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Merjenje izvedbe pri prenovi poslovnih tokov

Performance Measurement in Business Process Re-Engineering

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V prispevku sta podana razvoj in ovrednotenje sistema kazalnikov za merjenje uspešnosti prenove poslovnih tokov. Razvoj kazalnikov temelji na rezultatih anketne raziskave, ki je bila izvedena v 73 srednje velikih in velikih slovenskih podjetjih s področja kovinsko-predelovalne, elektro-strojne industrije in s področja elektronike.

Ker večina literature o prenovi poslovnih tokov temelji na študijih primera, smo pri preučevanju kazalnikov za merjenje uspešnosti prenove poslovnih tokov vzeli anketno raziskavo. Na podlagi pregleda literature smo razpoznali sedem bistvenih meril, ki so pomembna za uspešno vrednotenje prenove poslovnih tokov: stroški, kakovost, čas, prilagodljivost, zanesljivost, zadovoljstvo kupca in človeški viri oz. zadovoljstvo zaposlenih. Z uporabo analitičnih tehnik, ki zagotavljajo veljavnost in zanesljivost merilnega orodja, smo znotraj omenjenih področij razvili niz ustreznih kazalnikov merjenja.

(Ključne besede: tokovi poslovni, prenova tokov, merjenje izvedbe, raziskave anketne)

In this paper we present the development and validation of performance measurement indicators for a business process re-engineering (BPR) evaluation. The results are based on a survey carried out in 73 medium-sized and large Slovenian manufacturing companies in the mechanical, electro-mechanical and electronic industries.

Since BPR literature is mostly based on case studies, the survey research methodology was assumed for studying performance measurement indicators when addressed to the dimensions of BPR. Based on a literature review, seven crucial areas, important for a successful BPR evaluation, were identified: costs, quality, time, flexibility, dependability, customer satisfaction and human resources with employee satisfaction. New variables were developed within the crucial areas, using reliability and validity analysis.

(Keywords: business process reengineering, performance measurements, survey research)

0 UVOD

Področje merjena izvedbe v zadnjem času zaposluje številne akademike in menedžerje. To je v glavnem posledica vedno večjih zahtev, ki izhajajo iz konkurenčnega okolja. Neely [1] je razloge, zakaj so postala običajna finančna merila nezadostna, strnil v naslednje vsebinske sklope:

- *Spremembe v naravi dela*. Zaradi velikih vlaganj v napredne proizvodne tehnologije se je delež neposrednih stroškov dela zmanjšal in temu primerno se je zmanjšala ustreznost običajnih računovodskih sistemov.
- *Konkurenčnost na trgu*. Zvečevanje konkurenčnosti terja od podjetij iskanje izvirne strateške lege, ki, za podjetje, temelji na posebnih

0 INTRODUCTION

The subject of performance measurement is encountering increasing interest in academic and managerial circles. Neely [1] combined the following main reasons why traditional financial measures are no longer enough:

- *The changing nature of work;* because of the massive investments that have been made in process automation, the direct labour share was reduced and consequently the suitability of the traditional accounting systems reduced.
- *Increasing competition;* demands that firms search for an original strategic position, based on a firm's particular resources and capabilities. Companies do not compete only with price and costs,

virih in zmožnostih. Podjetja ne tekmujejo samo s ceno in stroški kot posledičnim konkurenčnim merilom, temveč se poskušajo razlikovati na podlagi kakovosti, prožnosti, prilagodljivosti zahtevam kupca, prenove in hitrega odziva.

- *Pojav naprednih proizvodnih osnutkov.* Zamisel vitke proizvodnje, celovito obvladovanje kakovosti, prenova poslovnih tokov, primerjanje s konkurenco, množinska prilagodljivost in sočasno inženirstvo so napredne proizvodne zamisli, ki so pripomogle, da so podjetja hkrati napredovala v smislu različnih konkurenčnih meril. Uspešnosti poslovanja tako ni več mogoče meriti enorazsežno skozi finančna merila.
- *Spremembe vlog v podjetjih.* Največ kritik o neustreznosti meril, s katerimi spremljamo poslovanje, so v osemdesetih in devetdesetih letih izrekli strokovnjaki, ki so se ukvarjali z računovodstvom. Drugo skupino, ki je prevzela dejavnejšo vlogo pri oblikovanju meril in njihovo uporabo, predstavljajo odgovorni za razvoj človeških virov. Merila so se vključila v celoten menedžment človeških virov, ki sestoji iz postavljanja ciljev, merjenja izvedbe, povratnih informacij in nagrajevanja.
- *Zahteve poslovnega okolja.* Porabniki želijo vse več informacij o izdelku ali storitvi in tudi o načinu, kako je izdelek narejen. Še najmanj, ali pa sploh ne, jih zanimajo bilančni in finančni kazalniki. Povečevanje ekološke zavesti je pripeljalo do izraza odgovornost podjetja. Podjetja so pod pritiskom javnosti, ki ji morajo sporočati informacije, s katerimi dokazujejo ekološko neoporečnost svojega poslovanja.
- *Razvoj informacijske tehnologije.* Razvoj informacijske tehnologije (IT) je ključno vplival na možnost uporabe prenovljenih sistemov za merjenje uspešnosti poslovanja, saj omogoča učinkovito zbiranje podatkov iz različnih virov, za več ljudi, ceneje in hitreje. IT ne omogoča zgolj zbiranja podatkov, ampak tudi njihovo analizo in predstavljanje in tako omogočajo boljše poslovne odločitve v podjetjih, kar se nazadnje kaže v obliki boljših poslovnih rezultatov. Kazalniki torej niso samo informacije, ki predstavljajo trenutno stanje, ampak usmerjajo menedžment pri poslovnih odločitvah.
- *Mednarodne nagrade za kakovost.* Kot prva je bila leta 1950 na Japonskem ustanovljena Demingova nagrada za kakovost, v Združenih državah Amerije ima velik pomen Baldrige Award. Evropsko združenje za menedžment

but they try to differentiate in terms of quality, flexibility, adaptability to customer's demands, innovation and quick response.

- *Specific improvement initiatives*; such as lean production, total quality management (TQM), business process reengineering (BPR), benchmarking, mass customisation and concurrent engineering caused companies to simultaneously pursue several competitive criteria. Therefore, business success can no longer be measured only with uni-dimensional cost measures.
- *Changing organisational roles;* many of the loudest critics of traditional performance measurement systems have come from the academic accounting community in the period from 1980 to 1990. Human resources managers and personnel managers are another group of business professionals who are now taking a more active role in business performance measurement. Performance measures integrated into total human resources management consist of goal setting, measurement, feedback and reward.
- *Changing external demands*; customers want more information about the product or service and also about how the product was produced. They are not especially interested in financial indicators. The growing ecological perception leads to the term company responsibility. Companies also depend upon public opinion, and they have to give them information that proves the ecological integrity of their businesses.
- *The power of information technology;* the key driver in the performance measurement revolution is undoubtedly the power of information technology. Not only has this made the gathering and analysis of data easier, but it has also opened up new opportunities for data gathering from different resources, for more people, cheaper and faster. Of course, IT plays a role not only in data gathering, but also in data analysis and presentation, and thus enables better business decision making that causes better business results. Therefore, indicators are not only information, presenting the current state, but they also direct management at business decisions.
- *National and international quality awards*; among the first was the Deming Prize for quality, introduced in Japan in 1950. Numerous other quality awards have since been introduced, such as the Baldrige Award, which is available in the USA, and the European Foundation for Quality Man-

kakovosti podeljuje priznanja za poslovno odličnost. Podjetja, ki se potegujejo za takšne nagrade, morajo opraviti obsežno ocenjevanje lastnega podjetja in sporočati podrobne informacije o lastni organiziranosti, strategijah, virih, toku informacij, odnosu do družbenega okolja, politiki kakovosti in nenazadnje o finančnih rezultatih.

Navedeni razlogi zahtevajo ponovno obravnavo in posodobitev sistemov merjenja, ki se po eni strani nanaša na prenovitev računovodskih sistemov, predvsem stroškov izdelka, ki temeljijo na dejavnosti, in po drugi strani na razširitev področja merjenja t.i. meritev brez stroškovne osnove, ki po naravi niso ekonomsko-finančni, ampak izhajajo iz potreb kupca [2].

V prispevku bo predstavljen razvoj sistema kazalnikov merjenja v podjetjih, ki so v preteklosti izvajala prenovo poslovnih tokov in se pri tem soočala z neustreznostmi sedanjih sistemov merjenja. Prenova poslovnih tokov je v zadnjih desetih letih postala eno izmed najbolj uveljavljenih menedžerskih orodij, ki se je pojavilo predvsem kot odgovor na svetovno konkurenco, nenehne spremembe tržišča in zahteve kupcev.

Za namen oblikovanja kazalnikov smo vzeli metodologijo anketnega raziskovanja, ki omogoča razvoj veljavnega in zanesljivega sistema kazalnikov za merjenje izvedbe v smislu prenove poslovnih tokov.

1 TEORETIČNE OSNOVE IN OBSEG RAZISKAVE

Obseg raziskave

Iz pregleda literature je razvidno, da je treba zamisel prenove poslovnih tokov preučevati v povezavi z logično dopolnjujočima področjema, kakršna sta na eni strani proizvodna strategija in na drugi strani kazalniki izvedbe, namenjeni preverjanju ustreznosti izbrane strategije in preverjanju ustreznosti izvedbe prenove tokov (sl. 1). Primerjava s konkurenco oz. z najboljšim v panogi, je prav tako vključena v okvir kot uspešno orodje, ki lahko sproži veliko projektov prenove poslovnih tokov.

Prenova poslovnih tokov

Prenovo poslovnih tokov sta Davenport in Short [3] leta 1990 opisala kot analizo in oblikovanje delovnih tokov in postopkov znotraj podjetja in med podjetji. Tri leta kasneje sta Hammer in Champy [4]

agement (EFQM) Award in Europe. Each of these awards requires firms to complete a comprehensive self-assessment as part of the application process and they have to submit detailed data on policies, organization, information, strategies, resources, social environment and financial results.

These reasons demand the revision and updating of performance measurement systems, which is on one hand related to innovation in accounting systems, by means of activity-based costing as it concerns, in particular, product costing, and on the other hand, the extension of the measuring of the so-called non-cost performances, by nature not explicitly economic-financial, but demanded by the customers [2].

In this paper the development of performance measurement indicators for BPR evaluation will be presented. It is based on experiences from the companies that performed BPR in the past and were confronted with the unsuitability of the existing performance measures. BPR was brought into force in the last 15 years as one of the best management intervention tools; it appeared as an answer to global competition, continuous market changes and customer demands.

For the purpose of indicators development the survey research methodology was assumed; this enables the development of a valid and reliable performance measurement system, when addressed to the dimensions of BPR.

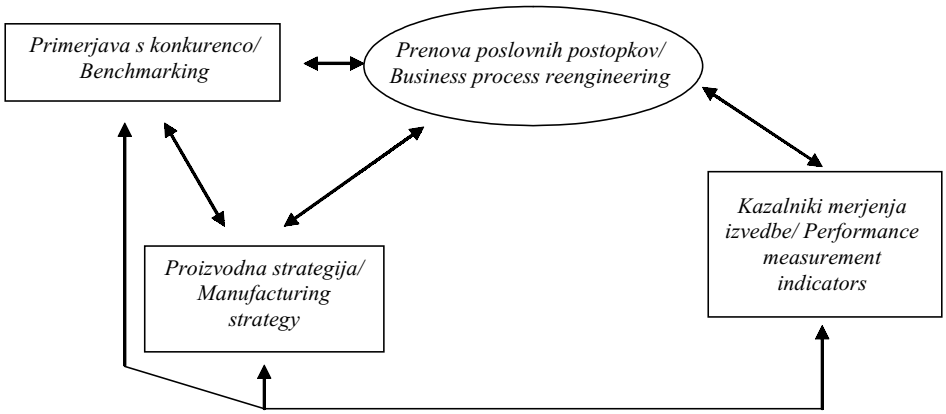
1 THEORETICAL BACKGROUND AND RESEARCH FRAMEWORK

Research framework

With regard to a literature review, the concept of BPR should be studied in connection with logical supplementary areas: manufacturing strategy and, on the other hand, performance indicators, meant for selected strategy and BPR performance verification (Fig. 1). Benchmarking is also added to the framework as a powerful tool for BPR and above all as a trigger for many BPR projects.

Business Process Reengineering

In 1990 Davenport and Short [3] described BPR as the analysis and design of workflows and processes within and between organisations. Three years later, Hammer and Champy [4] promoted BPR



Sl. 1. *Zamisel obsega raziskave*
Fig. 1. *Conceptual framework*

javno predstavila prenovo poslovnih tokov kot 'ponovno preučitev in korenito prenovo poslovnih tokov, z namenom, da dosežemo korenite spremembe s hkratnim merjenjem rezultatov učinka, kakor so stroški, kakovost in hitrost'. Od takrat je mogoče v literaturi zaslediti zelo živahno razpravo o prenovi poslovnih tokov. Akademska skupnost je razvila ogromno metodologij za izvedbo postopka prenove. Postopki prenavljanja so postajali vedno bolj popularni in zanimanje za zamisel prenove je vse do danes ostalo zelo veliko, kljub nekaterim kritičnim opazkam glede same zamisli, ki jih je mogoče zaslediti v literaturi s področja organizacijskih raziskav [5].

Merjenje izvedbe

Kljub temu, da so že Hammer in Champy [4], Davenport in Short [3] v svojih zgodnejših delih opozarjali na pomen merjenja izvedbe pri prenovi poslovnih tokov, se je bistvo oziroma način merjenja v zadnjih desetih letih močno spremenil. Merjenje izvedbe je bilo na področju proizvodnje do nedavnega omejeno predvsem na zastarele sisteme merjenja stroškov in na finančna poročila, kakor jih zahteva zakonodaja ([6] do [8]). Te meritve pa ne upoštevajo potrebe po izpolnjevanju zahtev kupca [9]. Kuwaiti in Kay [10] ugotavljata, da bi moral ustrezen sistem merjenja izvedbe v smislu prenove poslovnih tokov upoštevati dejstvo, da delo poteka skupinsko in da delavci ustvarjajo izdelek, kot končni rezultat proizvodnje, za kupca. V ta namen mora sistem merjenja izvedbe obsegati in ustrezno uravnotežiti številne razsežnosti, ki so potrebne za uspeh prenove tokov. Po pregledu literature smo razpoznali sedem bistvenih meril, ki so pomembna za uspešno vrednotenje prenove poslovnih tokov: stroški, kakovost, čas, prilagodljivost, zanesljivost, zadovoljstvo kupca in človeški viri oz. zadovoljstvo zaposlenih.

as ''the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed''. Since then, there have been considerable discussions in the literature about BPR and the academic community developed a range of methodologies for conducting BPR projects. BPR approaches have become increasingly popular in general and interest in BPR has remained high in spite of the somewhat sceptical stance in relation to the validity of the concept itself, noticed in some organisational studies literature [5].

Performance measurement

Although Hammer and Champy [4], and Davenport and Short [3] in their earlier publications have already emphasized the importance of performance measurement in business process re-engineering, the focus regarding measurements has changed greatly over the past ten years. Performance measurement, particularly in the manufacturing sector, has recently been dominated by outdated costing systems and financial reporting, as required by the legislature and the shareholders ([6] to [8]). These measures do not reflect the need for customer satisfaction [9]. Kuwaiti and Kay [10] ascertained that a relevant performance measurement system in the BPR context takes into account the fact that people work in teams, and actually produce a final output for a customer. For this reason, the PMS has to balance a number of dimensions to enable BPR to succeed. Based on a literature review, seven crucial areas, important for a successful BPR evaluation, were identified: costs, quality, time, flexibility, dependability, customer satisfaction and human resources with employee satisfaction.

Posamične meritve izvedbe

Po ugotovitvah, ki jih navajata De Toni in Tonchia [2], so se običajni sistemi merjenja, osredotočeni predvsem na stroške proizvodnje in produktivnost, na podlagi sprememb, ki izhajajo iz konkurenčnega okolja, preoblikovali v dve vrsti meritev:

- Meritve izvedbe, vezane na stroške, vključno s stroški proizvodnje in produktivnostjo. Za te stroške so značilne jasne povezave, ki jih je mogoče obravnavati v matematični obliki, npr. Goldov model [11], pri čemer dobimo končne rezultate podjetja, kar je čisti prihodek in donosnost.
- Meritve izvedbe brez neposredne stroškovne povezave, ki vedno bolj pridobivajo pomen. Običajno jih merimo z nedenarnimi enotami, zato ni mogoča neposredna povezava z ekonomskimi in finančnimi izkazi.

Meritve izvedbe, vezane na stroške

Johnson ([12] in [13]) je v svojih delih dokumentiral, da večina menedžerskih računovodskih sistemov, ki so še dandanes v uporabi, temelji na predpostavkah izpred šestdesetih let. Garnerjev [14] pregled literature iz računovodstva prav tako kaže na to, da je bila večina t. i. vrhunsko razvitih stroškovno naravnanih računovodskih teorij in praks razvitih okrog leta 1925 (npr. povrnitev vlaganj).

Johnson in Kaplan [15] poudarjata, da, zaradi dramatičnih sprememb poslovnega okolja v zadnjih šestdesetih letih, računovodski sistemi temeljijo na predpostavkah, ki niso več veljavne. Ena od najbolj široko kritiziranih praks je razporeditev neposrednega dela in režijskih stroškov glede na neposredne stroške dela.

Kot rezultat kritik, ki so se nanašale na običajni računovodski menedžment, je Cooper [16] razvil postopek, imenovan na stroških temelječe računovodstvo.

Meritve izvedbe, vezane na kakovost

Običajno je kakovost definirana v smislu prilagajanja podrobnostim in zato so meritve kakovosti v glavnem usmerjene na meritve, kakor so npr. število izmeta in stroški kakovosti [17]. Feigenbaum [18] je prvi ugotavljal, da so dejanski stroški kakovosti odvisnost preprečevanja, ocene in stroškov napak.

Crosbyjeva [19] trditev ''kakovost je zastonj'' temelji na predpostavki, da je za večino podjetij povečanje stroškov preprečevanja več ko le nadomestitev za znižanje stroškov zaradi napak. Crosby opozarja, da je večina podjetij zgrešila pri

Individual performance dimensions and measures

Based on the changes resulting from the competitive environment, traditional performance measures, focused mostly on costs and productivity, transformed into two types of measures [2]:

- Cost measures, including production costs and productivity. Cost performances are distinguished by having a direct link, explainable by mathematical formulae, for example, Gold's model [11], with the final results on the firm that is net income and profitability.
- Non-cost measures, which are increasingly important. The non-cost performances are generally measured by non-monetary units of measure, and cannot be calculated in a precise manner like cost performances.

Performance measures relating to costs

Johnson ([12] and [13]) documented that many management accounting systems used today are based on assumptions that were made 60 years ago. Indeed, Garner's review [14] of the accounting literature indicates that most of the so-called sophisticated cost accounting theories and practice were developed by 1925 (e.g., return of investment – ROI).

Johnson and Kaplan's [15] thesis is that because the business environment has changed dramatically in the last 60 years, management accounting is based on assumptions that are no longer valid. One of the most criticized practices is the allocation of indirect labour and overhead according to the direct labour costs.

Cooper [16] developed an approach known as activity-based costing, which overcomes many traditional problems of management accounting.

Performance measures relating to quality

Traditionally, quality has been defined in terms of conformance to specification, and hence quality-based measures of performance have focused on issues such as the number of defects produced and the costs of quality [17]. Feigenbaum [18] was the first to suggest that the true cost of quality is a function of prevention, appraisal and failure costs.

Crosby's [19] assertion that 'quality is free' is based on the assumption that, for most firms, an increase in prevention costs will be more than offset by a decrease in failure costs. He says that many

integraciji modela stroški kakovosti s postopki upravljanja. To pomeni, da četudi menedžerji ocenjujejo stroške kakovosti, manjkajo ustrezne dejavnosti za njihovo zniževanje.

S pojavom zamisli celovito obvladovanje kakovosti (COK-TQM) se je poudarek iz prilagajanja podrobnostim premaknil v smeri izpolnjevanja zadovoljstva kupca. Posledično se je začelo pojavljati večje število raziskav zadovoljstva kupcev in raziskav tržišča. To kaže tudi pojav Malcolm-Baldridgeve nagrade za kakovost v ZDA in Evropske nagrade za kakovost.

Druge splošno sprejete meritve kakovosti obsegajo statistični nadzor tokov ([20] in [21]) in Motorolina zamisel 6-sigm. Motorola, ki je eden vodilnih svetovnih proizvajalcev in dobaviteljev polprevodnikov, si je leta 1992 za cilj podjetja na področju kakovosti zastavila doseganje sposobnosti 6-sigm (3,4 napak na milijon delov). Zadnji dve vrsti meritev sta za oblikovanje sistema merjenja izvedbe še posebej pomembni, saj sta osredotočeni na postopek in ne na izplen.

Meritve izvedbe, vezane na čas

Čas opisujemo kot vir konkurenčnih prednosti in tudi kot temeljno meritev merjenja izvedbe [22]. Glede na filozofijo proizvodnje s pravočasno dobavo (JIT) so prezgodnja ali prepozna proizvodnja ali dobava prikazane kot izguba. Podobno je eden od ciljev optimalne proizvodne tehnologije skrajšanje pretočnih časov [23]. Galloway in Waldron [24] sta razvila sistem stroškov, ki temelji na času, poznan tudi kot računovodstvo pretoka.

Zanimiv postopek oblikovanja časovno usmerjenih meritev predlagajo Azzone in drugi [25]. Po njihovih ugotovitvah bi morala podjetja, ki želijo uporabljati čas v pomenu konkurenčne prednosti, uporabljati niz meritev, ki se nanašajo na notranji razpored (npr. število sprememb projekta, čas dodane vrednosti kot odstotek celotnega časa, zapletenost postopkov) ali zunanji razpored izmer izvedbe (npr. čas razvoja novega izdelka, čas trajanja postopka, čas izdelave ponudbe).

Meritve izvedbe, vezane na prilagodljivost

Merjenje prilagodljivosti so preučevali že številni avtorji, z različnimi postopki in upoštevajoč različne razsežnosti prilagodljivosti. Definicije prilagodljivosti so običajno splošne ali pa se nanašajo na podjetje oziroma proizvodnjo.

companies fail to integrate the cost of the quality model with their management process. This means that although managers estimate the cost of quality, they fail to take appropriate actions to reduce it.

When total quality management (TQM) appeared, the emphasis shifted away from 'conformance to specification' and towards customer satisfaction. As a result, customer opinion surveys and market research appeared frequently. The establishment of the Malcolm Baldrige National Quality Award in the USA and the European Quality Award reflects this trend.

Other common measures of quality include statistical process control ([20] and [21]) and the Motorola six-sigma concept. Motorola, which is one of the world's leading manufacturers and suppliers of semiconductors, set a corporate quality goal of achieving six-sigma capability (3.4 defects per million parts) by 1992. These last two measures of quality raise an important issue that is relevant to performance measurement system design because they focus on the measurement of the process rather than the output.

Performance measures relating to time

Time has been described as both a source of competitive advantage and the fundamental measure of manufacturing performance [22]. Under the just-in-time (JIT) manufacturing philosophy the production or delivery of goods that is just too early or too late is seen as a waste. Similarly, one of the objectives of optimised production technology is the minimization of throughput times [23]. Galloway and Waldron [24] have developed a time-based costing system known as throughput accounting.

An interesting approach to the design of time-based performance measures is proposed by Azzone et al. [25]. They suggest that companies that seek to employ time as a means of competitive advantage should use a generic set of measures related to internal configuration (e.g., the number of changes in the project, the value-added time as a percentage of total time, the complexity of procedures) and external configuration (e.g., new products development time, cycle time, bid time)

Performance measures relating to flexibility

Manufacturing flexibility has been considered by numerous authors, according to different approaches and considering the various dimensions of flexibility. The definition of flexibility is usually related to the general, company or manufacturing context.

Skinner [26] je preučeval prilagodljivost glede na tri različne razsežnosti, ki se nanašajo na:
1. postopek
2. izdelek
3. obseg proizvodnje.

Buffa [27] je prilagodljivost postopka opredelil v povezavi s časi priprave stroja in prilagodljivost izdelka v povezavi z raznolikostjo izdelka. Beckman [28] je preprosto razlikoval prilagodljivost postopka in prilagodljivost izdelka.

Gerwin [29] je kot prvi omenjal različne vrste prilagodljivosti na način, pri katerem je različne vrste prilagodljivosti povezoval z nedoločenostjo okolja, ki jih povzroča. Ločil je šest osnovnih vrst prilagodljivosti (glede na material, obseg, izdelek, mešano prilagodljivost, ki se nanaša na zmožnost upoštevanja zahtev kupca v pomenu raznolikosti izdelkov, dobavljivih v določenem času, prilagodljivost, ki se nanaša na čas priprave stroja in čas trajanja postopka).

Meritve izvedbe, vezane na zanesljivost, zadovoljstvo kupca in človeške vire

Če smo poprej ugotavljali, da obstajajo določene nejasnosti, ki se nanašajo na merjenje in razumevanje prilagodljivosti, je še veliko težje določiti in meriti zanesljivost, zadovoljstvo kupca in človeške vire.

Človeške zmožnosti oziroma zaposleni so gotovo najpomembnejše sredstvo vsakega podjetja. Pogosto se dogaja, da dve enako veliki podjetji, ki se ukvarjata z enako dejavnostjo in delujeta v enakem okolju, dosegata bistveno drugačne rezultate poslovanja. Razlogi za to so lahko sicer številni, vendar pa je razlika največkrat posledica različnih delovnih zmožnosti zaposlenih oziroma različne kakovosti človeških zmožnosti.

2 RAZISKOVALNA METODOLOGIJA

Za preučevanje predstavljenega problema smo vzeli metodologijo anketnega raziskovanja. Metodologija anketnega raziskovanja, z namenom, da bi preizkusili znane teorije, je dolgotrajen postopek, ki zahteva predhodni obstoj teoretičnega modela ali zamiselnega ogrodja [30]. Vsebuje veliko povezanih podpostopkov, to so: postopek predelave iz teoretičnega področja v izkustveno obliko, postopek oblikovanja vprašalnika in izdelavo predhodne vodilne študije, postopek zbiranja podatkov za testiranje teorije, postopek analize podatkov, postopek razlage podatkov in pisanje poročil.

Skinner [26] considers flexibility according to three dimensions, in relation to the objects of variation:
1. the process,
2. the product,
3. the production volume.

Buffa [27] specifies process flexibility in relation to set-up times, and product flexibility in relation to product variety. Beckman [28] simply distinguish between process flexibilities and product flexibility.

Gerwin [29] was the first to mention various dimensions of flexibility in a specific manner and relate them to the different types of environmental uncertainties that caused them. He distinguishes six basic types of flexibility (regarding materials, volume, products, the mix, defined as the ability to meet the market's requirements in terms of variety of products supplied in a certain time, flexibility relating to the change-over and to the standard cycle or re-routing flexibility).

Performance measures relating to dependability, customer satisfaction and human resources

If we have previously assessed that a certain ambiguity still persists regarding measuring and understanding flexibility it is even more complicated to define and measure dependability, customer satisfaction and human resources.

Human resources are undoubtedly the most important resources of the company. It happens frequently that two equally large companies, engaged in the same activity and working in the same environment, achieve essentially different business results. There can be of course numerous reasons for that, but mostly the difference results from different employee capabilities or from a different quality of human resources.

2 RESEARCH METHODOLOGY

For the proposed problem study survey research was used. Theory testing survey research is a long process that presupposes the pre-existence of a theoretical model or a conceptual framework [30]. It includes a number of related sub-processes: the process of reshaping the theoretical domain into the empirical domain; the design and pilot testing processes; the process of collecting data for theory testing; the data analysis process; and the process of interpreting the results and writing the report.

Pri izvedbi predstavljene raziskave smo upoštevali vse navedene faze. V predhodnem poglavju je predstavljen okvir raziskave, ki je bil izhodišče postopku predelave iz teoretičnega področja v izkustveno obliko z oblikovanjem vprašalnika. Trditve v vprašalniku so bile ovrednotene s pettočkovno Likertovo lestvico, v razponu od 'popolno nesoglašanje' do 'popolno soglašanje'. Kot ciljni vzorec smo izbrali slovenska srednja in velika podjetja iz kovinskopredelovalne in elektro-strojne industrije. Postopek vodilnga testiranja smo izvedli kot kritičen pregled vprašalnika petih akademikov s področja operacijskega menedžmenta z Univerze v Mariboru in Univerze v Vidmu (Italija) in treh višjih menedžerjev iz treh proizvodnih podjetij. Podatke smo zbrali po pošti in kasneje analizirali s pomočjo eno- in več-različnih metod analize podatkov.

Merilo kakovosti meritve

Napake merjenja so v anketnem raziskovanju glavni vir napak [31] in jih je treba obdržati na najnižji mogoči ravni. Ko govorimo o kakovosti meritve, imamo v mislih predvsem kakovost merilnih orodij in postopkov, ki jih uporabljamo pri merjenju [30]. Najpomembnejši vidik merjenja pa se prav gotovo nanaša na merjenje zapletenih, več-razsežnostnih oblik merjenja.

Vrednost meritve se v glavnem ocenjuje na podlagi njene veljavnosti in zanesljivosti. Ko govorimo o zanesljivosti, mislimo predvsem na stabilnost in doslednost meritve, medtem ko nas pri veljavnosti zanima predvsem ustreznost meritve [32].

Zanesljivost meritve

Zanesljivost se ocenjuje po zbiranju podatkov. Štiri največkrat uporabljene metode določanja zanesljivosti so:

- ponovno testiranje z istim testom,
- testiranjem z drugimi oblikami testa,
- cepitvena metoda,
- izračun notranje skladnosti testa.

Kadar določene zveze ali modele razvijamo prvič (kakor v naši raziskavi), se kot edina primerna metoda lahko uporabi metoda notranje skladnosti testa. Najpogostejši postopek za oceno notranje skladnosti testa je Cronbachov koeficient alfa [33]. Nunnally [34] navaja, da lahko novo razvite vrednosti sprejmemo v primeru, ko je $\alpha \geq 0{,}6$, priporočljivo mejo pa pomeni $\alpha \geq 0{,}7$. V primeru da je $\alpha \geq 0{,}8$, imamo zelo zanesljivo meritev.

Regarding the presented research process, all the stated phases were considered. In the previous section the conceptual framework is presented, which was the starting point for reshaping the theoretical domain into the practical domain by designing a questionnaire. The items on the questionnaire were evaluated using the five-point Likert scale, ranging from ´strongly disagree´ to ´strongly agree´. As the target sample medium-sized and large Slovenian companies from mechanical and electro-mechanical branches were selected. The pilot testing process was performed by a critical review of five academics in operations management at the University of Maribor (Slovenia) and at the University of Udine (Italy) and three general managers from three manufacturing firms. The data-collection process was made by mail and later the data were analysed using uni- and multi-variate data analysis.

Assessing the measurement quality

Measurement errors represent the major sources of error in survey research [31] and should be kept at the lowest possible level. When we address the issue of measurement quality, we think of the quality of the survey instruments and the procedures used to measure the constructs of interest [30]. However, the most crucial aspect concerns the measurement of complex constructs by multi-item measures.

The quality of the measures is mainly evaluated in terms of validity and reliability. Validity is concerned with whether we measure the right concept, while reliability is concerned with stability and consistency in measurement [32].

Reliability

Reliability is assessed after data collection. The four most common methods used to estimate reliability are:

- the Test-retest method,
- the Alternative-form method,
- the Split-halves method,
- the Internal consistency method

When developing variables for the first time the only convenient method for measuring reliability is the internal consistency method. The most popular test within the internal consistency method is the Cronbach coefficient alpha [33]. Nunnally [34] states that newly developed measures can be accepted with $\alpha \geq 0.6$, otherwise $\alpha \geq 0.7$ should be the threshold. With $\alpha \geq 0.8$ the measure is very reliable.

Veljavnost

Veljavnost meritve se nanaša na vsebino, merilo in veljavnost izdelka, ki ga merimo [35].

1. Veljavnost vsebine se ne ocenjuje numerično, ampak gre za pristransko oceno raziskovalcev. Ne moremo je določiti statistično, ampak se določa na podlagi kritične presoje raziskovalcev in znane literature. Za preverjanje veljavnosti vsebine je posamezne trditve vprašalnika poprej pregledalo pet akademikov s področja tokovnega vodenja.
2. Veljavnost, ki se nanaša na merilo, imenovana tudi veljavnost, ki jo lahko predvidimo oziroma zunanja veljavnost, se nanaša na obseg, do katerega merilno orodje zagotavlja neodvisnost meritve.
3. Veljavnost izdelka je od vseh različnih lastnosti, ki se nanašajo na meritev, najbolj zapletena in hkrati najbolj kritična za testiranje teorij. Meritev izpolnjuje pogoj veljavnosti izdelka, kadar meri to, kar smo se namenili meriti. Veljavnost izdelka lahko dosežemo tudi z uporabo projekcijskih analitičnih tehnik, kot je npr. projekcija na prvo glavno sestavino (PGS - PCA). Glavni namen projekcije na prvo glavno sestavino je ta, da dobimo čim manjše število linearnih kombinacij iz niza spremenljivk, ki ohranijo čimveč informacij izvirnih spremenljivk. Te linearne kombinacije imajo koeficiente enake lastnim vektorjem korelacijske matrike; lastni vektorji so med seboj pravokotni. Glavne komponente so razvrščene po padajočih vrednostih lastnih vektorjev.

Ugotavljanje veljavnosti in zanesljivosti

Razvoj veljavnih in zanesljivih meritev je postopek, ki je primerljiv s postopkom oblikovanja in preverjanja teorije [30]. Glavni namen postopka ni v tem, da omogoča oblikovanje orodja za testiranje teorije, ampak omogoča oblikovanje orodja, ki bo ponovno uporaben tudi za preverjanje drugih teorij in predvsem za uporabniške namene.

Na sliki 2 je shematično prikazan potek oblikovanja novih spremenljivk. Najprej rezultate vprašalnika, ovrednotene po Likertovi lestvici, vnesemo v enega od statističnih programskih paketov (SPSS, SAS/STAT). Sledi preverjanje kakovosti meritve. Če je koeficient alfa večji od 0,6 je meritev zanesljiva in postopek lahko nadaljujemo z uporabo projekcije na prvo glavno sestavino, za preverjanje veljavnosti. Glavni namen uporabe projekcijskih analitičnih tehnik je zmanjšanje števila spremenljivk ali preučevanje strukture in povezav med spremenljivkami. V našem primeru smo projekcijo na prvo glavno sestavino uporabili z namenom

Validity

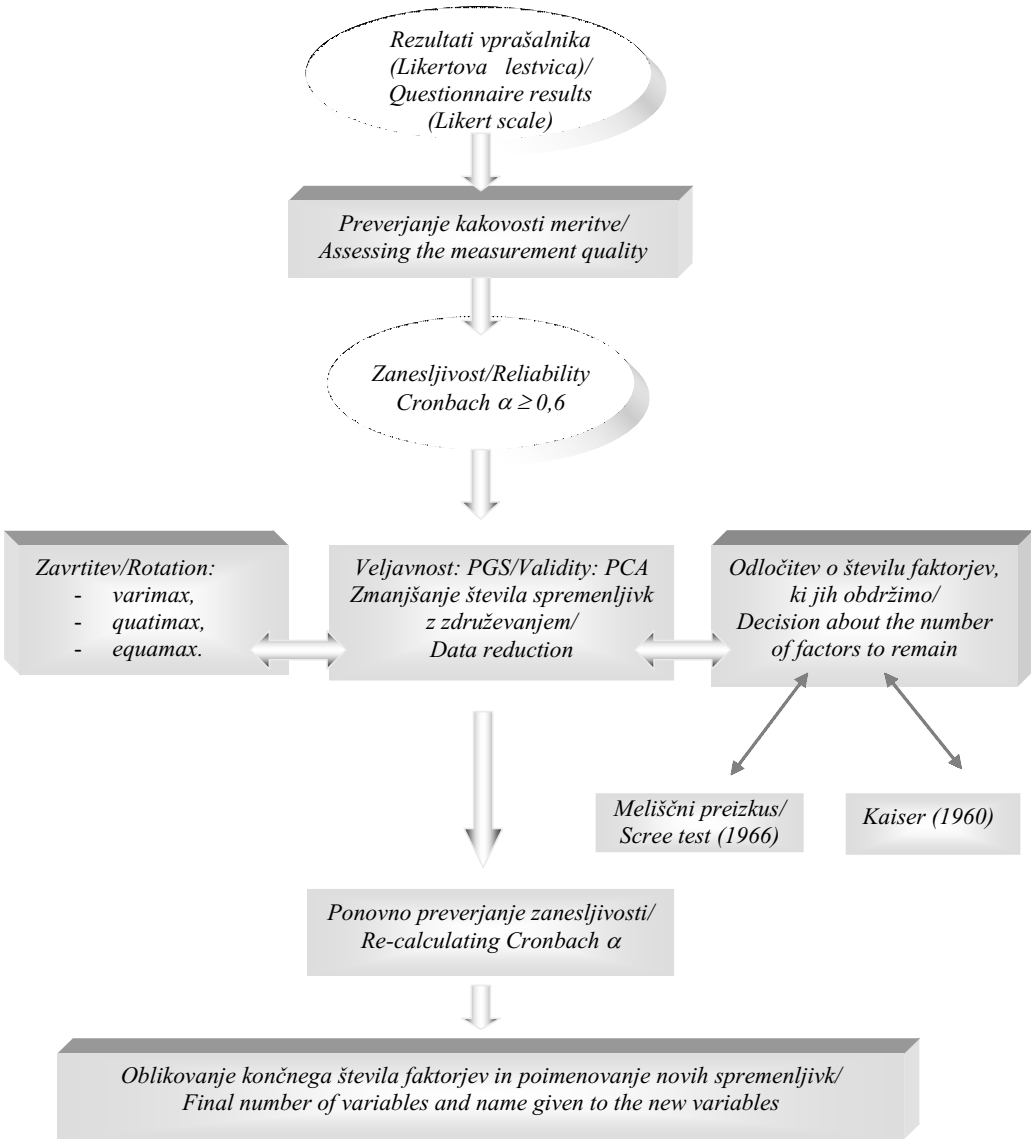
Validity regards content, criterion and construct [35]:

1. Content validity is not evaluated numerically – the researchers subjectively judge it. Content validity cannot be determined statistically but only by experts, and by referring to literature. To establish content validity, the items for each factor were critically reviewed by five academics in operations management.
2. Criterion-related validity, also called predictive validity or external validity, is concerned with the extent to which a measuring instrument is related to an independent measure of the relevant criterion.
3. Construct validity; among the different properties that can be assessed about a measure, construct validity is the most complex and, yet, the most critical to substantive theory testing. A measure has construct validity if it measures the theoretical construct or trait that it was designed to measure. Construct validity can also be established through the use of principal component analysis (PCA). The purpose of PCA is to derive a small number of linear combinations of a set of variables that retain as much of the information in the original variables as possible. These linear combinations have coefficients equal to the eigenvectors of the correlation (covariance) matrix; the eigenvectors are uncorrelated or orthogonal to each other. The principal components are sorted in descending order of the eigenvalues, which are equal to the variances of the components.

Steps in assessing reliability and validity

Developing valid and reliable measures is a process, parallel to that aimed at building and testing the theory [30]. The aim is not only to build an instrument to allow theory testing but also to have an instrument reusable for other theories as well as for application purposes.

Figure 2 presents a schematic review of the new variable construction process. First, the questionnaire results, assessed in terms of the Likert scale, are recorded to a statistics programme package (SPSS, SAS/STAT). Assessing the measurement quality follows. If the reliability coefficient alpha is greater than 0.6, the measure is reliable and the procedure can be proceeded by the PCA for assessing validity. Because the main applications of factor analytic techniques are to reduce the number of variables and to detect structure in the relationships between variables, the PCA was used as a data-reduction method. Various rota-



Sl. 2. *Shematski prikaz poteka oblikovanja novih spremenljivk*
Fig. 2. *Schematic review of the new variable construction process*

zmanjšanja števila spremenljivk. Kot pomoč pri razlagi rezultatov obstajajo različne strategije zavrtitve, to so: varimax, quatimax in equamax. Pri postopku, prikazanem na sliki 2 smo pri izločanju sestavin uporabili zavrtitev varimax. Pri odločitvi o številu dejavnikov, ki jih upoštevamo, smo sledili Kaiserjevemu merilu [36], po katerem lahko upoštevamo samo tiste dejavnike, katerih lastni vektor je večji od 1. Nato smo za vse možne nove spremenljivke še enkrat preverjali zanesljivost, s ponovnim izračunom Cronbachovega koeficienta alfa in v primeru, da je tudi ta večji od 0,6, sprejeli odločitev o končnem številu novih spremenljivk. Novo oblikovane spremenljivke smo na koncu še poimenovali.

tional strategies have been proposed as a support for results interpretation: varimax, quatimax and equamax. In the process presented in Figure 2, varimax rotation was used when extracting principal components. To decide how many factors to extract, the Kaiser [36] criterion was used. According to this criterion we can retain only the factors with eigenvalues greater than 1. After that, for all possible new variables, Cronbach alpha should be re-calculated and if greater than 0.6, the decision about the final number of new variables can be accepted. Finally, an appropriate name should be given to the new variables.

3 REZULTATI IN RAZPRAVA

Glede na priporočljiv potek oblikovanja novih spremenljivk, prikazanem na sliki 2, smo analizo rezultatov pričeli s preverjanjem zanesljivosti meritve. Najprej smo s programskim paketom SPSS izvedli analizo notranje skladnosti testa za postavke vprašalnika znotraj vseh kritičnih izmer merjenja izvedbe, kakor so prikazane v preglednici 1. Iz preglednice je razvidno, da se dobljene vrednosti koeficientov zanesljivosti gibljejo v mejah od 0,6383 do 0,8934. Po priporočilih, ki jih je podal Nunnaly [34], so dobljene meritve vseh kritičnih razsežnosti merjenja izvedbe zelo zanesljive in zato ni potrebno izločanje posameznih spremenljivk (z namenom izboljšanja zanesljivosti meritve).

Ker vse izhodiščne vrednosti izpolnjujejo pogoje zanesljivosti, smo nadaljevali s preverjanjem veljavnosti. Zaradi prostorskih omejitev bo v nadaljevanju predstavljen samo en primer oblikovanja novih spremenljivk. Izbrali smo značilni primer oblikovanja novih spremenljivk za področje merjenja kakovosti, pri katerem izhajamo iz osmih postavk.

Preglednica 2 prikazuje rezultate projekcije na prvo glavno sestavino, z uporabo zavrtitve varimax, izvedeno za kakovost. Program je oblikoval dvofaktorsko rešitev, z dvema lastnima vektorjema, ki sta večja od 1 (Kaiserjeva normalizacija). Lastna vektorja pomenita 56,313% variance prostora, vse preostale nadaljnje rešitve pa pomenijo zelo majhen delež skupne variance prostora. Zavrten vzorec faktorjev vpliva je večinoma zelo jasen, razen za kakovost, predstavljeno z zanesljivostjo dobav,

3 RESULTS AND DISCUSSION

Regarding the steps presented in the new variable development process (Fig. 2), the results analysis started with a reliability verification. First, an internal consistency analysis was performed separately using the SPSS program package for the items of each critical dimension, presented as areas and sub-areas in Table 1. The table shows that the reliability coefficients ranged from 0.6383 to 0.8934. According to the instructions, written by Nunnaly [34], those measurements for all critical dimensions of PM are very reliable and there is no need for an elimination of the defined items (meant for improving the reliability of the measurement).

With regard to all the initial values of the critical dimensions fulfilling the reliability conditions, we continued with validity testing. Because of the space limitations in the continuation only an example of the new variables design will be presented. We selected a representative example of new variables construction for quality, with the eight initial items.

Table 2 shows the results of the PCA with varimax rotation performed for quality. A two-factor solution was generated with an eigenvalue greater than 1.0 (Kaiser Normalization). It explained 56.313% of the variance, while subsequent solutions added just a little to the cumulative variance explained. The rotated factor pattern was very evident for the most part, except for the quality expressed by the delivery reliability, but it is still obvious that the delivery reli-

Preglednica 1. *Rezultati analize notranje skladnosti testa (Cronbach* a*) po posameznih področjih*
Table 1. *Internal consistency analysis results for the critical dimensions of PM*

Kritične razsežnosti merjenja izvedbe ***Critical dimensions of Performance Measurement***	***Izvirne številke postavk Original item numbers***	***Končno število postavk Final number of items***	***Cronbach α***
stroški / costs	79–85	7	0,6651
kakovost / quality	86–93	8	0,7546
čas / time	94–105	12	0,8934
prilagodljivost / flexibility	106–114	9	0,7579
zanesljivost / dependability	115–118	5	**0,6383**
zadovoljstvo kupca / customer satisfaction	119–124	6	0,7224
človeški viri oz. zadovoljstvo zaposlenih / human resources and employee satisfaction	125–131	7	0,8207
usposobljenost zaposlenih / employee empowerment	143–155	13	0,6763
merjenje stopnje povezovanja zaposlenih / employee integration	156–174	19	0,8658

Preglednica 2. *Kakovost: dvofaktorska rešitev s Kaiserjevo normalizacijo*
Table 2. *Quality: two-factor solution with varimax rotation*

Izvorne spremenljivke za kakovost ***Items on quality***	***1. faktor*** ***1st factor***	***2. faktor*** ***2nd factor***
stopnja izmeta in popravil / scrap level and reworks	**0,732**	0,095
uveljavljanje garancije / warranty claims	**0,749**	– 0,020
stroški izmeta in popravil / cost of scrap and rework	**0,858**	0,159
stroški sistema kakovosti / quality costs	**0,642**	0,241
kakovost dobaviteljev / in bound quality (of suppliers)	– 0,036	**0,866**
zadovoljstvo kupca / customer satisfaction	0,194	**0,722**
negovanje stikov s kupci / customer retention	0,252	**0,711**
zanesljivost dobave / delivery reliability	**0,455**	0,287
lastni vector/ eigenvalue	3,074	1,431
delež variance prostora / proportion of variance explained (%)	38,427	17,885
skupni delež variance prostora / cumulative variance explained (%)	38,427	56,313
ponovno izračunan Cronbach α / re-calculated Cronbach α	0,7483	0,6717
novo oblikovano ime / name given to the new variable	Notranja kakovost Internal quality	Zunanja kakovost External quality

vendar je kljub temu tudi tukaj zelo očitno, da postavka zanesljivost dobav izkazuje večji vpliv na prvi kakor na drugi faktor.

Ponovno preverjanje zanesljivosti z izračunom Cronbachovega koeficienta alfa prav tako potrjuje oblikovanje dveh novih spremenljivk. Tako smo v prvo spremenljivko združili stopnjo izmeta in popravil, uveljavljanje garancije, stroške izmeta in popravil, stroške sistema kakovosti in zanesljivost dobave. Drugo spremenljivko pa predstavljajo kakovost dobaviteljev, zadovoljstvo kupca in negovanje stika s kupci. Glede na vsebino in znano literaturo smo prvi faktor poimenovali notranja kakovost in drugega zunanja kakovost.

Na sliki 3 je podan pregled vseh novo oblikovanih spremenljivk, ki mu lahko rečemo tudi sistem kazalnikov za vrednotenje prenove poslovnih tokov, dobljen iz rezultatov raziskave.

4 SKLEP

Iz pregleda in primerjave teoretičnih modelov merjenja izvedbe v znani literaturi smo dobili vpogled v celovitost in obsežnost področja. Eden temeljnih problemov, s katerim se soočimo pri vzpostavljanju uporabnega sistema merjenja izvedbe, je poskus, da bi dosegli ravnovesje med manjšim številom ključnih meritev izvedbe (jasnih in preprostih, ki morda ne kažejo vseh organizacijskih ciljev) na eni strani in večjim številom podrobnih meritev oz. kazalnikov izvedbe (zapletenih in manj primernih za upravljanje, vendar zmožnih prikazati veliko različnih možnosti

ability item exhibited a much higher loading on the first factor than on the second factor. The development of the two new variables was repeatedly verified using Cronbach alpha for reliability (re-calculated Cronbach alpha for new variables).

The first factor consists of scrap level and reworks, warranty claims, cost of scrap and rework, quality costs and delivery reliability. The second factor consists of in-bound quality, customer satisfaction and customer retention. With regard to the content and existing literature the first factor was named Internal quality and the second factor External quality.

In Figure 3 a review of all the new developed variables, which could also be called performance indicators for the BPR evaluation, are presented, based on the results of the survey research.

4 CONCLUSION

A literature review and a comparison of the existing theoretical models of performance measurement gave us an insight into the integrity and comprehensiveness of the presented problem. One of the problems of devising a useful performance measurement system is trying to achieve some balance between having a few key measures on the one hand (straightforward and simple, but may not reflect the full range of organisational objectives), and, on the other, having many detailed measures (complex and difficult to manage, but capable of conveying many

izvedbe) na drugi strani. V splošnem dosežemo poravnavo tako, da zagotovimo jasno povezavo med izbrano strategijo, ključnimi parametri izvedbe, ki kažejo glavne cilje izvedbe, in nizom kazalnikov izvedbe za posamezne ključne parametre [37].

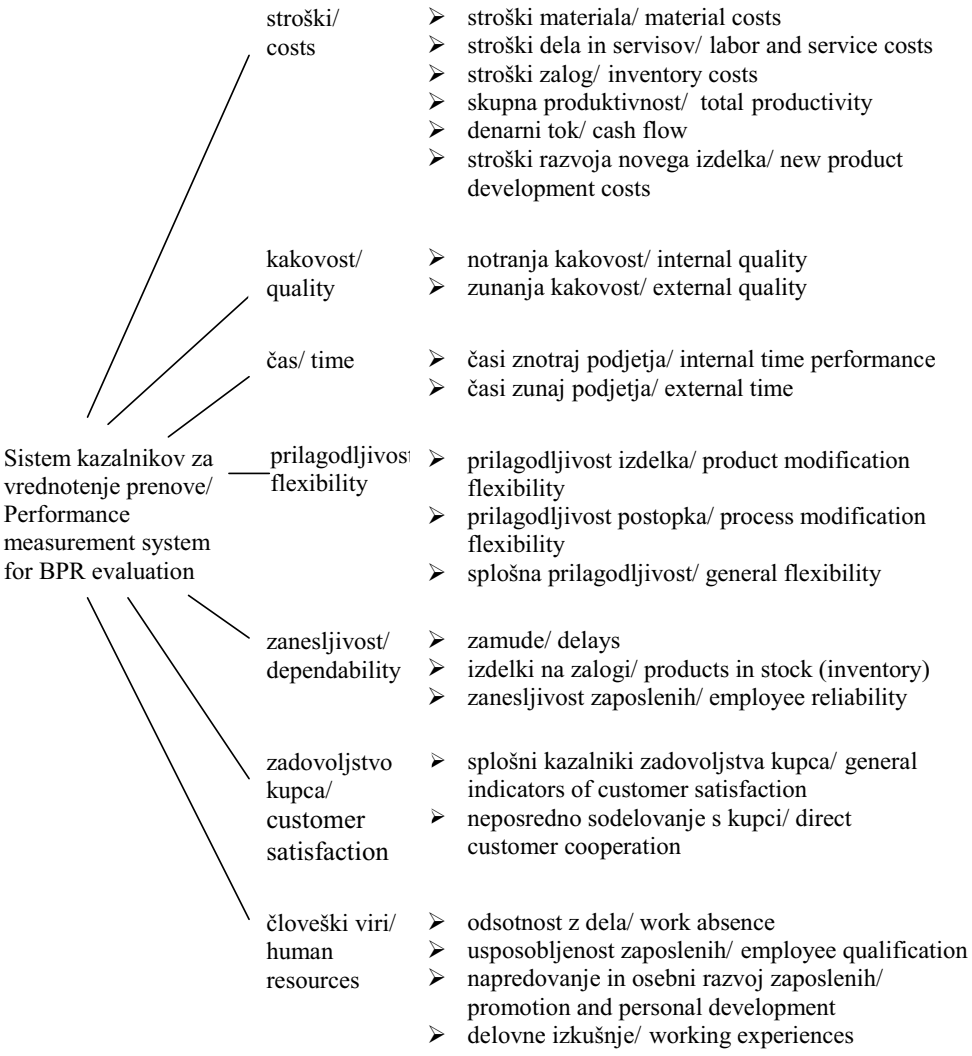
Pri obravnavanju posamičnih meritev izvedbe je najpomembnejše dejstvo, da morajo izhajati iz strategije. Merjenje je lahko "postopek kolikerosti", vendar je njegov glavni namen sprožiti pozitivno delovanje, in kot je izpostavil Mintzberg [38], je strategijo mogoče izpeljati samo s skladnim delovanjem in izvajanjem.

Kot najpomembnejši prispevek raziskave lahko izpostavimo razvoj sistema kazalnikov za vrednotenje prenove poslovnih tokov. Za

nuances of performance). Generally, a compromise is reached by making sure that there is a clear link between the competitive strategy, the key performance indicators that reflect the main performance objectives, and the bundle of detailed measures for key performance indicators [37].

Individual performance measures need to be positioned in a strategic context. Measuring may be the "process of quantification", but its effect is to stimulate action, and as Mintzberg [38] has pointed out, it is only through consistency of action that strategies are realized.

The most important contribution of the presented survey research is the development and validation of new variables when addressed to the di-



Sl. 3. *Sistem kazalnikov za vrednotenje prenove poslovnih postopkov*
Fig. 3. *Performance measurement system for BPR evaluation*

oblikovanje novih spremenljivk smo uporabili metode, ki sicer niso tako pogoste in izhajajo iz znanstvenega področja psihometrike. Pri oblikovanju spremenljivk smo uporabili merilno orodje, ki smo ga temeljito preverili iz vidika zanesljivosti in veljavnosti. Tako lahko z gotovostjo rečemo, da so novo razvite spremenljivke, oblikovane na osnovi izkušenj, zanesljive in veljavne.

Ker so merilne lestvice, ki smo jih pri izvedbi raziskave razvili, zanesljive in veljavne, je drug zelo pomemben prispevek v tem, da je mogoče raziskavo ponoviti – s tem smo zagotovili ponovljivost raziskave.

mensions of BPR. In the study, infrequently used scientific methods were employed; these methods are normally used in the scientific area of psychometrics. For new variables development a measuring instrument that was thoroughly tested for reliability and validity was used. The new variables are, therefore, empirically based and shown to be reliable and valid.

Since a used measuring instrument has been tested for reliability and validity, the second important contribution of the paper is that the results drawn from our research are more likely to be repeatable.

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