PRIMJENA QFD METODE NA PRIMJERU IZRADE KUPAONIČKOG NAMJEŠTAJA U FRAMINI d.o.o. VITEZ

APPLICATION OF QFD METHOD IN THE CASE OF BATHROOM FURNITURE IN FRAMINI LTD. VITEZ

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Keywords:
kvalitet, konstruisanje, razvoj proizvoda, QFD metoda

Ključne riječi:
quality, design, product development, QFD method

Paper received:
22.12.2020.

Paper accepted:
30.12.2020.

Stručni članak

REZIME

U današnje vrijeme, svaki novi proizvod je na iskušenju, slobodno možemo reći na rubu propasti, te je vrlo važno smanjiti troškove njegove proizvodnje. Troškove jednostavno možemo smanjiti degradacijom kvaliteta proizvoda. Međutim, ako to ne želimo, moguće je okrenuti se prema primjeni novih znanja i spoznaja, koje omogućuju bolje iskorištavanje resursa firme, smanjuju vrijeme plasiranja proizvoda na tržište i čak poboljšavaju kvalitet proizvoda. Jedan od generatora potencijalno velikih troškova je upravo proces konstruisanja, ili proces razvoja proizvoda u najužem smislu. Vrlo je moguće da se u procesu konstruisanja mnoge informacije izgube neposredno nakon dobivanja odgovarajućeg rješenja. Kako bi se to izbjeglo, potrebno je na neki način bilježiti nastale probleme, ideje za njihovo rješavanje, te ostale argumente koji proizađu prilikom rada u konstrukcijskom timu i osmišljavanja rješenja za nastale probleme.

Cilj ovog rada jeste da prikaže jednu od metoda koja u suštini predstavlja sistemsku tehniku utvrđivanja potreba i zahtjeva kupca na temelju koje će se osnovati i izraditi proizvod. Tehnika QFD koristi se za identifikaciju osnovnih potreba i zahtjeva kupaca. Nakon što su potrebe i zahtjevi kupaca prikupljeni treba ih sistematizirati prema zahtjevima tehnike. Velik broj podataka i informacija proizašlih iz intervjua, raznih dokumenata, te istraživanja tržišta, mora se sažeti odnosno smanjiti do te mjere da do izražaja dođu ključne potrebe i zahtjevi kupaca. U radu je dat primjer korištenja QFD metode na izradi kupaoničkog namještaja u firmi Framini d.o.o. Vitez (B&H).

Professional paper

SUMMARY

Nowadays, every new product is tempted, we can freely say it is on the edge of the downfall, and it is very important to reduce its production costs. We can simply reduce costs by degrading product quality. However, if we do not want it, it is possible to turn to the application of new knowledge and knowledge that will enable better resource utilization, reduce product placement time and even improve product quality. One of the generators of potentially large costs is just the process of designing, or the product development process in the strictest sense. It is very possible that a lot of information is lost in the process of constructing immediately after having obtained the appropriate solution. In order to avoid it, somehow it is necessary to note the problems that arise, the ideas for their solution, and other arguments that arise when working in the construction team and developing solutions to the problems that arise.

The aim of this paper is to present one of the methods which essentially represent a systematic technique for determining the needs and customer requirements on which to base and produce the product. The QFD technique is used to identify basic needs and customer requirements. After the needs and customer requirements are collected, they are systematized according to the requirements of the technique. A large amount of data and information derived from interviews, various documents, and market research has to be summarized or reduced to the extent that the key needs and customer requirements are expressed. This paper brings an example of using the QFD method for making bathroom furniture in the company Framini d.o.o. Vitez (B&H).

1. UVOD

Kvalitet je danas prerastao, iz objekta kontrole, u strateški cilj svake organizacije, postao je glavni nositelj konkurentnosti koji proizlazi iz važnosti stvaranja što veće vrijednosti za potrošače. Sistemskim i kontinuiranim upravljanjem kvalitetom stvara se pretpostavka za povećanje korisnosti proizvoda i usluga, a također je važan faktor koji potrošačima osigurava povoljnije uslove poput cijene, bolje i fleksibilnije usluge i svih ostalih faktora koji su važni iz perspektive potrošača. Takav pristup će organizaciji omogućiti dugoročno stabilan rast i razvoj poslovanja te porast profitabilnosti. Organizacija može računati na rast ukoliko uspije zadovoljiti prvenstveno potrebe potrošača, ali i svih ostalih zainteresiranih strana – zaposlenika, vlasnika, dobavljača i društva u cjelini. Potrošači kvalitet doživljavaju kao subjektivnu dimenziju i kada donose odluke o kupnji ravnaju se prema nivou kvaliteta primjerenog svojim mogućnostima i očekivanjima. Kvalitet je osobina, vrijednost, sposobnost zadovoljavanja potreba i očekivanja potrošača, prikladnost za upotrebu. Potrošači ocjenjuju proizvod prema njegovim osobinama, cijeni, pouzdanosti, izgledu, prema imidžu koji prati proizvod, ali i prema nekim posebnim pogodnostima koje mogu uživati koristeći određeni proizvod, poput besplatnih uzoraka ili besplatne dostave. Sve to predstavlja kvalitet iz perspektive potrošača. Međutim, postoji i druga strana, ona koja taj proizvod osmišljava, dizajnira, proizvodi – proizvođači. Proizvođači su svjesni da, ako žele produžiti svoj vijek trajanja i rasti na tržištu, moraju biti sposobni odgovoriti zahtjevima kupaca te proizvesti upravo onakav proizvod kakav to očekuje njihov kupac. [1]

Svakom je proizvođaču cilj opstati na tržištu, a opstanak itekako zavisi od zadovoljenja potreba potrošača, zato su dizajniranje, oblikovanje i sam proces proizvodnje aspekti kvaliteta iz gledišta proizvođača. Kada se uzmu u obzir sva ograničenja tržišta i mnoštvo konkurenata, jasno je da je na plećima proizvođača sve teži zadatak. U mnoštvu ponuda nije lahko zadovoljiti (i zadržati) kupca koji očekuje bolje usluge, bolje proizvode, niže cijene, fleksibilnost, dostupnost. Možemo reći da su upravo to ključni razlozi zbog kojih je došlo do promjene pristupa kvalitetu. Prema tome, kvalitet je postao filozofija upravljanja i strateški cilj svake organizacije.

Dakle, kvalitet je sastavni dio poslovanja u svim dijelovima organizacije, a glavni cilj je stvaranje

1. INTRODUCTION

Nowdays, quality has transformed from a control object into a strategic goal for any organization, and has become the main attribute of competitiveness which originates from the importance of creating the highest value for consumers. Systematic and continuous quality management creates a precondition for increasing the usefulness of products and services, and is also an important factor that provides consumers with more favorable conditions such as price, better and more flexible services and all other factors that are important from the perspective of consumers. Such approach will enable the organization to achieve long-term stable growth and business development and increase of profitability. An organization can achieve growth if it can, primarily, meet the needs of consumers, but also all other stakeholders - employees, owners, suppliers and society as a whole. Consumers perceive quality as a subjective dimension, and when making decisions about purchasing, they behave according to the level of quality appropriate to their abilities and expectations. Quality is the characteristic, value, ability to satisfy the needs and expectations of the consumer, the suitability for use. Consumers evaluate the product according to its characteristics, cost, reliability, appearance, according to the image accompanying the product, but also according to some special benefits that can be enjoyed using a particular product, such as free samples or free delivery. All this represents quality from a consumer perspective. However, there is also other side, the one that creates, designs and produces the product. Manufacturers are aware that, if they want to extend their lifetime and market growth, they must be able to respond to customers' demands and produce exactly the kind of product their customer expects. [1]

Each producers aim is to survive on the market, and survival depends largely on satisfying the needs of consumers, and therefore the design, creation and production process itself are aspects of quality from the manufacturer point of view. When considering all market constraints and number of competitors, it is clear that manufacturers have an increasingly difficult task on their shoulders. In a multitude of offerings, it is not easy to satisfy (and retain) a customer who expects better services, better products, lower prices, flexibility, availability. We can say that these are the key reasons that led to the change in an approach to quality.

Accordingly, quality has become the management philosophy and strategic goal of each organization.

Therefore, quality is an integral part of the business in all parts of the organization, and the

vrijednosti za potrošača, zadovoljavanje njegovih potreba svođenjem nedostataka na nulu. „Kvalitet je postao integralnim dijelom proizvodnje i poslovanja poduzeća u cjelini, podrazumijeva aktivno sudjelovanje u stvaranju promjena od postojećeg stanja kvaliteta prema krajnjem dugoročnom (trajnom) cilju, a svodi se na proizvodnju proizvoda / pružanje usluga, u skladu s potrebama, željama i prohtjevima potrošača, bez nedostataka.“ [1]

S obzirom da se proizvod izrađuje za potrošače koji će ga u konačnici koristiti, vrlo je važno da se taj proizvod ili usluga prilagodi stvarnim potrebama i očekivanjima potrošača. To je kvalitet koji percipira potrošač - kvalitet iz aspekta potrošača. Oblikovanje i proces proizvodnje proizvoda su aspekti kvaliteta s gledišta proizvođača. Stoga je moguće definisati kvalitet kao: kvalitet dizajna / konstrukcije (s obzirom na proces njegova nastajanja) i kvalitet konformnosti (usklađenosti sa specifikacijom, konstrukcijskim rješenjem). Zadovoljstvo kupca se postiže kroz dvije komponente: osobine proizvoda i oslobođenost od nepotpunosti. Osobina proizvoda prvenstveno utječe na prihod od prodaje, dok oslobođenost od nepotpunosti prvenstveno utječe na smanjenje troškova kroz eliminaciju škarta.

2. ALATI I METODE ZA UPRAVLJANJE KVALITETOM

Alati i metode praktične su tehnike, vještine, sredstva ili mehanizmi koje je moguće primijeniti za rješavanje specifičnih zadaća i problema vezanih za sisteme upravljanja kvalitetom. Alati i metode služe kao pomoć u dostizanju određenog cilja u sistemskom pristupu djelovanja ili istraživanja. U svakom sistemu upravljanja kvalitetom postoji više primjenjivih alata i metoda koje se koriste u zavisnosti od mogućnosti organizacije. Preduslovi uspješne primjene metoda i alata za upravljanje kvalitetom su u punoj potpori uprave, obrazovanju, velikoj potrebi za korištenjem alata ili metoda, definisanim ciljevima upotrebe.

Jedna od tih metoda (neki je zovu i tehnikom) jeste i QFD metoda (*Quality Function Deployment*) koju u [2] opisuju da služi za „razvoj ili redizajn proizvoda zasnovan na zahtjevima kupaca, promoviše višefunkcionalni timski rad i konkuretni inženjering u organizaciji, te skraćuje vrijeme razvoja proizvoda.“

main goal is to create value for consumers, by meeting their needs by reducing defects to zero. "Quality has become an integral part of the production and business operating of the enterprise as a whole, it implies an active participation in the creation of changes from the existing quality condition towards the ultimate long-term goal, and it comes down to the production of products / provision of services, in accordance with the needs, wishes and desires of consumers, without flaws. " [1]

Considering that the product is made for consumers who will, ultimately, use it, it is very important that product or service is adapted to the actual needs and expectations of the consumer. It is a quality perceived by the consumer - quality from the consumer's point of view. The design and process of product manufacturing are aspects of quality from the point of view of the manufacturer. Therefore, it is possible to define the quality as: quality of design / construction (with regard to the process of its creation) and conformity quality (compliance with the specification, construction solution). Customer satisfaction is achieved through two components: product features and freedom from incompleteness. Product property primarily affects sales revenue, while exemption from incompleteness primarily affects cost savings by eliminating scrap.

2. QUALITY MANAGEMENT TOOLS AND METHODS

Tools and methods are practical techniques, skills, means or mechanisms that can be applied to solve specific tasks and problems related to quality management systems. Tools and methods serve to help achieve a particular goal in a systemic approach to action or research. In each quality management system, there is a number of applicable tools and methods that are used depending on the organization's ability. Prerequisites for successful application of quality management methods and tools are full support of management, education, great need for using tools or methods, defined goals of use.

One of these methods (some call it a technique) is QFD method (Quality Function Deployment) described in [2] as "Product development or redesign based on customer requirements. It promotes multifunctional team work and competitive engineering and reduces product development time."

3. NASTANAK QFD METODE

Tokom pedesetih godina Japan je osjetio teškoće pri plasmanu svojih proizvoda zbog njihovog inferiornog kvaliteta u poređenju sa konkurencijom, na prvom mjestu iz SAD-a. To je navelo poznate teoretičare i praktičare kvaliteta da razviju nove filozofije i pristupe, ali i metode i tehnike, kao odgovor na novonastalu situaciju, istovremeno i sami radeći na njenoj primjeni. Krajem šezdesetih i početkom sedamdesetih godina prošlog vijeka u Japanu su počeli razvijati pristup za uočavanje potreba korisnika kroz proces dizajna i kroz dizajn proizvodnih sistema, tako da najveći broj istraživanja i najznačajniji rezultati dolaze upravo iz Japana. Dr. Yoji Akao je razvio ''hinshitsu kino tenkai'', tj. ''Quality Function Deployment'' od 1965. do 1967. u saradnji sa dr. Shigeru Mizunom. [3] Značajnu ulogu imaju i ostali eksperti za kvalitet kao što su dr. Fukuhara, Katsuyoshi Ishihara, Kiyotaka Oshiumi, Yasushi Furukawa, Akira Takayanagi. Oni su razvili alate i tehnike za QFD i organizovali ih u sveobuhvatan sistem da bi obezbijedili kvalitet i zadovoljstvo kupaca prilikom korištenja novih proizvoda ili usluga. Značajna istraživanja u Japanu su rađena u kompanijama kao što su *Matsushita Electric Industry*, *Mitsubishi Heavy Industry (MHI)* - brodogradilište, *Toyota Auto Body* za razvoj novih kombija, *Honda*, *Sony*, *Japan Business Consultants*, *Ohfuji*, *Noda*, *Ogino*, *Kaneko* i dr. Primjenu QFD metode u Sjedinjenim Američkim Državama je promovisao dr. Akao početkom osamdesetih godina prošlog vijeka. Značajna istraživanja su realizovali *American Society of Quality Control*, Bob King iz GOAL/QPC – Masačusetske konsultantske organizacije, Larry Sullivan iz *American Supplier Institute*, Don Clausing iz kompanije *Xerox*, Glenn H. Mazur iz QFD Instituta, Harold M. Ross iz kompanije *General Motors* (*Ford*), John Hauser iz *Hauser & Clausing*. Metodu su primenjivale i druge kompanije kao što su *Motorola*, *IBM*, *Procter & Gamble*, *Hewlett-Packard*, *AT&T*, *Cadillac*, *Chrysler*, *Florida Power*, *GE*, *NASA Langley Research*, *Kimberly-Clark*. [4]

U Evropu QFD stiže krajem osamdesetih kada je dr. Akao počeo saradnju sa kompanijom *Galgano & Associati* iz Italije. Istraživanja su rađena i u predstavništvu *American Supplier Institute* u UK, Univerzitetu Limerick u Irskoj koja je provodio Ian Ferguson, Univerzitetu Linkoping i Univerzitetu Karlstad u Švedskoj, Univerzitetu Cologne i QFD Institutu (QFD ID) u Njemačkoj i organizacijama kao što su *Volvo*, *Saab*, *Philips & VDT*, *Rover*, *Alitalia* i dr.

3. QFD METHOD OCCURRANCE

During the 1950s, Japan experienced difficulties in seling its products due to their inferior quality compared to competition, in the first place from the United States. This led well-known theorists and quality practitioners to develop new philosophies and approaches, but also methods and techniques, in response to the new situation, at the same time working on their own on its application. At the end of the 1960s and early 1970s, Japan began to develop approaches to identify users' needs through the design process and through the design of production systems, so that largest number of surveys and the most significant results come from Japan. Dr Yoji Aka has developed a "hinshitsu kino tank", i.e. Quality Function Deployment from 1965 to 1967 in collaboration with Dr Shigeru Mizun. [3] Other quality experts, such as Dr Fukuhara, Katsuyoshi Ishihara, Kiyotaka Oshiumi, Yasushi Furukawa, Akira Takayanagi, have played a significant role. They have developed tools and techniques for QFD and have organized them into a comprehensive system to ensure quality and customer satisfaction when using new products or services. Significant researches were done in Japan in companies such as Matsushita Electric Industry, Mitsubishi Heavy Industry (MHI) - shipyard, Toyota Auto Body for the development of new vans, Honda, Sony, Japan Business Consultants, Ohfuji, Noda, Ogino, Kaneko and others. The application of the QFD method in the United States was promoted by Dr Aco in the early 1980s. Significant researches were carried out by American Society of Quality Control, Bob King of GOAL / QPC - Massachusetts Consulting Organization, Larry Sullivan of American Supplier Institute, Don Clausing from Xerox, Glenn H. Mazur of QFD Institute, Harold M. Ross of General Motors (Ford), John Hauser, Hauser & Clausing. The method was also used by other companies such as Motorola, IBM, Procter & Gamble, Hewlett-Packard, AT & T, Cadillac, Chrysler, Florida Power, GE, NASA Langley Research, Kimberly-Clark. [4]

In Europe, QFD arrived at the end of the 1980s when Dr Akao began collaborating with Galgano & Associati from Italy. Research was also conducted at the American Supplier Institute in the UK, Limerick University in Ireland by Ian Ferguson, Linkoping University and Karlstad University in Sweden, Cologne University and QFD Institute (QFD ID) in Germany and organizations such as Volvo, Saab, Philips & VDT, Rover, Alitalia and others.

Prve primjene QFD metode bile se vezane samo za projektovanje, tj. razvoj novih proizvoda, ali se danas ona primjenjuje u sve više funkcija unutar preduzeća.

4. RAZVIJANJE FUNKCIJE KVALITETA – QFD

QFD predstavlja skraćenicu engleskog naziva "Quality Function Deployment", koji se bukvalno prevodi "raspoređivanje funkcije kvaliteta", ali se u stručnim krugovima najčešće pod QFD podrazumijeva "planiranje kvaliteta usmjerenog ka zahtjevima kupaca - korisnika". Ime QFD izražava njegovu pravu svrhu, a to je zadovoljenje kupaca (Quality) prevođenjem njihovih potreba u dizajn i obezbjeđivanjem da sve organizacione jedinice (Function) rade zajedno kako bi se sistematski razbile njihove aktivnosti u finije i finije detalje koji mogu da se kvantifikuju i kontrolišu (Deployment). Dr Yoji Akao definiše QFD kao "metod za razvoj kvaliteta u dizajnu koji ima za cilj da zadovolji potrošača i da zatim prevede zahtjeve kupaca u ciljeve dizajna i glavne tačke obezbjeđenja kvaliteta koji će se koristiti tokom proizvodnje".

Osnovni je zadatak, dakle, postići vrijednost razumijevanjem želja i potreba kupca i potom ta očekivanja realizovati kroz proces razvoja. Ovo uključuje identifikovanje informacije od kupca primjenom odgovarajućih marketinških tehnika za istraživanje tržišta, tako da se istaknu ključne potrebe i zahtjevi kupca, njenu primjenu u procesu proizvodnje i u procesu kontrole proizvodnje, odnosno planiranje resursa, izvršilaca i procesa, kao i predviđanje potencijalnih neusaglašenosti i preventivnih mjera kako bi krajnji proizvod (izlaz iz procesa) bio usaglašen s projektovanim kvalitetom [5].

U toku korištenja QFD metoda je evoluirala i mijenjala se, tako da danas postoje različiti pristupi i načini korištenja. Najpoznatiji je sistem matrica "The Matrix of Matrices", koji se najčešće koristi u Japanu i dijelu SAD-e, i četiri faze matrica ''The Four Phases of Matrices'', koji se primjenjuje uglavnom u SAD-u i Evropi.

Četiri faze matrica, "The Four Phases of Matrices", razvio je dr. Fukuhara u Japanu i kasnije ga je Američki institut za nabavku (*American Supplier Institute*) prenio u SAD. Ovakav pristup počinje razvojem tzv. kuće kvaliteta, "House of Quality", prve matrice u kojoj se zahtjevi korisnika prenose u karakteristike proizvoda/usluge bitne za njegov razvoj.

The first applications of QFD method were related only to the design, i.e. development of new products, but today it is applied to more and more functions within the company.

4. QUALITY FUNCTION DEPLOYMENT - QFD

QFD is the abbreviation for the English phrase *Quality Function Deployment*, and professional circles under QFD usually think of "quality planning focused on customer requirements." QFD's name expresses its true purpose, and this is customer satisfaction (quality) by translating their needs into design and ensuring that all organizational units work together to systematically break down their activities into finer and finer details that can be quantified and controlled (Deployment). Dr Yoji Akao defines QFD as a "quality development method in a design aimed at satisfying consumers and then translating customer requirements into the design goals and the main quality assurance points to be used during production".

The basic task, therefore, is to create value by understanding the wishes and needs of the customer and then realize these expectations through the process of development. This includes identifying information from the customer using appropriate marketing techniques for market research by highlighting the key needs and requirements of the customer, its application in the production process and in the production control process, i.e. planning resources, executors and processes, as well as redistributing potential disturbances and preventive measures so that the final product (output from the process) is compatible with the expected quality. [5]

During the use of the QFD method, it evolved and changed, so today there are different approaches and ways of using it. The most famous is "The Matrix of Matrices", which is most commonly used in Japan and in a part of the United States, and there are also four stages of the matrix, "The Four Phases of Matrices", mainly applied in the US and Europe.

Four phases of the matrix, was developed by Dr Fukuhara in Japan and later transferred to the US by the American Supplier Institute. This approach begins with the development of the so-called "House of Quality", i.e. the first matrix in which user requests are transferred to the characteristics of the product / service essential for its development.

Zatim se u drugoj matrici karakteristike proizvoda prenose u karakteristike dijelova proizvoda, u trećoj matrici se dijelovi povezuju s planiranjem procesa, a u četvrtoj se planiranje procesa povezuje sa planiranjem proizvodnje, slika 1. [2]

Korištenjem ove četiri matrice, zahtjevi korisnika se na ovaj način prenose u zahtjeve za dizajn proizvoda i u samu proizvodnju. Treba naglasiti da se u okviru četiri faze ne vrši samo prenos iz jedne u drugu već i da se u svakoj fazi vrši rangiranje elemenata matrice i da se samo oni koje su značajni prenose u sljedeće matrice. Pored ova dva najznačajnija, kombinacijom QFD metode sa nekim drugim metodama nastaju različiti načini primjene. [6]

Na slici 1. su prikazane četiri faze QFD metode koje omogućuju:

- Pretvaranje zahtjeva kupca u karakteristike proizvoda,
- Pretvaranje karakteristika proizvoda / usluge u karakteristike komponenti,
- Pretvaranje karakteristika komponenti u tehnologiju (procese),
- Pretvaranje procesa u radne upute.“[2]

Then in the second matrix, the product characteristics are transferred to the characteristics of product parts. In the third matrix, the parts are connected with the process planning, and in the fourth, process planning is associated with the production planning, Figure 1. [2]

By using these four matrices, user requirements are thus transferred to requirements for product design and manufacturing. It should be emphasized that within the four phases not only the transfer from one to the other is carried out, but also that at each stage the ranking of the elements of the matrix is carried out and that only those that are significant are transferred to the following matrices. In addition to these two most important, different modes of application are created by combining the QFD method with some other methods. [6]

In Figure 1, four phases of the QFD method are shown which enable:

- Converting customer requests into product characteristics,
- Converting product/service characteristics into components characteristics,
- Converting component characteristics into technology (processes),
- Converting the process into work instructions. . [2]

Slika 1. *Faze u QFD metodi [2]*

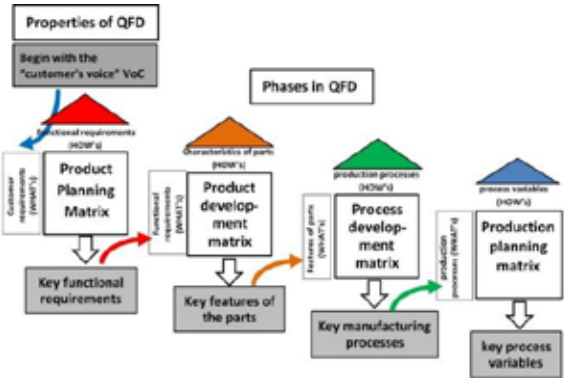


Figure 1. *Phases in QFD method [2]*

5. USLOVI ZA PRIMJENU I KORISTI OD PRIMJENE QFD METODE

Okruženje u kome se primjenjuje metoda bi trebalo da je slično onom za implementaciju TQM-a, što prije svega podrazumijeva podršku najvišeg rukovodstva, organizacionu kulturu i timski rad. Ovo je jedan od glavnih razloga zbog kojih se metoda najčešće i najuspješnije primjenjuje u organizacijama u Japanu, a u manjoj mjeri u SAD-u i Evropi.

5. REQUIREMENTS FOR APPLICATION AND BENEFITS FROM THE APPLI-CATION OF THE QFD METHOD

The environment in which the method is applied should be similar to the implementation of the TQM, which primarily implies the support of the top management, organizational culture and team work.

This is one of the main reasons why the method is most often and most successfully applied in organizations in Japan, and to a lesser extent in the US and Europe.

Bitni su uslovi, tj. faktori uspjeha, i obuka za primjenu metode, razumijevanje pojmova koji se koriste u primjeni, pravilna primjena faza i koraka metode, donošenje odluka na osnovu zahtjeva korisnika. Koristi od primjene su mnogobrojne i u kvalitativnom i u kvantitativnom smislu. Najbitnije koristi su:

- postizanje unapređenja orijentacije ka korisnicima/kupcima (minimiziranje pogrešne interpretacije zahtjeva korisnika i potreba za izmjenama, pojačavanje veza sa korisnicima, povećanje zadovoljstva korisnika, smanjenje broja žalbi);
- efektivniji razvoj proizvoda/usluga (kraći razvojni ciklus, smanjenje troškova razvoja i proizvodnje, smanjenje izmjena projektovanja) i
- unapređenje komunikacije i promocija timskog rada (uključivanje zaposlenih iz različitih procesa, unapređenje interne i eksterne komunikacije, sistematizacija dokumentacije i mogućnost primjene u budućim postupcima, unapređenje organizacione kulture). [2]

6. PRIMJENA QFD METODE NA PRIMJERU KUPAONIČKOG NAMJEŠTAJA FIRME FRAMINI D.O.O.

Faza I: Planiranje proizvoda = Glas kupca => Karakteristike proizvoda

Faza I je faza od izuzetne važnosti, jer se dokumentuju zahtjevi kupca, ulazni podaci, mogućnosti, vrši se analiza potražnje na tržištu, planiranje proizvoda koji odgovara zahtjevima kupca i potražnji na tržištu, te utvrđivanje kritične karakteristike ciljanog proizvoda, kao i tehnička mogućnost da se prevedu zahtjevi kupca u mjerljiv parametar. Prikupljanje i mogućnost da se prevedu ulazni parametri koji dolaze od kupca, a koji vrlo često nisu tehnički mjerljivi, u tehnički mjerljive podatke od krucijalnog je značaja za uspješno provođenje kompletnog QFD procesa. [7] (Slika 2.)

Međutim, mi smo u ovoj prvoj fazi uporedili analizu proizvoda namijenjenog za bosanskohercegovačko tržište i vanjsko tržište. Analiza je pokazala da je proizvod namijenjen za vanjsko tržište skuplji zbog dimenzija, materijala i dodatnih dijelova koji se ugrađuju u proizvod radi sigurnosti i praktičnosti. Na slici 3. prikazan je proizvod koji je namijenjen za bh. tržište (a) i vanjsko tržište (b).

Essential requirements, i.e. success factors, include training in applying the method, understanding the terms used in the application, correct application of phases and method steps, decision making based on user requirements. Benefits of application are numerous in both qualitative and quantitative terms. The most important benefits are:

- Enhancing orientation towards user / customers (minimizing misinterpretation of user requirements and changing needs, enhancing customer relationships, increasing customer satisfaction, reducing complaints);
- more effective product/service development (shorter development cycle, reduced development and production costs, reduced design changes) and
- improvement of communication and promotion of team work (inclusion of employees from different processes, improvement of internal and external communication, systematization of documentation and the possibility of applying in future procedures, improvement of organizational culture). [2]

6. QFD METHOD APPLICATION IN THE EXAMPLE OF THE BATHROOM FURNITURE OF COMPANY FRAMINI LTD.

Phase I: Product Planning = Voice of the customer => Product Characteristics

Phase I is a phase of great importance because it documents customer requirements, input data, capabilities, market demand analysis, product planning that meets customer requirements and market demand, and determines the critical characteristics of the target product as well as the technical ability to translate customer requirements in a measurable parameter. The collection and the ability to translate the input parameters that come from the customer, which are often not technically measurable, into technically measurable data is of crucial importance for the successful implementation of the complete QFD process. [7] (Figure 2)

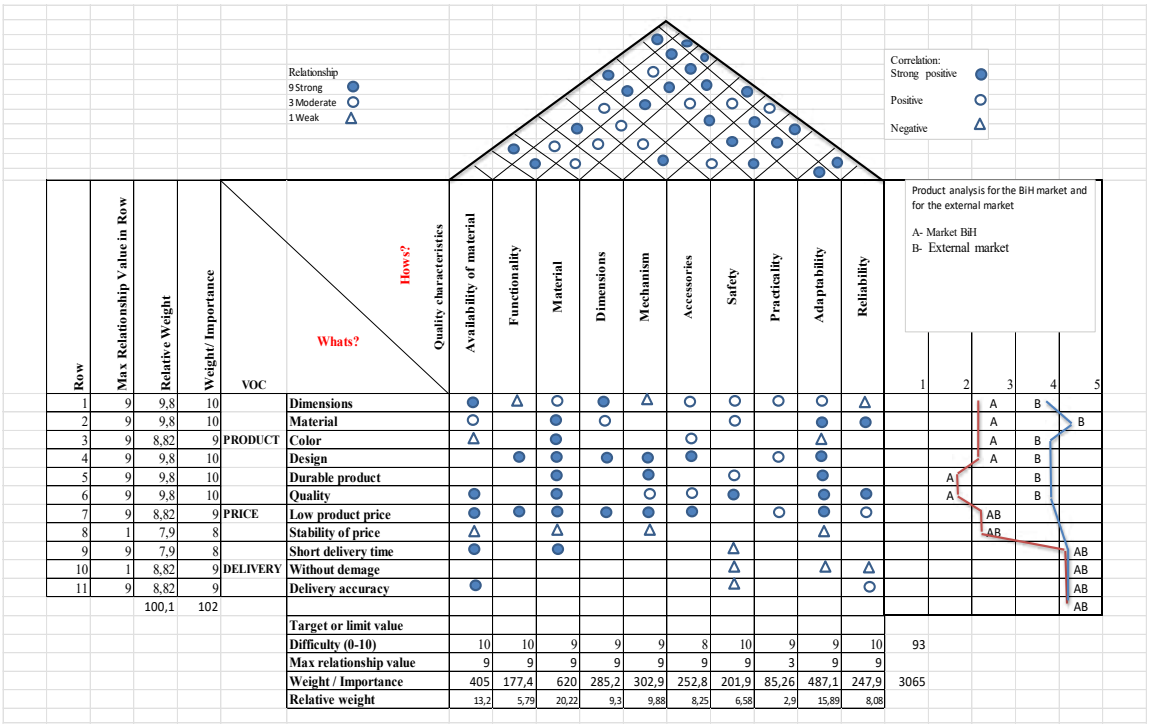
However, in this first phase, we compared the analysis of products intended for the B&H market and the external market. The analysis has shown that the product intended for the external market is more expensive due to dimensions, materials and additional parts that are incorporated into the product for safety and convenience. Figure 3 shows a product that is intended for the B&H market (a) and the external market (b).

U lijevoj koloni, u polju ŠTA, bilježe se svi zahtjevi koje definiše kupac/korisnik, a koje proizvod treba da zadovolji. Nakon toga, u polju KAKO, definišu se karakteristike proizvoda koje su značajne za zadovoljenje zahtjeva kupaca, koji su prethodno uneseni u polje ŠTA. Nakon toga se određene obrade ovih podataka iz polja KAKO prve "kuće" prenose u polje ŠTA druge "kuće".

Dakle, određene su funkcionalne osobine proizvoda: dostupnost sirovina, funkcionalnost, materijal, dimenzije, mehanizam, dodaci (police, opruge, otvori, nosači), sigurnost, praktičnost, prilagodljivost uslovima, pouzdanost. Najvišom se pokazala korelacija između Glasa kupca (*eng. Voice of Customer, VOC*) i funkcionalnih osobina proizvoda kod: materijala (620), prilagodljivost uslovima (487,1) i dostupnost sirovina (405). Ovo su karakteristike na kojima se treba temeljiti razvoj proizvoda odnosno način na koji će firma pružiti svoje usluge da bi zadovoljila očekivanja kupaca.

In the left column, in the WHAT field, all the requirements defined by the customer / user, which the product should satisfy, are recorded. After that, in the HOW field, the product characteristics that are significant for satisfying customer requests, previously entered in the WHAT field, are defined. After that, certain procesed data from the first "house", field HOW TO, are transferred to the WHAT field of the second "house".

So, the functional features of the product are determined: availability of raw materials, functionality, material, dimensions, mechanism, accessories (shelves, springs, holes, supports), safety, practicality, adaptability to conditions, reliability. The highest correlation between the Voice of Customer (VOC) and the functional features of the product is found in: materials (620), adaptability to conditions (487.1) and availability of raw materials (405). These are the characteristics on which the development of the product should be based, or the way in which the company will provide its services in order to meet customer expectations.



Slika 2. *QFD Faza I*
Figure 2*. QFD Phase I*

Slika 3. *Izgled proizvoda a) za domaće tržište; b) za vanjsko tržište*
Figure 3. *Product a) for domestic market; b) for external market*

Faza II: Razvoj proizvoda = Karakteristike proizvoda/usluge => Karakteristike dijelova Tokom ove faze se kreira osnovni koncept proizvoda-specifikacije dijelova i sve se dokumentuje. Specifikacije proizvoda, koje se dokumentuju u ovoj fazi moraju sadržavati definisane zahtjeve kupca koji se dalje razvijaju tokom sljedeće faze planiranja procesa. Za cjeloukupan rad tokom vođenja QFD procesa bitno je da je uključen jedan tim od prve do zadnje faze. Na taj način se subjektivni kriteriji svode na minimum [7]. Cilj ove faze je locirati kritične dijelove ili sklopove proizvoda, zatim zabilježiti kritične karakteristike proizvoda, te uspostaviti vezu između kritičnih dijelova/ sklopova i zahtjevanih karakteristika.

Za sve karakteristike proizvoda, upisane u polju "ŠTA", utvrđuju se, u polju "KAKO", kritični dijelovi proizvoda, tačnije karakteristike kritičnih dijelova proizvoda, koji su značajni za ostvarenje prethodnih karakteristika proizvoda.

Druga faza se izrađuje po potrebi, a s ciljem sužavanja problema, ako se proizvod može podijeliti na sastavne dijelove.

U drugoj fazi QFD analize, prethodno utvrđene funkcionalne karakteristike proizvoda pretvaramo u projektne karakteristike. Najvažnijim funkcionalnim karakteristikama dodjeljujemo najveće prioritete (10). Najveća korelacija u ovoj fazi se pokazala kod: Moguća izrada elemenata s posebnim specifikacijama (801,96), kombinovanje elemenata različitog kvaliteta (728,1), razvoj proizvoda (717,72), primjenjivost kod kupca (696,66), moguća standardna proizvodnja (611,3).

Phase II: Product development = Product / service characteristics => Parts characteristics

During this phase, the basic concept of the product - specifications of parts are created and everything is documented. Product specifications documented at this stage must include defined customer requirements that are further developed during the next phase of the process planning. For the overall operation during the QFD process, it is important that a one team from the first to the last phase is involved. In this way, the subjective criteria are reduced to a minimum [7]. The aim of this phase is to locate critical parts or product assemblies, then to record critical product characteristics, and establish a link between critical parts/assemblies and required characteristics.

For all product characteristics, entered in the "WHAT" field, in the field "HOW", critical parts of the product are determined, more precisely the characteristics of critical parts of the product, that are important for achieving the previous characteristics of the product.

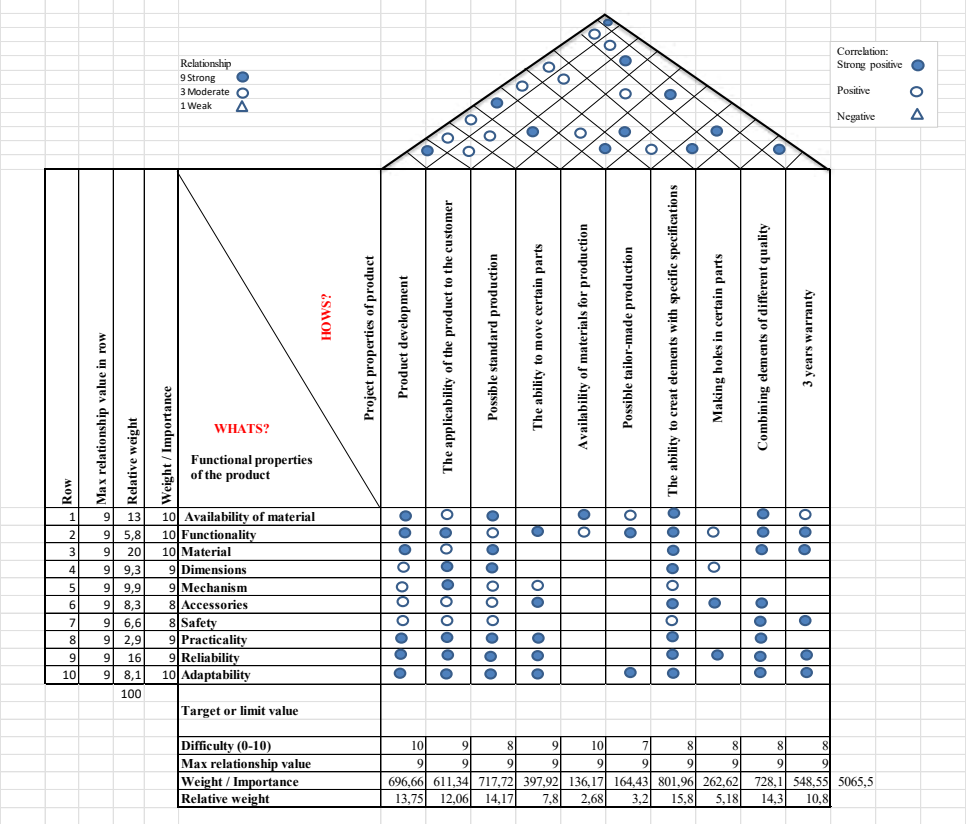
The second phase is developed as needed, with the aim of narrowing the problem if the product can be divided into components.

In the second phase of the QFD analysis, the previously determined functional characteristics of the product are transformed into design characteristics. The most important functional characteristics are assigned the highest priority (10). The largest correlation in this phase was shown in: Possibility of production of elements with special specifications (801.96), combination of elements of different quality (728.1), standard

Dakle, analiza je pokazala da bi trebalo proizvoditi proizvod koji ima veliku primjenu kod kupca, sa mogućnošću raznih kombinacija materijala. Samim tim se pravi ravnoteža između želje kupca i cijene koštanja. Određuju se prioriteti, prati se razvoj proizvoda. Slika 4 pokazuje detalje druge faze.

production possibility (717.72), product development (696.66), the applicability of the product to the customer (611.34).

Therefore, the analysis has shown that there should be produced a product which has a great customer usability, with the possibility of various combinations of materials. Therefore, there is a balance between the customer wishes and the cost. Priorities are being determined, product development is monitored. Figure 4 shows the details of the second phase.



Slika 4. *QFD Faza II (vlastito istraživanje)*
Figure 4. *QFD Phase II (own research)*

Faza III: Razvoj procesa = Karakteristike dijelova = Karakteristični parametri procesa

Tokom ove faze potrebno je izraditi dijagram toka procesa proizvodnje kao i dokumentovati parametre procesa, odnosno, njegove ciljne vrijednosti. Vrši se utvrđivanje kritičnih procesa i tokova procesa, te po potrebi treba unaprijediti proizvodnu opremu, utvrditi parametre kritičnog procesa.

Za postizanje definisanih proizvoda/ poluproizvoda propisuje se tehnologija izrade (planiranje procesa). Za sve kritične dijelove proizvoda i njihove karakteristike, upisane u polje ŠTA, utvrđuju se, u polju KAKO, kritični

Phase III: Process development = Parts characteristics = Characteristic process parameters

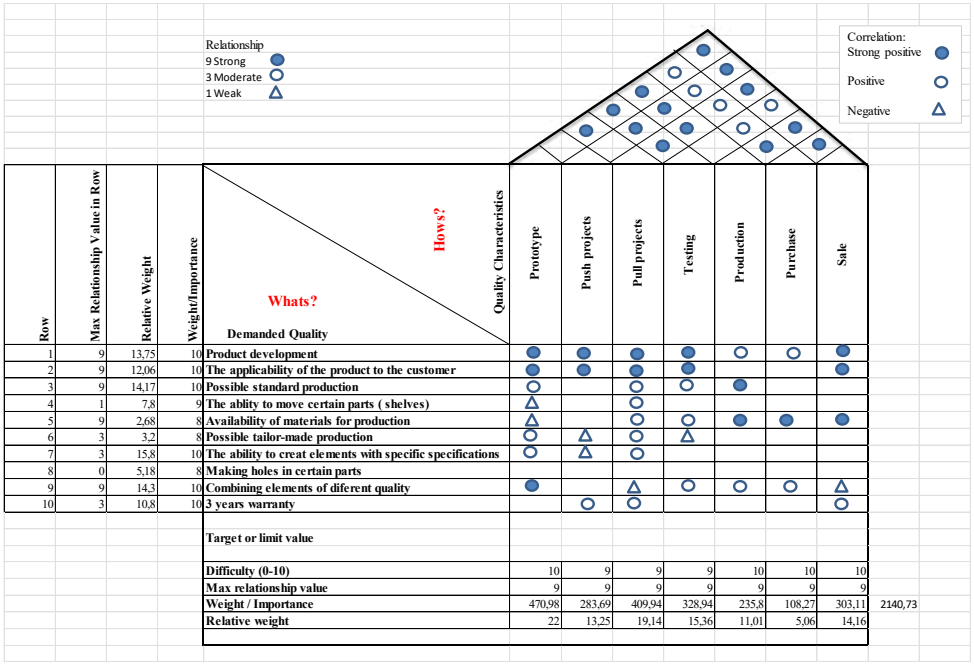
During this phase, it is necessary to create a flowchart of the production process as well as to document the parameters of the process, that is, its target values. The critical processes and process flows are established, and if necessary, the production equipment will be improved and the parameters of the critical process determined.

To achieve defined products / semi-products, the production technology (process planning) is prescribed. For all critical parts of the product

procesi, tj. operacije/zahvati, sa njihovim parametrima, kojima se ostvaruju kritične karakteristike dijelova proizvoda.
Kritični procesi sa njihovim parametrima se prenose u polje ŠTA četvrte "kuće".

and its characteristics, entered in the WHAT field, in the field HOW, critical processes, i.e. operations / procedures, with their parameters, which achieve critical characteristics of parts of the product, are determined.

Critical processes with their parameters are transferred to the WHAT field of the fourth "house".



Row	Max Relationship Value in Row	Relative Weight	Weight/Importance	Whats? / Hows? / Quality Characteristics / Demanded Quality	Prototype	Push projects	Pull projects	Testing	Production	Purchase	Sale	
1	9	13,75	10	Product development	●	●	●	●	○	○	●	
2	9	12,06	10	The applicability of the product to the customer	●	●	●	●			●	
3	9	14,17	10	Possible standard production	○		○	○	●			
4	1	7,8	9	The ablity to move certain parts (shelves)	△		○					
5	9	2,68	8	Availability of materials for production	△		○	○	●	●	●	
6	3	3,2	8	Possible tailor-made production	○	△	○	△				
7	3	15,8	10	The ability to creat elements with specific specifications	○	△	○					
8	0	5,18	8	Making holes in certain parts								
9	9	14,3	10	Combining elements of diferent quality	●		△	○	○	○	△	
10	3	10,8	10	3 years warranty		○	○				○	
				Target or limit value								
				Difficulty (0-10)	10	9	9	9	10	10	10	
				Max relationship value	9	9	9	9	9	9	9	
				Weight / Importance	470,98	283,69	409,94	328,94	235,8	108,27	303,11	2140,73
				Relative weight	22	13,25	19,14	15,36	11,01	5,06	14,16	

Slika 5. *QFD Faza III (vlastito istraživanje)*
Figure 5. *QFD Phase III (own research)*

Slika 5. pokazuje detalje treće faze QFD metode. Projektne osobine proizvoda se pretvaraju u karakteristične parametre procesa. Analiza je pokazala da su ključni procesi: izrada protota, tzv. *pull* projekti, prodaja i testiranje.

Figure 5 shows the details of the third phase of the QFD method. Project properties of products are transformed into characteristic process parameters. The analysis has shown that key processes are: prototyping, pulling projects, sales and testing.

Faza 4: Planiranje proizvodnje = Karakteristični parametri procesa => Postupci => Kontrola kvaliteta procesa
Tokom planiranja procesa proizvodnje moraju se definisati vrijednosti odnosno indikatori koji će se pratiti tokom produkcionog procesa. Također, tokom ove faze se definišu krizna mjesta i djelovanja da se izbjegnu nepravilnosti. Utvrđuju se postupci kontrole kvaliteta do nivoa instrukcija i uputa za rad [7]. Dakle, vrši se ocjenjivanje karakteristika kritičnih dijelova proizvoda i procesa, zatim se uspostavlja metoda kontrole proizvoda i procesa, uspostavlja se nadzor te metode testiranja i praćenje parametara proizvoda i procesa.

Phase 4: Production planning = Characteristic process parameters => Procedures => Process quality control
During the production process planning, there have to be defined the values or indicators which will be monitored during the production process. Also, during this phase, crisis locations and activities are defined to avoid irregularities. Quality control procedures are determined up to the level of instructions and directions for work. Therefore, an assessment of characteristics of critical parts of products and processes is carried out, then a method of control of products and processes is established, monitoring of the method of testing and monitoring of parameters of products and processes is established.

Za propisane tehnologije izrade pišu se proizvodna uputstva (instrukcije za planiranje proizvodnje). Za sve kritične procese, upisane u polje ŠTA, utvrđuju se, u polju KAKO, mjere koje treba preduzeti, odnosno postupci kontrole kvaliteta, da bi se proces poboljšao te samim tim odvijao sa sigurnošću odnosno sa što manje nedostataka.

Četvrta faza je faza planiranja proizvodnje. U ovoj fazi se utvrđeni procesi pretvaraju u radne upute. U ovoj zadnjoj fazi su odabrana tri procesna koraka, a to su: tzv. *push* projekti (projekti koji idu proaktivno od organizacije prema kupcima), tzv. *pull* projekti (projekti koje kupci traže od organizacije), proces prodaje, prikazano u tabeli 1. Za ova tri procesna koraka su odabrane kontrolne tačke, kontrolne metode i ključni pokazatelji performansi kako bi se ostvarili odgovarajući ciljevi.
Dakle, ostvarivanje svih ključnih pokazatelja performansi će osigurati da krajnji cilj postane stvarnost.

For the prescribed production technologies, the production instructions and directions are written (production planning). For all critical processes, entered in the WHAT field, in the field HOW, the measures to be taken are established, i.e. the quality control procedures, in order to improve the process, so that it is carried out with certainty and with as few shortcomings as possible.

The fourth phase is the stage of production planning. At this stage, the established processes are transformed into working instructions. In this final phase, three process steps are selected: push projects (pro-active projects by the organization towards customers), pull projects (projects that customers require from the organization), the sales process, shown in Table 1. In order to achieve the desired goals, for these three process steps are selected control points, control methods and key performance indicators.

Thus, the achievement of all key performance indicators will ensure that the ultimate goal becomes a reality.

Tabela 1. QFD Faza IV (vlasito istraživanje)

Osobine procesa /Kritični procesni koraci	Kontrolne tačke	Kontrolna metoda	Ključni pokazatelji performansi
Izrada prototipa	x	x	x
Push projekti	- Validacija, odjel prodaje - Prezentacija kupcu - Broj prihvaćenih projekata - Lab. testiranje kod kupca - Industrijska proba kod kupca - Realizacija prodaje	- Analiza tržišta - Broj projekata - Broj projekata, MG, vol. - Broj projekata, MG, vol. - Broj projekata, MG, vol. - Realizirana MG, vol, - WIN rate	x 25% više predstavljenih pro. 18% više prihvaćenih pro. 13% više prihvaćenih pro. 10% više prihvaćenih pro. 5% rast prodaje iz *push* pro
Pull projekti	- Validacija, odjel prodaje - Prezentacija kupcu - Broj prihvaćenih projekata - Lab. testiranje kod kupca - Industrijska proba kod kupca - Realizacija prodaje	- Analiza tržišta - Broj projekata - Broj projekata, MG, vol. - Broj projekata, MG, vol. - Broj projekata, MG, vol. - Realizirana MG, vol, - WIN rate	x 25% više predstavljenih pro. 18% više prihvaćenih pro. 13% više prihvaćenih pro. 10% više prihvaćenih pro. 10% rast prodaje iz *push* projekata
Testiranje	X	x	X
Proizvodnja	X	x	X
Nabava	X	X	X
Prodaja	Volumen prodaje Kontribucijska marža WIN rate Prodaja po aplikaciji Prodaja po tržištima Segmentacija kupaca	Sedmični izvještaj Mjesečni izvještaj Kvartalna kalkulacija Kvartalna kalkulacija Mjesečna kalkulacija Broj posjeta ključnim kupcima	22% rast prodaje, volumen 10% rast kontribucijske marže 15% realiziranih projekata 5% rast prodaje po alokaciji 5% rast prodaje po tržištu 12 posjeta ključnim kupcima, 6 osnovnim kupcima

Table 1. QFD Phase IV (own research)

Process charac./ Critical process steps	Control points	Control method	Key performance indicators
Prototyping	x	X	x
Push projects	- Sales department validation - Presentation to the customer - Number of accepted projects - Lab. testing at the customer - Industrial test at the customer - Realization of sales	- Market analysis - The number of projects - Number of projects, MG, vol. - Number of projects, MG, vol. - Number of projects, MG, vol. - Realized MG, vol, - WIN rate	x 25% more presented projects 18% more accepted projects 13% more accepted projects 10% more accepted projects 5% sales growth from push projects
Pull projects	- Validation by sales department - Presentation to the customer - A number of accepted projects - Lab. testing at the customer - Industrial testing at the customer - Realization of sales	- Market analysis - Number of projects - Number of projects, MG, vol. - Number of projects, MG, vol. - Number or projects, MG, vol. - Implemented MG, vol. - WIN rate	x 25% more presented projects 18% more accepted projects 13% more accepted projects 10% more accepted projects 10% sales growht from push projects
Testing	X	X	X
Production	X	X	X
Procurement	X	X	X
Sales	Volume of sales WIN rate receipts Sales by application Sales by market Segmentation of customers	Weekly report Monthly report Quarterly calculation Quarterly calculation Monthly calculation Number of visits to key customers	22% sales growth, volume 10% increase in the contribution margin 15% of implemented projects 5% growth in sales by application 5% growth in sales by market 12 visits to key customers, 6 to core customers

7. ZAKLJUČAK

Kupci subjektivno vrednuju proizvode i usluge. Oni ocjenjuju upotrebljivost i vrijednost dopadljivosti. Zapravo ocjenjuju vrijedi li proizvod, odnosno je li ono što dobivaju njegovim korištenjem "pokriva" cijenu koju moraju platiti da bi ga imali. Dakle, pitanje je hoće li određeni proizvod svojom korisnošću, dizajnom, privlačnošću uvjeriti kupca da za njega plati određenu cijenu. Najvažnije karakteristike kvaliteta za potrošače su funkcionalnost, pouzdanost i trajnost. To se i očituje u definiciji kvaliteta, koja kaže da je kvalitet zapravo usklađenost proizvoda sa zahtjevima kupaca, te sposobnost i prikladnost za upotrebu.

Kvalitet procesa neke firme direkno je vezan za poslovanje te firme. Poboljšanjem kvaliteta procesa direktno utječemo na napredak poslovanja odnosno na poboljšanje proizvodnosti, ekonomičnosti i rentabilnosti.

7. CONCLUSION

Customers subjectively value products and services. They assess the usability and value of admiration. Whether the product is valid, or whether the benefits obtained by using the product cover the price they have to pay in order to have a particular product. So, the question is whether a particular product will, by its usefulness, design, and attractiveness, convince the customer to pay a certain price for it. The most important quality characteristics for consumers are functionality, reliability and durability. This is also reflected in the definition of quality that says quality is in fact compliance of products with customer requirements, and ability and suitability for use.

The quality of a company's process is directly related to the business of that company. By improving the quality of the process, we directly influence the progress of our business, that is,

Na osnovu toga može se reći da ulaganjem u programe poboljšanja kvaliteta osiguravamo rast proizvodnosti, smanjujemo troškove kvaliteta, a samim time se dobiva jači tržišni položaj.
Na osnovu analize koju smo koristili kroz ovaj rad možemo reći da bi svaka organizacija trebalo da proizvodi proizvod koji je lahko primjenjiv kod kupca, da organizacija treba biti uključena u čitav proces razvoja, te da bi proizvodi trebalo da su primjenjivi u više aplikacija, ali isto tako složenog sastava kako kupac ne bi mogao naći zamjenu te koristiti drugi proizvod. Preduslov za opstanak na tržištu jeste povećanje kvaliteta i produktivnosti rada, uz istovremeno smanjenje troškova i povećanje izvoza.
Kroz QFD metodu su utvrđeni zahtjevi kupaca koji su prevedeni u karakteristike proizvoda te potrebne procese koji će osigurati najučinkovitije predstavljanje tih proizvoda na tržištu.

improvement of productivity, economy and profitability.
Based on this, it can be said that by investing in quality improvement programs, we ensure productivity growth, we reduce quality costs and, therefore, obtain a stronger market position.
Based on the analysis we have used in this paper, we can say that each organization should produce a product that can be used by the customer, that an organization should be involved in the entire development process, and that products should be available for multiple applications, but also composition of the product should be complex so that customer could not find a replacement and use another product. The precondition for survival in the market is to increase the quality and labor productivity, while at the same time reducing costs and increasing exports.
Through the QFD method, customers' requirements have been identified and translated into product characteristics and the necessary processes that will ensure the most effective representation of these products on the market.

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