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Applications of statistical and related methods to new technology and product development process —

Part 3: Quantitative approaches for the acquisition of voice of customer and voice of stakeholder

Application des méthodes statistiques et des méthodes liées aux nouvelles technologies et de développement de produit —

Partie 3: Acquisition quantitative du retour client (voice of customer) ou du retour des parties prenantes (voice of stakholders)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 69, *Applications of statistical methods*, Subcommittee SC 8, *Application of statistical and related methodology for new technology and product development*.

A list of all parts in the ISO 16355 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Quality Function Deployment (QFD) is a method to assure customer or stakeholder satisfaction and value with new and existing products by designing in, from different levels and different perspectives, the requirements that are most important to the customer or stakeholder. These requirements can be well understood through the use of quantitative and non-quantitative tools and methods to improve confidence of the design and development phases that they are working on the right things. In addition to satisfaction with the product, QFD improves the process by which new products are developed.

Reported results of using QFD include improved customer satisfaction with products at time of launch, improved cross-functional communication, systematic and traceable design decisions, efficient use of resources, reduced rework, reduced time-to-market, lower lifecycle cost, and improved reputation of the organization among its customers or stakeholders.

This document demonstrates the dynamic nature of a customer-driven approach. Since its inception in 1966, QFD has broadened and deepened its methods and tools to respond to the changing business conditions of QFD users, their management, their customers, and their products. Those who have used older QFD models find these improvements make QFD easier and faster to use. The methods and tools shown and referenced in the standard represent decades of improvements to QFD; the list is neither exhaustive nor exclusive. Users can consider the applicable methods and tools as suggestions, not requirements.

This document is descriptive and discusses current best practice, it is not prescriptive by requiring specific tools and methods.

Applications of statistical and related methods to new technology and product development process —

Part 3: Quantitative approaches for the acquisition of voice of customer and voice of stakeholder

1 Scope

This document describes quantitative approaches for acquisition of the voice of customer (VOC) and voice of stakeholder (VOS) and its purpose, and provides recommendations on the use of the applicable tools and methods. It is not a management system standard.

NOTE It does not provide requirements or guidelines for organizations to develop and systematically manage their policies, processes, and procedures in order to achieve specific objectives.

Users of this document include all organization functions necessary to assure customer satisfaction, including business planning, marketing, sales, research and development (R&D), engineering, information technology (IT), manufacturing, procurement, quality, production, service, packaging and logistics, support, testing, regulatory, and other phases in hardware, software, service, and system organizations.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10004:2018, *Quality management — Customer satisfaction — Guidelines for monitoring and measuring*

ISO 3534-1:2006, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

ISO 3534-4:2014, *Statistics — Vocabulary and symbols — Part 4: Survey sampling*

ISO 16355-1:2015, *Application of statistical and related methods to new technology and product development process — Part 1: General principles and perspectives of Quality Function Deployment (QFD)*

ISO 20252:2012, *Market, opinion and social research — Vocabulary and service requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3534-1, ISO 3534-4, ISO 16355-1, ISO 10004 and ISO 20252 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

4 Basic concepts of QFD

The basic concepts of QFD are described in ISO 16355 1:2015, Clause 4.

5 Integration of quantitative voice of customer (VOC) and voice of stakeholder (VOS) acquisition with customer research methods

Integration of quantitative voice of customer (VOC) and voice of stakeholder (VOS) acquisition with customer research methods is described in ISO 16355-1:2015, 8.2 and ISO 16355-2:2017, Clause 5.

6 Types of QFD projects

QFD projects encompass new developments, as well as generational improvements to existing products. The types of QFD projects are described in ISO 16355-1:2015, Clause 6 and ISO 16355-2:2017, Clause 6 Notes.

7 QFD team membership

7.1 QFD uses cross-functional teams

Cross-functional teams are described in ISO 16355-1:2015, 7.1.

7.2 Core team membership

Core team membership is described in ISO 16355-1:2015, 7.2.

7.3 Subject matter experts

Subject matter experts' involvement is described in ISO 16355-1:2015, 7.3.

7.4 QFD team leadership

QFD team leadership is described in ISO 16355-1:2015, 7.4.

NOTE It is common for quantitative VOC and VOS acquisition to be led by market researchers. This can be an internal department or outsourced to a third-party organization.

8 Types of information

8.1 General

Quantitative methods and tools are used in QFD to understand, structure, prioritize, and analyze voice of customer and stakeholder. These are summarized in Table 1.

8.2 Market strategy and trends

8.2.1 General

Quantitative information is useful in setting strategies and projects for new product development. It is the basis for both the objective and subjective decision making described in ISO 16355-2:2017, 9.1.2.

8.2.2 Analytic network process (ANP)

The ANP is used to prioritize alternative plans for achieving strategic objectives that require input from multiple stakeholders[1]. ANP is described in 9.1.

8.2.3 Porter 5 force competitive analysis

This is used in strategic planning to give a high level view of future market opportunities and threats. Its use in QFD is described in ISO 16355-2:2017, 9.1.2.3.

8.2.4 Market position analysis

This is used to show current and trending changes in markets. Its use in QFD is described in 9.8.

8.2.5 Project selection

Quantification is used to identify both objective and subjective criteria that can be used to synthesize a prioritized project portfolio. The analytic hierarchy process (AHP) is used throughout QFD for this purpose. Its use in QFD is described in ISO 16355-2:2017, 9.1.2.8.

8.3 Market segments

8.3.1 General

Quantitative information is useful in identifying potential market segments and applications during new product development which is described in ISO 16355-2:2017, 9.2.2.

8.3.2 Demographic market segmentation

Market segments can be analyzed according to demographic attributes using cross tabulations. Its use in QFD is described in 9.9.

8.3.3 Attitudinal and cultural dimensions

Demographics, attitudes, and culture can affect how customers respond to surveys and visits. Quantification of these factors and its use in QFD is described in 9.5.

8.3.4 New Kano model studies

Using knowledgeable consumers to respond to Kano model satisfaction surveys, the new Kano model can be used to reveal hidden market segments. Its use in QFD is described in ISO 16355-5:2017, 10.3.4.4.8.1.

8.3.5 Repertory grid technique

In addition to the obvious physical characteristics of a product, for example shape or color, there can also be unconsciously perceived customer-specific characteristics. The repertory grid technique helps customers and stakeholders reveal their personal constructs by organizing and scoring product characteristics. Its use in QFD is described in 9.15.

8.4 Competitive space

8.4.1 General

In new product development, it is important to understand the alternative choices that customers can make. This can include both similar products as well as new technologies. The following tools are useful in ISO 16355-2:2017 and ISO 16355-4.

8.4.2 Benchmarking

Benchmarking is used to capture customer perceptions about current and competitive products, as well as to plan future product placement in QFD. Customer perception benchmarking is used in the quality planning table described in ISO 16355-4:2017, 12.2.

8.4.3 Market position analysis

Market position analysis is used to understand how competing products are perceived by customers. Its use in QFD is described in 9.8.

8.4.4 Multidimensional scaling (MDS)

MDS is used to graphically display visual maps of competitive market space and opportunities. Its use in QFD is described in 9.10.

8.4.5 Repertory grid technique

Repertory grid technique is used to capture customer perceptions regarding competing products. Its use in QFD is described in 9.15.

8.5 Customer and stakeholder applications

8.5.1 Frequency of use or application

How often a customer uses a product for a certain problem or opportunity can influence design choices. Cross tabulations can be used to gather and analyze this information. Its use in QFD is described in 9.9.

8.5.2 Robust parameter design

Robust parameter design can incorporate the impact of customer usage and application as well as environmental influences in order to make the product more robust to these factors. Its use in QFD is described in ISO/TS 16355-6 and ISO 16336.

8.6 Customer needs

8.6.1 Functional needs using text analytics and text mining

Text analytics of big data is used to augment interview- and observation-derived customer needs, as described in 9.16. Customer needs are defined in ISO 16355-1:2015, 3.3 and ISO 16355-4:2017, 9.1.3.3. The use of AHP to prioritize them is described in ISO 16355-4:2017, 11.2. The house of quality is described in ISO 16355-5:2017, 9.3.6.

8.6.2 Emotional or attractive needs using kansei engineering

In QFD, customer needs are described as the benefit to the customer of their problem solved, their opportunity enabled, or their image (self or to others) enhanced. Problem solved and opportunity enabled are functional needs as described in 8.6.1. Image enhanced to self or to others are addressed using kansei engineering. Kansei engineering uses quantitative techniques such as the semantic differential, factor analysis, and multivariate analysis to explain what components at what performance level drive design elements that lead targeted customers to experience specific emotions. This is explained in ISO/TR 16355-8:2017, Clause 8. For category-type variables, the quantification methods can be used, as described in 9.13.

8.7 Prioritization

8.7.1 General

Prioritization is used throughout QFD to focus the efforts of the design team. Modern QFD uses the analytic hierarchy process (AHP) in voice of customer and stakeholder analysis to structure and prioritize customer needs.

8.7.2 Analytic hierarchy process (AHP)

Prioritize business and project goals as well as prioritize market segments using AHP. (ISO 16355-2:2017, 9.1.2.8 and 9.1.3). Prioritize customer needs using AHP. (ISO 16355-4:2017, 11.2)

8.7.3 L-matrices

Structure and prioritize customer segments using L-matrices and AHP. (ISO 16355-2:2017, 9.2.3)

8.7.4 Cluster analysis

Structure customer needs using cluster analysis (9.4) instead of affinity diagram and hierarchy diagram. (ISO 16355-4:2017, 10.2 and 10.3)

8.7.5 Analytic network process (ANP)

Prioritize customer needs using the analytic network process (ANP) (9.1).

8.7.6 Benchmarking

Benchmark customer perceptions of current and competitive products (ISO 16355-4:2017, 12.2).

8.8 Product requirements, feature sets, concept options

8.8.1 Conjoint analysis

Conjoint analysis is used to determine what combination of product attributes and performance levels are most preferred by customers. Its use in QFD is described in 9.3.

8.8.2 Customer needs — Functional requirements matrix (house of quality)

The house of quality is used to transfer prioritized customer needs into prioritized functional requirements in QFD. Its use in QFD is described in ISO 16355-5:2017, 9.3.6.

8.8.3 Quantification method III

This variation on correspondence analysis helps uncover hidden use cases and appropriate concepts to address them. Its use in QFD is described in 9.13.2.

8.8.4 Regression analysis

Regression analysis is used to predict the effects of product performance on customer evaluations. Its use in QFD is described in 9.14.

8.8.5 Repertory grid technique

Repertory grid technique is used to what product features are desired by customers. Its use in QFD is described in 9.15.

8.8.6 Text analytics and text mining

Text analytics of big data helps extract product features that are referenced frequently in online reviews. Its use in QFD is described in 9.16.

8.9 Distribution, logistics and inventory, sales channels

New Lanchester strategy can be used to take competitive advantage of distribution and sales channels. Its use in QFD is described in ISO 16355-2:2017, 9.1.2.6.

8.10 Customer satisfaction surveys and preference benchmarking

8.10.1 Customer satisfaction surveys

Customer satisfaction surveys are described in ISO 10004. Sample survey development guidance is described in Annex A. These can be used to produce customer satisfaction surveys based on sample survey methods.

8.10.2 Factor analysis and covariance structure analysis

Customer satisfaction and dissatisfaction surveys can be analyzed to help developers prioritize which product attributes and functional requirements are strongly associated with customer excitement or basic expectations. Its use in QFD is described in 9.6.

8.10.3 Fuzzy set theory

Customer scoring on a linear satisfaction scale is difficult when the scores are not crisp. Fuzzy set theory can be used to improve the process. Its use in QFD is described in 9.6.

8.10.4 Net promoter score (NPS)

Net promoter score is used to measure customer loyalty in terms of likelihood of recommending a product to others. Its use in QFD is described in 9.11.

8.10.5 Neural networks and artificial intelligence

Neural networks are computer models that use surveys to create and test a hypothesis of customer satisfaction and preferences. Its use in QFD is described in 9.12 and 9.2.

8.10.6 Regression analysis

Regression analysis is used to predict the effects of product performance on customer evaluations of current, competitive, and proposed products. Its use in QFD is described in 9.14.

Table 1 — Quantitative voice of customer tools used in QFD

New product development phase	Method or tool	Detailed information
8.2 Market strategy and trends	Analytic network process (ANP)	9.1
	Porter 5 force competitive analysis	ISO 16355-2:2017, 9.1.2.3
	Market position analysis	9.8
	Project selection	ISO 16355-2:2017, 9.1.2.8

Table 1 *(continued)*

New product development phase	Method or tool	Detailed information
8.3 Market segments	Demographics using cross tabulation	9.9
	Attitudinal and cultural dimensions	9.5
	New Kano model	ISO 16355-5:2017, 10.3.4.4.8.1
	Repertory grid technique	9.15
8.4 Competitive space	Benchmarking	ISO 16355-4:2017, 12.2
	Market position analysis	9.8
	Multidimensional scaling (MDS)	9.10
	New Lanchester strategy	ISO 16355-2:2017, 9.1.2.6
	Repertory grid technique	9.15
8.5 Customer and stake-holder applications	Frequency of use or application	9.9
	Robust parameter design	ISO/TS 16355-6, ISO 16336, ISO 16337
8.6 Customer needs	Functional needs using text analytics and text mining	9.16
	Emotional or attractive needs using kansei engineering	ISO/TR 16355-8:2017, Clause 8
8.7 Prioritization	Analytic hierarchy process (AHP)	ISO 16355-2:2017, 9.1.2.8 and 9.1.3
	L-matrices	ISO 16355-2:2017, 9.2.3
	Cluster analysis	9.4
	Analytic network process (ANP)	9.1
	Benchmarking	ISO 16355-4:2017, 12.2
8.8 Product requirements, feature sets, concept options	Conjoint analysis	9.3
	Fuzzy multiple-objective decision models for FMEA	9.7.6
	House of quality	ISO 16355-5:2017, 9.3.6
	Quantification method III and factor analysis	9.13.2
	Regression analysis	9.14
	Repertory grid technique	9.15
	Text analytics and text mining	9.16
8.9 Distribution, logistics and inventory, sales channels	New Lanchester strategy	ISO 16355-2:2017, 9.1.2.6
8.10 Customer satisfaction surveys and preference benchmarking	Customer satisfaction surveys	ISO 10004 and Annex A
	Factor analysis with covariance structure analysis	9.6
	Fuzzy set theory	9.7
	Net promoter score (NPS)	9.11
	Neural networks/artificial intelligence	9.12, 9.2
	Regression analysis	9.14