© Strojniški vestnik 46(2000)9,622-631
ISSN 0039-2480
UDK 658.51:659.2:002.66
Pregledni znanstveni članek (1.02)

© Journal of Mechanical Engineering 46(2000)9,622-631
ISSN 0039-2480
UDC 658.51:659.2:002.66
Review scientific paper (1.02)

Uporaba referenčnih arhitektur pri gradnji informacijsko integriranega podjetja

The Use of Reference Architectures in Creating an Information-Integrated Enterprise

Nataša Vujica-Herzog - Andrej Polajnar

Gradnja informacijskih sistemov, ki je v preteklosti potekala precej nenačrtno, je vzrok, da so v proizvodnih obratih nameščene različne vrste računalniške opreme, različnega časa izdelave, različne stopnje možnosti za povezovanje in različnih možnosti za dopolnjevanje funkcij, kar vse vpliva na učinkovitost njihove uporabe [1]. V prispevku bo predstavljen celovit pristop h gradnji informacijsko integriranega podjetja, ki temelji na uporabi referenčnih arhitektur z namenom, da se zapolni vrzel, ki nastaja na omenjenem področju.

(Ključne besede: sistemi informacijski, arhitektura referenčna, integracije podjetij)

The rather uncontrolled and unharmonised building of information systems that has taken place over the years means that today many workshops are equipped with software and hardware with different times of production, unequal levels of connectivity and updating of functions. This, of course, is crucial for the performance of an information system [1]. This paper presents a holistic approach to the development of an information-integrated enterprise. It is based on reference architectures and is meant to fill the gap occurring in this field.

(Keywords: information systems, reference architecture, information-integrated enterprises)

0 UVOD

Na vsakem koraku se srečujemo z dejstvom, da je informacija tisti najbolj dragoceni vir, ki v pravem trenutku omogoča najboljšo odločitev. Informacije so za naš obstoj pomembne v vsakdanjem življenju pa tudi v poslovnem oziroma proizvodnem okolju.

Računalniška tehnologija že po naravi daje možnost za doseganje pomembnih učinkov na področjih povečanja obsega proizvodnje, višje in enakomerne kakovosti izdelkov, zmanjšanja porabe surovin in energije, sledljivosti proizvodnje, varnosti in zanesljivosti obratovanja, humanizacije dela itn., vendar je za uspešno delovanje računalniško podprtih sistemov za vodenje proizvodnje potrebna tudi ustrezna organiziranost podjetja, ustrezna izobrazbena struktura delavcev in tudi primeren način zasnove in uvajanja sistemov vodenja.

1 REFERENČNE ARHITEKTURE ZA GRADNJO INFORMACIJSKIH SISTEMOV

Arhitektura je integrirano strukturirano oblikovanje sistema, njegovih elementov in njihovih

0 INTRODUCTION

Every day we find that information is the most valuable resource that helps us make the right decision at the right time. Information is crucial for our survival in everyday life, as well as in our business and manufacturing environment.

Computer technology serves to increase the volume of output, to improve the quality of products, to reduce the consumption of raw materials and energy, and to upgrade the traceability of production, safety and reliability of operation, humanisation of work, etc. In spite of this, the enterprise must be appropriately organised, the profile and the education of the personnel adequate, and the management systems appropriately designed and implemented if we want computer-supported production management systems to work effectively.

1 REFERENCE ARCHITECTURES FOR THE DESIGN OF INFORMATION SYSTEMS

Architecture is the integrated and structured design of a system, its elements and the relations

razmerij, glede na obstoječe zahteve sistema [2]. Aktivnosti podjetja sestavljajo zunanji in notranji deli. Notranje aktivnosti so: razvoj, proizvodnja, distribucija in prodaja izdelkov, vodenje in upravljanje samega sistema. Zunanje aktivnosti so: povezave poslovnega sistema s finančnimi institucijami, vladnimi službami, trgom itn. Za uspešno poslovanje in delovanje podjetja je potrebna integracija lastnega znanja z zunanjim znanjem, ki je posledica trga, zahtevanih standardov itn. Arhitekture za gradnjo integriranih podjetij določajo sredstva za opis notranjih in zunanjih aktivnosti podjetja in informacijske potrebe na vnaprej določen način.

V raziskavo o primernosti uporabe v slovenskih podjetjih so bile vključene štiri arhitekture [3]: GRAI-GIM, PERA, CIMOSA in ARIS. Primerjava arhitektur je pokazala, da so zelo različno grajene in dajejo poudarek različnim področjem, čeprav se vse nagibajo k istemu cilju: gradnji informacijsko integriranega podjetja. Iz tega sledi, da si mora podjetje samo izbrati tisto arhitekturo, ki bo najbliže njihovemu načinu razmišljanja in razumevanja, uporabe metod za modeliranje itn.

2 SODELOVANJE VODSTVA PODJETJA

Uveljavljeno pravilo za celovito uvajanje sistemov za vodenje v podjetje pravi, da je treba sisteme vodenja 'načrtovati od vrha navzdol, graditi in uvajati pa od spodaj navzgor' [4]. Odgovornost in podpora vodstva podjetja za sprejemanje in izvajanje vseh glavnih odločitev v začetnih fazah uvajanja sistema za vodenje je ključnega pomena za uspešnost in usklajenost vseh nadaljnjih projektov, ki izvirajo iz začetne vizije oziroma načrta.

3 PRIMER UPORABE REFERENČNIH ARHITEKTUR

V nadaljevanju bo prikazan primer uporabe arhitektur pri uvedbi informacijske integracije v srednje veliko slovensko podjetje (Zakon o gospodarskih družbah) [3]. V podjetju je 160 zaposlenih, od tega jih je sto zaposlenih v neposredni proizvodnji in šestdeset v strokovnih službah. Njihovi izdelki se kot sklopi pojavljajo v izdelkih priznanih svetovnih podjetij evropskega porekla, npr. Mercedes Benz, Steyr, VW, Citroen.

Osnovna dejavnost podjetja je vezana na obdelavo pločevine (sl. 1). Proizvodni proces vključuje vse faze, od predpriprave materiala in razreza, do končne stopnje vlečenja, obrezovanja in kalibriranja. Kot dodatno dejavnost izvajajo še upogibanje cevi (sl. 2) in po potrebi za sestavo karoserijskih delov tudi ročno ali strojno obdelavo različnih pločevinastih izdelkov.

Izbira ustrezne arhitekture je precej zahtevna naloga, saj mora podjetje pred tem dovolj dobro

between them, made to fit the requirements of the existing system [2]. The activities of an enterprise are internal and external. Internal activities include product development, manufacturing, distribution, sales and the management of the system. External activities are responsible for the connections of the business system with financial institutions, government agencies, the market, etc. In order to achieve business efficiency it is necessary to integrate internal and external knowledge. The latter is a consequence of the demanding market, severe standards, norms, etc. The architectures for building an information-integrated enterprise determine the means for describing internal and external activities, as well as the information needs in advance.

Four architectures for potential use in Slovenian enterprises have been studied [3]: GRAI-GIM, PERA, CIMOSA and ARIS. The analysis of these architectures has revealed that they have very different structures and focus on different fields, although they all pursue the same goal, i.e. the setting up of an information-integrated enterprise. Hence it follows that the company alone should decide which architecture best fits its way of reasoning, its concepts, use of modelling methods, etc.

2 CO-OPERATION OF TOP MANAGEMENT

One of the well-established rules for the introduction of management systems says that they should be 'planned with a top-down approach and built in the opposite direction' [4]. The responsibility of top management and their support in the implementation of the major decisions in the initial phases of introducing an overall management system are of key importance for the efficiency and harmonisation of all further projects arising from the initial plan.

3 AN EXAMPLE OF USING REFERENCE ARCHITECTURES

The use of reference architectures in introducing information integration into a medium-sized enterprise (The companies act) will be shown [3]. There are 160 people employed: one hundred in manufacturing and sixty in administration. Their products are built into vehicles manufactured by major international companies such as Mercedes Benz, Steyr, VW, Citroen, etc.

The basic activity of the company is sheet metal (car body panel) working (Fig. 1). The manufacturing process includes all phases, from material pretreatment and cutting-up to drawing, trimming and calibration. Pipe bending is an additional activity (Fig. 2) Hand or machine working of sheet metal products is carried out only when needed for the assembly of car body parts.

To choose the right architecture is not an easy task as the company must be very well aware of

poznati svoje cilje, omejitve, zahteve. Pri izbiri smo upoštevali naslednje pomembne predpostavke:
- jasnost, preprostost in razumljivost arhitekture,
- dobro predstavitev metod za modeliranje poslovnih procesov, podatkov, funkcij,
- nakazane možnosti za uporabo programske opreme,
- združljivost podatkov o izdelku. Na tržišču obstaja veliko poskusov izdelave t.i. nevtralnega formata, ki omogoča prenos podatkov o izdelku od faze oblikovanja do odstranitve izdelka iz proizvodnega programa (DXF, IGES, STEP itn.).

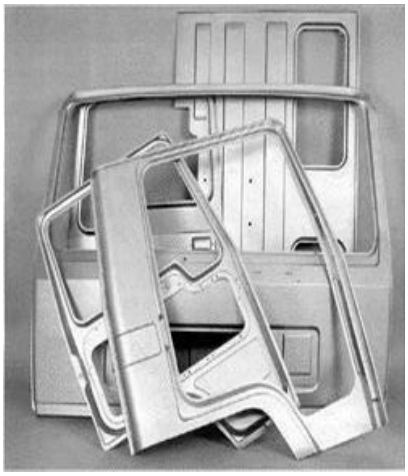
Kot izhodišče oziroma osnovo smo izbrali arhitekturo PERA, ki v skladu s sistemskim pristopom definira faze v krogu razvoja sistema. Ker arhitektura PERA nima podrobno definiranih matematičnih tehnik modeliranja, ki so potrebne za kasnejše programiranje, smo vključili še arhitekturo ARIS, ki ima za posamezna področja natančno definirane tehnike modeliranja z ustrezno programsko podporo.

Primer uporabe podrobneje opredeljuje prvi dve fazi 'nivo koncepta' in 'nivo specifikacije', ki sta za gradnjo informacijskega sistema tudi najpomembnejši in najbolj zahtevni (sl. 3). Celoten primer uporabe je preobsežen, da bi ga predstavljali v prispevku, zato bodo osvetljene samo nekatere najbolj zanimive podrobnosti.

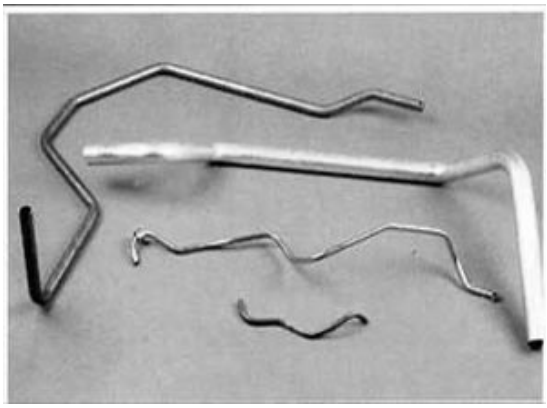
its goals, limitations and demands. In our selection we were particularly interested in:
- the clarity, simplicity and understandability of the architecture;
- adequate representation of methods for modelling business processes, data and functions;
- the possibilities for using software;
- compatibility of product data. The market offers many options of the so-called neutral format to ensure the transfer of product data from the design phase to the withdrawal of the product from the production program (DXF, IGES, STEP, etc.).

We selected the PERA architecture because it defines the layers in the life cycle of the system development process in accordance with the systems approach. Since PERA offers no precisely defined mathematical modelling technique indispensable for subsequent programming, we had to include the ARIS architecture known for having precisely defined modelling techniques supported by adequate software.

Our example discusses in detail the first two layers, the 'concept' and the 'specification' layer, which are the most important and also the most complex parts in information-system design (Fig. 3). The example is too extensive to be presented completely, so we will show only the most interesting parts.



Sl. 1. *Izdelava najzahtevnejših ravninskih in prostorninskih prirezov*
Fig. 1. *Manufacturing of complex plane and 3D parts*



Sl. 2. *Ukrivljanje cevi*
Fig. 2. *Bending of pipes*

Uvodno poglavje na 'nivoju koncepta' ugotavlja, kaj je sprožilo ali kaj je glavni vzrok za izdelavo računalniško podprtega sistema za vodenje [4]. V nadaljevanju je treba definirati **cilje** investicije, npr. povečanje zmogljivosti, izboljšanje kakovosti, povečanje zanesljivosti obratovanja, ter izoblikovati merila za vrednotenje stopnje doseganja ciljev. Naslednji element, ki ga je treba opredeliti, je **okolje**, kjer se bo sistem uporabljal. V tem delu predstavljamo naročnika oz. investitorja, njegovo proizvodnjo,

The introductory part of the 'concept layer' defines the reasons for setting-up the computer-supported management system [4]. Further on, the investment **goals**, such as higher production capacity, improved quality, better operating reliability, etc., have to be defined and the criteria for evaluating the achievement of goals must be set. The next element to be defined is the **environment** in which the system will be used. In this part we present the customer, his production and some technical aspects of the sys-

nekatere tehnične vidike naprave oz. sistema, ki ga imamo namen računalniško podpreti, ter ekonomski in organizacijski vidik investitorja oz. projekta.

Sledi opredelitev **glavnih funkcij** računalniško podprtega sistema za vodenje ter definiranje projekta, s katerim jih bomo izpeljali, skupaj z ustreznimi termini, osebjem in stroški.

tem to be computerised, and also the customer's or project's economic and organisational aspect.

After that, **the main functions** of the computer-supported management system are defined. The project in which they will be realised is defined, including the time schedule, personnel and costs.

Sl. 3. *Arhitektura PERA z dodanim 'nivojem odstranitve sistema' in podrobnejšim opisom 'nivoja koncepta' in 'nivoja specifikacij'*

Fig. 3. *PERA architecture with the added 'system decomission layer' and a detailed description of the 'concept layer' and the 'specification layer'*

Pomemben del uvoda pomeni tudi **opredelitev koristi** in stroškov izbranega sistema za vodenje ter izračun rentabilnosti investicije. Uvodni del je hkrati tudi povzetek.

Podjetje: V obstoječem sistemu je ogromno podatkov. Čas, ki je potreben, da te podatke zberemo, je zaradi tehnične zastarelosti programske opreme zelo dolg. Problemi se pojavljajo tudi zaradi številnih omejitev v programu, ki je bil zasnovan samo za serijsko proizvodnjo – dandanes se večinoma izvaja maloserijska oziroma celo naročniška proizvodnja. Obstoječi program nima vgrajenih dovolj dobrih algoritmov za dinamično načrtovanje in spremljanje proizvodnje.

CILJ: Gradnja integriranega, prilagodljivega, preglednega informacijskega sistema, ki bo zagotavljal hitre in točne informacije, potrebne za sprejemanje poslovnih odločitev ter za vodenje in krmiljenje proizvodnje.

OKOLJE: Organiziranost družbe z informacijskimi tokovi, ki sledijo poslovnim postopkom.

The definition of **benefits** and costs of the anticipated management system and the calculation of the return on investment are another two important elements of the introductory part.

Enterprise: There is an enormous amount of data in the existing system and it takes a very long time to collect it because the software is outdated. Problems occur due to many restrictions of the program which had been designed exclusively for series production, but is currently used only for small-batch or even to-order production. The algorithms of the existing software are not powerful enough to perform dynamic production planning and monitoring.

GOAL: To build an adaptable, transparent and integrated information system which will provide the quick and accurate information necessary to support business decision making and production steering and management.

ENVIRONMENT: An enterprise with organised information flows that follow business processes.

KORISTI: Preden se v podjetje uvede nov informacijski sistem, se pogosto pojavlja vprašanje, katere koristi bo ta sistem v delovanje podjetja prinesel. Štiri glavne skupine koristi, ki jih prinaša računalniška obdelava podatkov, so:

- znižanje stroškov poslovanja (stroškov ročnega dela in materiala – predvsem pisarniškega) – pomeni jedro skupine 'merljivih' koristi,
- večja ažurnost informacij, kar omogoča hitrejši odziv na trenutne poslovne dogodke,
- bolj natančne informacije, kar omogoča določen odziv na poslovne dogodke,
- bolj kakovostne informacije omogočajo večjo učinkovitost upravljanja poslovanja.

Analiza sedanjega stanja se navadno začne s podrobnejšim opisom tehničnega procesa sistema ali naprave, ki jo želimo dograditi z računalniško podprtim sistemom za vodenje, z opisom njenega rednega obratovanja ter tudi izrednih stanj ali nepravilnosti. Sledi opis dosedanjega načina vodenja oziroma obstoječega sistema vodenja.

Ker je vsak sistem vodenja integriran v organizacijsko strukturo, je treba opredeliti tudi organizacijo podjetja s poudarkom na organizacijski strukturi, organizaciji poteka del, organizaciji obratovanja ter organizaciji poročanja.

Sledi opis okvirne količine in vrste podatkov, ki se izmenjujejo, njihov način prenosa in zaščita.

Podjetje: Zaradi delitve dela, ki izhaja iz organiziranosti starega velikega podjetja, iz katerega je nastalo več manjših podjetij, so sedanji procesi neoptimalni in potrebni prenove ter ustrezne računalniške podpore. Sedanji informacijski sistem še vedno uporablja preveč papirnih dokumentov.

Program 'kosovnic' nima možnosti izdelave variantnih kosovnic. Izdelava 'delovnih postopkov' s sedanjim programom je zasnovana za serijsko proizvodnjo, zato je uporaba za maloserijsko proizvodnjo zelo otežena (problemi se pojavljajo pri parametrih za izračunavanje pretočnosti izdelka skozi delovni proces, parametrih za oblikovanje velikosti serij, za obračun stroškov proizvodnje in plač zaposlenih, problem zelo velikih oziroma zelo kratkih izdelovalnih časov za operacijo, številčenje stroškovnih in delovnih mest).

Sistem delovnih in stroškovnih mest ne omogoča oblikovanja procesnega in ciljno usmerjenega računovodstva (controllinga).

Dinamično načrtovanje materialnih potreb: sedanji sistem se ne prilagaja novim razmeram (npr. niso mogoči sprememba roka izdelave med izvajanjem naročila, upoštevanje izpada dobave naročenega materiala, prerazporeditev zaradi ozkih grl v proizvodnji).

Dinamično načrtovanje in spremljanje proizvodnje: pri dnevni spremljavi učinkovitosti proizvodnje je zelo problematično spremljanje rokov in hkratno spremljanje učinkovitosti na vmesnih operacijah.

BENEFITS: Before introducing a new information system we often wonder what benefits it will bring to the functioning of the enterprise. Data processing brings four major benefits:

- Costs reduction (manual work and material costs) - this is the core of 'measurable' benefits
- Better updating of information - this speeds up the reaction to business events
- Greater accuracy of information - this makes the reactions to business events more accurate
- High-quality information - this increases the efficiency of business administration

The analysis of the existing state usually starts with a detailed description of a technical process of the system we intend to upgrade with a computer-supported management system. It describes operation under regular and irregular conditions, in case of errors, etc., which is followed by a description of the previous or existing management technique or system.

Every management system is integrated into an organisational structure, so it is necessary to determine the organisation of the company with an emphasis on the organisation scheme, organisation of work flow, organisation of operation, and organisation of feed-back documentation.

The approximate amount and type of data to be exchanged is given together with the method of data transmission and data protection.

The enterprise has inherited a division of labour from the organisation scheme of the former large enterprise. As a consequence, the existing processes are not optimised and therefore need re-engineering and computer support. The existing information system still uses too much paper documentation.

The program 'List of Parts' offers no possibility to generate variations of 'List of parts'. The generation of working methods with the existing program has been designed for the needs of series production, so it is quite inconvenient to use for the needs of small-batch production. Difficulties occur for several parameters: the parameters for calculating product flow times through the working process, the parameters for defining the size of series, and the parameters for the determination of manufacturing and labour costs. Another problem arises from very short and very long machining times for operation, numeration of cost centres and workplaces.

Controlling cannot be performed within the existing workplace and cost centre system.

Dynamic material planning: The existing system is not adapted to new circumstances. It is not possible to change the time schedule during the implementation of an order, to take into account material supply failures, or to redistribute operations in case of bottlenecks.

Dynamic production planning and follow-up: When following-up the efficiency of production it is very difficult to monitor time schedules and the performance at intermediate operations simultaneously.

Nov sistem za vodenje bo vplival tudi na **spremembo organizacije** dela ter spremembo vsebine in obsega dela določenih ljudi. Zato je treba v tej fazi jasno določiti, kakšne so zahteve glede nove organizacje dela, kako bodo sestavljene skupine operaterjev, kakšna bo vsebina dela.

Podjetje: Nova organizacijska shema upošteva procesno orientiranost in izhaja iz informacijskih tokov. Pomanjkljivost prvotne poslovne funkcije trženja je bila v tem, da so tehnične podlage za ponudbe izdelovali v ločeni organizacijski enoti – tehnološkem sektorju. Proces izdelave ponudbe je bil zelo dolg, prihajalo je do številnih nerazumevanj (neskladnosti), saj je komercialist sam sprejemal tehnično dokumentacijo in se dogovarjal s kupcem. Dokumentacijo je kasneje sicer predal tehnologu, vendar mu razen risbe ni mogel ponuditi potrebnih informacij. Vse dodatne informacije je tehnolog ponovno iskal pri komercialistu, zato je bila pot do oblikovanja prodajne cene in oblikovanja ponudbe zelo dolga in polna približkov.

Posledica reinženiringa poslovnih procesov je spremenjen potek dela. V novi shemi komercialist in prodajni inženir skupaj obiščeta poslovnega partnerja. Komercialist se dogovarja o finančnem delu ponudbe, prodajni inženir pa o tehničnem delu. Tako je mogoče hkrati pregledati tehnično dokumentacijo, razjasniti morebitna vprašanja, zahteve, povezane s kakovostjo obdelave, velikostjo serij, transportom. Predračun, ki ga izdela prodajni inženir, je tako bolj natančen in ponudba je izdelana v krajšem času.

Prvotna poslovna funkcija nabava je naročala material neodvisno od dinamičnih potreb proizvodnje. Novo predlagana poslovna funkcija je 'tehnični sektor s prodajo', v kateri komercialist in prodajni inženir oblikujeta ponudbo.

Pri razvoju ali osvajanju novih izdelkov uporabljamo projektni pristop z imenovanjem skupine, v kateri so strokovnjaki s področja tehnologije (izdelajo delovne postopke, merne skice orodij, naročijo in spremljajo izdelavo orodij, izdelajo vzorce in poskusno serijo) in nabavnik, ki hkrati s potrebami razvoja naroči material in izdelavo orodij.

V prvotni organizacijski shemi sta bila zajeta samo načrt in logistika, v novo, ki se preimenuje v 'pripravljalno področje', pa je prenesena nabava in terminska služba iz proizvodnje. S tem ukrepom bo mogoče materialno oskrbo izvajati skladno s potrebami dinamike proizvodnje. Z novo obliko organizacije bo krmiljenje proizvodnje potekalo na popolnoma nov, drugačen način. Do sedaj se je npr. podrobno načrtovanje – terminiranje izvajalo ročno, v novem osnutku pa načrtujemo dinamično krmiljenje proizvodnje neposredno iz načrta.

The new management system will **change the organisation** of work, and consequently the content and the scope of the work of some employees. It is therefore necessary to define the requirements of the future organisation of work in this layer.

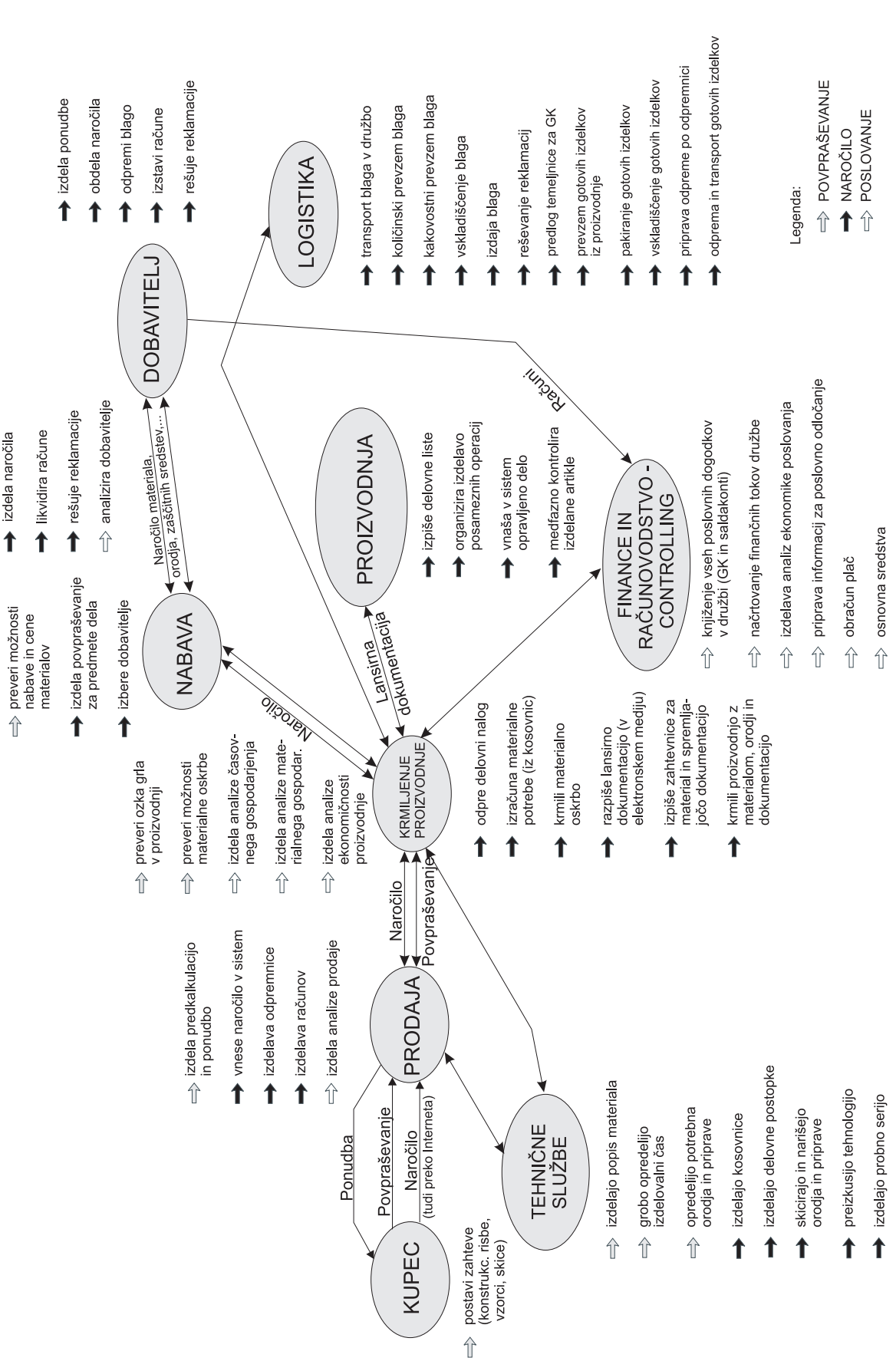
Enterprise: The new organisation scheme is process-oriented and based on information flows. The weakness of the former marketing function resulted from the fact that a separate department, i.e. the Technological Sector, prepared the technical documentation for offers. To draw up offers in such circumstances was a very long process, full of misunderstandings. The sales executive alone had to take over the technical documentation and negotiate with the customer. Later he handed the documentation over to the production engineer, but could give him no relevant information apart from the drawings. In order to get all the necessary information, the production engineer had to contact the sales executive again and again, so it took a long time to set the selling price and submit the offer.

The flow of work has been changed though the re-engineering of business processes. In the new organisation scheme the sales executive and the sales engineer visit the business partner together. The sales executive discusses the commercial part of the offer, and the sales engineer the technical part. In this way it is possible to go through all the details of the technical documentation, and at the same time resolve all the problems regarding the size of series, the quality of products, transportation issues and other requirements. The pre-calculation made by the sales engineer is now much more precise and the offer submitted much sooner.

The former business function called 'Purchasing' ordered material regardless of the dynamic manufacturing demands. In the suggested new business function called 'Technical sector and sales' the sales executive and the sales engineer work on the tender together.

The development of new products will use the project-oriented approach. A special project team will be formed for this purpose, consisting of experts in technology and a purchasing officer. The experts in technology will design working methods and tool drawings, they will order and monitor the tool-making, and also make the trial samples and the trial batch. The purchasing officer orders the material and the manufacture of tools synchronously with the demands of the development process.

The former organisation scheme included only the plan and logistics, but in the new organisation scheme, called 'Preparation', purchasing and time scheduling are added from the workshop environment. In this way it will be possible to harmonise the materials supply with the dynamics of production needs. In the new organisation scheme production steering will run in a completely different way. Until now, time schedules were made manually, but in future dynamic production control will be generated directly from the plan.



Sl. 4. *Poslovni informacijski sistem – tokovi*

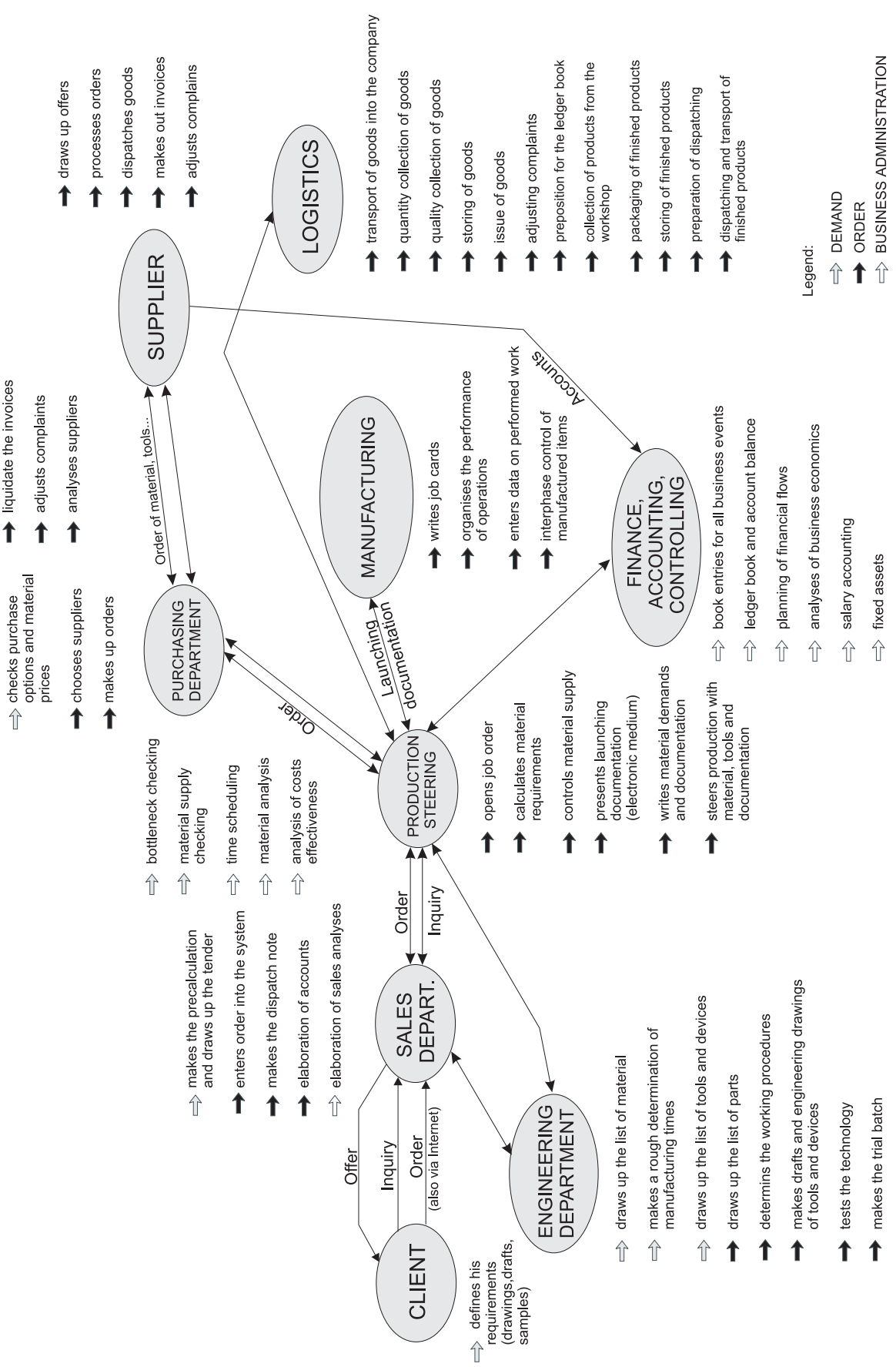


Fig. 4. *Business information system - flows*

Poslovna funkcija 'proizvodnja' se bo v osnovi delila na izdelavo elementov in izdelavo sklopov. Bistvena sprememba nove organiziranosti je uvedba lastnega (controlling) računovodstva.

Posamezno delovanje je opredeljeno v opisu delovnega procesa. Za posamezne izvajalce pa je njihovo delo opisano s konkretnimi delovnimi navodili.

Na nivoju 'specifikacije funkcij' je zelo pomembno področje oziroma poglavje **koncept in struktura sistema ter alokacija funkcij**.Če smo se v okviru analize potreb in postavitve zahtev ter pri opredeljevanju funkcionalnih specifikacij ukvarjali predvsem z namenom, funkcijami in mehanizmi delovanja bodočega sistema za vodenje, potem je v nadaljevanju specifikacij poudarek predvsem na opredelitvi njegove strukture.

Opredelitev strukture sistema pomeni podrobnejšo zamisel o logični arhitekturi in fizični realizaciji. Konkretno to pomeni, da moramo opredeliti elemente in njihove medsebojne povezave vseh ključnih strukturnih podsistemov sistema za vodenje ter definirati povezave med vsemi podsistemi.

Rezultat je logična struktura in njej ustrezna fizična struktura sistema, ki kaže, prek katerih logičnih oz. fizičnih enot se bodo izvajale funkcije (sl. 4).

4 SKLEP

Informacijske tehnologije in uvajanje računalniške podpore vodenju in odločanju na vseh nivojih podjetja je postal potreben pogoj za udeležbo v konkurenčni tekmi za obstoj na trgu. Večina podjetij po svetu in doma ima namen v naslednjih letih še okrepiti računalniško podporo proizvodnje, poslovanja in odločanja. Referenčne arhitekture s podrobnim opisom pomembnejših področij, ki jih je treba pri gradnji informacijsko integriranega podjetja upoštevati in veliko izbiro metod za modeliranje, so pri tem lahko v veliko pomoč.

The business function 'Production' will be separated into the manufacture of components and the manufacture of units. The essential change in the new organisation scheme is its own controlling.

Individual operations are defined in the description of the working process. The details for individuals are given in the instructions for work.

A very important part of the specification layer is the one dealing with the **system concept and structure and with the allocation of functions**. In the requirement analysis and in functional specifications we focused on the goals, functions and operating mechanisms of the future management system, but in the continuation of specifications emphasis is placed on the definition of its structure.

The definition of the system structure implies a detailed scheme of the logic architecture and physical realisation. This means that we have to define the elements and the links between them for all key subsystems of the management system to be introduced. The links between the subsystems also have to be defined.

The result is a logic structure with a corresponding physical structure of the system. This structure clearly shows over which logic or physical units the functions will be implemented (Fig. 4).

4 CONCLUSION

Information technology and computer-supported management and decision-making have become a necessity for competition and survival on the international market. Most companies at home and abroad intend to intensify their computer support in manufacturing and decision-making in the near future. Reference architectures with their detailed descriptions of fields that have to be included in the information-integrated enterprise and a wide range of modelling methods are a great help in this respect.

5 LITERATURA
5 REFERENCES

[1] Jovan, V. (1999) Avtomatizacija in informatizacija v slovenskih proizvodnih podjetjih. *Zbornik prve konference Avtomatizacija in informatizacija v industriji in gospodarstvu,* str. 206, Slovenija.

[2] Bernus, P., K. Mertinez, G. Schmidt (1998) Handbook on architectures of information systems. *ISBN 3-540-64453-9 Springer-Verlag Berlin Heilderberg New York.*

[3] Vujica Herzog, N. (2000) Model izgradnje informacijsko integriranega podjetja s pomočjo referenčnih arhitektur. *Magistrsko delo, Fakulteta za strojništvo,* Maribor.

[4] Strmčnik, S. (ed.) (1998) Celostni pristop k računalniškemu vodenju procesov. *ISBN 961-6210-51-3, Fakulteta za elektrotehniko*, Ljubljana.

Naslov avtorjev: mag. Nataša Vujica Herzog
prof. dr. Andrej Polajnar
Fakulteta za strojništvo
Univerze v Mariboru
Smetanova 17
2000 Maribor

Authors' Address: Mag. Nataša Vujica Herzog
Prof. Dr. Andrej Polajnar
Faculty of Mechanical Eng.
University of Maribor
Smetanova 17
2000 Maribor, Slovenia

Prejeto: 17.4.2000
Received:

Sprejeto: 20.12.2000
Accepted: