

Šest sigm: zahtevna pobuda kakovosti

Six Sigma: A Complex Quality Initiative

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Zahtevna pobuda kakovosti, ki se nanaša hkrati na vodstvo, orodja in infrastrukturo, imenovana šest sigm, se je pojavila šele v zadnjem času. Postopek šest sigm temelji na strogih japonskih teorijah o celovitem vodenju kakovosti v izdelovalnem postopku. Cilj postopka šest sigm je izboljšanje učinkovitosti organizacije kakor tudi učinkovito upoštevanje potreb odjemalcev ter ustvarjanje ekonomskega blagostanja tako za odjemalca kakor tudi dobavitelja. Šest sigm, katere cilj je 3,4 kosov na milijon (knm - ppm), uvaja in uporablja sistematično, projektno usmerjeno metodologijo Določi, izmeri, analiziraj, izboljšaj in krmili (DIAIK - DMAIC). Prispevek podaja uvod v postopek šest sigm in pregled njene metodologije.

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(Ključne besede: kakovost, izboljšave procesov, metodologija šest sigm, metodologija DIAIK)

A complex quality initiative that addresses the leadership, tools and infrastructure issues at the same time, called Six Sigma, has recently emerged. The Six Sigma approach was based on rigorous Japanese theories of total quality management (TQM) for use in the manufacturing process. The objective of Six Sigma is to improve organization efficiency as well as effectiveness in meeting customer needs, ultimately creating economic wealth for the customer and the provider. Aiming for 3.4 parts per million (ppm), Six Sigma introduces and employs a systematic project-oriented methodology through a Define, Measure, Analyze, Improve and Control (DMAIC) cycle. This paper gives an introduction to, and overview of Six Sigma methodology.

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0 UVOD

Metodologija šest sigm se je formalno pojavila v podjetju Motorola v osemdesetih letih dvajsetega stoletja čeprav nekateri avtorji namigujejo, da se je Motorola prvič lotila šest sigm pobude kakovosti že sredi šestdesetih [1]. Motorolina specifična povezanost s šest sigmami se prične, ko ta uvede program izboljšanja kakovosti, osredotočen na proizvodnjo. Njihov postopek je temeljil na strogih japonskih teorijah celovitega vodenja kakovosti (CVK - TQM) za uporabo v izdelovalnem postopku, kjer se napake razmeroma preprosto prepoznajo in štejejo [2].

Oče postopka šest sigm je bil pokojni Bill Smith, glavni inženir pri Motoroli in znanstvenik. Oblikoval je originalne statistike in obrazce, ki so začetki kulture šest sigm. Močno podprta od najvišjega vodstva je bila pobuda šest sigm razširjena na celotno podjetje. Kmalu je bilo zahtevano usposabljanje šest sigm za vse zaposlene. Od vsakega posameznika se je pričakovalo, da je razumel postopek in da ga bo uporabil za vse, kar bo počel [3]. Kratek čas je bil izvirni namen šest sigm osredotočen na

0 INTRODUCTION

Six Sigma methodology formally emerged at Motorola in the 1980s although some authors suggest that Motorola first embarked on its Six Sigma quality initiative in the mid 1960s [1]. Motorola's specific involvement with Six Sigma began when it implemented a quality-improvement program focused on manufacturing. Their approach was based on rigorous Japanese theories of total quality management (TQM) for use in the manufacturing process, where defects are relatively easy to spot and count [2].

The father of Six Sigma was the late Bill Smith, a senior engineer and scientist. He crafted the original statistics and formulae that were the beginnings of the Six Sigma culture. Strongly supported by company's top management, the Six Sigma initiative was spread throughout the company. Soon, Six Sigma training was required for every employee. Every single person was expected to understand the process and apply it to everything that they did [3]. While the original goal of Six Sigma was to focus on the

izdelovalni postopek, kmalu pa je postalo jasno, da se morajo dostava, marketing ter funkcije izvedbe naročila kupca prav tako osredotočiti na doseganje standardov šest sigm kakovosti in odstranjevanje napak skozi organizacijske postopke [4]. Zelo kmalu je postopek šest sigm pridobil številne zagovornike, ki so privzeli in uporabili načela šest sigm; njihova dokumentirana odkritja in uspehi so omogočili drugim podjetjem, da so jim sledili.

1 DEFINICIJE IN FILOZOFIJA ŠEST SIGM

Pri Motoroli je šest sigm bila, in je še vedno, definirana kot program izboljšanja kakovosti z namenom zmanjšanja števila napak pod 3,4 kosov na milijon izdelanih. Pri tem uporabljajo normalno porazdelitev in močno povezavo med neustreznostmi izdelka oziroma napakami in številom izdelanih kosov, zanesljivostjo, časom izdelave, opremo, načrti itn. [5]. Vendar obstaja nekaj zmede in negotovosti med ljudmi o tem, kako se prevaja kakovost šest sigm statistično v 3,4 napak na milijon. V resnici je razlika med resnično vrednostjo šest sigm in Motorolino vrednostjo šest sigm.

Statistično, pojem šest sigm sloni na normalni porazdelitvi. Če privzamemo normalno porazdelitev, potem lahko preprosto izračunamo, koliko je priložnosti za izdelke z napakami oz. kmn tako, kakor to prikazuje slika 1.

Če so specifikacijske meje omejene z ustreznostjo $\pm 3\sigma$ in če je proces centriran, so možnosti 2700 kmn, 1350 na vsaki strani izbranega razpona, medtem ko v primeru, če so izbrane meje podane z ustreznostjo $\pm 6\sigma$ so možnosti le še 0,002 kmn.

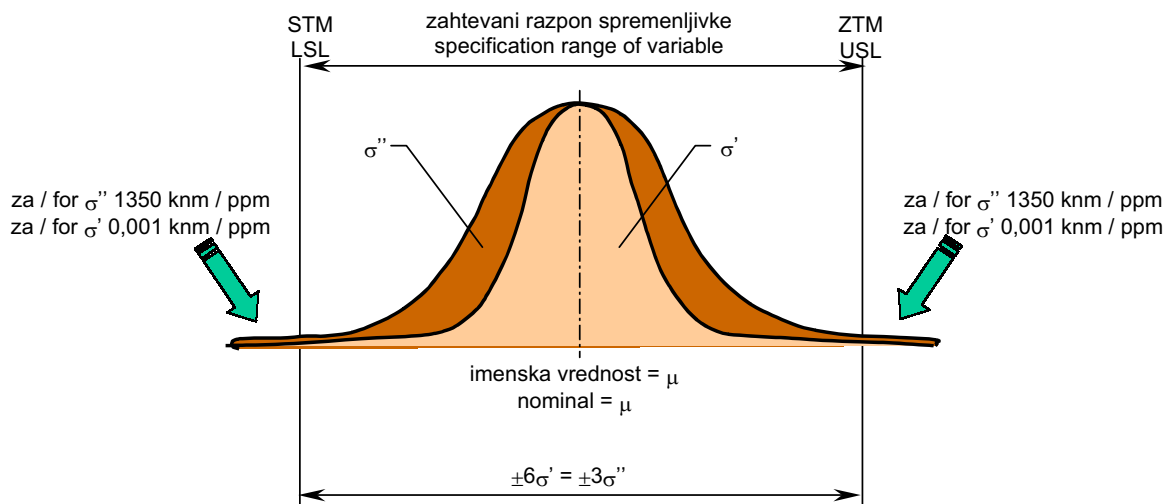
manufacturing process, it became clear that the distribution, marketing and customer-order processing functions also needed to focus on reaching Six Sigma quality standards and eliminate defects throughout the organization's processes [4]. Very soon, Six Sigma gained several proponents who adopted and implemented Six Sigma principles, documented their discoveries and successes, enabling other companies to follow their lead.

1 SIX SIGMA DEFINITIONS AND PHILOSOPHY

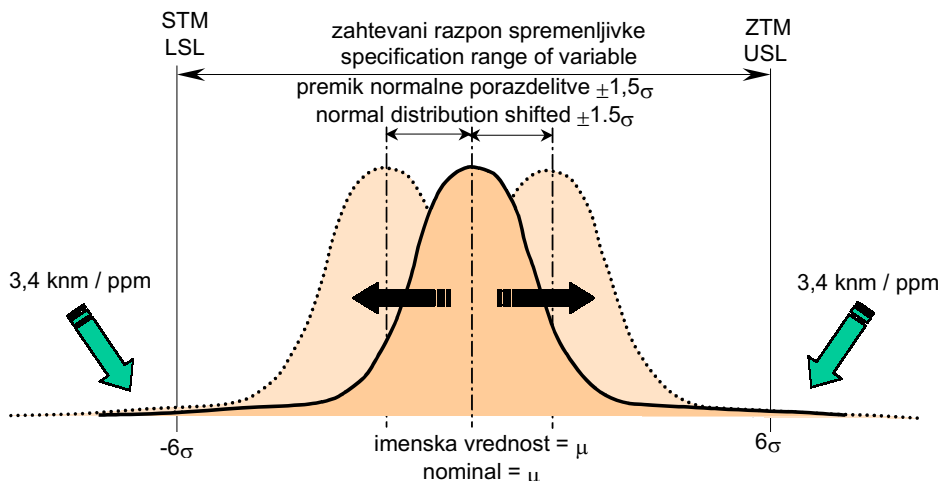
At Motorola, Six Sigma has been, and still is, defined as a quality-improvement program with the goal of reducing the number of defects to as low as 3.4 parts per million opportunities. It uses the normal distribution and the strong relationship between product nonconformities, or defects, and the product yield, reliability, cycle time, inventory, schedule, and so on [5]. However, there is some confusion and uncertainty among many people as to how Six Sigma quality translates statistically into 3.4 defects per million. In fact, there is a difference in the true value of Six Sigma and Motorola's value of Six Sigma.

Statistically, Six Sigma is based on the normal distribution. Assuming the normal distribution it is easy to calculate how many chances there are for defective parts or ppm, as shown in Fig. 1.

If the specification limits are met with $\pm 3\sigma$ conformance, and the process is centered, the chances are that there will be 2700 ppm, 1350 on each side of specification range, however, if the specification limits are met with $\pm 6\sigma$, chances are that there will be only 0.002 ppm.



Sl. 1. Število napak za ustreznost tri sigme in šest sigm
Fig. 1. Number of defects for three-sigma and six-sigma conformance



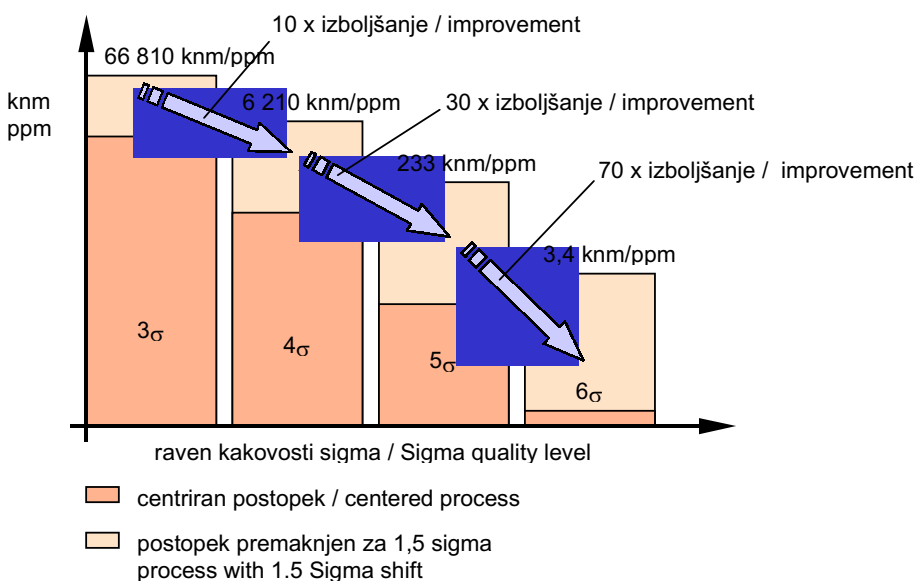
Sl. 2. Število napak za ustreznost šest sigm pri premiku srednje vrednosti postopka za $\pm 1,5\sigma$
 Fig. 2. Number of defects for six-sigma conformances with a shifted process mean

Domnevamo, da je opazovana spremenljivka centrirana brez kakršnihkoli premikov srednje vrednosti. Vendar je v praksi nemogoče najti centrirane postopke brez premikov srednje vrednosti spremenljivke. Zaradi tega je Motorola dodala povprečno vrednost premika za $\pm 1,5\sigma$ glede na srednjo vrednost postopka, ta je bil pozneje splošno sprejet v podjetjih, ki so bila vključena v pobude šest sigm. Skladno s sprejeto vrednostjo premika za $\pm 1,5\sigma$ lahko pričakujemo, da se bodo možnosti za napako povečevale kot rezultat premikanja srednje vrednosti spremenljivke ali nihanja v smeri izbranih mej, kar je prikazano na sliki 2.

It was supposed that the observed variable is centered without any shifts of the mean value. However, in practice it is impossible to find centered variable values without any shifts. Therefore, Motorola added an average shift value of $\pm 1.5\sigma$ to the process mean, which was later widely accepted by companies involved in Six Sigma initiatives. Accordingly, with an accepted shift value of $\pm 1.5\sigma$ it is to be expected that the chances of a defect will increase as a result of the variable mean value movement or swinging toward specification limits, as shown in Fig. 2.

Dejansko je povprečno podjetje nekje med tri in štiri sigm, samo najboljša podjetja dosegajo 6 sigm, medtem ko imajo na primer letalski poleti stopnjo nevarnosti le 0,43 knm kar je 10-krat bolje od kakovosti šest sigm [3]. Slika 3 prikazuje vpliv premika za $\pm 1,5\sigma$, kakor tudi zahtevane izboljšave za

Currently, the average company is somewhere between three and four sigma, best-in-class companies are reaching 6 sigma, while, for example, airline flights which have a fatality rate of 0.43 ppm, are 10 times better than Six Sigma quality [3]. Fig. 3 illustrates impact of shifts of $\pm 1.5\sigma$, as well as the required improvements for steps of one sigma. It is



Sl. 3. Število napak v odvisnosti od ravni kakovosti sigma
 Fig. 3. Defects rate versus sigma quality level

eno sigmo. Razvidno je, da je za premik ravni kakovosti za en sigm, s pet na šest sigm, napor za izboljšanje kakovosti veliko večji kakor pri premiku s treh na štiri sigmo.

Ne obstajajo jasne in enopomenske definicije pojma šest sigm. Za različne ljudi ima šest sigm različne pomene in razlago [6].

Nekatere izmed definicij:

- Šest sigm je formalna metodologija za postopke merjenja, analiziranja, izboljšanja in nato nadziranja (krmiljenja). Statistični postopek zmanjšuje pojave napak od ravni treh sigm do ravni šest sigm [7].
- Šest sigm je pobuda kakovosti, da statistične meritve zaposlenih dosežejo 3,4 neustreznih izdelkov na milijon izdelanih - navidezna izločitev napak [8].
- Šest sigm je obširna metodologija na osnovah statistike, katere namen je doseči nič manj kakor popolnost v vsakem posameznem postopku in izdelku podjetja [9].

Vsestranske in, po mnenju avtorjev, najbolj ustrezne definicije pojma šest sigm navajajo, da šest sigm poudarja inteligentno mešanico modrosti organiziranja s preskušeni statističnimi orodji za izboljšanje tako učinkovitosti kakor zmožnosti upoštevanja potreb odjemalcev. Končni cilj ni izboljšanje zaradi izboljšanja, ampak bolj ustvarjanje ekonomskega blagostanja za odjemalca in prav tako dobavitelja [3]. To nakazuje, da kakovost šest sigm ne nadomešča obstoječe in trajajoče pobude kakovosti v organizaciji, ampak da se najvišje vodstvo osredotoča na tiste postopke, ki so prepoznani kot ključni za kakovost v očeh odjemalcev. Ti kritični sistemi so nato predmet natančnih pregledov in močnih naporov za izboljšanje; uporaba najmočnejših "mehkih" in "trdih" veščin organizacije lahko pripelje do napredka.

2 ŠEST SIGM IN ČLOVEŠKI VIRI

Zelo pomembna značilnost postopka šest sigm je ustvarjanje infrastrukture, ki zagotavlja, da imajo dejavnosti za izboljšanje učinkovitosti na voljo potrebne vire. Ustvarjanje uspešne infrastrukture šest sigm je izhodiščni postopek, katerega namen je zavestno uvajati kakovost med vse zaposlene pri njihovem vsakdanjem delu [3]. Infrastrukture so lahko zelo specifične, odvisno od kulture in strateških poslovnih ciljev organizacije. Pomanjkljivosti pri zagotovitvi takšne infrastrukture so prvi razlog, zakaj ni uspelo 80 odstotkov vseh uvajanj CVK v preteklosti [10].

Za vsako organizacijo je pobuda šest sigm edinstvena. Vendar obstajajo dejavniki, ki so skupni vsaki zgodbi o uspehu. Uvajanje šest sigm vključuje vse zaposlene z vseh organizacijskih stopenj znotraj podjetja. Toda glavni nosilci sprememb so predvsem vodstvo, predstavniki vodstva in lastniki postopkov,

obvious that a shift in one sigma quality level from five sigma to six sigma is a much more difficult improvement effort than a shift from three to four sigma.

There are no clear and unique definitions of Six Sigma. For different people Six Sigma has different meanings and interpretation [6].

Some of the definitions include:

- Six Sigma is a formal methodology for measuring, analyzing, improving and then controlling processes. The statistical approach reduces the occurrences of defects from a three-sigma level to a six-sigma level [7].
- Six Sigma is a quality initiative that employs statistical measurements to achieve 3.4 defective parts per million – the virtual elimination of errors [8].
- Six Sigma, a comprehensive, statistics-based methodology that aims to achieve nothing less than perfection in every single company process and product [9].

The most comprehensive and, in the authors' opinion, most adequate definitions of Six Sigma state that Six Sigma emphasizes an intelligent blending of the wisdom of the organization with proven statistical tools to improve both the efficiency and the effectiveness of the organization in meeting customer needs. The ultimate goal is not improvement for improvement's sake, but rather the creation of economic wealth for the customer and provider alike [3]. This implies, not that Six Sigma replaces existing and ongoing quality initiatives in an organization, but that senior management focuses on those processes identified as critical-to-quality in the eyes of customers. These critical systems are then the subject of intense scrutiny and improvement efforts, using the most powerful soft and hard skills the organization can bring to bear.

2 SIX SIGMA HUMAN RESOURCES

A very powerful feature of Six Sigma is the creation of an infrastructure to ensure that performance-improvement activities have the necessary resources. Creating a successful Six Sigma infrastructure is an ongoing process, the aim of which is to infuse an awareness of quality into the way all employees approach their everyday work [3]. Infrastructures can vary significantly, depending on the culture and strategic business goals of organizations. Failure to provide this infrastructure is the number one reason why 80% of all TQM implementations failed in the past [10].

For each organization the Six Sigma infrastructure is unique. However, there are factors common to every success story. Six Sigma implementation involves all employees from all organizational or hierarchical levels within the company. However, the main *change agents* are:

strokovnjaki s najvišjo ravno znanj 6σ , vodje projektov 6σ in uporabniki metod in orodij. Ta skupina je majhen toda kritičen odstotek organizacijskega osebja, primarno odgovornega za uspešno uvajanje pobude šest sigm.

Vodstvo. Uvajanje postopka šest sigm vsebuje določene spremembe v nekaterih glavnih poslovnih dejavnostih in uvedbo orodij za doseganje strateških ciljev podjetja. Ta dosežek mora biti voden od zgoraj navzdol in mora imeti nedvoumno podporo najvišjega vodstva podjetja. Najvišje vodstvo je pobudnik vsake uspešne uvedbe kakovosti šest sigm. Ali bodo projekti šest sigm uspešni ali neuspešni je predvsem odvisno od tega, kako bodo izvajalci razumeli vrednost metodologije šest sigm in jo iskreno predstavili znotraj podjetja. Kasnejši umik vodstva lahko pripomore pri prepoznavanju resničnih predstavnikov vodstva, ki bodo predstavili spremembe in pri vseh zaposlenih zavestno uvajali kakovost pri njihovem vsakdanjem delu. Prav tako lahko pomaga določiti prednost načel in potrebnih del pri utemeljevanju in uvajanju načrta povezav. Skozi razpravo in načrtovanje se zaposleni lahko sami usmerijo v pravo smer, da bo njihova lastna izkušnja z izvajanjem postopka šest sigm uspešna.

Predstavniki vodstva in lastniki postopkov.

Predstavniki vodstva so zelo usposobljeni vodje poslovanja, ki predstavljajo in vodijo razvoj kakovosti šest sigm na posameznih področjih poslovanja in filozofijo šest sigm ter so neposredno odgovorni za njen uspeh. V velikih podjetjih se za vodjo pobude šest sigm imenuje predstavnik vodstva z visokim položajem in polnim delovnim časom. Praviloma predstavniki vodstva vključujejo tudi vodje, ki uporabljajo postopek šest sigm pri svojem vsakdanjem delu. Naloga predstavnikov vodstva je tudi odstraniti vse možne proceduralne, kulturne in druge ovire za uvajanje šest sigm. Pri uvajanju projekta šest sigm so predvsem odgovorni za:

- izbiro kandidatov za vodje projektov 6σ ,
- določitev kriterijev za izbiro projektov,
- izbiro projekta kakovosti šest sigm,
- razdelitev potrebnih virov za projekt,
- odstranitev vseh ovir za pobude šest sigm,
- predstavitev projekta šest sigm in spremembe pri uvajanju in
- odobritev celotnih projektov.

Lastniki postopkov in sistemov (sponzorji) pomagajo uvajati in usklajevati dejavnosti izboljšanja projektov šest sigm na svojih področjih odgovornosti. Naloge lastnikov postopkov pri uvajanju projektov šest sigm so:

- pridobiti potrebno odobritev za vsako spremembo postopka,
- izbira članov skupine,
- natančno poznavanje postopka,
- vzdrževanje motivacije in stroškovne učinkovitosti skupine,
- zagotoviti podporo pri uvajanju izboljšav postopka in
- biti povezan z vizijo šest sigm.

leadership; champions and sponsors; master black belts; black belts; and green belts. This group represents a small but critical percentage of the organization's personnel that is primarily responsible for successful Six Sigma implementation.

Leadership. Six Sigma implementation involves changes in the company's major business activities and the application of tools for achieving companies strategic goals. This effort should be lead from the topdown, and should have complete support from company's top management. Top management is the foundation of any successful Six Sigma implementation. Whether Six Sigma succeeds or fails depends to a large extent on how well executives understand the value of the Six Sigma methodology and sincerely promote it within the company. An executive retreat can help identify true champions who will promote change and make employees aware of quality in their approach to everyday work. It can also help prioritize the principles and actions necessary in establishing an implementation road map. Through discussion and planning, employees can orient themselves in such a way that their individual experience with the execution of Six Sigma is successful.

Champions and sponsors. Champions are fully-trained business leaders who promote and lead the deployment of Six Sigma in a significant area of the business. Six Sigma champions are high-level individuals who understand Six Sigma and are committed to its success. In larger organizations Six Sigma will be led by a full-time, high-level champion. As a rule, champions also include leaders who use Six Sigma in their day-to-day work. The champions' role is, also, to remove all potential procedural, cultural and other barriers to Six Sigma implementation. Champions in Six Sigma implementation are primarily responsible for:

- selection of black belt candidates,
- project selection criteria determination,
- Six Sigma project selection,
- allocation of the necessary project resources,
- removal of all barriers to Six Sigma initiatives,
- Six Sigma promotion and change implementation,
- completed projects approval.

Sponsors are owners of the processes and systems that help initiate and coordinate Six Sigma improvement activities in their areas of responsibility. Sponsors' tasks in Six Sigma implementation are to:

- obtain the necessary approval for any process changes,
- select team members,
- communicate process knowledge,
- maintain team motivation and accountability,
- ensure that process improvements are implemented and sustained,
- communicate the Six Sigma vision.

Strokovnjak z najvišjo stopnjo znanj 6 σ je zelo usposobljen vodja poslovanja, ki predstavlja in vodi razvoj metodologije šest sigm na posameznem področju poslovanja. Predstavlja najvišjo stopnjo tehnične in organizacijske strokovnosti. Zagotavlja tehnično vodstvo programa šest sigm. Zato mora imeti specifična znanja vodij projektov 6 σ in razumeti matematično teorijo, na kateri slonijo statistične metode [3]. Pomaga *vodjem projektov 6 σ* v običajnih ali posebnih razmerah in kadarkoli je mogoče, naj bi vodil usposabljanja v orodjih in metodologijah šest sigm. Odgovornosti strokovnjakov s najvišjo stopnjo znanj 6 σ so:

- oblikovati strategijo poslovanja skupaj z najvišjim vodstvom,
- pomagati pri izbiri projektov, ki ustrezajo strateškim potrebam poslovanja,
- voditi in nadzirati usposabljanje za program šest sigm,
- poučiti večkratne vodje projektov 6 σ ,
- usklajevati projekte in vire,
- izboljšati celotno učinkovitost izvajanja projekta,
- prispevati mnenje o metodologiji šest sigm,
- usklajevati dejavnosti za kompletiranje projekta,
- sodelovati v več projektih,
- spodbujati druge v smeri skupne vizije,
- poročati o viziji šest sigm,
- delovati kot agent za spremembe pri usklajevanju novih idej in najboljših rešitev in
- potrditi končane projekte.

Vodje projektov 6 σ so ustrezno usposobljeni strokovnjaki za šest sigm, ki vodijo skupine izboljšanja, delajo na projektih in so mentorji *uporabnikom metod in orodij*. So tehnično usmerjeni posamezniki, dejavno vključeni v postopek organiziranja sprememb in razvoj le-teh. Poleg tega polni delovni čas delajo na projektih izboljšanja postopkov, po navadi kot vodje skupin ali pa dajejo potrebne podpore *uporabnikom metod in orodij*. Neposredno so deležni podpore predstavnikov vodstva, lastnikov postopkov in vrhovnega vodstva. Vodje projektov 6 σ morajo:

- razvijati in voditi nadroben načrt projekta,
- izbrati, poučevati in uporabljati najbolj učinkovita orodja,
- načrtovati in voditi sestanke skupine,
- voditi skupino v smeri učinkovite uporabe metodologije šest sigm,
- nadzirati zbiranje in analizo podatkov,
- opazovati kritične dejavnike za uspeh,
- izračunati prihranke projekta,
- slediti in poročati o mejnikih ter nalogah,
- dokončati 4 do 6 projektov na leto,
- biti mentorji uporabnikom metod in orodij,
- voditi spremembe in
- širiti vizijo šest sigm.

Uporabniki metod in orodij. Manj široko usposobljeno osebje programa šest sigm je vključeno v projekte izboljšanja postopka kot člani skupine ali vodje skupin. Od njih pričakujemo, da razumejo orodja in metode šest sigm in so hkrati sposobni voditi

A master black belt is a fully-trained business leader who promotes and leads the deployment of Six Sigma in a significant area of the business. This is the highest level of technical and organizational proficiency. The master black belt provides technical leadership of the Six Sigma program. Thus, they must have specific black belts' knowledge, as well as an understanding of the mathematical theory on which the statistical methods are based [3]. The master black belt should provide help to black belts in unusual or specific situations and, whenever possible, training in Six Sigma tools and methodologies should be conducted by the master black belt. Master black belts responsibilities are to:

- formulate business strategies with senior management,
- aid in selecting projects that fit strategic business needs,
- conduct and oversee Six Sigma training,
- coach multiple Black Belts,
- leverage projects and resources,
- improve overall project execution efficiency,
- share Six Sigma methodology expertise,
- coordinate activities to drive project completion,
- participate in multiple projects,
- motivate others toward a common vision,
- communicate the Six Sigma vision,
- function as a change agent to leverage new ideas and best practices,
- approve completed projects.

Black belts are fully-trained Six Sigma experts who lead improvement teams, work on projects and mentor green belts. They are technically oriented individuals, actively involved in the process of organizational change and development. Furthermore, they are full-time professionals who work on process-improvement projects, usually as a team leader or providing needed support to green belts. Champions and leadership directly support black belts. A black belt has to:

- develop and manage a detailed project plan,
- select, teach, and use the most effective tools,
- schedule and lead team meetings,
- lead the team in the effective utilization of the Six Sigma methodology,
- oversee data collection and analysis,
- monitor critical success factors,
- calculate project savings,
- track and report milestones and tasks,
- complete four to six projects a year,
- mentor Green Belts,
- lead change,
- disseminate the Six Sigma vision.

Green belts. Less-extensively trained Six Sigma personnel involved in process-improvement projects as a team members or team leaders. They are expected to understand Six Sigma tools and methods and, at the same time, be capable of managing Six

projekte šest sigm od zasnove do konca. Naj bi približno 20 odstotkov delovnega časa porabili za delo na projektih [11]. Uporabniki metod in orodij so v glavnem odgovorni za:

- sodelovanje pri oceni postopka,
- zbiranje podatkov,
- sprejemanje in kompletiranje vseh določenih podrobnih dejavnosti,
- uvajanje izboljšav in
- sodelovanje na vseh sestankih.

Infrastruktura šest sigm je prikazana na sliki 4.

3 UVAJANJE PROJEKTA ŠEST SIGM

Uspešen razvoj projekta šest sigm vključuje številne usklajene podrobnosti [3]. Program uvajanja se mora začeti pri vodstvu. To naj bo seznanjeno z glavnimi načeli in orodji, ki so potrebni za uspešen razvoj programa šest sigm. Vodstvo uvaja spremembe v organiziranju poslovanja podjetja in hkrati naredi korake v smeri inovativnega in kreativnega delovnega okolja. To vključuje zmanjšanje števila ravni v organizacijski hierarhiji, odstranjevanje postopkovnih ovir za eksperimentiranje in spremembe ter vrsto drugih sprememb, sprejetih za lažje preskušanje novosti brez strahu pred posledicami.

Poslovni postopki so razviti na temelju sklenjenih povezav z odjemalci, zaposlenimi in dobavitelji. To vključuje razvoj ustreznih metod za ocenjevanje vstopnih veličin odjemalcev, dobaviteljev in zaposlenih. Kulturne, politične in postopkovne ovire za uspeh naj bi bile prepoznane.

Potrebe po usposabljanju so zagotovljene znotraj podjetja, usposabljanje od vrha navzdol pa je vedeno z orodji, metodami in filozofijami za izboljšanje sistema.

Sigma projects from concept to completion. Green belts should spend approximately 20% of their working time on projects [1]. Green belts are mainly responsible for:

- process expertise contribution,
- data collection,
- acceptance and completion of all assigned action items,
- improvements implementations,
- participation in all meetings.

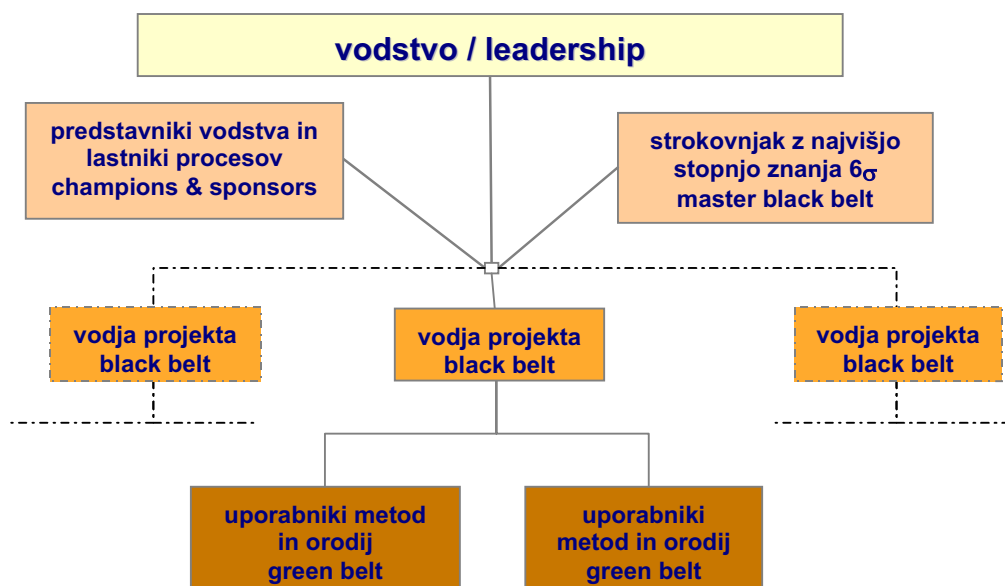
The Six Sigma infrastructure is illustrated in Fig. 4.

3 SIX SIGMA IMPLEMENTATION

Successful Six Sigma deployment involves several high-leverage items [3]. Program implementation has to begin with leadership. Leadership should be trained in the main principles and tools necessary for successful deployment of Six Sigma. Leadership initiates changes in the company's business infrastructure, and, at the same time, makes steps toward a innovative and creative working environment. This involves a reduction in the number of levels in the organizational hierarchy, the removal of procedural barriers to experimentation and change, and a variety of other changes designed to make it easier to try new things without fear of reprisal.

Business processes are developed to establish close communication with the customer, the employees, and the suppliers. This includes developing appropriate methods for assessing the input of customers, suppliers and employees. Cultural, political and procedural obstacles to success should be identified.

Training needs are assessed within a company, and top-to-bottom training is conducted in system improvement tools, techniques, and philosophies.



Sl. 4. Sestava šest sigm

Fig. 4. The Six Sigma infrastructure

Okolje za stalno izboljšanje postopka je razvito skupaj s sistemom kazalcev za opazovanje napredka in uspeha.

Poslovne postopke, ki naj bi bili izboljšani, izbira lahko vodstvo ali posamezniki z globokim poznavanjem postopka na vseh stopnjah organizacijske hierarhije.

Projekte šest sigm vodijo posamezni zaposleni, skupine pa uporabniki metod in orodij ob pomoči vodij projektov 6σ .

Zato so ključni dejavniki uspeha programa šest sigm, naštetih v naslednjem vrstnem redu po pomembnosti [3]:

- izvršilno vodstvo,
- osredotočenje na odjemalca,
- strateški cilji,
- izbira projekta,
- usposabljanje in izvajanje,
- viri,
- izbira vodje projekta 6σ ,
- metrike in povratna zveza,
- kultura,
- komunikacije,
- načrtovanje in
- rezultati.

4 VODENJE PROJEKTA ŠEST SIGM

Projekti stalnih izboljšav postopka šest sigm so vodeni od zasnove do konca, skozi pet korakov ali faz vodenja projekta, imenovanih z začetnicami DIAIK (sl. 5). Teh pet korakov ali faz vodenja projekta so: definiraj, izmeri, analiziraj, izboljšaj, krmili (nadzoruj).

An environment for continuous process improvement is developed, along with a system of indicators for monitoring progress and success.

Business processes that need to be improved are chosen by management and individuals with intimate process knowledge at all levels of the organization's hierarchy.

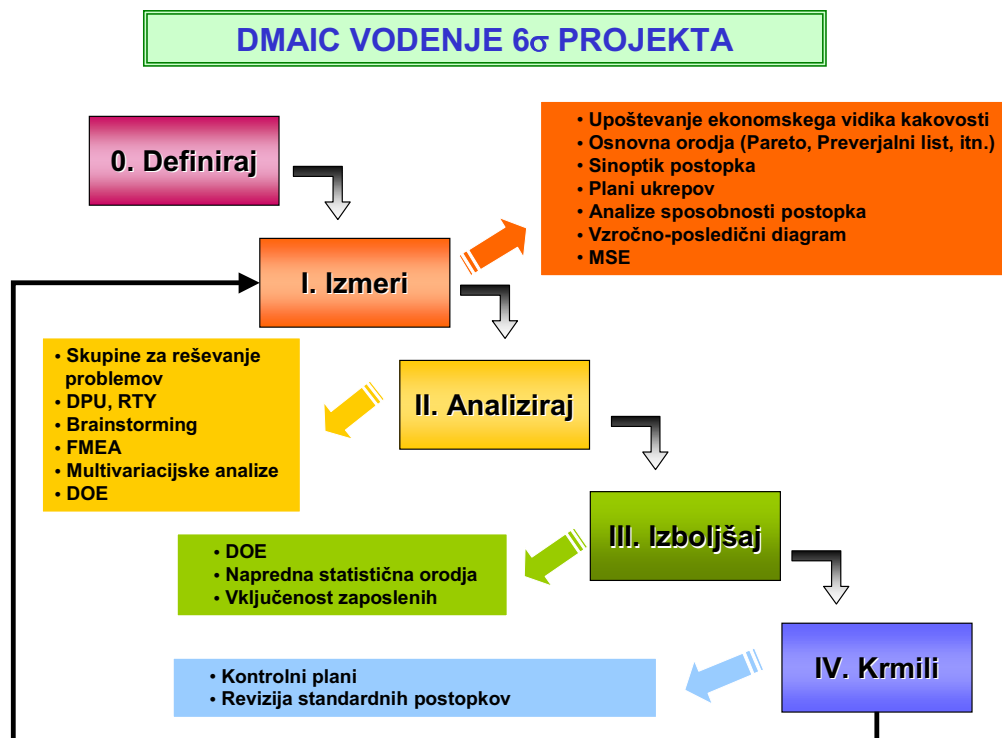
Six Sigma projects are conducted by individual employees and teams lead by green belts and assisted by black belts.

Hence, the key drivers of the success of Six Sigma in descending order of importance are [3]:

- executive leadership,
- customer focus,
- strategic goals,
- project selection,
- training and execution,
- resources,
- black belt selection,
- metrics and feedback,
- culture,
- communications,
- planning,
- results.

4 SIX SIGMA PROJECT MANAGEMENT

Six Sigma projects of continuous process improvement are led, from concept to completion, through five project-management steps or phases named DMAIC, Fig. 5. DMAIC is an acronym, which stand for the five steps of project management: Define, Measure, Analyze, Improve, Control.



Sl. 5. Koraki vodenja projekta DIAIK

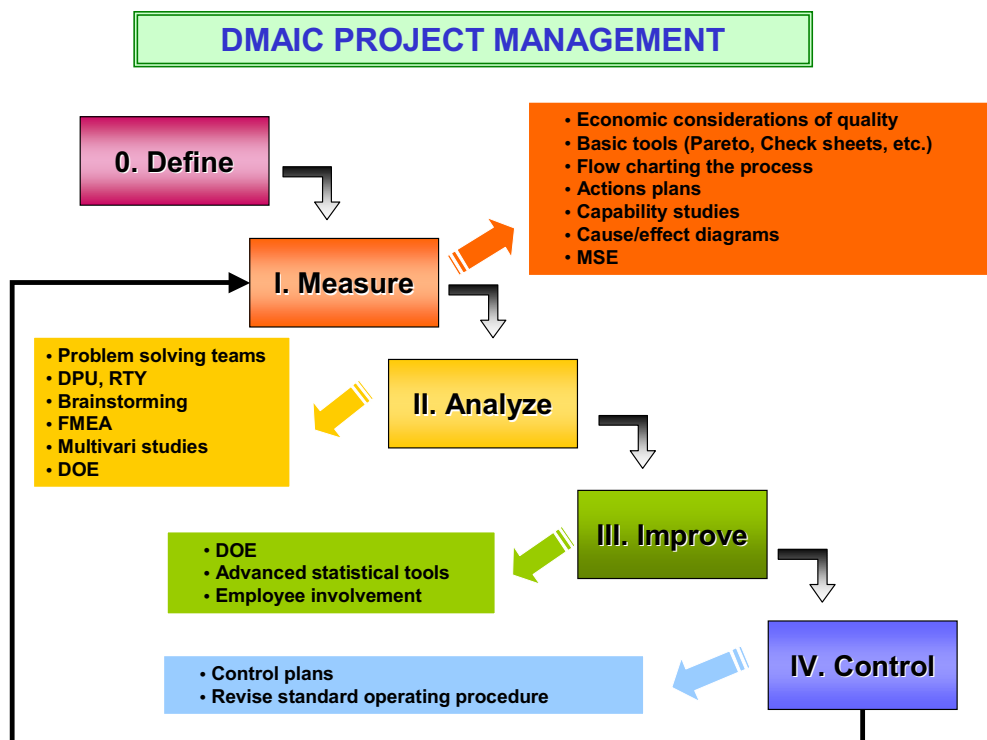


Fig. 5. The DMAIC project management steps

Definiraj je prvi korak, v katerem se določijo meje projektov. Določene so ključne vhodne in izhodne spremenljivke postopka kakor tudi notranji in zunanji odjemalci ter dobavitelji. V tej fazi naj bi odgovorili na vprašanje: *kdo so odjemalci in kaj so njihove prednosti?*

Skozi fazo **izmeri** naj bi določili trenutne razmere glede na definirane projektne cilje. Ključne vhodne in izhodne spremenljivke so stopnjevane glede na njihov pomen za postopek. Začetne meritve se izvajajo za zagotovitev ustreznih informacij za nadaljnjo analizo. V tej fazi naj bi odgovorili na vprašanje: *kako je predstavljen postopek in kako ga merimo?*

V fazi **analiziraj**, ki sloni na zbranih informacijah, uporabljamo številna statistična orodja za raziskovanje in določitev povezav med vhodnimi in izhodnimi spremenljivkami. Odgovorili naj bi na vprašanje: *kaj so najbolj pogosti vzroki za napake?*

V fazi **izboljšaj** uporabljamo in uvajamo možne izboljšave postopka in storitve. V tej fazi izvajamo široko zasnovane raziskave s ključnimi spremenljivkami z namenom, da bi dosegli optimalne rezultate. Dali naj bi odgovor na vprašanje: *kako odstraniti vzroke napak?*

Zadnja faza kroga izboljšanja postopka DIAIK je **krmili** (nadziraj). V tej fazi se ocenjujejo uvedene izboljšave postopka in doseženi rezultati projektov. Na vprašanje – *kako vzdrževati izboljšave?* naj bi odgovorili v tej končni fazi postopka DIAIK.

V primeru, ko cilji projekta niso doseženi, fazi krmili sledi faza izmeri in nadaljnji napor za izboljšanje. Prav tako se vodstvo lahko odloči končati projekt

Define is a first step in which project boundaries are defined. Key input and output variables for the process are determined, as well as internal and external customers and suppliers. In this phase it is necessary to answer the questions: *who are the customers and what are their priorities?*

During the **measure** phase a current situation in the process should be specified according to defined projects goals. Key input and output variables are graded according to their importance for a process. Initial measurements are conducted to provide valuable information to further analysis. The question: *How is the process performing and how is it measured?* Should be answered in this phase.

In the **analyze** phase, based on gathered information, several statistical tools are used to explore and establish relationships between input and output variables. The question: *what are the most important causes of the defects?* Should be answered.

During the **improve** phase possible process and service improvements are exploited and implemented. In this phase extensive experimentation with key variables takes place to achieve the optimum results. The answer to the question: *How to remove the causes to the defects?* should be given.

The last phase of the DMAIC process-improvement circle is **control**. In this phase the implemented process improvements and the achieved results from the projects are evaluated. The question: *How to maintain the improvements?* Should be answered in this final phase of DMAIC process.

If the project goals are not achieved, the after Control phase follows the Measure phase, and efforts for further improvements. Also, leadership can decide

pred koncem, če se izkaže, da nadaljnje delo pri projektu ne bo dalo uspeha. Poleg vseh prej omenjenih komponent uspeha šest sigm, so prav tako zelo pomembni še: zgodnja komunikacija s zaposlenimi, merilni sistemi in infrastruktura informacijske tehnologije [6].

5 SKLEP

Namen postopka šest sigm je izboljšati učinkovitost organizacije kakor tudi učinkovito prepoznati potrebe odjemalca, končno ustvarjanje ekonomske blaginje za odjemalca in dobavitelja. Nadalje, močan poudarek postopka šest sigm je ustvarjanje odlične infrastrukture za podporo sprememb prečnih povezav znotraj organizacije. Uvajanje programa šest sigm in razvoj glavnih načel in metodologij je težavna naloga, ki mora izvirati iz vodstva. Vodstvo je močna oporna točka, od katere je odvisno uspešno uvajanje programa šest sigm.

Kot relativno nova metodologija kakovosti (vsaj v našem prostoru) se šest sigm že odlikuje s številnimi oblikami prednosti. Podjetja, ki so uvedla postopek šest sigm, pridobivajo prednosti predvsem z

- izboljšano učinkovitostjo / finančno,
- izboljšanim zadovoljstvom odjemalcev in
- izboljšanim razvojem izdelkov.

Postopek šest sigm je učinkovita pot za ugotovitev, kje so največje potrebe postopka in katere so šibke točke postopka. Prav tako postopek šest sigm zagotavlja merljive indikatorje in ustrezne podatke za analizo.

Čeprav je program šest sigm večletni napor, so doseženi rezultati poplačilo, osnutek sam pa spreminja vlogo in pomen kakovosti.

6 LITERATURA

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to finish the project without completion if it is clear that further work on the project will not result in success. In addition to all of the aforementioned components of Six Sigma success, early communication to employees, measurement systems, and an information technology infrastructure are also important [6].

5 CONCLUSION

The objective of Six Sigma is to improve organization efficiency as well as an effectiveness in meeting customer needs, ultimately creating economic wealth for the customer and provider. Furthermore, Six Sigma's strong point is the creation of an infrastructure to support cross-functional changes within an organization. The implementation of Six Sigma and the deployment of the main principles and methodologies is a difficult task that has to originate from leadership. Leadership is a strong supporting point upon which the successful implementation of Six Sigma depends.

As a relatively new quality methodology Six Sigma has already resulted in several benefit dimensions. Companies that have applied Six Sigma gain benefits primarily through:

- improved performance / financial success,
- improved customer satisfaction,
- improved product development.

Six Sigma is an effective way to find out where are the greatest process needs and which are the softest points in the process. Also, Six Sigma provides measurable indicators and adequate data for the analysis.

Although Six Sigma is a multi-year undertaking, the results are rewarding and the concept are changing the quality profession.

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