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Računalniško obvladovanje kakovosti v avtomobilski industriji

Computer-Supported Quality Control in the Automotive Industry

Drago Metljak - Alojzij Sluga

Predstavljen je sistem računalniško podprtega spremljanja proizvodnje in obvladovanja kakovosti v verigi dobaviteljev v avtomobilski industriji. Opisan je standardiziran splošen model tovarne z najpomembnejšimi poslovno-proizvodnimi funkcijami in v tem okviru tudi funkcije sistema računalniško podprte kakovosti (RPK - CAQ). Poudarek je dan na opisu modela merjenja in obvladovanja procesov in izdelkov, obvladovanja neskladnosti in sistemskega uvajanja izboljšav. Za ponazoritev sta prikazana dva primera uspešne uporabe sistema RPK.

(Ključne besede: obvladovanje kakovosti, CAQ, zasledovanje proizvodnje, QS9000)

We present a computer-supported system for monitoring and quality control in a supply chain in the automotive industry. A standardized general model of a factory revealing the structure of the important business and manufacture functions, including functions of the CAQ (computer-aided quality) system, is defined. Within the model there is an emphasis on (1) the measurement and control of processes and products, and (2) the management of nonconformities and systematic corrective and preventive action and continual improvement. For illustration, two case studies of successful CAQ-system implementations are demonstrated.

(Keywords: quality control, CAQ, production monitoring, QS9000)

0 UVOD

Podjetja, vključena v verigo dobaviteljev v avtomobilski industriji, so z vidika obvladovanja kakovosti pod nenehnim pritiskom svojih odjemalcev. Po eni strani jim narekuje tempo sama standardizacija kakovosti, še bolj pa po drugi strani stopnjujejo pritisk vedno večje zahteve za kakovost in krajšanje dobavnih rokov, ki jih določajo odjemalci. Povsod je opazna zahteva po zmanjševanju stroškov, tako proizvodnih kakor stroškov zaradi kakovosti in še posebej zaradi nekakovosti.

Sodoben proizvodni postopek mora biti kar najbolj prilagodljiv, hitro se mora odzivati na poslovne postopke. Organizacija postaja vse bolj prožna, segmenti proizvodnega postopka dobivajo večjo samostojnost ukrepanja in pripadajočo odgovornost. Vse bolj se v proizvodni postopek vključujejo dobavitelji. Povezave dobavitelj - odjemalec so vse bolj mednarodne, srečujemo se z zahtevami, ki jih postavljata metodologiji zagotavljanja kakovosti ISO 9001 in še bolj QS 9000 s svojimi zahtevami po vnaprej opredeljenih postopkih in njihovem doslednem izvajanju, protokoliranju itn. Te in podobne probleme

0 INTRODUCTION

Companies that are part of the supply chain in the automotive industry are under constant customer pressure from the point of view of quality management and control. The pace of quality control is imposed by quality standardization from one side, and the stringent requirements regarding quality and shorter lead times imposed by customers on the other. Particular requirements to cut the costs of production, of improve and detect failures are present.

Modern production processes must become more flexible and be able to react to business processes. Organization is becoming more flexible, and the key segments of the production process are gaining more autonomy when it comes to decision making, and responsibility is being adequately redistributed. More and more suppliers are being included in the production process and customer–supplier chains and relationships are becoming more international. The requirements arising from quality assurance methodology as defined by ISO 9000 and QS 9000, in terms of well-defined processes, consistent opera-

je mogoče učinkovito premagovati le z uvajanjem računalniške podpore kakovosti, opisane v nadaljevanju.

Eden izmed pomembnih vidikov v verigi avtomobilske industrije je uvajanje tehnologije RPK, ki je zaradi svoje zapletenosti zahteven projekt.

1 ANALIZA POSTOPKOV PODJETJA

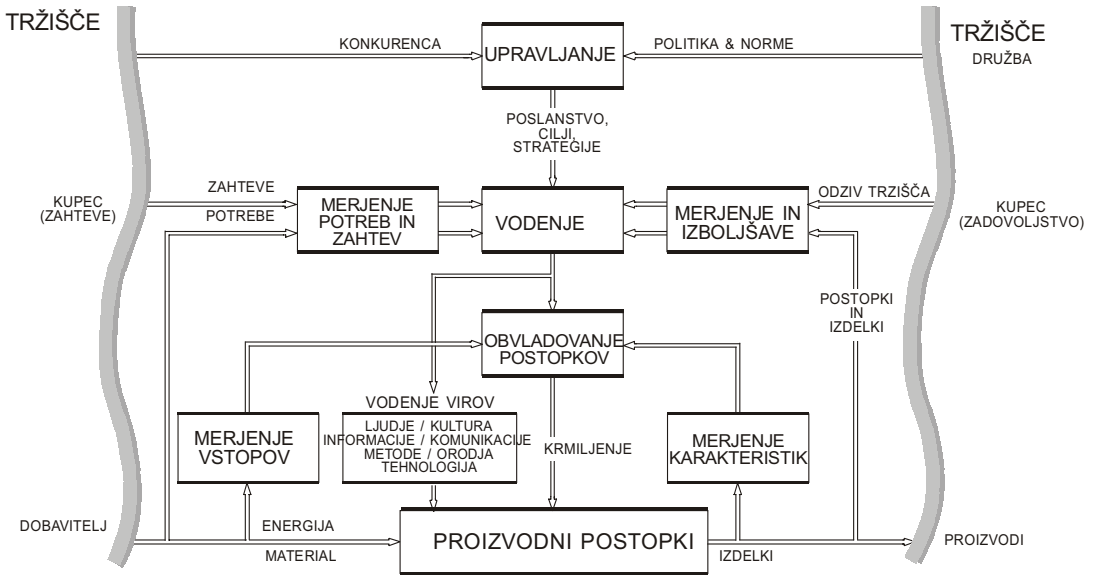
Da bi se lahko dobro pripravili na uvajanje računalniškega spremljanja proizvodnega postopka in kakovosti, moramo najprej dobro proučiti poslovne in proizvodne postopke, ki jih želimo podpreti. To najlaže naredimo, če si podjetje ponazorimo kot model, na katerem analiziramo posamezne poslovne in proizvodne postopke.

tions and recording in protocols are the basis for these chains. These issues can only be effectively managed by computer-aided quality operations.

The important issue for the customer–supplier chain is the introduction of CAQ technology, which, due to its complexity, is an exacting project.

1 AN ANALYSIS OF COMPANY PROCESSES

In order to have a sound basis for the introduction of a computer-supported system for monitoring and quality control one first has to carry out a thorough analysis of the business and production processes. It is probably best if we illustrate the enterprise as a model in which the business and production processes are analyzed. The objective of the analysis



Sl. 1. *Model upravljanja proizvodnega podjetja*

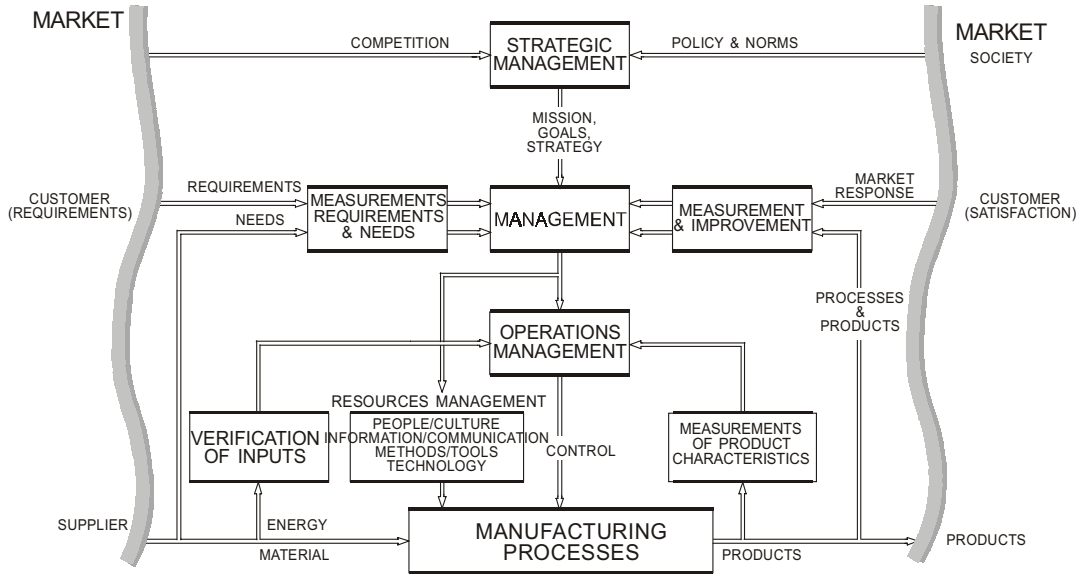


Fig. 1 *Model of enterprise management*

Namen teh analiz je jasna definicija in razmejitev poteka posameznih postopkov ter njihova organizacijska, logistična, tehnološka, strukturna in informacijska slika.

Na sliki 1 je predstavljen model upravljanja, vodenja in obvladovanja proizvodnih postopkov v podjetju. Slika prikazuje trinivojsko strukturo, upravljanje/vodenje/izvajanje in pripadajoče povezave s tržiščem. Za uspešno vodenje je treba na kakšen način opazovati in meriti zahteve in potrebe tržišča, prav tako pa tudi njegove odzive. Odziv tržišča je v končni fazi zadovoljstvo kupca. Na podlagi vrednotenja teh opazovanj in merjenj se lahko izvaja vodenje, ki se na proizvodnem nivoju izvaja kot obvladovanje proizvodnih postopkov, vodenje virov in merjenje vhodnih in izhodnih karakteristik proizvodnih postopkov. Koncept je skladen s standardom ISO 9001:2000 [1]. Označene številke v okvirčkih se navezujejo na poglavja omenjenega standarda. V nadaljevanju je podrobneje opisan model upravljanja, vodenja in obvladovanja proizvodnih postopkov, predstavljen na sliki 1.

Na upravljavski ravni vodstvo družbe/podjetja določa njegovo razvojno strategijo izdelkov, marketinško, finančno, kakovostno in proizvodno strategijo.

Vodstvo na temelju strateških usmeritev izvaja dejavnosti, potrebne za njihovo uresničitev. Marketing na podlagi zahtev tržišča določi zahteve za izdelek ter zahteve za proizvodne tehnologije v nadaljnjem razvoju se te zahteve preoblikujejo v tehnologije, primerne za razvoj izdelka in njegovo izdelavo. V razvoju izdelka in proizvodni tehnologiji pripravijo izdelčno in tehnološko kosovnico, ki ju dajo v upravljanje s proizvodnjo, ta pa jih v dodelani obliki sporoča nabavni službi. Nabavna služba pred nakupom komponent in tehnologij, potrebnih za proizvodnjo, upravlja z dobavitelji tako, da so izpolnjene strateško določene zahteve. Nabavljena sredstva se predajo v upravljanje s proizvodnimi viri. V upravljanju s proizvodnjo upravljajo z energijo, vhodnimi materiali in komponentami na podlagi tehnično-tehnološke dokumentacije iz izdelčnega in procesnega razvoja skladno z naročili. V upravljanju s proizvodnimi viri upravljajo z razpoložljivimi proizvodnimi sredstvi in merilnimi in nadzornimi napravami. Nad proizvodnimi sredstvi bdi vzdrževanje. Rezultat proizvodnega postopka so izdelki in množica operativnih proizvodnih podatkov. Na proizvodni ravni nastaja torej največja množica podatkov, s katerimi je treba selektivno in postopkovno usmerjeno upravljati, še zlasti ob motnjah proizvodnega postopka. Ti podatki se potem v bolj zgoščeni obliki uporabljajo pri delu na vodstveni ravni, v še bolj zgoščeni in integrirani obliki na upravljavski ravni ter v namensko izbrani obliki pri uvajanju popravnih ukrepov in izboljšav.

is a clear definition and a distinction between specific processes and their organizational, logistic, technological, structural and informational description.

Figure 1 shows a conceptual model of the management and control of the production process in a factory. It reveals a three-level structure, i.e. strategic management, management and operations and adequate links with the market. For successful management we must observe and measure the needs and requirements of the market/customer, as well as measuring their response. The key response can be customer satisfaction. Based on an assessment of these observations and measurements the proper management can be established and reflected at the production level as resource management, production process control, and supervising of input and output process characteristics. The presented concept conforms with ISO 9001:2000 [1]. The labeled numbers in the boxes are associated with the chapters of the standard. In the next part the model of management and control of the production process is discussed in more detail.

On a strategic level the management defines the strategy of the product, marketing, financial, quality and production strategy.

The management at the management level, based on strategic directives, executes all activities that are necessary for their realization. Based on customer requirements, marketing defines the requirements for the product and the technology for its realization. The deployment of these requirements is the basis for the preparation of technology with reference to the product development and its producability. Product development and the development of production technology enable the preparation of a bill of material for the product and the technology. The bill of material is then worked out by production management and forwarded to procurement. The procurement manages the suppliers in such a way that strategic requirements are fulfilled before any actual purchase of components and/or technology. Supplied means are then transferred to resource management, materials and components. Production management then manages the energy, input materials and components according to technical and workshop documentation based on product and process development in conformance with customer orders. The management of production resources is engaged with the available production means, e.g. tools, machines, measurement as well as measuring and monitoring devices. Maintenance is responsible for these means. The outputs of the production process are the products with actual characteristics and a host of operative production data. Thus, on the shop-floor level here is a great deal of data in a factory. These data have to be managed selectively, with the reference to the processes, particularly when disturbances to the production process occur. The aggregated data are then used for decision making at the management level. Particular selections of data are

Funkcija kakovosti upravlja s sistemom kakovosti, tako da zagotovi nemoteno in optimalno izvajanje tako zastavljenega poslovnega in proizvodnega postopka, skladno z izbranim modelom zagotavljanja kakovosti.

Analiziranje delovanja podjetja in postopkov znotraj njega ima namen ugotoviti (1) dejanski potek (organizacijski, logistični, strukturni) posameznih postopkov, (2) njihovo informacijsko strukturo, (3) način njihovega delovanja ob načrtovani računalniški podpori, (4) zahteve do informacijskih sistemov, ki jih želimo računalniško podpreti in (5) skladnost s standardi kakovosti, po katerih mora podjetje poslovati.

2 MERJENJE IN OBVLADOVANJE POSTOPKOV IN IZDELKOV

Podporo nadzora proizvodnega postopka in zagotavljanja kakovosti bomo opisali na primeru upravljanja z izboljšavami, prikazanem na sliki 2. Imena modulov in zaslonska slika se nanašajo na RPK sistema programskega paketa RQM, ki je opisan v 4. poglavju. Pri tem funkcijska struktura modulov podpira zahteve standarda QS 9000 [2].

Posamezne bistvene funkcije proizvodnega postopka in postopke njegovega nadzora spremljajo posamezni funkcijski moduli sistema RPK. Ti moduli po eni strani komunicirajo s pripadajočimi postopki, ki jih podpirajo, po drugi pa z bazo podatkov RPK, kjer so shranjeni vsi podatki o stanju proizvodnje in kakovosti. Moduli sistema RPK imajo na tak način v povezavi s sliko 1 vlogo detektorjev, ki opazujejo, merijo in vrednotijo stanje opazovanih postopkov. Po zajetju podatkov v postopku sledi njihovo vrednotenje in nato ugotavljanje skladnosti dobro/slabo. To se nanaša na nadzor toka materiala in upravljanje z njim, t.i. materialno poslovanje. Prav tako zajemamo tudi t.i. nematerialne probleme, npr. različne predloge za izboljšave, pritožbe odjemalcev, poročila o odstopanju pri izvajanju presoj ipd. Povedano drugače, računalniška podpora nadzora proizvodnega postopka in kakovosti omogoča merjenje in nadzorovanje stanja postopkov in izdelkov.

Tako ti moduli delujejo kot identifikatorji odstopanj od načrtovane kakovosti in posledično tudi kot vir kasnejših predlogov za izboljšave. V okviru materialnega poslovanja je prožilec postopka izboljševanja, npr. (1) notranja reklamacija v proizvodnem postopku, (2) zunanja reklamacija, (3) obvestilo o težavah v proizvodnem postopku, (4) zavrnitev šarže pri medfaznem ali pošiljke pri končnem pregledu.

Drugo skupino proženj zahtevkov za izboljšave pomenijo moduli, ki podpirajo nematerialno poslovanje, npr. (1) razni predlogi za izboljšave, (2) poročilo o odstopanju pri izvajanju

used for corrective actions and for improvements. The quality function manages a quality system in order to ensure trouble-free and optimum execution of the particular business and production processes in conformance with the appointed model of quality assurance.

An objective of the analysis of operations of a company and its processes is to determine (1) the de facto course (organizational, logistic and structural) of the processes, (2) their informational structure, (3) the manner of working of the planned computer support, (4) the requirements for information systems that are expected to be computer supported, and (5) conformance with quality standards, which have to be taken into account in the course of the company's operations.

2 PROCESS AND PRODUCT MEASUREMENT AND CONTROL

Computer support of the production process and quality assurance is shown in the case of improvement management in Fig. 2. The module names and the screen picture are from the CAQ system RQM, which is described in more detail in Section 4. The functional structure of the modules supports the requirements of the QS 9000 standard [2].

Particular vital functions of production process and monitoring processes are supported by particular functional modules of the CAQ system. These modules communicate with processes that they belong to on one side, and on the other side, they communicate with a CAQ database where all the data about the state of production as well as the quality data are stored. Thus, in the context of Fig. 1 the modules of the CAQ system play the role of detectors, which monitor, measure and analyze the state of the observed processes. After the data acquisition for a process the data analysis takes place. From this follows a statement of conformance, e.g. good/non-conformable. This procedure is typical for material management. In addition, we also capture non-material issues, e.g. propositions for improvement, customer complaints, reports of deficiencies found during the audit. Hence, computer support to the monitoring of the production process and the quality of products allows us to measure and monitor the state of the processes and products.

These modules also act as identifyers of deviations from planned quality and, consequently, they act as a source of propositions for improvement. In terms of material management it is a kind of generator of a process of improvement, e.g. (1) internal claim in production process, (2) customer complaint, (3) information on about nonconformities in realization processes, (4) rejection of a lot at in-process control or at out-going control.

The other group of possible claims for improvement represents modules, which support nonmaterial operations, e.g. (1) various propositions for improvement, (2) report of nonconformance as no-

presoje sistema kakovosti, (3) razne pritožbe in pripombe, (4) delo z moduli sistema RPK, ki podpirajo delo z zadolžitvami. Npr. izvajanje presoj ima za posledico zadolžitve s točno določenimi nalogami in roki, timsko delo z analizo FMEA prav tako, delo po postopku APQP samo po sebi ustvarja zadolžitve, s katerimi je treba upravljati. Ne nazadnje, reševanje vseh vrst reklamacij prav tako terja nadzor njihovega reševanja.

2.1 Obvladovanje neskladnosti

Neskladnosti določamo na tak ali drugačen način. Materialne neskladnosti v praksi obravnavamo kot reklamacije. Reklamacije na splošno razvrstimo v (1) zunanje (reklamacije novih izdelkov, reklamacije iz tržišča oz. odjemalcev in reklamacije pri uporabniku zaradi nekakovosti dobaviteljev), ter (2) v notranje (reklamacije zaradi notranje neskladnosti, reklamacije, zajete v vhodnem nadzoru, in reklamacije, do katerih prihaja v proizvodnji). Vsaka vrsta reklamacije zahteva načeloma svoj postopek reševanja. Sami postopki pa so lahko podobni. Pri tem se zahteva tudi ustrezna razpoložljivost podatkov.

Obvladovanje neskladnosti izdelkov vključuje zbiranje, tehnično ter komercialno obdelavo ter upravljanje z neskladnimi izdelki. Upravljanje z neskladnimi izdelki poteka v sodelovanju z logističnim podsistemom. Tehnična obdelava obsega klasifikacijo problema, analizo vzroka neskladnosti, samo tehnično določitev rešitve problema in nato izvajanje ukrepov oz. uvajanje izboljšave. Komercialna obdelava neskladnosti je usmerjena v ugotavljanje in zbiranje stroškov, nastalih zaradi same neskladnosti in reklamacijskega postopka.

V avtomobilski industriji je uveljavljen način obdelave neskladnosti po 8D metodi. Faze te metode reševanja so (1) določitev tima, (2) opis problema, (3) takojšnji ukrepi, (4) določitev vzroka, (5) popravni ukrepi, (6) trajne izboljšave, (7) organizacijske izboljšave in (8) sporočilo vodstvu. Vsaka faza ima točno določeno vsebino, odgovornega nosilca in termin rešitve naloge. Naj obdelujemo neskladnost na kateri koli način, vedno pri vsakem koraku postopka njenega reševanja nastane neka zadolžitev oz. ukrep, ki ga moramo nekomu dodeliti in nadzorovati njegovo izvajanje.

Pri obdelavi neskladnosti si pomagamo z orodji in vsemi potrebnimi podatkih o izdelčni in postopkovni kakovosti, stanju delovnega naloga, proizvodnega postopka in merilnih sredstvih, ki jih ponuja sistem RPK. Osnovno orodje je reklamacijski modul s svojimi vrednotenji in funkcijami za podporo upravljanja z neskladnostmi. Dodatna orodja so (1) standardna vrednotenja v sistemu RPK in njegovih

ticed by internal auditing of the quality system, (3) various claims and observations, (4) work with modules of the CAQ system that support handling with assignments. For example, audit processing generates assignments with defined tasks and deadlines, teamwork with FMEA analysis likewise, APQP procedure defines assignments too. One has to handle these assignments with complaint processing, which also requires a kind of supervision.

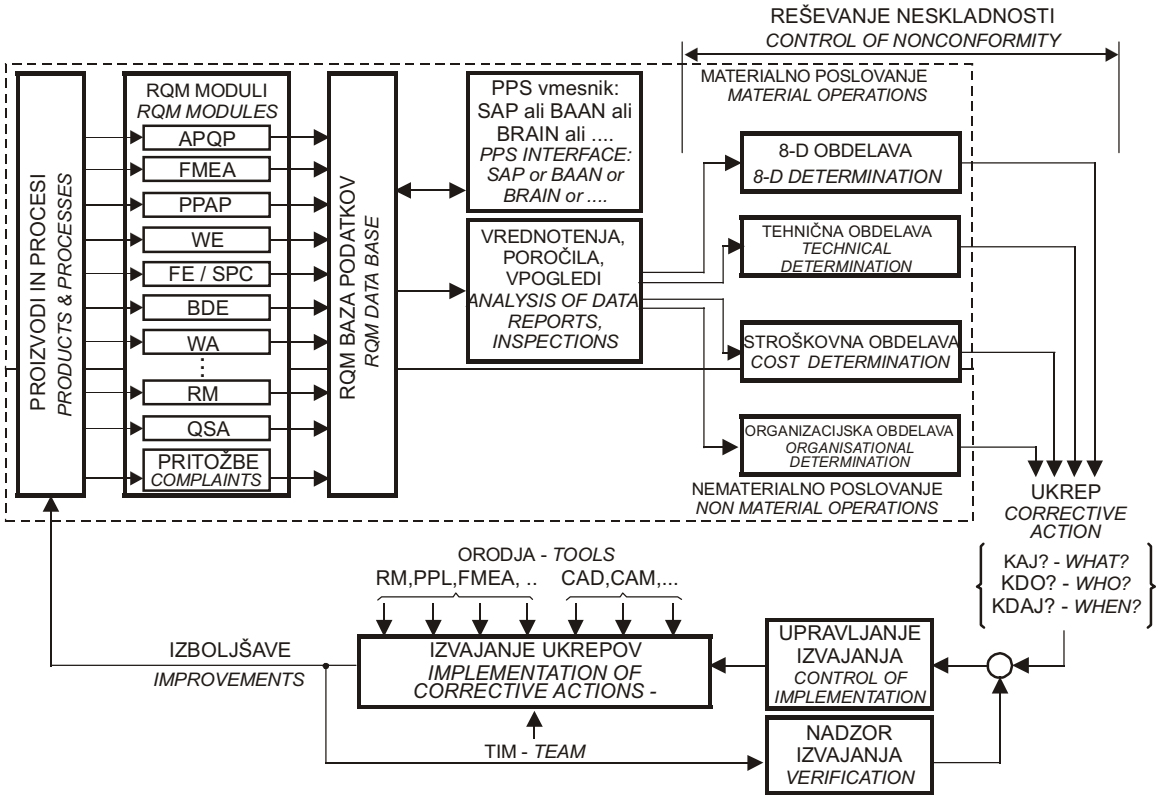
2.1 Control of nonconformity

Nonconformities are established in various ways. The material type of nonconformity is usually treated as a complaint. Complaints are usually systemized in two groups, i.e. (1) external complaints (customer complaint or complaints from the market during the warranty period, complaints abow purchased products or about supplier products) and (2) internal complaints (complaints resulting from internal nonconformance, complaints in incoming control and complaints from production). Each type of complaint requires its own method of solution. Of course, procedures can be similar. However, the availability of particular data is required for complaint treatment.

Control of nonconforming products includes identification, technical and commercial handling and supervision of nonconforming products. Supervision of nonconforming products is in close relation to the logistic subsystem. The technical handling includes classification of nonconformity, determination of the causes of nonconformity, a technical determination of the corrective action needed and afterwards the implementation of the corrective action or improvement. The commercial handling of nonconformity is focused into costs related to nonconformity itself and costs due to the complaint process.

In the automotive industry a popular way of handling nonconformity is the use of the 8D method. The phases of this method are as follows: (1) team determination, (2) problem description, (3) immediate actions to ensure that nonconformities do not recur, (4) determining the causes of nonconformity, (5) determining and implementing the corrective action needed, (6) continual improvement, (7) organizational improvements, (8) report for management. The content, responsible personnel and deadline for the solution are defined for each phase. Generally, whatever the method for controlling, the nonconformity is to be performed the assignment and the measures are generated that are allocated to someone. In addition, the controlling of the action taken is also defined.

In the handling of nonconformity the tools and the necessary product and process quality data, the status of the work order, the status of the production process and of the measuring devices that offer the CAQ system are of significant assistance. The basic tool is the module for complaints that provides analysis and functionality to support the control of nonconformity. Additional tools are: (1) standard



Sl. 2. *Nadzorovano uvajanja izboljšav*
Fig. 2 *Control of the introduction of improvements*

modulih, (2) druga povpraševanja in namenska oz. problemsko usmerjena vrednotenja, izdelana z modulom AUGE (modul RQM za izdelavo uporabniških vrednotenj in poizvedovanj v bazi podatkov), (3) metoda FMEA in (4) modul za upravljanje s kosom in nadzornimi načrti. Bistveno pri tem je, da so podatki vedno v bazi podatkov in jih lahko vedno prikličemo v ustrezni obliki, primerni za obdelavo ali vrednotenje, oziroma jih med postopkom obdelave neskladnosti dopolnjujemo. Ti podatki so tudi izhodišče za poglobljeno analizo vzrokov, ki so pripeljali do neskladnosti. S sledljivostjo, vgrajeno v sistem, pridemo do podatkov, ki so vzrok ali pa posledica dejanskega problema. Primer: če odjemalec reklamira slabo izdelane kose, pridemo preko podatka o izdelku in dobavnici do delovnega naloga in nadzornega načrta ter naprej do posameznih rezultatov meritev izdelkov in procesnih veličin, ki so bile uporabljene pri izdelavi danega naloga. Od tu naprej lahko določimo vzroke za nekakovost in jih lahko tudi ustrezno odpravimo. Prav tako lahko pri reševanju problema uporabimo podatke oz. vrednotenja, ki so sestavni del drugih modulov.

Podobno obdelujemo tudi neskladnosti, ki za seboj nimajo "reklamiranega" izdelka, t.i. neskladnosti organizacijske narave ali različne predloge za izboljšave. V obeh primerih moramo najprej predlog izboljšave (tehnične ali organizacijske narave) oz. pritožbo najprej zajeti, jo klasificirati z ustreznimi šifranti, analizirati, poiskati oz. optimirati

evaluations that are built-in toth RQM system and its modules, (2) other queries and designed, problem-oriented evaluations as a part of the AUGE model (RQM module for generating user-specific evaluations and queries in the database), (3) the FMEA method, and (4) the module for the management of items and control plans. However, it is essential that the data are available in the database and that they are accessible in a form required for the processing of nonconformity and which can be updated and complemented easily. These data also serve for the in-depth analysis of the causes of nonconformity. The traceability that is built in to the system helps us to find the data that are the cause or the consequence of the treated problem, e.g. if a customer claims nonconforming products one can find a corresponding supply order, work order, control plan, measurement data of the product's characteristics, and the process parameters applied. Thus, we can identify the causes of the nonconformity and take proper corrective action. When processing a particular problem one can also use data that are related to other modules.

A similar method is used for the handling of nonconformities that are not product related, i.r. to handle an organizational type of nonconformity or when handling various propositions for an improvement. In both cases we have to capture the proposition or complaint, to classify, to analyze, to find an optimized solution, to distribute assignments,

rešitev, razdeliti zadolžitve ter nadzorovati izvajanje izboljšav.

Razdelitev zadolžitev se izvaja v obliki t.i. seznamov zadolžitev To-Do, ki jih dobijo uporabniki sistema RPK na zaslon ob prijavi v sistem. Seznam se sproti obnavlja. To je okno s seznamom vseh, posameznemu izvajalcu dodeljenih, zadolžitev z oznako datuma zapadlosti. Izvajalec si s seznama v okviru prednosti izbere dodeljeno zadolžitev, pri čemer se sproži izbrana zadolžitev, in jo rešuje. Ko jo reši, določi morebitne stroške, označi stanje zadolžitve za rešen in le-ta izgine s seznama.

Pri uvajanju informacijskega sistema RPK je bistveno, da so pravilno in dovolj na široko zastavljeni vsi potrebni šifranti, tako da z njimi lahko podpiramo reševanje (1) funkcijskih problemov, ki se kažejo kot pojavne oblike izvirnih napak (npr. motor ne vžge, ker je akumulator prazen), (2) reševanje funkcijskih napak (npr. stikalo ne vklaplja), (3) reševanje dejanskih napak izmer (npr. premer gredi se ne ujema z risbo) in (4) reševanje nematerialnih napak (npr. prepozna dostava polizdelkov, sprememba delovnih navodil). Orodje in metodologija dela so vedno enaki, različna je le vsebina dela.

3 RAČUNALNIŠKA PODPORA PROIZVODNEGA POSTOPKA IN KAKOVOSTI

Kakor je razvidno iz opisanega, je spremljanje proizvodnje po zahtevah standarda QS 9000 na običajen način zelo problematično. Če pa imamo pred očmi še kakovost podatkov in njihovo učinkovito razpoložljivost, je običajen način spremljanja povsem neučinkovit. Proizvodni postopek je s svojim ponavljajočim se delom v proizvodnji, še posebej, če je le ta organizirana po načelih zagotavljanja kakovosti po QS 9000, malodane neizčrpen vir podatkov, ki jih je brez sodobne in ustrezno vpeljane informacijske tehnologije že skorajda nemogoče obvladovati v okvirih sprejemljivih stroškov in časovnih odzivov. Neustrezna informacijska podpora takšne proizvodnje ima za posledico drago in zamudno pripravo podatkov v obliki, količini in odzivnih časih, ki največkrat ne izpolnjujejo pričakovanj svojih uporabnikov in zahtev standarda kakovosti.

3.1 RQM - primer sistema RPK

Kot primer računalniške podpore spremljanja proizvodnega postopka lahko uporabimo RPK programski sistem RQM, ki učinkovito podpira vse bistvene proizvodne funkcije po zahtevah standarda QS 9000.

Prednost sistema RQM pred posameznimi programskimi paketi in sistemi, ki lahko podpirajo posamezne dele proizvodnega postopka, je v njegovi celovitosti in medsebojnih povezavah med moduli sistema ter zelo razdelanimi funkcionalnimi podrobnostmi. Z njimi podrobno podpiramo spremljanje proizvodnje in zahteve standarda

and to monitor and record the improvement actions taken.

The distribution of assignments is carried out by a so-called To-Do list of assignments that is displayed when users log on to the system. The list is updated simultaneously. A window list contains all the assignments of particular user and the due dates. The user selects and solves the one with the highest priority. When it is solved, the user defines the potential cost and changes its status to solved.

The very important issue during the implementation of the CAQ system is to develop a coding system in order to support (1) functional problems of a product that manifest themselves as root faults (e.g. an engine does not start becouse the battery is empty, (2) solving functional errors (e.g. switch does not work), (3) solving dimensional errors (e.g. the diameter of a shaft is not consistent with the specifications), (4) solving nonmaterial nonconformity (e.g. late delivery of input materials/components, change of work instructions), and so on. The methodology of the work is always the same; the difference is only in the content.

3 COMPUTER SUPPORT OF THE PRODUCTION PROCESS AND THE QUALITY OF PRODUCTS

From the desciption above it is evident that it is quite problematic to monitor production according to QS 9000 in a traditional way. If we also take into account the quality of data and their efficient disposal, then it is clear that the classical monitoring of production is not adequate at all. The production process is in a repeatable part of production a source of the vast data, in particular if it is organized according to QS 9000, that cannot be managed adequately without proper information technology in an acceptable time and at an acceptable cost. Improper information technology support in such production results in costly and time-consuming data preparation in terms of form, quantity, quality, and responsiveness and consequently it does not fulfill user expectations and the requirements of quality standards.

3.1 RQM - CAQ system

For the case study of computer support for monitoring and quality control the CAQ system RQM is shown. It supports all the vital production functions according to QS 9000.

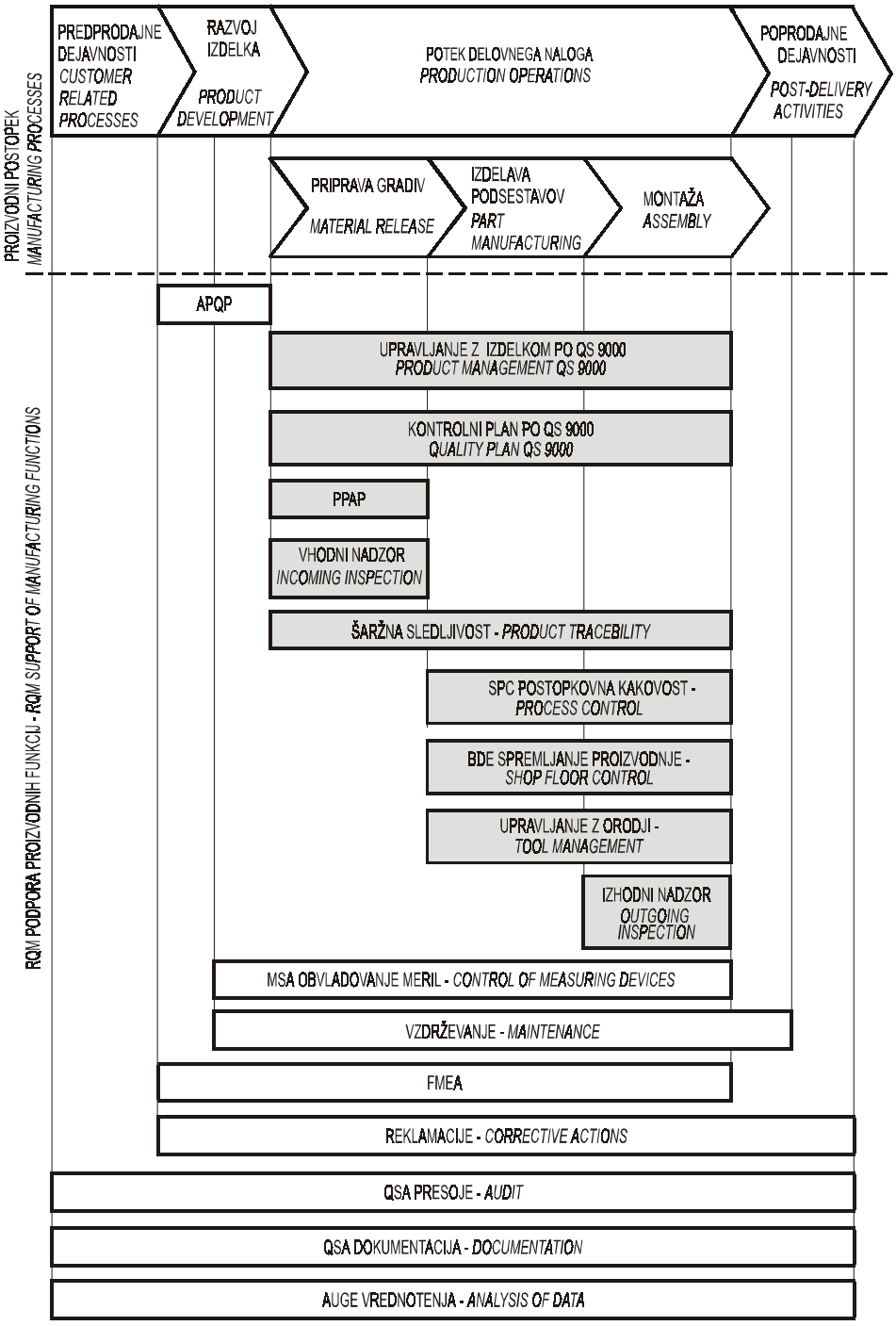
The RQM system has several advantages over other program packages and systems that support various segments of the production process independently. Its main advantage lies in its integrity and in the mutual connection between modules of the system and in the structural support down to the very detail. Thus, it allows supporting the monitoring of production and the requirements of quality

kakovosti z upoštevanjem posameznih specifičnih zahtev.

Prednost tega sistema nasproti celovitim poslovnim rešitvam, poleg njegove zelo razdelane funkcionalnosti, pa je še v integrirani podpori postopkov upravljanja s proizvodnjo in kakovostjo, ki jih celoviti poslovni informacijski sistemi običajno ne podpirajo zadovoljivo. Sistem RQM izpolnjuje stroge zahteve standarda kakovosti in nemalokrat še strožje zahteve posameznih uporabnikov v verigi

standards taking into consideration particular requirements of a particular production.

In addition, the advantage of the RQM system over existing enterprise resource planning (ERP) systems lies, besides in its detailed functionality at the production level, in the integral support of production and quality management, which a typical ERP system does not support satisfactorily. The RQM system fulfils the stringent requirements of quality standards as well as the even tighter ones



Sl. 3. *Podpora proizvodnega postopka s sistemom RQM*
Fig. 3 *RQM system support for a production process*

avtomobilskih dobaviteljev [3]. Sistem RQM in podobni sistemi za spremljavo proizvodnega postopka in podporo kakovosti delujejo optimalno le, če so na eni strani integrirani s sistemom za načrtovanje proizvodnje in na drugi strani s proizvodnim postopkom. Zaradi tekoče izmenjave podatkov je primerna integracija tudi z drugimi informacijskimi podsistemi v podjetju.

3.2 Opis sistema RQM

Osnovna misel, ki je botrovala razvoju sistema RQM, je ena izmed definicij kakovosti, ki pravi, da kakovost pomeni ustrezno zadovoljstvo kupca ob najmanjših stroških. To pomeni, da mora sistem podpirati vse postopke v podjetju, ki neposredno in posredno vplivajo na stanje proizvodnega postopka, izdelka in njegovo kakovost ter jih obenem stroškovno nadzorovati [4]. Na sliki 3 je prikazana podpora proizvodnega postopka s sistemom RQM. Slika poleg same predstavitve sistema prikaže tudi zapletenost in celovitost računalniške podpore spremljanja proizvodnega postopka in obvladovanja kakovosti.

Na zgornjem delu slike je ponazorjen proizvodni postopek, ki ga sestavljajo predprodajne dejavnosti, napredovanje delovnega naloga in poprodajne dejavnosti. Sam proizvodni postopek je simbolično predstavljen s pripravo materialov in komponent, izdelavo podsestavov in njihovo montažo. Sivo označeni moduli so moduli, ki so neposredno povezani z izdelčno sledljivostjo v proizvodnem postopku.

V spodnjem delu slike 3 so predstavljeni moduli sistema RQM in njihova podpora posameznim delom proizvodnega postopka oziroma s proizvodnjo in kakovostjo povezanih poslovnih postopkov. Razvoj izdelka je podprt z modulom RQM-APQP (načrtovanje kakovosti izdelkov in planov kontroliranja), pri katerem po postopku petih faz upravljamo z zadolžitvami pri razvoju izdelka in njegovem uvajanju v proizvodnjo. Rezultat razvoja proizvoda v skladu z obvladovanjem kakovosti je med drugim tudi izdelani nadzorni načrt z natančno opredeljenimi kakovostnimi in postopkovnimi karakteristikami po posameznih delovnih operacijah proizvodnega postopka. Ta načrt je kasneje osnova za spremljanje proizvodnje in izdelka. Upravljanje z izdelkom in pripadajočimi nadzornimi načrti je tudi podprto z ustreznim modulom. Preden dobavitelj prične redno dobavljati izdelek, mora skozi postopek odobritve prvih vzorcev po postopku PPAP (postopek odobritve sestavnih delov) in šele za tem lahko steče njegova redna proizvodnja. Materiale na vhodu nadziramo s podporo vhodnega nadzora, z modulom RQM-WE, njihovo sledljivost v proizvodnem postopku nadzorujemo s šaržno sledljivostjo, izdelčno kakovost in kakovost ter stabilnost proizvodnega postopka pa nadzorujemo z modulom RQM-FE/SPC, pač glede na način vzorčenja in mesto pregleda oz. testiranja. Dogajanja na stroju oz. mestu dela in okoli

of the users in a supply chain in the automotive industry [3]. The RQM system and similar computer-supported systems for monitoring production process and quality control are efficient if they are integrated with the system for production planning and also with other information subsystems in a company.

3.2 Description of the RQM system

The basic proposition that has driven the development of the RQM system is one of definitions of quality that states that quality means customer satisfaction at the minimum cost. This means that the system has to support all the processes in a company that influence the state of the production process, the product and its quality, either directly or indirectly, and at the same time it has to monitor their costs [4]. In Fig. 3 the possible RQM system support is shown. Besides the support structure it reveals the complexity and wholeness of the computer support for monitoring te production process and quality control.

The production process is presented in the upper part of Fig. 3. It consists of customer-related processes, product development and production and post-delivery activities. Material release, part production and assembly symbolically represent production process. The gray marked modules are the ones that are in direct relation with product traceability in the production process.

In the lower part of Fig. 3 the modules of the RQM system that support individual parts of the production process and with production and quality, related business processes. Product development is supported by the APQP (Advanced Product Quality Planning and Control Plan) module, where responsibility at product development and its introduction into production according to a five-step procedure is managed. The output of the product development in terms of quality control is, among other things, a quality control plan where detailed specifications of quality and process characteristics related to all operations involved are given. This plan is a basis for process and product control. Product management and related quality plans are also supported by a corresponding module. Before the supplier starts to deliver its product on a regular basis it is subjected to the PPAP (Production Part Approval Process) procedure. Materials and products are monitored by incoming inspection and verification of purchased product, module RQM-WE, their traceability in the production process is monitored by batch traceability, product quality and stability and the quality of the production process are monitored and controlled by module RQM-FE/SPC, relative to a way of sampling and a type of control or testing. Monitoring the state of work devices and tools, work order status, prod-

njega, stanje delovnega naloga, uporabljene materiale ter procesne karakteristike zajemamo z modulom RQM-BDE.

Sledljivost proizvodnega postopka je širše gledano povezana še z upravljanjem z merili in določanjem merilne zmožnosti (postopek MSA - analiza merilnih sistemov), vzdrževanjem (proizvodnih sredstev in objektov), izboljšavami in optimizaciji proizvodnega procesa in izdelka (FMEA), upravljanju z neskladnostmi in uvajanjem izboljšav (reklamacijski modul RQM-RM), presojami izdelka in sistema kakovosti in z dokumentacijo sistema kakovosti. Moduli sistema RQM so medsebojno povezani. Tam, kjer je to primerno, delamo neposredno s podatki, zbranimi v drugih modulih oz. v drugih delih informacijskega sistema podjetja. S tem vmesni izpisi in ponovni vnosi podatkov niso več potrebni, tako sistemsko zagotavljamo skladnost in objektivnost podatkov.

3.3 Primeri uporabe sistema RQM

V Sloveniji sistem RQM kot celovit sistem še ni močno zastopan, ker v naših podjetjih načeloma še ni mogoče najti sistematičnega postopka za celovito računalniško podporo spremljanja proizvodnje in kakovosti z uporabo specialističnih informacijskih sistemov. Dostikrat se v podjetjih zadovoljijo z delnimi in manj povezanimi informacijskimi rešitvami, oziroma pričakujejo, da jim bodo tovrstne probleme rešili celoviti poslovno-informacijski sistemi. Ti sistemi žal ne omogočajo reševanja opisane problematike tako celovito in s takšnimi postopkovno usmerjenimi funkcijskimi podrobnostmi, kakršne podpira RQM. Vendar usmeritve nakazujejo, da se potrebe po uporabi tovrstnega informacijskega sistema povečujejo. Posamezni moduli RQM so v nekaterih slovenskih podjetjih že nekaj časa opazni. Primer podjetja, ki se je sistematsko lotilo uvajanja celovite informacijske podpore nadzora kakovosti in spremljave proizvodnega procesa, je Cablex d.o.o. v Ljubljani. Podjetje uvaja hkrati sistem CAQ in sistem za upravljanje materialnih tokov po vnaprej izdelanem načrtu postopnega uvajanja. Pri tem so podrobneje analizirali svoje sedanje informacijske vire in potrebe ter na temelju ugotovitev načrtovali celovit informacijski sistem. Sistem bo sestavljen iz več komponent različnih ponudnikov, ki bodo v končni fazi delovali kot enovit informacijski sistem.

RQM je v Nemčiji eden najboljših tovrstnih programskih sistemov in je nameščen v najvidnejših nemških avtomobilskih tovarnah in tovarnah, vključenih v verigo njihovih dobaviteljev. Poleg teh namestitev ga uporablja še druga kovinsko predelovalna, elektrotehnična in elektronsko usmerjena proizvodnja, tako da skupno število

uct identification, materials used, and process characteristics are captured and monitored by module RQM-BDE.

In broad terms the traceability of a production process is also in relation to the control of measuring and monitoring devices and measurement capability determination (MSA - Measurement Systems Analysis), maintenance (production devices and buildings), improvement and optimization of production process and product (FMEA), control of nonconformity and improvement (module RQM-RM), verification of products and internal audit, and to quality-system documentation. RQM modules are mutually linked. Data are used as needed, no matter how and where they were captured, in other modules, in an other part of a company information system. Various intermediate printouts and repeated data entering are not necessary any more. Thus, consistency and objectivity of data are systematically assured.

3.3 Case studies of RQM implementations

In Slovenia there is no implementation of the RQM system as a whole system implementation. This is due to a lack of a systematic approach to full computer support of monitoring of production and quality with an aide of specialized information system. Usually, companies are supposed to be able to satisfy information needs by introducing partial, only weakly linked solutions, or it is supposed that these issues may be solved by introducing an enterprise-wide business-computer-supported information system. Unfortunately, the latter cannot support the issues under consideration, particularly with all the detailed functionality, in particular on operation level, as fully as a RQM, or similar, system. However, trends indicate that the need for such an information system is increasing. In Slovenian industry there are single modules of RQM system already in use. Cablex Ltd. from Ljubljana is a company in which a systematic approach to simultaneous support to quality control and to monitoring of production is being introduced. In addition, in the company CAQ system and the system for material flow management are systematically and concurrently planned for implementation. In the project an intensive analysis of requirements and existing information resources has been performed. On this basis a fully computer-supported information system has been planned. The system will be composed of several components from various suppliers and it will work as a single information system.

In Germany, the RQM system is one of the leading systems in this class and is widely used in renowned automotive industries and also in companies that are included in their supplier chains. In addition to automotive industries, several installations of the RQM system are in metal manufacturing, the electro-technical and electronic industries. There are

namestitev presega številko 300. V nadaljevanju sta prikazana dva primera uspešne uporabe sistema RQM. Oba primera sta obenem primera integriranih rešitev različnih programskih izdelkov v celovito informacijsko rešitev.

Primer uporabe RQM pri tovarni Daimler Chrysler

Daimler Chrysler AG, tovarna gonil v Gaggenau-u [5] se je odločila za posodobitev svojega informacijskega sistema (stanje leta 2000). Problem, ki so ga najprej hoteli rešiti z instalacijo RPK, je bil premajhna razumljivost in razpoložljivost podatkov, ki so se zbirali in obdelovali v 14 znanih programskih paketih oziroma sistemih. Ko bo vpeljan sistem RPK, bodo vpeljali še poslovno-informacijski sistem SAP, vendar samo module, ki podpirajo finančno in poslovno delovanje podjetja. S sistemom RPK se bo povezal na ravni poslovnega sistema. Rešitev, ki so jo zahtevali od ponudnika sistema RPK, je morala biti navznoter (1) integriran sistem z objektno usmerjeno podatkovno strukturo, navzven pa (2) odprt sistem modularne zgradbe, (3) zgrajen s standardnimi moduli, ki se jih lahko vzdržuje, (4) z vmesniki do obstoječih uporab in ki (5) povezuje podjetje v enovit podatkovni model. Podjetje Pickert & Partner GmbH je izpolnilo pričakovanja z instalacijo RPK sistema RQM z moduli Audit, Auge, Upravljanje z reklamacijami, Vhodna kontrola, Kontrolni načrti, Upravljanje z merili in Statistični nadzor proizvodnega postopka. Na dveh strežnikih je instalirana baza podatkov Oracle, s katero se sporazumeva približno 950 delovnih mest. Nekaj okvirnih karakterističnih številk: sistem upravlja 117.000 različnih izdelkov, 18.500 vhodnih gradiv, 30 vhodnih skladišč, ki letno opravijo 100.000 prevzemov in 160 delavcev v vhodnem nadzoru opravi 2600 reklamacij 1.500 dobaviteljem. Metrološki modul skrbi za približno 90.000 meril.

Z modulom RQM-AUDIT upravljajo vse presoje sistema kakovosti v podjetju, ki ima približno 8000 sodelavcev. Modul RQM-AUGE je namenjen uporabniško specifičnim vrednotenjem. Pri tem uporabnikom ni treba podrobneje poznati podatkovne strukture informacijskega sistema. Z njim si v postopku obdelave neskladnosti in pri podpori procesa odločanja pripravijo ustrezna vrednotenja oz. prikaze želenih podatkov. Z modulom RQM-RM upravljajo vse tipe reklamacij in obenem nadzorovano uvajajo izboljšave. Modul RQM-PPL upravlja nadzorne načrte izdelkov skladno z zahtevami QS 9000 in dodatnimi specifičnimi zahtevami naročnika. Z moduli RQM-WE in RQM-EMP upravljajo vhodna gradiva in prve vzorce po postopku PPAP. Modul RQM-PMV upravlja z merili, določa merilno sposobnost po metodologiji MSA in je integriran s programom

over 300 systems installed in Germany. In the next two cases the successful installation of RQM system is presented. In both cases the fully integrated solution consisted of components from various suppliers.

RQM System Implementation at DaimlerChrysler

DaimlerChrysler AG, the power-transmission factory in Gaggenau (de) [5], decided to update its information system in order (1) to enhance the transparency and availability of data that have been acquired and used in 14 existing program packages by the introduction of a single CAQ system, and (2) to introduce a SAP system as a computer-supported business information system. SAP functionality would include modules for financial and business support (state-of-the-art 2000). SAP and CAQ integration would be realized on a management information level. Thus, the features of a solution that was required from a tendering firm were as follows: (1) an integrated system with an object-oriented data structure and architecture, (2) an open, modular structured system, (3) standardized modules with good maintainability, (4) interfaces to existing applications, and (5) integrability on the enterprise level in terms of a uniform data model. The company Pickert & Partner GmbH (P&P) fulfilled the requirements and introduced the following RQM modules: Audit, Auge, Complaint management, Incoming inspection, Quality plans, Statistical process control and Management of measuring and monitoring devices. An ORACLE database is installed on two servers and is accessible by 950 workstations. Some other approximative characteristics: 8.000 employees, the system controls 117.000 items, 18.500 input materials, 30 input stores where 100.000 acceptances are performed by 160 people. 2.600 complaints are sent to 1.500 suppliers. A metrology module supports control of over 90.000 measuring and monitoring devices.

The module RQM-AUDIT supports all kinds of quality system audits in the company. The module RQM-AUGE supports user-specific evaluations. Users do not need to know the data structures of the information system in more detail. Such typical evaluations and data presentations are to support a handling of non-conformity and to support management decision-making. The module RQM-RM supports all types of complaint handling and also improvement management. Module RQM-PPL supports quality-control plans for products in accordance with the requirements of QS 9000 and specific customer requirements. RQM-WE supports incoming inspection, module RQM-EMP supports control of the first part of the approval process in accordance with PPAP procedure as defined in QS 9000. The module RQM-PMV supports management and control of measuring and monitoring devices, enables determination of measurement system capability in accordance with MSA methodology and is integrated with the program system ROBI (the information system for

ROBI (informacijski sistem za upravljanje z modularnimi nadzornimi sredstvi v proizvodnji). RQM-PMV je zaradi večje preglednosti razpoložljivosti meril povezan z medmrežjem. Modul RQM-SPC povezuje poleg ročnih SPC delovnih mest še praktično vse 3D merilne stroje in SPC avtomate v proizvodnem postopku.

Primer RQM uporabe pri BMW

V tovarni BMW AG v Wackersdorfu izdelujejo konzolne plošče za vozila serije 3. Zahteva naročnika projekta je bila, da se izvede nadzor proizvodnje s spremljanjem stanja napredovanja delovnega naloga, mest dela, strojev in naprav ter njenih postopkovnih parametrov in izdelčne kakovosti. Ti podatki se povezujejo s sistemom za načrtovanje proizvodnje (program lastne izdelave) in prek njega na poslovni ravni s sistemom SAP. Nalogo je ponudnik rešil z uvedbo RPK in zbiranje proizvodnih in postopkovnih podatkov (ZPPP - BDE) sistema RQM z moduli RQM-BDE, RQM-SPC in RQM-ISH (vzdrževanje). Strežnik baze podatkov je v 60 km oddaljenem Landshutu. Stanje proizvodnega postopka in kakovost izdelkov nadzorujejo z vrednotenji, ki jih omogočata modula BDE in SPC. Stiskalnice za brizganje plastike so povezane s sistemom BDE z logičnimi krmilniki Simatic, ki imajo nalogo zbirati in prikazovati (1) stanje delovnega naloga, (2) določene karakteristike postopka, (3) stanje proizvodnje, (4) stanje proizvodne opreme ter (5) materialno in (6) osebno sledljivost ter jih (7) sporočati v sistem RPK in (8) jih posredovati drugim informacijskim sistemom. RPK delovna mesta, v proizvodnem postopku jih je 8, so opremljena z bralniki črtne kode za identifikacijo izdelkov, gradiv in dokumentov. Parametri postopkov se v sistemu RPK nadzorujejo z vidika toleranc in v primeru njihove prekoračitve sistem sporoči napako. Sistem ZPPP v sodelovanju s podatki, zbranimi iz modula ISH (vzdrževanje strojev in opreme) in SPC (kakovost izdelka) preračunava indeks izdatnosti celotne opreme (ICO - OEE), ki kaže stopnjo doseganja optimalne proizvodnje in njene kakovosti. Ta pokazatelj združuje podatke o doseženi kosovni proizvodnji, njeni kakovosti in načrtovanem času, v katerem naj bi bili izdelki narejeni.

4 SKLEP

Sodobna proizvodnja, še posebej to velja za avtomobilsko, zaradi zahtev standardov, zahtev odjemalcev in izrazitih informacijskih dejavnosti zahteva računalniško podporo na vseh ravneh podjetja. Še posebej velja to za merjenje postopkov in nadzor uvajanja izboljšav. Poleg tega je kakovostna in sistematična priprava na uvajanje računalniške podpore kakovosti in spremljanje proizvodnje

management modular monitoring devices in manufacturing). RQM-PMV is also accessible on Intranet in order to servis several functions with the availability of devices. Module RQM-SPC supports statistical process control for various work systems, e.g. SPC workstations, 3D-Measuring machines, SPC automatic machines in the production process.

RQM system implementation at BMW

BMW AG, the factory manufactures cockpits for Series 3 cars in Wackersdorf, Germany. It is a completely new factory using the latest concepts of manufacturing. The requirements were to build a system for the monitoring of production, of work order deployment, of work systems statuses and process parameters, and of product quality. These data should be integrated with the Production Planning and Control system, which is originally a product of BMW, and with the SAP system on a business level. P&P offered the CAQ system RQM modules as follows: RQM-BDE (capturing and managing of production and process data), RQM-SPC in RQM-ISH (maintenance of machines and devices). The server is located in Landshut, 60 km away from the factory. BDE and SPC modules monitor the state of the production process and product quality. Plastic jet presses are connected to the BDE module with Simatic logic controllers, which have to capture and present (1) work order status, (2) critical process characteristics, (3) status of production, (4) conditions of production machines and devices, (5) material traceability, (6) labor traceability, (7) transmit data to CAQ system, (8) transmit data to other information systems. There are 8 CAQ workstations in the production process. They are also equipped with bar-code readers for the registration and identification of the products, materials and documents. Process parameters are monitored and in the case of violation of tolerances the system notifies shop-floor management of the exceeded parameter(s). The BDE module, also based on data captured in modules IHS and SPC, calculates and notifies the process performance index OEE (overall equipment efficiency) that characterizes deviations in terms of optimum production and quality. This index combines information about product quantity, product quality in relation to planning on a one-day planning-horizon basis.

4 CONCLUSION

Modern production can be characterized by stringent customer requirements, intensive information activities, requirements arising from standards, and calls for computer support on at all levels of the company. In particular, this is the case in measuring and monitoring the processes and products and in improvements in management. The desired performance of computer-support implementation in quality

ključnega pomena za njeno uspešno izvedbo. Za nekatere dejavnosti v okviru izvedbe pa je celo pogoj, kakor npr. integracija med različnimi informacijskimi sistemi.

V tujini se spremljanje proizvodnega postopka na opisan način močno uveljavlja v celotnih dobaviteljskih verigah v avtomobilski industriji in zunaj nje. Večja podjetja s svojim položajem dobesedno zahtevajo oz. predpisujejo informacijsko podporo spremljanja proizvodnega postopka in nemalokrat zahtevajo od dobaviteljev rešitve, ki so jih vpeljali sami. Če želijo tudi naša podjetja enakopravno nastopati v teh verigah, morajo že sedaj pričeti vpeljevati v svojo proizvodnjo tovrstne metode dela in računalniško podprto tehnologijo.

Problemi, ki jih srečujemo v slovenski industriji na splošno, kažejo pomanjkljivo razumevanje celovite računalniške podpore kakovosti in širše, pomanjkljivo razumevanje in poznavanje prednosti, ki jih ponuja sodobna informacijska tehnologija. Prav tako je opaziti pomanjkljivo poznavanje lastnosti (prednosti in pomanjkljivosti) posameznih programskih sistemov, kar vodi podjetje k manj optimalnim informacijskim rešitvam. Pri njihovem uvajanju je dano premalo poudarka natančni analizi postopkov, ki jih želimo podpreti, načinu izvedbe njihove podpore in premajhni proučitvi informacijske ponudbe na tržišču. V podjetjih, v katerih tovrstni paketi uspešno delujejo, gre predvsem zasluga intenzivnim in sistematičnim pripravam pred uvajanjem ter ugodnemu razumevanju informacijske tehnologije in njene vloge v poslovnem in proizvodnem postopku.

control and in the monitoring of production can only be achieved if the preparation for introduction is systematic. For example, good preparation is required for the successful integration of various systems.

Measurement and monitoring of the production process, as presented in this paper, are being introduced intensively in the automotive and other industries. Major companies, from their position, require a verbatim or direct computer support of monitoring of the production process and in many cases they even suggest their own solutions for monitoring in order to be compatible. If Slovenian companies want to cooperate in these supply chains on equal terms they have to start introducing these kinds of methods of work and computer-aided technologies.

The key issues in Slovenian industry, in general, are in an insufficient understanding of computer-supported quality and monitoring of production and in an insufficient familiarity with the potential benefit that may result from information technology. An insufficient acquaintance with the features of program systems (advantages and deficiency) is also present, which leads to non-optimum solutions for a particular company. There is not enough emphasis given on a thorough analysis of the processes that are going to be supported, on the way of the support and on insufficient investigation of a respective supply in the market. In the companies where computer-supported systems work effectively it is due to intensive and systematic preparation before the introduction and an objective understanding of information technology and its role in business and the production process.

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Naslova avtorjev: Drago Metljak
PSM d.o.o.
Runkova 10
1000 Ljubljana

Prof. dr. Alojzij Sluga
Fakulteta za strojništvo
Univerze v Ljubljani
Aškerčeva 6
1000 Ljubljana

Authors' Addresses: Drago Metljak
PSM Ltd.
Runkova 10
SI-1000 Ljubljana, Slovenia

Prof.Dr. Alojzij Sluga
Faculty of Mechanical Eng.
University of Ljubljana
Aškerčeva 6
SI-1000 Ljubljana, Slovenia

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