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Influencing Indicators Determination - Precondition for Successful Innovation Management in Mechanical Industry

Borut LIKAR[1)], Janez KOPAČ[2)], Mirko MARKIČ[1)]* and *Tomaz KERN[3)]

1) Faculty of Management Koper,
University of Primorska,
Cankarjeva 5,
6000 Koper, **Slovenia**
2) Faculty of Mechanical Engineering
Universiy of Ljubljana
Aškerčeva 6
1000 Ljubljana, **Slovenia**
3) Faculty of Organizational Sciences,
University of Maribor
Kadričeva c. 55a,
4000 Kranj, **Slovenia**

borut.likar1@guest.arnes.si

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The purpose of the study was to establish the most important influencing parameters concerning innovation processes aimed at achieving improved business performance in the machinery and equipment manufacturing industry in Slovenia.
A five steps research methodology was applied. Initially, a group of variables among the statistical data was selected, and then some additional variables were defined. In the third step, the variables were dispersed among the following categories: input, process, indirect output and direct output variables. In the fourth step, reciprocal correlations among particular variables were calculated prior to the final selection of the most important correlations and their interpretation.
The influential input and process variables were estimated, and these indicate not only the sequence of activities but also particular areas where additional effort needs to be invested in innovation.
The research limitations are related to statistical methodology since the used correlation coefficient itself does not provide any information on the direction of the cause-effect relation. Further limitations are connected with statistical data failing to cover all the important topics related to the innovation performance within a company. There are also some misleading questions/definitions in the SURS/Eurostat which partially result in subjective results. The time delay factor also represents one of the limitations of the study. Namely, a change in certain influencing parameters (e.g. R&D expenditure) normally requires a certain period of time to actually come into effect.
The findings also represent a set of suggested guidelines in which enterprises, national policy leaders and also supporting environment organisations should put their efforts.
The way of analysing and interpreting the data deriving from the mechanical industry are new. Besides, the results and conclusion are also original and may be applied by the aforementioned target groups.

Određivanje utjecajnih pokazatelja - preduvjet za uspješno upravljanje inovacijama u strojarstvu

Izvornoznanstveni članak

Svrha ove studije bila je definiranje najznačajnijih utjecajnih parametara vezanih za procese inovacija kojima se želi ostvariti poboljšanje učinka poslovanja u industriji proizvodnje strojeva i opreme u Sloveniji.
Primijenjena je metodologija istraživanja u pet koraka. U početku je odabrana skupina varijabli iz statističkih podataka, a zatim su utvrđene dodatne varijable. U trećem koraku varijable su disperzirane u sljedeće kategorije: ulazne, procesne, posredne izlazne i neposredne izlazne varijable. U četvrtom koraku izvršen je izračun recipročnih korelacija između određenih varijabli prije finalnog odabira najznačajnijih korelacija i njihova tumačenja.
Izvršena je procjena utjecajnih ulaznih i procesnih varijabli, a one ukazuju ne samo na redoslijed aktivnosti nego i na određena područja u kojima valja uložiti dodatne napore u inovacije.
Ograničenja istraživanja odnose se na statističku metodologiju, budući da korišteni koeficijent korelacije sam po sebi ne pruža nikakve informacije o smjeru odnosa uzroka i posljedica. Daljnja ograničenja vezana su za činjenicu da statistički podaci ne pokrivaju sve važne teme u pogledu inovacijskog učinka u poduzeću. Osim toga, u Statističkom uredu Republike Slovenije/Statističkom uredu Europske unije (SURS/Eurostat) postoje određena pitanja i definicije koje vode u krivom smjeru, što jednim dijelom rezultira subjektivnim rezultatima. U ograničenja studije ubrajamo i faktor vremenske odgode. Radi se o tome da promjena određenih utjecajnih parametara (npr. izdatak za istraživanje i razvoj) obično zahtijeva određeno vrijeme da bi počela djelovati.
Nalazi ujedno predstavljaju i set predloženih smjernica prema kojima bi poduzeća, voditelji nacionalne politike kao i popratne ekološke organizacije trebale usmjeriti svoje napore.
Način analize i tumačenja podataka izvedenih iz strojarstva nešto je novo. Uz to su rezultati, kao i zaključak, originalni i mogu ih primijeniti gore navedene ciljne skupine.

1. Introduction

Pursuant to the collected statistical data [1], [2] alarming 21.1% of Slovenian companies prove to be innovative out of which 28.2% in the manufacturing sector. Special emphasis was given to the machinery and equipment manufacturing industry (statistical class DK29) [3], where 34.9% of companies actively pursue innovation.

What is more, an in-depth analysis noticeably shows that situation re innovation in SME is even worse where medium-sized companies record twice as less innovativeness as the large ones while small companies even fourfold less! [2].

Regarding the aforementioned it may be inferred that the machinery and equipment manufacturing industry in the EU and Slovenia is somewhat well developed yet there is still a great opportunity for improvement!

Consequently, key influential factors need to be defined for building grounds for implementation of concrete steps. The situation calls for a systemic and systematic approach [4-6].

Plenty of literature tackles different approaches to pursue innovation yet one of the fundamental ones proves to be an analysis of innovation processes on the basis of input, process and output groups of indicators, which tend to be relatively varied.

Input indicators (also referred to as "investment" indicators) include e.g. expenditure on R&D or employees training [7], [8]. Process indicators take into account the organisation or management of innovation processes, the use of appropriate management techniques (market research, problem analysis and idea creation techniques, forecasting techniques, etc.), and innovation environment within a company. On the other hand, output indicators identify results, e.g. the number of patents and new products, market shares, revenues from the sales of innovations and innovative products etc. [9], [10]. Many researches showed correlations among input, process and output variables. Thus, Hollenstein showed correlations between input indicators (e.g. research input, development input) and output-oriented indicators (e.g. number of patents, number of innovation projects) and market-oriented measures (sales share of new products) – thus indicating the innovativeness of a firm [11]. Iansiti showed correlations among input indicators (e.g. technology from suppliers, technology from other groups) and process indicators (e.g. research groups, project management, communication) and technological potential and yield [7].

The results of Parthasarthy's study show [12] that both innovation input and innovation process have implications for innovation frequency, i.e. a number of new products introduced. He realised that R&D intensity, by itself, positively influences the invented technologies; developing them into new products and marketing them frequently requires a corresponding level of functional integration.

Regardless of the fact that many approaches try to solve the aforementioned problem, i.e. defining the key influential factors, an apposite method has thus far not been developed. The aforementioned methods hold another important limitation, namely they were all tested on somewhat small sample of companies and failed to focus on the machinery and equipment manufacturing industry.

2. Design of the research

The Statistical Office of the Republic of Slovenia (henceforth: SURS) collected the data on target industry (the latest data available is single series collected in the period from 2001 to 2002). The said data was collected pursuing standardized methodology [13], [14], [15] which represents the basis for a systematic research and took into consideration a total of 152 companies in its research. Pursuant to the Classification of Products by Activity [3], our research encompassed Slovenian companies from statistical class DK29: manufacture of machinery and equipment and was conducted in the following steps.

2.1. Definition of variables

At the outset, a group of variables was selected from the statistical data using the SURS/Eurostat methodology. In addition to the SURS variables, some additional ones were defined for the purposes of this research.

The variables were then classified in the following groups of categories (see Table 1): input variables (henceforth: v), process variables (henceforth: p), output indirect variables (henceforth: ip), output direct variables (henceforth: in).

Table 1. The table presents variables used in the survey. A more detailed explanation of variables based on CIS and a way of data collection is available in original survey materials [13], [15]. From the Answer (measurement unit) it is evident whether the variable is continuous or categorical, which represents a reason for using Spearman's coefficient of correlation.
Legend: SLO = Slovenia, SIT = Slovenian Tolar replaced with EUR in 2007 (1 Tolar = 239.64 EUR), R&D = Research and Development

Tablica 1. Tablica prikazuje varijable korištene u elaboratu. Podrobnije objašnjenje varijabli baziranih na CIS-u i način prikupljanja podataka može se naći u originalnim materijalima elaborata[13], [15]. Iz odgovora (mjerne jedinice) vidi se je li varijabla kontinuirana ili kategorijalna, što je razlog za uporabu Spearmanovog koeficijenta korelacije. Legenda: SLO = Slovenija, SIT = slovenski Tolar koji je 2007. godine zamijenjen Eurom (1 EUR = 239.64 Tolara), R&D = Istraživanje i razvoj

Variable / Varijabla	**Answer (measurement unit) / Odgovor (mjerna jedinica)**
Input / Ulazne varijable	
Total number of employees (v1) / Ukupan broj zaposlenika (v1)	No. of employees / broj zaposlenika
Proportion of employees with at least higher education (v2) / Udio zaposlenika s najmanje višom školskom spremom (v2)	Proportion / udio
Strategy – introduction of new or significantly improved corporate strategies (v3) / Strategija – uvođenje novih ili bitno poboljšanih korporativnih strategija (v3)	yes, no / da, ne
Management – introduction of advanced management techniques within your company (v4) / Upravljanje – uvođenje naprednih tehnika upravljanja unutar vašeg poduzeća (v4)	yes, no / da, ne
Organisation – introduction of new or significantly improved organizational structures (v5) / Organizacija – uvođenje novih ili bitno poboljšanih organizacijskih struktura (v5)	yes, no / da, ne
Intramural research & experimental development (R&D) expenditure (v6) / Izdatci za razvoj unutarnjeg istraživanja i eksperimentalnog razvoja (R&D) (v6)	proportion of all expenditures / udio u ukupnim izdatcima
Extramural research & experimental development (R&D) expenditure (v7) / Izdatci za razvoj vanjskog istraživanja i eksperimentalnog razvoja (R&D) (v7)	proportion of all expenditures / udio u ukupnim izdatcima
Expenditure for acquisition of machinery and equipment (v8) / Izdatci za nabavu strojeva i opreme (v8)	proportion of all expenditures / udio u ukupnim izdatcima
Expenditure for acquisition of other external knowledge (v9) / Izdatci za stjecanje drugih vanjskih znanja (v9)	proportion of all expenditures / udio u ukupnim izdatcima
Expenditure for training personnel directly aimed at the development and/or introduction of innovations (v10) / Izdatci za osoblje koje vrši obuku neposredno usmjerenu na razvoj i/ili uvođenje inovacija (v10)	proportion of all expenditures / udio u ukupnim izdatcima
Expenditure for marketing new products and services / total expenditure of a company (v11) / Izdatci za marketing novih proizvoda i usluga u odnosu na ukupne izdatke poduzeća (v11)	proportion of all expenditures / udio u ukupnim izdatcima
Design, other preparations for production/deliveries expenditure (v12) / Izdatci za idejno rješenje i druge pripreme za proizvodnju/isporuke (v12)	proportion of all expenditures / udio u ukupnim izdatcima
Total innovation expenditure (v13) / Ukupni izdatci za inovacije (v13)	proportion / udio
Innovation activities coverage – revenues arising from performing own activities (v14) / Pokrivanje rada na inovacijama – prihod od vlastitog rada (v14)	(x 1000) SIT
Innovation activities coverage – subsidies, grants… (v15) / Pokrivanje rada na inovacijama – subvencije, potpore… (v15)	(x 1000) SIT
Process / Procesne varijable	
Innovation cooperation with other enterprises in SLO (p1) / Suradnja na inovacijama s drugim poduzećima u SLO (p1)	yes, no / da, ne
Innovation cooperation with suppliers of equipment, materials, components or software in SLO (p2) / Suradnja na inovacijama s dobavljačima opreme, materijala, komponenata ili programske podrške u SLO (p2)	yes, no / da, ne
Innovation cooperation with customers in SLO (p3) / Suradnja na inovacijama s kupcima u SLO (p3)	yes, no / da, ne
Innovation cooperation with competition in SLO (p4) / Suradnja na inovacijama s konkurentima u SLO (p4)	yes, no / da, ne
Innovation cooperation with consultants in SLO (p5) / Suradnja na inovacijama s konzultantima u SLO (p5)	yes, no / da, ne

Innovation cooperation with commercial laboratories or R&D enterprises in SLO (p6) / Suradnja na inovacijama s komercijalnim laboratorijima ili poduzećima za istraživanje i razvoj u SLO (p6)	yes, no / da, ne
Innovation cooperation with universities or other higher education institutes in SLO (p7) / Suradnja na inovacijama sa sveučilištima ili drugim ustanovama višeg obrazovanja u SLO (p7)	yes, no / da, ne
Innovation cooperation with state or private non-profit research institutes in SLO (p8) / Suradnja na inovacijama s državnim ili privatnim neprofitnim znanstveno-istraživačkim ustanovama u SLO (p8)	yes, no / da, ne
Innovation cooperation with EU or EFTA member states – other enterprises (p9) / Suradnja na inovacijama s državama članicama Europske unije ili Europske slobodne trgovinske zone – druga poduzeća (p9)	yes, no / da, ne
Innovation cooperation with EU or EFTA member states – suppliers (p10) / Suradnja na inovacijama s državama članicama Europske unije ili Europske slobodne trgovinske zone – dobavljači (p10)	yes, no / da, ne
Innovation cooperation with EU or EFTA member states – customers (p11) / Suradnja na inovacijama s državama članicama Europske unije ili Europske slobodne trgovinske zone – kupci (p11)	yes, no / da, ne
Innovation cooperation with EU or EFTA member states – competition (p12) / Suradnja na inovacijama s državama članicama Europske unije ili Europske slobodne trgovinske zone – konkurencija (p12)	yes, no / da, ne
Innovation cooperation with EU or EFTA member states – consultants (p13) / Suradnja na inovacijama s državama članicama Europske unije ili Europske slobodne trgovinske zone – konzultanti (p13)	yes, no / da, ne
Innovation cooperation with EU or EFTA member states – commercial laboratories or R&D enterprises (p14) / Suradnja na inovacijama s državama članicama Europske unije ili Europske slobodne trgovinske zone – komercijalni laboratoriji ili poduzeća za istraživanje i razvoj (p14)	yes, no / da, ne
Innovation cooperation with EU or EFTA member states – universities (p15) / Suradnja na inovacijama s državama članicama Europske unije ili Europske slobodne trgovinske zone – sveučilišta (p15)	yes, no / da, ne
Innovation cooperation with EU or EFTA member states – state or private non-profit research institutes (p16) / Suradnja na inovacijama s državama članicama Europske unije ili Europske slobodne trgovinske zone – državne ili privatne neprofitne znanstveno-istraživačke ustanove (p16)	yes, no / da, ne
Sources of information – within the enterprise (p17) / Izvori informacija – unutar poduzeća (p17)	0-was not applied, 1-low, 2-medium, 3-high) / 0-nije primijenjeno, 1-slabo, 2-srednje, 3-jako
Sources of information – other enterprises within a group of enterprises (p18) / Izvori informacija – druga poduzeća unutar skupine poduzeća (p18)	the same / isto
Sources of information – supplier of equipment, material, components, software (p19) / Izvori informacija – dobavljači opreme, materijala, komponenata, programske podrške (p19)	the same / isto
Sources of information – clients and customers (p20) / Izvori informacija – kupci i klijenti (p20)	the same / isto
Sources of information – competition within a branch (p21) / Izvori informacija – konkurenti unutar jedne industrijske grane (p21)	the same / isto
Sources of information – universities and other higher education institutions (p22) / Izvori informacija – sveučilišta i druge ustanove višeg obrazovanja (p22)	the same / isto
Sources of information – state or private non-profit research institutes (p23) / Izvori informacija – državne ili privatne neprofitne znanstveno-istraživačke ustanove (p23)	the same / isto
Sources of information – competition, meetings, publications (p24) / Izvori informacija – konkurencija, sastanci, publikacije (p24)	the same / isto
Sources of information – fairs, exhibitions (p25) / Izvori informacija – sajmovi, izložbe (p25)	0-was not applied, 1-low, 2-medium, 3-high) / 0-nije primijenjeno, 1-slabo, 2-srednje, 3-jako)
Hindering factors – excessive risk (p26) / Ometajući faktori – pretjerano visoki rizik (p26)	0-unimportant, 1-low, 2-medium, 3-high / 0-nije primijenjeno, 1-slabo, 2-srednje, 3-jako)
Hindering factors – excessive innovation costs (p27) / Ometajući faktori – pretjerano visoki troškovi inovacije (p27)	the same / isto
Hindering factors – lack of appropriate sources of finance (p28) / Ometajući faktori – nedostatak odgovarajućih izvora financiranja (p28)	the same / isto
Hindering factors – organisational rigidities within the enterprise (p29) / Ometajući faktori – organizacijske krutosti unutar poduzeća (p29)	the same / isto
Hindering factors – lack of qualified personnel (p30) / Ometajući faktori – nedostatak kvalificiranog osoblja (p30)	the same / isto
Hindering factors – lack of information on technology (p31) / Ometajući faktori – nedostatak informacija o tehnologiji (p31)	the same / isto

Hindering factors – lack of information on markets (p32) / Ometajući faktori – nedostatak informacija o tržištima (p32)	the same / isto
Hindering factors – rules, regulations and standards (p33) / Ometajući faktori – pravila, propisi i standardi (p33)	the same / isto
Output indirect / Posredne izlazne varijable	
Did the company introduce onto the market any new or significantly improved products? (ip1) / Je li poduzeće izbacilo na tržište nove ili bitno poboljšane proizvode? (ip1)	yes, no / da, ne
Did the enterprise introduce onto the market any new or significantly improved procedures? (ip2) / Je li poduzeće izbacilo na tržište nove ili bitno poboljšane postupke? (ip2)	yes, no / da, ne
Increased offer of products and services (ip3) / Povećana ponuda proizvoda i usluga (ip3)	0-unimportant, 1-low, 2-medium, 3-high / 0-nevažno, 1-slabo, 2-srednje, 3-jako
Improved quality in goods or services (ip4) / Poboljšana kvaliteta robe ili usluga (ip4)	the same / isto
Improved production flexibility (ip5) / Poboljšana fleksibilnost u proizvodnji (ip5)	the same / isto
Increased production capacity (ip6) / Povećani proizvodni kapacitet (ip6)	the same / isto
Decreased costs of salaries per produced unit/transaction (ip7) / Smanjeni troškovi plaća po proizvedenoj jedinici/transakciji (ip7)	the same / isto
Reduced required material or energy per produced unit/transaction (ip8) / Smanjena potrebna količina materijala ili energije po proizvedenoj jedinici/transakciji (ip8)	the same / isto
Improved environmental impact or health and safety aspects (ip9) / Poboljšani utjecaj na okoliš ili zdravstveni i sigurnosni aspekti (ip9)	the same / isto
Fulfilled rules, regulations or standards (ip10) / Ispunjena pravila, propisi ili standardi (ip10)	the same / isto
Lack of customer responsiveness to new goods or services (ip11) / Nedostatak reakcije kupaca na novu robu ili usluge (ip11)	the same / isto
Marketing - Changing significantly your enterprise's marketing concepts/strategies (ip12) / Marketing - Značajne promjene u koncepcijama/strategijama marketinga vašeg poduzeća (ip12)	yes, no / isto
Aesthetic change (or other subjective changes) - Significant changes in the aesthetic appearance or design or other subjective changes in at least one of your products (ip13) / Estetska promjena (ili druge subjektivne promjene) - Značajne promjene u estetskom izgledu ili dizajnu, ili druge subjektivne promjene u najmanje jednome od vaših proizvoda (ip13)	yes, no / isto
In Slovenia – patent (ip14) / U Sloveniji – patent (ip14)	No./ br.
In Slovenia – model (ip15) / U Sloveniji – model (ip15)	No./ br.
In Slovenia – sample (ip16) / U Sloveniji – uzorak (ip16)	No./ br.
In Slovenia – trademark (ip17) / U Sloveniji – zaštitni znak (ip17)	No./ br.
In Slovenia – protected rights (ip18) / U Sloveniji – zaštićena prava (ip18)	No./ br.
Abroad – patent (ip19) / U inozemstvu – patent (ip19)	No./ br.
Abroad – model (ip20) / U inozemstvu – model (ip20)	No./ br.
Abroad – sample (ip21) / U inozemstvu – uzorak (ip21)	No./ br.
Abroad – trademark (ip22) / U inozemstvu – zaštitni znak (ip22)	No./ br.
Abroad – protected rights (ip23) / U inozemstvu – zaštićena prava (ip23)	No./ br.
Output direct / Neposredne izlazne varijable	
Enterprise's revenues arising from new product or service / net revenues from sales (in1) / Prihodi poduzeća koji su rezultat novog proizvoda ili usluge / neto prihodi od prodaje (in1)	proportion / udio
Market's revenues arising from new product or service / net revenues from sales (in2) / Tržišni prihodi koji su rezultat novog proizvoda ili usluge / neto prihodi od prodaje (in2)	proportion / udio
Enterprise's revenues arising from new product or service for export / net revenues from sales (in3) / Prihodi poduzeća koji su rezultat novog proizvoda ili usluge za izvoz / neto prihodi od prodaje (in3)	proportion / udio
Market's revenues arising from new product or service for export / net revenues from sales (in4) / Tržišni prihodi koji su rezultat novog proizvoda ili usluge za izvoz/ neto prihodi od prodaje (in4)	proportion / udio
Enterprise's profit (in5) / Dobit poduzeća (in5)	(x 1000) SIT
Profit/employee (in6) / Dobit/zaposlenik (in6)	(x 1000) SIT
Profit/total revenue (in7) / Dobit/ukupan prihod (in7)	proportion / udio
Increased market or market share (in8) / Povećano tržište ili udio na tržištu (in8)	0-unimportant, 1-low, 2-medium, 3-high / 0-nevažno, 1-slabo, 2-srednje, 3-jako

2.2. Data analysis

The results of simple statistics encompassed number of companies included in the research, mean value and standard deviation.

The crucial part of our research concerns the comparison – through correlation – of input, process and output (indirect and direct) variables. The Spearman's coefficient of correlation (henceforth: SCC) was used for calculating the correlation coefficients. The SCC were defined with restriction to those with SCC>=0.2 and p<=0.05.

From the statistical point of view the used correlation coefficient itself does not provide any information on the direction of the cause-effect relation. But in a case of understanding the process, reasons and consequences and other variables as well, the correlation coefficient can be applied carefully for interpreting the cause-effect relation. Therefore, the correlation among indicators could be used as a rough measurement of influence of the mentioned input/process indicator.

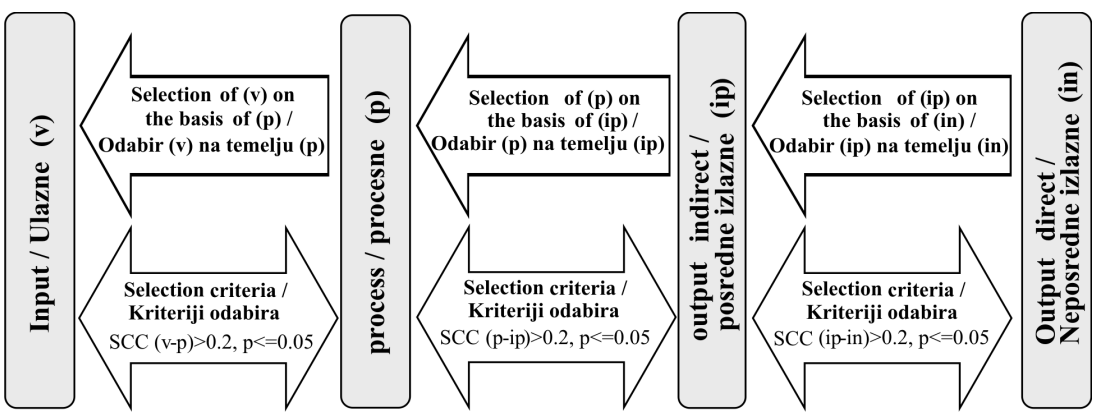

Figure 1. The picture indicates the method of variables selection and types of connections/correlations assessed
Slika 1. Slika prikazuje metodu odabira varijabli kao i vrste procijenjenih veza/korelacija

2.3. Correlations of variables

The so-called retrospective demonstration [16] was applied in our analysis (see Figure 1). The results presented as "output direct" variables, served as a starting point. Special emphasis was placed to a part of these variables which were regarded as dependent: enterprise's revenues arising from new product or service/net revenues from sales (in1), market's revenues arising from new product or service/net revenues from sales (in2), enterprise's profit (in5) and increased market or market share (in8).

On the basis of these selected variables, the influential independent "output indirect" variables related to "output direct" with the highest SCC were determined. Taking into account thus defined "output indirect" variables (in this step dependent), the process was repeated and "process" variables (independent) connected with "output indirect" variables were defined.

After defining these important "process" factors, attention was paid to their correlation with "input" variables. The procedure was repeated and "input" variables (independent), which correlate with "process" (now dependant) variables, were thus defined.

3. Results

The results of correlations according to the Figure 1 and data in Table 1 are presented in Table 2.

3.1. Correlations between "output direct" and "output indirect" variables

Particularly strong correlation may be established with the following two variables: implementing new or considerably improved products (ip1) and process (ip2). It seems that these variables have a great influence on the revenues arising from the introduction of new product or service for the enterprise (in1 – i.e. a product which is new for the company yet already exists on the market) and also the portion of revenues arising from the introduction of new product or service which represents a novelty on the market (in2). Calculated SCC values are 0.80-0.60.

The same output variables are also strongly correlated (0.20<SCC<0.25) with the following variables: marketing – a significant modification of enterprise's marketing concepts/strategies (ip12); reduction of requisite material or energy per produced unit/transaction (ip8) and an increase in production capacity (ip6).

Table 2. The results of correlations between pairs of variables as per groups
Slika 2. Rezultati korelacija između parova varijabli po skupinama

input / ulazne		**process / procesne**				**output indirect / posredne izlazne**				**output direct / neposredne izlazne**
independent / nezavisne	SCC	dependent / zavisne		independent / nezavisne	SCC	dependent / zavisne		independent / nezavisne	SCC	dependent / zavisne
v12	0.67	p2		p3	0.55	ip3		ip1	0,80	in2
v10	0.55	p2		p13	0.55	ip14		ip2	0,60	in2
v7	0.44	p22		p8	0.53	ip14		ip13	0,36	in1
v15	0.31	p24		p19	0.52	ip9		ip9	0,30	in5
v14	0.31	p22		p24	0.50	ip9		ip3	0,29	in8
v6	0.31	p22		p10	0.49	ip3		ip12	0,24	in2
v1	0.30	p22		p31	0.41	ip8		ip8	0,22	in2
v13	0.28	p31		p2	0.41	ip13		ip6	0,21	in2
v11	0.27	p25		p20	0.39	ip3				
v5	0.25	p33		p23	0.38	ip8				
v4	0.23	p33		p21	0.37	ip3				
				p25	0.37	ip1				
				p30	0.36	ip8				
				p33	0.33	ip6				
				p22	0.33	ip9				
				p17	0.28	ip3				
				p26	0.23	ip1				
				p29	0.23	ip13				
				p27	0.20	ip13				
				p32	0.20	ip13				

Other important influencing variables re in1, in5 or in8 seem to be: significant modifications in the aesthetic appearance or design (ip13); improved environmental impact or health and safety aspects (ip9) and an increase in the offer of products and services (ip3). Calculated SCC values are (0.29<SCC<0.36).

3.2. Correlations among "output indirect" and "process" variables

Based on the identified »output indirect« variables from the previous section, the aim of this step was to identify the influencing process variables.

The most important correlations were observed among the variables from the two aforementioned groups: innovation cooperation with customers (p3); research institutes in SLO (p8); EU or EFTA member states consultants (p13) and suppliers (p10) on one side and number of domestic patents (ip14) and consequentially an increased offer of products and services (ip3) on the other side. Calculated SCC values are in the region of 0.50.

Sources of information from suppliers of equipment, material, components, software (p19) and from competition, meetings, publications (p24) strongly correlate/influence the improved environmental impact or health and safety aspects (ip9), where SCC is over 0.50.

Other important factors (0.37<SCC<0.39) are sources of information from clients and customers (p20), the state or private non-profit research institutes (p23), competition within a branch (p21) and fairs, exhibitions (p25).

A look at the hindering factors influencing the possibility to reduce requisite material or energy per produced unit (ip8) and to increase production capacity (ip6) proves to be most interesting. The most important influencing factors (0.33<SCC<0.41) are assumed to be a lack of information on technology (p31), a lack of qualified personnel (p30) and rules, regulations and standards (p33).

A lack of information about the markets (p32) represents another hindering factor (SCC=0.23) in introducing new or considerably improved products (ip1). The other negative factors (0.20<SCC<0.23) influencing

significant modifications in the aesthetic appearance of product are supposed to be excessive innovation costs (p27), organisational rigidities within the enterprise (p29) and excessive risk involved (p26).

3.3. Correlations among "process" and "input" variables

In the previous section (Correlations among "output indirect" and "process" variables) we established that innovation-related cooperation with suppliers of equipment, materials, components or software in SLO (p2) is one of the important parameters. If the influencing input factors are examined, strong correlations (0.55<SCC<0.67) with the following input variables may be observed: design, other preparations for production/ deliveries expenditure (v12) and with expenditure for training personnel directly aimed at the development and/or introduction of innovations (v10).

Various sources of information (p22, p24) also proved to be important (correlated with other process variables). They mainly correlate (0.30<SCC<0.44) with: extramural research & experimental development (R&D) expenditure (v7), innovation activities coverage – subsidies, endowments…(v15) , innovation activities coverage – revenues arising from performing own activities (v14) and intramural research & experimental development (R&D) expenditure and total number of employees (v6).

Other influencing factors (0.23<SCC<0.28) seem to be a total innovation expenditure (v13), the expenditure for marketing new products and services / total expenditure of a company (v11), an introduction of new or significantly improved organizational structures (v5) and an introduction of advanced management techniques within the company (v4).

4. Summary of the results and discussion

The most important result of the innovation activity is an increased market share and consequently revenues and profit. The presented research established that the output indirect variables seem to have the most significant direct influence on the aforementioned, namely the introduction of new or considerably improved products (ip1) and processes (ip2). An alarming 25% of companies which perform only a small portion of appropriate innovation activities may be found in Slovenian machinery and equipment manufacturing sector. At the same time one extremely important fact needs to be taken into consideration, i.e. an enterprise – regardless of its size – is classified in the statistical group of innovative enterprises by introducing only one new product. The latter thus represents a »statistical benefit« for large companies. The next important parameter is a significant modification in the aesthetic appearance or design (ip13), yet the statistics show that there are still 63 % of all enterprises which fail to perform such activities. Pertaining to the aforementioned output results, it is important to mention that a moderate influence of modifications in marketing concepts/strategies (ip12) which are introduced by only 28 % of enterprises and reduced required material or energy per produced unit/transaction (ip8) which may be established in 36.8 % of analysed enterprises. Last but not least, it seems that the environmental factor (ip9) is becoming more and more important. The eco-management [17] is especially important for countries in transition as well as less-developed countries. An important consequence of the innovation activity is also an increased market or market share (in8), which is significantly influenced by increased offer of products and services (ip3) – the answers also indicate that this factor is regarded as important by companies (value 2.2 on scale 0-unimportant, 1-low, 2-medium, 3-high).

Surprisingly, an improved environmental impact or health and safety aspects (ip9) moderately influences the enterprise's profit (in5). The latter seems to be a positive side-effect of global environmental efforts.

The analysis of correlations among "output indirect" and "process" variables shows the highest values among the increased offer of products or services (ip3) on one hand and the sources of information obtained from customers and clients (p3, 37.5 % of all companies are using such sources) and also research institutes (p8, 33 % of all companies cooperate with them) on the other. The fact that there is no significant correlation between innovation cooperation with suppliers of equipment, materials, components or software (p2, even though 46 % of all companies cooperate with them) and introduction of new/improved products/procedures (ip1, ip2) should not be neglected. We could reasonably expect that a leading strategy was influenced considerably by the information received from the suppliers of equipment, material, components, software as well as universities and research institutes and also by adequate quality management [18] yet the influence proves to be rather moderate. With regard to the aforementioned facts, it may be concluded that the companies pursue the strategy of followers yet there are some indices that some of the companies strive towards following the leading strategy.

As for the hindering factors, namely a shortage of information on technology (p31), a shortage of qualified personnel (p30) and rules, regulations and standards (p33), it was established that these factors are also significantly related with overcoming the extant state. Notwithstanding the fact that the companies fail to find the said factors very important (values of simple statistics around 1 on the scale of 0-unimportant and 3-high), we are convinced that these factors are crucial!

As regards the "process" and "input" variables, the most important influencing input variables are suggested: design and other production/deliveries preparations expenditure (v12, its value is almost 0!) and the expenditure for training personnel directly aimed at the development and/or introduction of innovations (v10, again its value is almost 0!). It may be established that these influencing parameters are very important even though the companies fail to make any investment into the said activities - but they obviously should! Other influencing factors are intramural/extramural R&D expenditure, innovation activities coverage – subsidies, endowments as well as revenues arising from performing own activities (v6, v7, v14, v15).

In other words, a different sample shows very comparable results as surveys by Mulej [25] and by Uršič [26].

5. Conclusions

Despite many encouraging indicators and at times somewhat misleading statistical data, only a moderate portion of innovative potential of enterprises is exploited. The incontestable fact remains that the influence of innovation on the entire profit as well as on revenues arising from the new products remains too low.

We are thus strongly convinced that a clear strategy [19] of innovation and related further activities are the most important factor in a comprehensive management of innovation processes within an enterprise [20]. As evident from the research results, an adequate training [21], which is also one of the priorities of the EU programmes, is one of the first steps. Further steps are related to the establishment of an adequate organisational environment (which the SURS research fails to encompass). It is also essential to exploit all available resources - national and international – and to strive towards improving cooperation with organisations having knowledge (universities, R&D institutes) also of the forthcoming technologies. Such approach definitely leads towards a significantly increased value added! The design proves to be very important as well [22]! At the same time, the influence of lost/stolen ideas and intellectual property rights (which has become more and more important) cannot be neglected [23].

The conditions within the company need to be prepared in order for the inventions to become innovations. Results of our research indicate that there are some parameters/ activities which are extremely important but are not recognised and not financed as crucial. It remains essential to decide where to invest efforts and other resources.

A comprehensive and systematic approach is required since the innovation put on the market is only the last of the links in the invention-innovation chain. One of the most important steps is definitely "innovation of management" so that later on such management would be able to efficiently manage the innovation process. We are strongly convinced that creative way of thinking is an essential value – as claimed by Mulej [24] – and in relation with knowledge and determination this value proves to be even the most important factor. In order to support this the labour law legislation needs to be flexible enough to promote efficient employment and remuneration of employees [29].

Thus, Slovenia is only beginning its way from the institutional to the real transitional into an innovative economy and society [27, 28].

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