the applicability of comprehensive information quality management and the reliability of recursive equations need further research.

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