



Technical Report

ISO/TR 16355-9

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

Part 9: Unified case study applying QFD to hardware, service, software, and hybrid products

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

*Partie 9: Étude de cas unifiée appliquant la méthode QFD aux
matériels, aux services, aux logiciels et aux produits hybrides*

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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*.

A list of all parts in the ISO 16355 series is 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 is 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.

The case study presented in this technical report illustrates how comprehensive QFD and related methods and tools were used by a company which operated 70 % of the U.S. airport food and beverage market, and set a strategic goal to increase top line revenues. It was recognized by this company that its strategic goal could not be achieved with the approach traditionally followed by the company to develop new products and services, which was a product-out approach focused on unit cost reduction. While cost reduction could positively impact per-item profit, top-line revenue growth could only come from increasing prices and number of items sold. That is why they decided to adopt QFD (a market-in approach) to increase the quality perceived by multiple customer segments and who would demand more product and be willing to pay a higher price.

As a result of applying QFD thinking and methods the company transformed the design of the food products, the way these were processed, and the way they were sold. This included transforming the design of airport facilities and staff skills including the customer sales interface, on-site food preparation areas, staff training and the supply chain of both innovative product materials and process equipment. It was a way of achieving a whole-system transformation that achieved their strategic targets in a short period.

The full scope of comprehensive QFD methods and tools were not all used by this company, but based on public information available in the original food and beverage case study,^[1] an extrapolation into this single case study has been made using additional QFD related case studies included in the first eight parts of the ISO 16355 series of standards. The purpose is to show that QFD tools and methods are readily tailorable for different products, processes, services, software, and system transformations. Thus, some figures and tables have been modified from other case studies to exemplify how they might have looked had they been used in the original food and beverage case. It is generally not recommended that a single project use all these tools due to the time and resources required.

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

Part 9: Unified case study applying QFD to hardware, service, software, and hybrid products

1 Scope

This document applies the various details and case studies from ISO 16355-1 through ISO/TR 16355-8 to a unified case study based on public information available from a food and beverage case study.^[1] By reframing the different case studies into a single story, the relationships and information flows of QFD are more easily followed. This document briefly explains how the methods and tools of QFD and associated methods might work in this food and beverage study. Detailed steps are found in the ISO 16355 series as referenced in this document and readers are able to use these when implementing QFD.

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 16355-1, *Application of statistical and related methods to new technology and product development process — Part 1: General principles and perspectives of quality function deployment (QFD)*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 16355-1 apply.

4 Basic concepts of QFD

The basic concepts of QFD are referenced in ISO 16355-1:2021, Clause 4.

5 Integration of VOC and VOS analysis and product development methods

5.1 QFD support for product development methods

QFD support for product development methods is referenced in ISO 16355-1:2021, 5.1.

5.2 Flow of product development with VOC and VOS analysis

5.2.1 Organization of the VOC and VOS analysis

The flow of VOC and VOS analysis methods and tools vary according to the organization and project requirements. Typically, they begin with broad concerns and through prioritization flow down to specifics.

5.2.2 Outline of VOC and VOS analysis

[Figure 1](#) shows the organization of the main phases of QFD used in this document.. Later in the document, each clause and subclause will detail the step and suggest applicable methods and tools with guidance referenced in other parts of the ISO 16355 series of standards that are used to accomplish the step.

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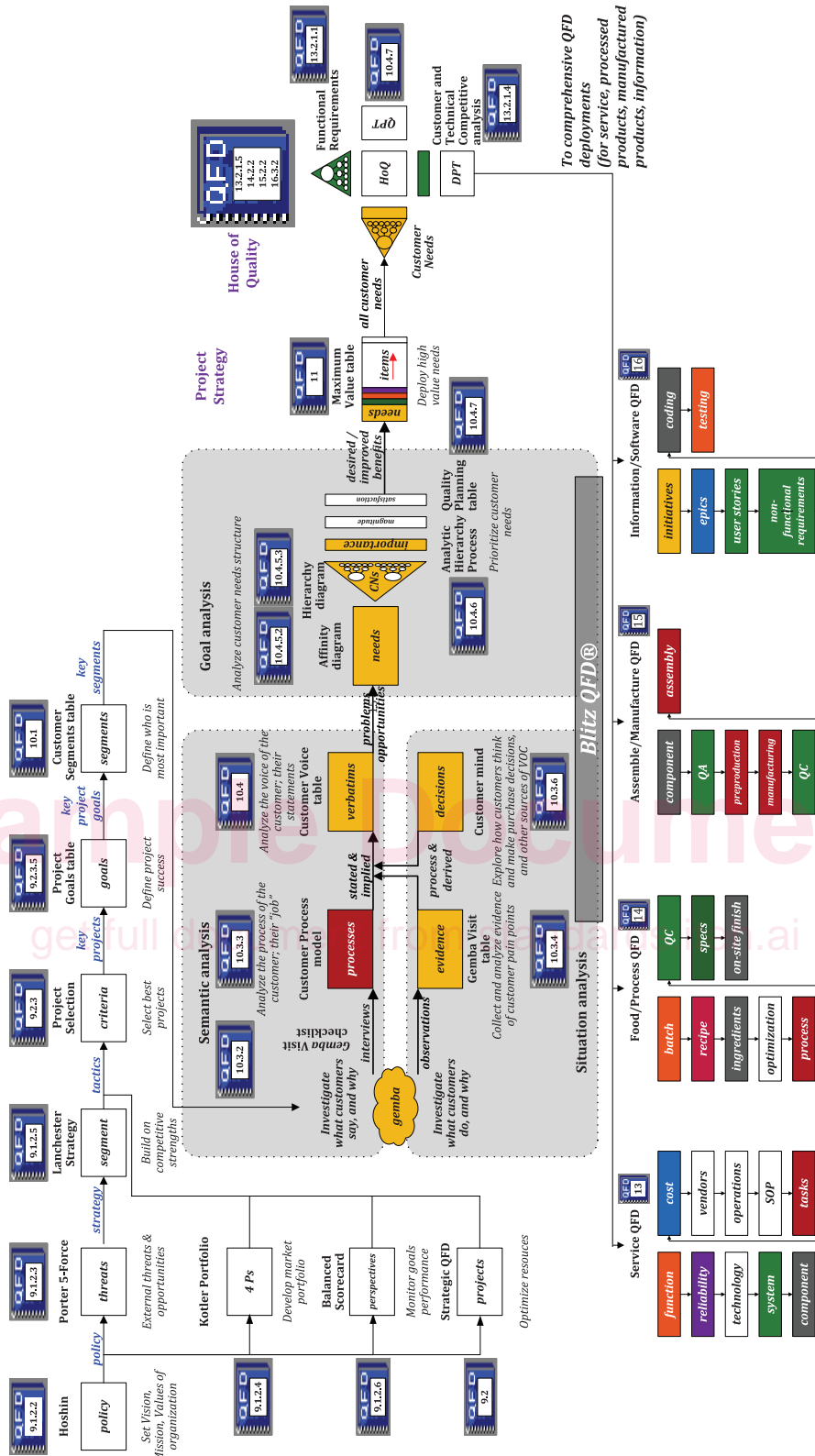


Figure 1 — Airport service project full QFD flow diagram with clause and sub-clause numbers

6 Types of QFD projects

QFD projects encompass new developments as well as generational improvements to existing products. The types of QFD projects are referenced in ISO 16355-1:2021, Clause 6. This document includes the upgrade

of existing products and services to achieve strategic organizational goals. It lies somewhere between a generational improvement and a new offering.

7 QFD team membership

7.1 QFD recommends the use of cross-functional teams

Cross-functional teams are referenced in ISO 16355-1:2021, 7.1.

7.2 Core team membership

Core team membership is referenced in ISO 16355-1:2021, 7.2. Core team membership changes as the project proceeds. Recommended membership is detailed in ISO 16355-5:2017, Table 1.

EXAMPLE The core QFD team of the local facility included a multi-unit manager, general manager, controller, commissary manager, and a marketing manager. They began by tasking their QFD consultant with interviewing key product development managers to custom tailor a QFD process to fit their business. The QFD team then attended a customer tailored QFD Green Belt training on their core QFD methods and tools.

7.3 Subject matter experts

Subject matter experts involvement is referenced in ISO 16355-1:2021, 7.3.

7.4 QFD team leadership

QFD teams are led by members of business functions such as sales, marketing, market research, innovation, engineering, quality, operations, or others.

NOTE 1 QFD team leadership roles are detailed in ISO 16355-5:2017, 7.4.

NOTE 2 The QFD team leader takes a position of being function-agnostic so as to remain neutral to any business department or activity.

EXAMPLE This study was commissioned by the corporate vice president of operations, and the senior team included the corporate director of catering standards, a brand executive, members of the new business team, and the director of total quality management. The division senior team members included the vice president of products and standards, director of food and beverage standards, director of procurement, and several general managers from various local facilities. The team selection was coordinated by the vice president of total quality management. The process began with a QFD technical diagnosis to ascertain which QFD methods and tools were most appropriate based on the management structure, corporate culture, and product. A QFD gold belt executive presentation was made to the senior leadership to inform them of the tasks and timelines of the project and what support was needed from them to promote success.

8 Seven management and planning tools

The seven management and planning tools are referenced in ISO 16355-2:2017, 8.2.

NOTE The full range of QFD methods and tools are outlined in ISO 16355-1:2021, Table A.1.

9 New technology and product development voices

9.1 Voice of business

9.1.1 General

The new product development process addresses the various stakeholders' voices. While voice of customer is commonly considered a good starting point, QFD in fact often begins with the voice of the business or organization. This emphasizes that only a healthy ongoing concern will adequately serve its customers,

somewhat akin to the pre-flight emergency instructions of "put your own oxygen mask on first before helping others."

9.1.2 Strategic planning

9.1.2.1 General

This top-line revenue growth strategy began with the voice of the business; the guideline being that customers are best served when the business is strong. The several business functions also represented different objectives and clarifying and prioritizing these voices would better focus the project. QFD has adapted several methods and tools to create, analyse, implement, and measure the success of organizational strategy.

NOTE Strategic planning methods are referenced in ISO 16355-2:2017, 9.1.2[2].

Table 1 — Revenue forecasts for major food service business lines

Business line	Revenue (today)		Total target revenue increase		Analysis of growth potential		Revenue increase per business line		
	% of total current revenue	million \$	% of total current revenue	million \$	Competitive situation	Customer willingness to spend more for extra quality	% of total revenue increase	million \$	% of current business line revenue
Airports	50 %	600			Good (no alternatives for customers)	High	80 %	288	48 %
Highway travel plazas	30 %	360			Poor (alternatives typically few miles away)	Moderate	15 %	54	15 %
Railway stations	20 %	240			Neutral (few alternatives right outside the station)	Low	5 %	18	8 %
Total	100 %	1 200	30 %	360				360	

Table 2 — Revenue forecasts for airport product types

Product types in airport	Revenue (today)		Total revenue increase		Analysis of growth potential		Revenue increase per product type		
	% of total current business line revenue	million \$	% of current business line revenue	million \$	Customer willingness to spend more for extra quality	Risk of cannibalizing other products if improved	% of total business line revenue increase	million \$	% of current product type revenue
Made to order food	20 %	120			Very high	Low	40 %	115,2	96 %
Prepared food	15 %	90			Moderate	Moderate	15 %	43,2	48 %
Snacks	10 %	60			Low	Moderate	5 %	14,4	24 %
Fresh drinks	30 %	180			High	High	20 %	57,6	32 %
Packaged drinks	25 %	150			Low	High	20 %	57,6	38 %
Total	100 %	600	48 %	288			100 %	288	

EXAMPLE Top-line revenue growth forecasts were formulated with external and internal experts by analysing the major product categories of airport, highway, and rail station food services. Current revenue in dollars and as a percentage were first projected if no structural changes were implemented, and then re-balanced in light of competitive opportunities, as shown in Table 1. The airport business was further analysed by different product types as shown in Table 2.

9.1.2.2 Hoshin kanri (policy management and deployment)

9.1.2.2.1 General

Hoshin kanri implements strategic intent by applying quality measurement and improvement activities to both targets and the means to achieve them. Hoshin was used to take organizational strategies and identify projects, for which QFD was used to assure the strategies would be achieved.

NOTE Detailed guidance of hoshin kanri is referenced in ISO 16355-2:2017, 9.1.2.2.

9.1.2.2.2 Deployment of hoshin targets and means

Forecasted strategic goals are decomposed in either or both of two ways in hoshin kanri.

Targets-to-targets deployment and means-to-means deployment.

Target-to-means deployment.

9.1.2.2.3 Targets-to-targets deployment and means-to-means deployment

Targets-to-targets and means-to-means deployments are used to breakdown executive level goals and actions into more detailed targets and means for direct reports, who then, in turn, break them down into further details for their direct reports, and so forth. This is useful with easily quantifiable and measurable metrics which are then examined to confirm lower level targets and means sum to higher management level ones. Insufficiencies and deviations at lower levels thwart organizational visions and missions if not made visible. In targets-to-targets deployment, targets are assigned to direct reports and it is recommended to resist negotiation of targets to prevent shortcomings.

NOTE Targets-to-targets deployment is detailed in ISO 16355-2:2017, 9.1.2.2.3.

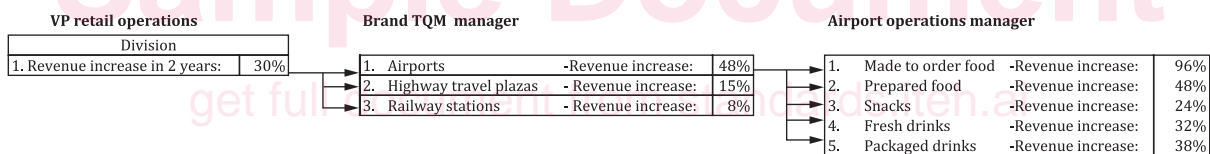


Figure 2 — Revenue increase targets deployed to lower level targets in tree diagram

EXAMPLE The company began with target-to-target deployment to determine which product type would deliver the highest revenue increase. Overall revenue increases at the retail operations level were broken into targets for the brand TQM manager overseeing airport, highway, and railway business lines. Airport operations were then assigned revenue increase targets with made-to-order food items showing the best growth potential as shown in the tree diagram in Figure 2. These targets reflect the strategy in Table 2 in a more process-oriented model. This figure shows only one branch being deployed because the highest potential for revenue increase was in airport locations, but sometimes all branches will be deployed for better visibility. Other brand TQM manager branches for highway and railway are deployed to their respective highway travel plaza operations manager and railway stations operations manager.

In means-to-means deployment, the means to achieve the targets are similarly deployed lower level means to decompose activities into more detailed actions for direct reports and their direct reports. Details of criteria performance measures, responsibilities and schedules are added. These details are subject to negotiation with managers to assure they are achievable in the required time frame and that appropriate resources and funding are available. Direct report's performance measures are reviewed to confirm they sum to manager's means performance measures.

NOTE Means-to-means deployment is detailed in ISO 16355-2:2017, 9.1.2.2.3.

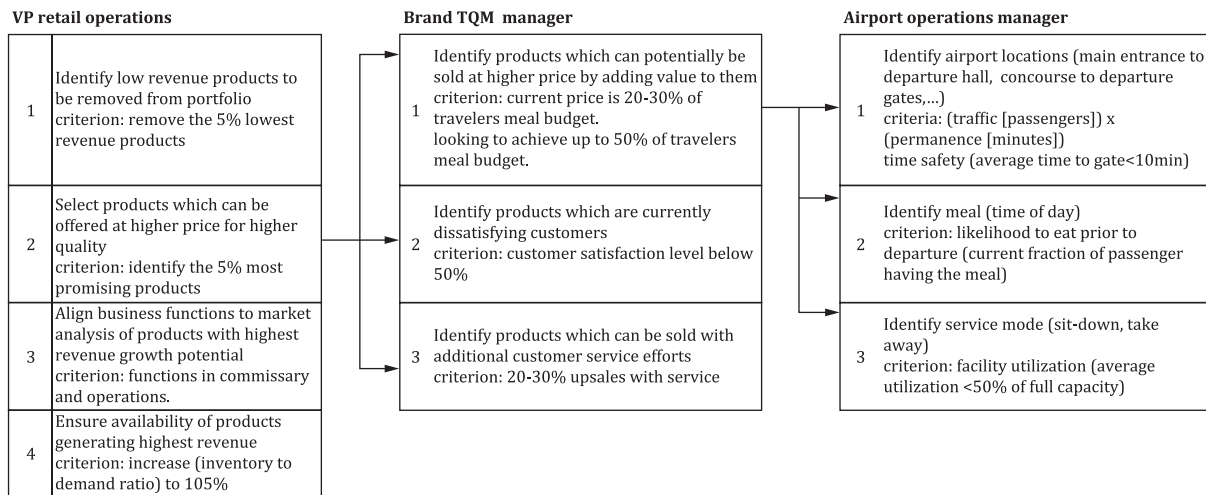


Figure 3 — Means to achieve targets deployed to lower level means in tree diagram

EXAMPLE The VP of retail operations deployed and negotiated selecting products which sell for a higher price for higher quality to the brand TQM manager, who then deployed and negotiated identifying products to be potentially sold at higher prices by adding value to them to the local airport operations manager to identify best locations, service times, and serve modes as shown in the tree diagram in Figure 3. This figure shows only one branch being deployed, but other VP branches could be similarly deployed to the marketing manager to identify low revenue products and to the logistics manager to ensure availability of high revenue generating products. Aligning business functions is retained by the VP as part of their responsibility. Sometimes all branches will be deployed for better visibility.

9.1.2.2.4 Target-to-means deployment

Target-to-means deployments confirm that means are sufficient to achieve targets both down and across organizational functions and departments. They are reviewed by upper management, peer managers, and direct reports to share proposed activities and investigate any interactions that encourage support as well as preventing or mitigating potential negative impacts. The two approaches of targets-to-targets and means-to-means and target-to-means are used independently or sequenced as the organization matures.

Target-to-means deployment juxtaposes the targets which are negotiated between managers and their direct reports with their respective means to achieve them. As with targets, means also include performance targets and how to measure them in addition to schedules and responsibilities. The purpose of juxtapositioning the targets and means of managers and their direct reports is as follows.

- Show the strength of relationships between targets and means to assure means are sufficient to achieve targets.
- Show the strength of relationships between managers and their direct reports, especially where manager targets and means are allocated among several direct reports in different departments or work groups.
- Indicate portions of manager targets and means retained by the manager and not deployed to direct reports.

Two common juxtapositionings are L-matrices comprised of two axes, typically showing how a manager's means transform into direct reports' targets. These are tailored for each direct report, who then deploy their targets into means which become targets for their direct reports. This process is repeated across the organization and down each management level. Its purpose as stated above is create a roadmap of activity sufficiency and responsibility. L-matrices are deployed differently in line and staff organizations. In line organizations such as manufacturing, manager targets are deployed into direct reports' sub-targets, which are further deployed into their direct reports' sub-sub-targets. In staff organizations, the manager's means are deployed into their direct reports' targets who are tasked with carrying out their manager's means though more detailed means of their own. These detailed means then become targets for their direct reports, and so forth.