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Application of statistical and related methods to new technology and product development process

Part 1: General principles and perspectives of quality function deployment (QFD)

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National foreword

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

Part 1: General principles and perspectives of quality function deployment (QFD)

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

Partie 1: Principes généraux et perspectives de déploiement de la fonction qualité (QFD)

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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 Technical Committee ISO/TC 69, *Applications of statistical methods*, Subcommittee SC 8, *Application of statistical and related methodology for new technology and product development*.

This second edition cancels and replaces the first edition (ISO 16355-1:2015), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— throughout the text, addition of relevant informative references to the other parts in the ISO 16355 series, which are also added to the Bibliography.

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

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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 are 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 life cycle cost, 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 will find these improvements make QFD easier and faster to use. The methods and tools shown and described represent decades of improvements to QFD; the list is neither exhaustive nor exclusive. Users should 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.

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

Part 1: General principles and perspectives of quality function deployment (QFD)

1 Scope

This part of ISO 16355 describes the quality function deployment (QFD) process, its purpose, users, and tools. 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 part of ISO 16355 will 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

There are no normative references cited in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
quality function deployment
QFD
managing of all organizational functions and activities to assure product quality

Note 1 to entry: The organization is responsible for product quality and strives for it via defining, testing, building, commercializing, and supporting the product.

Note 2 to entry: Literal definition is that the "quality function" is "deployed" to all other business functions and departments who play a role in assuring quality and customer satisfaction.

3.2
voice of customer
VOC
communications from the customer

Note 1 to entry: The communications from the customer may be verbal, written, video, audio, animation, or other form and may be descriptive, behavioural, or ethnographic.

Note 2 to entry: *Customer* is defined in ISO 9000:2015, 3.2.4.

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3.3
customer need
potential benefit to a customer

Note 1 to entry: The benefit to a customer from having their problem solved, their opportunity enabled, their image (self or to others) enhanced, or being advanced to a more desirable state.

Note 2 to entry: The benefit is positively stated.

Note 3 to entry: The benefit describes a single issue.

Note 4 to entry: The benefit is independent of the product or features.

Note 5 to entry: A need may be explicit or latent.

Note 6 to entry: *Customer* is defined in ISO 9000:2015, 3.2.4.

3.4
functional requirement
characteristic that a product or service is specified to possess

Note 1 to entry: The characteristic could be an inherent performance of the product or an action that the product shall be able to accomplish. The manner in which the product accomplishes the action should not include specific mechanisms or internal procedures is not part of the functional requirement.

Note 2 to entry: *Product* is defined in ISO 9000:2015, 3.7.6.

Note 3 to entry: *Service* is defined in ISO 9000:2015, 3.7.7.

3.5
voice of stakeholder
VOS
communications from the stakeholder

Note 1 to entry: The communications from the stakeholder may be verbal, written, video, audio, animation, or other form and may be descriptive, behavioural, or ethnographic.

Note 2 to entry: *Stakeholder* is defined in ISO 9000:2015, 3.2.3.

3.6
customer gemba
location where true information is found

Note 1 to entry: Gemba is a Japanese word meaning the place where the truth is discovered. In Six Sigma, this usually refers to the shop floor where internal activities take place. In QFD for new product development, the new product does not exist yet, so the gemba changes to where the customer's activities or encounters take place.

Note 2 to entry: There may be no physical location, i.e. for eCommerce or some processes.

Note 3 to entry: Gemba visits help discover unknown requirements.

3.7
hoshin kanri
method for management and deployment of strategic organizational policy

Note 1 to entry: English translations include policy management, policy deployment, management by policy, and strategy deployment.

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4 Basic concepts of QFD

4.1 Theory and principles of QFD

Quality function deployment is an approach for ensuring quality throughout but not necessarily at each stage of the product development process, starting with the initial product concept. In 1987, the co-founder of QFD, Yoji Akao, defined comprehensive QFD as converting the "consumers' demands into quality characteristics and developing a design quality for the finished product by systematically deploying the relationships between the demands and the characteristics, starting with the quality of each functional component and extending the deployment to the quality of each part and process. The overall quality of the product will be formed through this network of relationships."[10] Since that time, QFD users have extended QFD and its applicable methods and tools upstream in the product development process to initial project strategy and downstream to the commercialization and even retirement of the product from the market. The network of relationships becomes a framework for new product development. QFD can be applied to products, services, and processes (hereafter referred to as products).

As a quality method, the aim is to assure that decisions regarding product development have a defined and repeatable process, are based on factual information, have definable and measurable targets, involve all relevant business departments, and focus first and best efforts where they matter most to customers. QFD should begin upstream in the product development process in order to assure that decisions are made in this way, as downstream rework can be costly in terms of money and delays.

The principles of QFD are as follows:

a) prioritize information to focus;

b) understand how to cause good quality;

c) listen to the voice of the customer;

d) observe the customer's situation;

e) capture information from other sources;

f) improve internal communications through the transformation of information between perspectives.

4.2 QFD use of the word of function

In modern organizations, the "quality function" shall collaborate and coordinate with other functions (marketing, engineering, manufacturing, service support, information technology, and others involved in product development) in order to assure customer satisfaction with the resulting product. Thus, the quality function is deployed (hence, the term QFD) across critical business activities and ideally across the entire organization.

NOTE The term function is used in multiple ways in QFD. The following are some of the common uses.

In the term quality function deployment, function refers to the organizational units, in this case, the quality function that is often tasked with process control, improvement, inspection, and other related activities.

In the term function deployment, function refers to product function, defined in value engineering and function analysis as a verb (active) + noun (measurable) that describes what a product does but not how it does it regardless of the level or perspective.

4.3 Spirit of QFD

A commitment among all critical departments to work together for the benefit of the customer or stakeholder. A personal connection to the customer should be established.

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As a central principle, customer needs or requirements shall be known or acquired and understood adequately by all relevant stakeholders. It shall be validated if product requirements meet the needs of the customer or stakeholder.

4.4 Display of information

Visual display of information improves communications. Due to the various organizational functions in the QFD team and the complexity of the information as it flows through the development and commercialization process, visual displays of the information are helpful. This is especially true in global organizations with many languages and cultures.

5 Integration of QFD and product development methods

5.1 QFD support for product development methods

Integration of QFD into new product development processes is both desirable and possible. Successful integration has been accomplished with other product development methods such as Stage-Gate™[1)] and product development support methods such as Design for Six Sigma, Design for Lean Sigma, and others. This may be done at an enterprise level, business group level, project level, or technology level. This integration should be guided by a QFD expert familiar with these methods.

NOTE 1 QFD is designed to link together the various phases of product development such as strategy, portfolio, marketing, competitiveness, systems, voice of customer, requirements analysis, concept development, optimization, change management, reliability, cost, safety, manufacturing, support, logistics, quality, and other product development phases. This linking assures that priorities at each phase are supported by downstream phases and decisions at each phase can be viewed for their impact on upstream phases. In this way, QFD improves both the product and the process by which it is created.

NOTE 2 QFD can integrate tools and methods from different new product development processes. Conversely, different new product development processes can utilize QFD tools and methods.

NOTE 3 The applicable tools lists are not exhaustive. They are meant to illustrate tools that have been effectively used in QFD. Other tools might also be useful according to the project.

5.2 Flow of product development with QFD

5.2.1 Organization of the QFD flow

The flow of QFD methods and tools may vary according to the organization and project requirements. Typically, they begin with broad concerns and through prioritization flow down to specifics. Figure 1 illustrates the organization of the clauses of this part of ISO 16355. Each box describes the general stage in product development such as project, customers, and so forth. Within each box are specific steps and their respective clause numbers such as “8.2.1 Identify customers” and so forth. Later in this part of ISO 16355, each clause will describe the step and suggest applicable methods and tools that can be used to accomplish the step. This helps align the voice of the business, voice of the customer, voice of the engineer, and voice of the process.

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5.2.2 Flow chart of product development with QFD

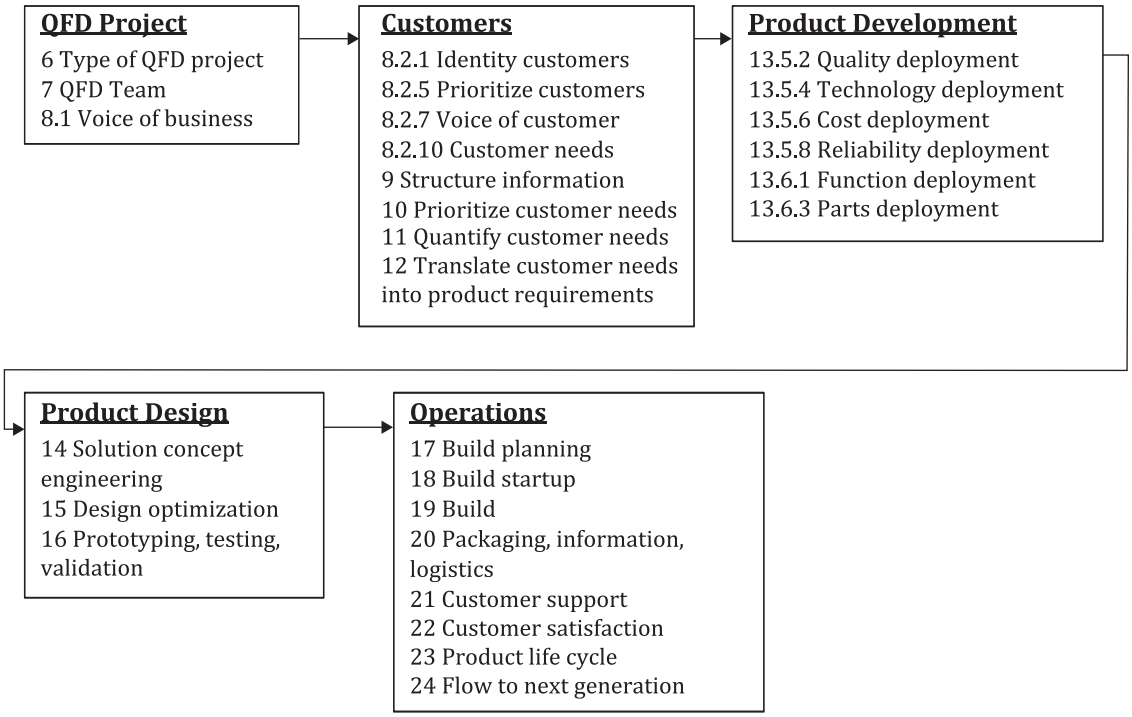

Figure 1 — Flow chart of product development with QFD

6 Types of QFD projects

6.1 General

QFD projects can encompass new developments, as well as generational improvements to existing products.

a) QFD can be applied to both existing and new markets, as well as to both existing and new technologies.

b) QFD projects can be driven by external sources such as market and customer demands, competitive threats or opportunities, technology change, regulatory changes, and other external factors, as well as internal sources such as cost reduction, manufacturing opportunities, new materials, knowledge management, and other internal factors.

c) QFD projects can focus on hardware, service, software, software as a service, process, systems, interface, or some combination. They can be either business-to-consumer (B2C) or business-to-business (B2B). Big, complex projects may benefit from increased customer involvement. Methods such as continuous QFD (see A.25) may be helpful.

d) QFD projects can be applied at any level: societal, environmental, end product, system, subsystem, component, production, material, process, service process, support, or supplier. Projects may progress upstream from micro detail to macro systems, downstream from macro to micro, or expand outward from a midstream level. QFD projects may have defined launches or may be continuous.

e) QFD may be employed at any management level from business operations to strategic business planning and control.

f) QFD projects may be used to document and preserve market and technical knowledge of the organization.

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The QFD tools and the sequence in which they are used should be adapted to the type of project.

The QFD tools and sequence should be adapted to the management structure and culture and problems of each organization to improve participation, integration, and long-term utilization of the method. There is no "one way" to do QFD that fits all organizations.

QFD tools and sequence have evolved since the first studies in the 1960s in the automobile parts industry that used simple diagrams and matrices to identify design elements and downstream manufacturing details. When end-user products, non-manufactured products such as service and software, and business processes began using QFD, additional tools were added to address human tasks, information, and other complexities (see A.22). In more recent years, organizational resource constraints have led to a quicker approach that addresses both complexity and speed (see A.23). It is consistent with quality methods in general and with customer-driven methods like QFD in particular that the methods and tools should evolve and adapt to the ever-changing business environment of its practitioners, in order for them to remain viable and practicable. This evolution is demonstrated in the Bibliography of case studies.

NOTE QFD is not a method to design a product or process; it is an infrastructure to ensure the product or process satisfies customers.

6.2 Applicable methods and tools

a) Systems engineering

b) Stage-Gate™[2)]

c) Design for Six Sigma phase activities

d) Design for Lean

e) Cross-functional management swim-lane charts (see ISO/TR 16355-8:2017, Clause 20)

f) Knowledge management (see ISO 16355-5:2017, 9.3.7)

g) Continuous QFD (see A.25 and ISO 16355-2:2017, 9.2.5.15)

7 QFD team membership

7.1 QFD uses cross-functional teams

The basic concept of QFD is to ensure quality throughout each stage of the product development process while keeping the focus on customer satisfaction. Team membership should consist of a core team and invited subject matter experts.

7.2 Core team membership

Core team members should represent business functions needed for the project. They should extend end-to-end across the development and commercialization process to prevent information gaps from diminishing customer satisfaction.

7.3 Subject matter experts

Subject matter experts whose specialty is required to develop and review requirements may be invited as the project requirements flow down to different departments in the organization. Common experts include marketing (consumer insights, consumer experience, statisticians, conjoint analysis, survey design, and other marketing areas), engineering (electronics, components, value engineers, software,

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materials, packaging, and other engineering areas), manufacturing (stamping, forming, equipment, supply, industrial, and other manufacturing areas), quality (Six Sigma, statisticians, inspection, gage, design of experiments, supplier quality, and other areas activities), services (technical writers, technical support, phone centres, and other service areas), as well as other areas of expertise.

7.4 QFD team leadership

QFD team leaders or moderators should be trained in the QFD tools and methods in order to effectively lead the QFD project. Additional tools, as identified in the appendices, may be useful. Basic team facilitation and moderation skills are recommended. (See ISO 16355-5:2017, 7.4.)

The QFD team leader should take a position of being function-agnostic so as to remain neutral to any business department or activity.

8 QFD voices

8.1 Voice of business

8.1.1 Since QFD is applied to projects, these projects have many goals or objectives for the organization. Constraints may also exist. These goals may derive from development decisions and business strategy.

8.1.2 Business and project goals may include financial targets such as revenue, profit, and facility and resource optimization, marketing targets such as market opportunity, market share, market growth, and competitiveness, and others. (See ISO 16355-2:2017, 9.1.3.)

8.1.3 Constraints may include time/schedule, human resources and technical expertise, and cost/investment.

QFD is a quality method, so the goals and constraints should include a metric and measurement method, current performance level of the metric, desired performance level of the metric, timeframe in which to achieve the desired performance level of the metric, and who will judge if the desired performance level of the metric has been met within the timeframe.

8.1.4 Applicable methods and tools

a) Strategic planning methods

   1) Hoshin kanri (policy management) (see ISO 16355-2:2017, 9.1.2.2)

   2) Porter five force analysis (see ISO 16355-2:2017, 9.1.2.3)

   3) Kotler's market portfolio planning (see ISO 16355-2:2017, 9.1.2.4)

   4) Blue Ocean Strategy (see ISO 16355-2:2017, 9.1.2.5)

   5) New Lanchester strategy for sales and marketing (see ISO 16355-2:2017, 9.1.2.6)

b) Balanced scorecard (see ISO 16355-2:2017, 9.1.2.7.2)

c) Project prioritization and selection using the analytic hierarchy process (AHP) (see ISO 16355-2:2017, 9.1.2.8)

d) Project goals table (see A.2 and ISO 16355-2:2017, 9.1.3)

e) Project goals prioritization with AHP (see A.3 and ISO 16355-2:2017, 9.1.3.3)

f) Heterarchy diagram

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8.1.5 Project scope

The project should also have a clearly defined scope in order to prevent scope drift and creep. (See ISO 16355-2:2017, 9.1.5.)

NOTE After market information is acquired, the scope can be adjusted to reflect new information regarding demand and competition.

8.1.6 Applicable methods and tools

a) Scope boundary analysis (see A.4 and ISO 16355-2:2017, 9.1.5.2)

b) Process beginning/end table (see A.5 and ISO 16355-2:2017, 9.1.5.3)

8.2 Voice of customer (VOC) or voice of stakeholder (VOS)

8.2.1 Definition of customer or stakeholder

A product provides benefit to one or more customers. There may also be a chain of involved customers or stakeholders including constituents (of a social service), end users and consumers, intermediate users such as dealers, installers, operators, maintenance, and other users and internal customers such as human resources, manufacturing, and other departments who reflect the underlying customer value network of delivery of the product to the user. The relationships among these various customers should be clarified. When many customers exist, they may be prioritized in order to focus resources first on high-priority customers. (See ISO 16355-2:2017, 9.2.1.)

8.2.2 Applicable methods and tools

a) Value chain mapping (see ISO 16355-2:2017, 9.2.1.2)

b) Analytic hierarchy process (AHP) (see A. 13 and ISO 16355-2:2017, 9.2.3)

c) User personae (see ISO 16355-2:2017, 9.2.1.3)

d) Stakeholder analysis (see ISO 16355-2:2017, 9.2.1.4)

8.2.3 Marketing perspective and engineering perspective

For product development, customers or stakeholders should be defined from both a marketing perspective (channel, region, size, and other related demographics) and an engineering perspective (who, what, when, where, why, and how the product will be or could be used). (See ISO 16355-2:2017, 9.2.2.)

NOTE Product use modes might be important in studies for parameter design for robust products and for reliability.

8.2.4 Applicable methods and tools

a) Customer value chain and network mapping (see ISO 16355-2:2017, 9.2.1.2)

b) Market segmentation

c) Customer segments table (see A.6 and ISO 16355-2:2017, 9.2.2.2)

d) User personae (see ISO 16355-2:2017, 9.2.1.3)

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8.2.5 Prioritize customers or stakeholders

Customers or stakeholders should be prioritized and information acquisition should begin with high-priority customers whose satisfaction is most critical to achieving the business and project goals. (See ISO 16355-2:2017, 9.2.3.)

Customer identification and prioritization should be based on statistical information.

8.2.6 Applicable methods and tools

a) AHP (see A.13 and ISO 16355-2:2017, 9.2.3)

b) Project goals/customer segments matrix (see A.7 and ISO 16355-2:2017, Table 17)

c) Cluster analysis (see ISO 16355-3:2019, 9.4)

d) Factor analysis (see ISO 16355-3:2019, 9.6 and ISO/TR 16355-8:2017, 8.10)

e) Stakeholder analysis (see ISO 16355-2:2017, 9.2.1.4)

8.2.7 What is contained in the voice of customer (VOC) or voice of stakeholder (VOS)

VOC and VOS is raw, unprocessed information from the customer or stakeholder. It often includes complaints, needs, functional requirements, performance specifications and targets, solutions, components, materials, activities, information, and other customer or stakeholder statements. To be most useful, these may be sorted, analysed, structured, quantified, and prioritized by key customers.

8.2.8 Sources of VOC and VOS

VOC and VOS may be acquired through the applicable methods and tools. (See ISO 16355-2:2017, 9.2.5 and ISO 16355-4:2017, 9.1.2.)

Voice of customer or stakeholder may be obtained through non-quantitative and quantitative methods below. Surveys should be properly designed, tested, and evaluated.

8.2.9 Applicable methods and tools

a) Gemba visit checklist (see ISO 16355-2:2017, 9.2.5.2.2)

b) Customer process model (see A.8 and ISO 16355-2:2017, 9.2.5.2.3)

c) Gemba visit table (see A.9 and ISO 16355-2:2017, 9.2.5.2.4)

d) Customer support and help systems (see ISO 16355-2:2017, 9.2.5.4)

e) Focus groups (see ISO 16355-2:2017, 9.2.5.6)

f) Social media (see ISO 16355-2:2017, 9.2.5.7)

g) Questionnaires (see ISO 16355-2:2017, 9.2.5.8)

h) Interviews (see ISO 16355-2:2017, 9.2.5.9)

i) Customer satisfaction surveys (see ISO 16355-2:2017, 9.2.5.10)

j) Lead user analysis (see ISO 16355-2:2017, 9.2.5.11)

k) Warranty returns, complaints (see ISO 16355-2:2017, 9.2.5.12)

l) Conference papers, reports, and studies (see ISO 16355-2:2017, 9.2.5.17)

m) Sales call reports

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n) Technical visits and maintenance records (see ISO 16355-2:2017, 9.2.5.13)

o) Continuous QFD (see A.25 and ISO 16355-2:2017, 9.2.5.15)

p) Design thinking (see ISO 16355-2:2017, 9.2.5.16)

q) Big data analytics

8.2.10 Translating VOC/VOS into customer needs

QFD project teams constrained by resources, budget, and time shall focus their efforts where they matter most to the customer. The customer, not the QFD team, should determine these priorities whenever possible. To get accurate priorities, VOC should be translated into an information set about which the customer has greater domain knowledge – customer needs.

Customer needs are defined in QFD as being benefits the customer receives when their problems are solved, their opportunities are enabled, or their image (self and to others) is enhanced, independent of the specific product or solution. The purpose is to derive true customer needs identifying and separating customer from possible solutions specified by the customer or the product development team. Clear separation of needs and solutions leads to more flexibility and innovation in finding appropriate solutions for all stakeholders. (See ISO 16355-4:2017, Clause 9.)

8.2.11 Applicable methods and tools

a) Cause-to-effect diagram (see ISO 16355-4:2017, 9.2.3)

b) Customer voice table (see A.10 and ISO 16355-4:2017, 9.2.4)

c) Focus groups (see ISO 16355-2:2017, 9.2.5.6)

d) Continuous QFD (see A.25 and ISO 16355-2:2017, 9.2.5.15)

9 Structuring information sets

9.1 General

To obtain accurate, unbiased, and unambiguous prioritization and quantification and to reduce the effort of both customers and team members to obtain, these information should be organized into a logical structure. Structuring should be done by members of the group that “own” the information set and have greater domain knowledge.

Customer needs should be structured by the customer.

Information set structuring should assure that information groups are mutually exclusive and collectively exhaustive (MECE) to ensure no overlapping or missing elements. Overlapping or missing elements can reduce the accuracy of later analyses such as prioritization. (See ISO 16355-4:2017, Clause 10.)

9.2 Applicable tools and methods

a) Affinity diagram (see A.11 and ISO 16355-4:2017, 10.2)

b) Hierarchy diagram (see A.12 and ISO 16355-4:2017, Clause 10.3)

c) Networks

d) Heterarchy diagram (network of elements sharing common elements in which each element shares the same horizontal position of power and authority)

e) Mind maps

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f) Key needs analysis

10 Prioritization

10.1 General

In order to focus where maximum benefit to customers or stakeholders is provided with minimal effort by the QFD team, prioritization of the information set should not be neglected.

Prioritization should be done by the group that "owns" the information.

Customer needs should be prioritized by the customer.

Priorities should be as accurate, unbiased, and unambiguous as possible as they may serve later QFD activities related to cost and resource allocation. Thus, the mathematical limitations of different numerical scales should not be ignored.

Ordinal ranking and rating scale numbers do not support +, –, ×, or / mathematical functions. Ratio scale numbers (also referred to as absolute relative scale with meaningful ratios) should be used if these mathematical functions are to be used later. (See ISO 16355-4:2017, Clause 11.)

10.2 Applicable tools and methods

a) Analytic hierarchy process (AHP) (A.13 and ISO 16355-4:2017, 11.2)

b) Analytic network process (ANP) (see ISO 16355-3:2019, 9.1)

c) Fuzzy AHP

d) Fuzzy ANP

e) Continuous QFD (A.25 and ISO 16355-2:2017, 9.2.5.15)

11 Quantification

11.1 General

Quantification of customer needs may include customer current and hoped-for satisfaction levels, customer scoring of the magnitude of current product and benchmarking competitive alternatives, and other factors that reflect customer value. Quantification of customer needs may also include minimum acceptance levels (below which there is no real benefit) and maximum thresholds (beyond which there is no additional benefit). Quantifications may be used as adjustments to recalculate customer needs priorities to reflect market opportunities and competitive threats.

Quantification values should not neglect the limitations of different numerical scales. Ratio scale numbers (also referred to as absolute relative scale with meaningful ratios) should be used if the mathematical functions of +, –, ×, and / are to be used in the adjustment recalculations.

11.2 Applicable tools and methods

a) Focus groups (see ISO 16355-2:2017, 9.2.5.6)

b) Interviews (see ISO 16355-2:2017, 9.2.5.9)

c) Porter five force analysis (see ISO 16355-2:2017, 9.1.2.3)

d) New Lanchester strategy for sales and marketing (see ISO 16355-2:2017, 9.1.2.6)

e) Quality planning table (see A.14 and see ISO 16355-4:2017, 12.2)

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f) New Kano model (see ISO 16355-5:2017, 10.3.4.4)

12 Translation of one information set into another

12.1 General

QFD flows information sets through the various development and commercialization functions of the organization. These flows are called deployments and often require the language of one information set to be transformed into another information set or a single information set broken down into more details. This translation can be visually displayed to check for completeness and accuracy and can be mathematically quantified for complex information sets. (See ISO 16355-5:2017, Clause 9.)

12.2 Applicable tools and methods

a) Maximum value table for critical needs (see A.15 and ISO 16355-5:2017, 9.2)

b) House of Quality and other L-matrices for comprehensive studies (see A.16 and ISO 16355-5:2017, 9.3)

c) Other tools in the new management and planning tool set (see A.21 and ISO 16355-2:2017, 8.2)

13 Transfer of prioritization and quantification from one information set into another

13.1 Transfer of prioritization

Prioritizations and quantifications of one information set may be transferred into prioritizations and quantifications of another information set. In a QFD L-matrix, prioritization is done with weights to show the strength of relationship or contribution of the columns of the matrix to the rows of the matrix. In the House of Quality matrix, weights quantify the relationship or contribution between customer needs and functional requirements. Setting targets for the functional requirements can be improved by examining their weighted contribution to customer needs. (See ISO 16355-5:2017, 10.2.)

QFD can use many types of matrices for transferring priorities and quantifications. The House of Quality is one instance of an L-matrix. It is so named because the original Japanese labels had the word “quality” in both axes (demanded quality in the rows and quality characteristics in the columns). Other matrices include information related to functions, parts, technologies, failure modes, cost, and other dimensions of the design and development process. It is recommended to refer to matrices by the information in the “rows/columns” matrix. Thus, in this format, the House of Quality can be referred to as the customer needs/functional requirements matrix. In addition to the L-matrix, QFD can use T-matrices, Y-matrices, C-matrices, and others.

NOTE There are different approaches to quantifying weighted contributions or relationships. An approach that is appropriate for the analysis can be used.

a) Classical QFD matrices using three levels of relationships described as weak (W), moderate (M), strong (S) and assigned values of 1, 2, 4 or 1, 3, 5 or 1, 3, 9, respectively.

   NOTE Strengths of this approach: familiarity, 1, 3, 9 addresses problem of transferred priorities being too close in value. Weaknesses of this approach: with only three levels, QFD teams might struggle to agree on the appropriate level, these are ordinal scales without fixed intervals so that resulting QFD math functions have results that tell order but not relative importance.

b) Modern QFD matrices use five or nine levels of relationships described as weak (W), moderate (M), strong (S), very strong (V), or extremely strong (X), as well as intervals such as weak-to-moderate

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