CODEN STJSAO
ZX470/1374
ISSN 0562-1887
UDK 658.5:658.3:65.012.2

Influence of Polyvalence Professionals on Product Development Process Efficiency

Jure MEGLIČ, Tomaž KERN, Benjamin URH, Janez BALKOVEC* and *Matjaž ROBLEK

Faculty of organisational sciences,
University of Maribor,
Kidričeva cesta 55a
4000 Kranj
Slovenia

jure.meglic@fov.uni-mb.si

Original scientific paper

Product development is one of a company's key processes for meeting customer demands, providing long-term market share growth, revenues and company value. The main question we are addressing in this paper is how the professionals with more and better developed competencies (polyvalence professionals) increase efficiency of the product development process. We presume that the efficiency of the product development process is significantly influenced by the matching rate between the competencies of professionals and the task requirements of the process. The hypothesis was tested in an international study in which five footwear companies from three European countries participated. By analysing variances and using correlation and regression analyses, we prove the influence of polyvalence professionals on the product development process efficiency. We also prove that polyvalence professionals are the strategic resources who provide a company's long-term competitive advantage, allowing efficient development of new products thus having high response rate to customer demands.

Utjecaj polivalentnosti zaposlenih na efikasnost procesa razvoja proizvoda

Izvornoznanstveni članak

Razvoj proizvoda jedan je od najvažnijih procesa u poduzećima za zadovoljavanje potreba potrošača, ostvarivanja dugoročnog porasta tržišta, prihoda i vrijednosti poduzeća. Osnovno pitanje našeg istraživanja jest, kako zaposleni s više i bolje razvijenim kompetencijama (polivalentni zaposleni) povećavaju efikasnost procesa razvoja proizvoda. Oslanjamo se na hipotezu da na efikasnost procesa razvoja proizvoda značajno utječe kvocijent između kompetencija zaposlenih i zahtjeva aktivnosti u procesu. Hipoteza je bila provjerena u međunarodnoj provjeri gdje je surađivalo pet obućarskih poduzeća iz tri europske zemlje. Analizom varijabli i upotrebe korelacijske i regresijske analize, potvrđuje se utjecaj polivalentnih zaposlenih na efikasnost procesa razvoja proizvoda. Također se potvrđuje da su polivalentni zaposleni, strateški resursi, koji poduzeću ostvaraju dugoročnu kompetitivnu prednost, omogućavajući efikasan razvoj novih proizvoda s visokim utjecajem potrošača.

Keywords
Allocation
CAD
Competencies
PDM
Polyvalence professionals
Product development process

Ključne riječi
Alokacija
CAD
Kompetencije
PDM
Polivalentni zaposleni
Proces razvoja proizvoda

Received (primljeno): 2008-03-15
Accepted (prihvaćeno): 2009-02-27

1. Introduction

A product development process has a successful product as its main objective. In order to be considered successful a product has to satisfy the needs of the customer better than the competitors [12-13, 35]. The economic importance of product development is well illustrated by the fact that the main part of product value is determined in the product development process [43]. A product development process transforms customer's needs into realistic product specifications and gives practical value to the product. The primary technology of the product development process is the competencies of professionals. In addition, we can no longer consider product development process merely as a narrowly defined process of technical product specifications.

In our study, we wanted to demonstrate the relation between the efficiency of the product development process and the polyvalence professionals[1]. The study is based on the assumptions that polyvalence professionals have the greatest influence on the product development efficiency. Besides influences from professionals,

[1] The polyvalence professional is an employee who has developed more and better his competencies, which are most important to sucessfully perform his role in the product development process and consequently achieves better results.The synonym polyvalence is taken from the chemistry definition.

companies are constantly subjected to changes from external and internal environment [36]. When reaching their planned or desired business objectives, companies depend strongly on their efficiency, i.e. the efficiency of using their resources. The main economic rule that drives all companies into constant competition is the difference between the obtained and the invested assets (in most cases we talk about the financial aspects, i.e. revenues as a consequence). Because of this, companies try various approaches to preserve a sufficient level of economies and management techniques developing the products.

The most suitable technique, i.e. the method of human resources allocation, was not the subject of our study. We wanted to prove that the polyvalence professionals within the product development process are the factor which significantly influences the efficiency of the product development process. It is also an important condition to create and use the most suitable method for the allocation of human resources and product development process organisation so as to achieve higher efficiency. Within the framework of the research, we thus focused on the following hypotheses:

H1 – There is a positive relation between the number of tasks performed in a single execution of the process and the matching rate of competency polyvalence defined by the process tasks requirements. The higher the rate, the greater the number of tasks executed within the process.

H2 – There is a negative relation between the matching rate of the competency polyvalence defined by the process tasks requirements, the number of participants in the process and the number of tasks in the process. The higher the rate, the lower the relation between the number of participants and the number of executed tasks within the process.

H3 – There is a negative relation between the time needed for executing the process and the matching rate of competency polyvalence defined by the process tasks requirements. The higher the rate, the shorter the time needed for executing the process.

H4 – There is a negative relation between the number of messages within the process and the matching rate of competency polyvalence defined by the process tasks requirements. The higher the rate, the lower the number of messages within the process.

H5 – There is a negative relation between the frequency of errors, i.e. causing standstills in the process and the matching rate of competency polyvalence defined by the process tasks requirements. The higher the rate, the lower the number of errors, i.e. standstills within the process.

2. Material and methods

In our study, we used the exploratory research approach in two main phases. The study was carried out in five medium-sized competitive companies from various countries: Austria, Slovenia and Croatia, all of them in the footwear industry. We were looking for a statistical relation between competencies of the employees and efficiency of the product development process. Furthermore, we tried to identify the most relevant competencies. The efficiency of the product development process within the companies was measured using the following indicators: 1) the time between the creation of an idea to the start of production (IN1), 2) the ratio between the number of employees and the number of tasks (IN2), 3) the ratio between the number of messages and the number of tasks (IN3), 4) the number of tasks performed in a single repetition of the process (IN4) and 5) the number of standstills within the process (IN5).

In the first phase of our study, we established a realistic eEPC model (also known as AS-IS model) of the product development process for each of the participating companies. These models were based on the objective approach of business process modelling [17] and were recorded as structural eEPC models [39]. The main ingredients of the process are resources, tasks and messages. The resources include human resources, materials for work and the objects of work. The key characteristic of the human resources is that they perform work and are able to accept decisions about it. The tasks are defined as a group of occurrences within the process, which have important features in common and are relatively tightly connected. The messages are the ingredients of the process and consist of data and form. The document is the carrier of the message, which gives the source (sufficient) information on how to perform a particular task.

In the second phase, we formed lists of competencies required for tasks including a structuralised presentation of the process and lists of competencies of human resources based on interviews performed at a particular company [21]. When creating the competency profiles within the product development process, we used the McClelland approach involving the cognitive aspect (the theory of consistency), which shows his perspective of three elements that form the personality of an individual: the motive, the features and the schemes. The proposed competence concept is multi-form because it involves knowledge, skills and behaviour of the professionals. It is also multi-level because it can be described using an individual or a collective aspect [15], where process task is characterized by all competencies necessary for its execution. Based on this and previous mentioned cognitions, we created the final list of 88 required competencies (see Appendix), which are specific for the product development process in the footwear industry.

With the questionnaire, based on the five level Likert scale, we first tested the importance of the influence of a particular competency in achieving efficiency within the product development process. Assessment of the development of an employee's particular competency was carried out using the 360-degree assessment procedure as the second step. The most important outcome of the 360-degree assessment procedure is objectivity of the assessment procedure, where the ratter groups were self, boss, peer, and direct report [34]. The final assessment of a particular competency for a professional was calculated on the basis of average assessment of all four assessors.

We then calculated the new variable CC (we defined it as the difference between the assessment of the importance of a competence within the product development process and the assessment of the development of a competence on the level of an professional within the process, because we have to equalize the different assessment levels between investigated companies). With this newly calculated variable we performed a hierarchical regression and correlation analysis with an individual indicator of the process. As several factors influence the efficiency of the product development process, either directly or indirectly, the study space was limited to the influence of one of the factors, so that the other factors could be statistically supervised in a suitable way. The influence of other factors on the efficiency of the product development process was included by surveying the company's management using a special questionnaire. This special questionnaire took into consideration the factors from the external and internal company's environment.

As a principal population for determining the sample on which we performed the survey, we selected 76 employees involved in the product development process in selected companies. For the needs of assessing the influences of other factors on the efficiency of the process, the survey also covered 31 employees from company management. The objective of the second sample was to set up a statistical control from the influence of other factors from internal and external environment. The primary sample of 76 employees included 43,42 % women and 56,58 % men with an average age of 41,34 years and from 1 to 37 years of service, but there was no statistical relevant difference in competence assessment procedure. In their current company, the employees had been employed from 1 to 37 years; in the same job position from between 0,5 to 32 years. A more detailed overview of the general indicators is presented in the Table 1.

The average level of occupational or professional education of the assessed employees is slightly higher than secondary school education. The average level of education shows that women have a slightly higher education than men, but the difference is negligible. The main difference noticed during our survey was that the level of education differed more due to professional's country of origin.

3. Results

3.1. External and internal environment influences

When determining the basic research problem, which covers only a narrow section of human factors, we tried to include other factors as well that could have an important influence on the efficiency of product development. The first set of factors was formed in the broadest sense, i.e. factors from a broader environment. For the purposes of research, we did not need a detailed study of these factors, only their statistical surveillance in relation to the researched problem. The survey we used to measure the influence of an individual factor was carried out between the company management. We classified the factors into content segments and measured the influence of a particular factor by using an assessment of detailed and narrowly defined factors with the five-level Likert scale. To calculate the influence of an individual factor we used a multiple linear regression.

3.1.1. Influences from the broader external environment

The factors that we researched within the framework of a broader external environment include: the economic sub-environment (BEE1), the technological sub-environment (BEE2), the cultural sub-environment (BEE3), the demographic sub-environment (BEE4),

Table 1. Statistical overview of the sample by characteristic socio-demographic variables

Tablica 1. Statistički pregled uzorka kroz socijalno-demografske varijable

	Range	Median	Average	St.Dev.
(SDF1) Average age	23-61	41	41,34	8,682
(SDF2) Average years of service (total)	37-1	21	20,77	9,563
(SDF3) Average years of service within the company	37-0,67	13	14,92	9,152
(SDF4) Average years of service at the same job position	32-0,50	8	9,07	7,834
(SDF5) Average level of occupational or professional education	2-7	5	5,29	0,977

the political and legal sub-environment (BEE5) and the natural sub-environment (BEE6). We ascertained that the broader external environment influences the number of tasks performed in a single repetition of the process, the relation between the number of the employees, the number of tasks and the relation between the number of messages and the number of tasks.

3.1.2. Influences from the narrower external environment

The factors we researched within the framework of the narrower external environment include: the goods market (materials and products) (NEE1), the workforce market (NEE2), the capital market (NEE3) and the market for business and technical information (NEE4). The influence of the narrower external environment was demonstrated in practically all five indicators of efficiency.

3.1.3. Factors from the internal environment

The factors that we investigated within the framework of the internal environment are the ownership of the company (IF1), management and leadership (IF2), company organisation (IF3), financial conditions (IF4), infrastructure and the working conditions (IF5), technical and technological factors (IF6), information/communication technology (IF7), the culture organisation (IF8) and quality (IF9). We concluded that from all the internal environment factors within the product development process, the ownership of the company, quality, infrastructure and working conditions have the biggest influence.

3.2. Bivariate correlation analysis

We tried to ascertain the general tendency towards the relation between polyvalence professionals and the individual indicators of efficiency of product development process by using the correlation analysis. We decided on bivariate correlation analysis in order to calculate the Pearson coefficient of the correlation. We used the variable CC, which we defined as the difference between the competency of an individual and the company-assessed importance of individual competency (i.e. the company where the individual works). The table below presents the Pearson correlation coefficients for the indicators of efficiency in the product development process.

We noted a moderate negative statistical relation between the time needed for executing the process (H3) and the competencies. The majority of the competencies still correlate with a high level of trust with the indicator, but many can be found in the segment with 95 % trust as well, which still presents a very high level of trust. A rather strong negative statistical relation exists between competencies and the number of participants in the process (H2), which was expected. The polyvalence professionals ought to substantially influence a smaller circle of the employees related to the product development process as sources. With Competencies CC75, CC76 and CC84 there exists a positive relation with the indicator, but it is negligible. A negative statistical relation is evident between the competencies and the number of messages within the process (H4), which is important because it defines the use of special information (CAD) tools. We have also noted several positive correlations of competencies; however, the correlation factors are extremely low, making them statistically in significant. Between the number of process tasks in a single repetition and the competencies (H1) there exists an important statistical correlation with a high level of trust. In addition, we have noted four negatively correlated competencies CC48, CC75, CC76 and CC48; however, the correlation factor was not statistically significant. We can conclude that between the competencies and the frequency of errors, i.e. causing standstills in the process, there is a statistically typical negative relation (H5). We can also conclude, based on the analysis, that the polyvalence professionals have a positive effect in decreasing the number of errors, i.e. causing standstills in the process.

Table 2. Explanatory model of the influence of the control variables on the efficiency of the product development process. (The model shown presents the calculated values of ß coefficients of the influence of social demographic factors (SDF), internal factors (IF), factors from the narrower external environment (NEE) and factors from the broader external environment (BEE).

Tablica 2. Model utjecanja kontrolnih varijabla na efektivnost procesa razvoja proizvoda. (Model prikazuje kalkulirane vrijednosti ß koeficijenata utjecaja socijalno demografskih faktora (SDF), unutrašnjih faktora (IF), faktora bližnjeg vanjskog okruženja (NEE) i faktora šireg vanjskog okruženja (BEE).

	SDF2	SDF3	SDF4	SDF5	IF1	IF5	IF9	NEE1	NEE3	NEE4	BEE2	BEE3	BEE4	BEE5
H1	0	0	0	0	0,494	-0,413	-0,448	0,561	0	0	0	-0,463	0	0,584
H2	-0,273	0,376	0	0	-0,548	0,52	0,371	0,565	0	0	0,383	0,528	0	-0,837
H3	0	0	0	0	0	0	0,524	0	0,508	0	0	0	0	0
H4	0	0,221	-0,216	0,17	-0,414	0	0,371	0,419	0	0	0	0,423	-0,619	0
H5	0	0	0	0	0	0,442	0	0	0	0,484	0	0	0	0

Table 3. Bivariate correlation analysis with indicators of efficiency (*p = 0,05; **p = 0,01)

Tablica 3. Bivarijantna korelacijska analiza s indikatorom efektivnosti (*p = 0,05; **p = 0,01)

	H1	H2	H3	H4	H5		H1	H2	H3	H4	H5
CC01	0,499**	-0,530**	-0,421**	-0,184	-0,667**	**CC44**	0,350**	-0,379**	-0,383**	-0,052	-0,635**
CC02	0,527**	-0,553**	-0,442**	-0,254*	-0,650**	**CC45**	0,479**	-0,500**	-0,469**	-0,171	-0,638**
CC03	0,293*	-0,307**	-0,329**	-0,087	-0,453**	**CC46**	0,198	-0,236*	-0,113	-0,124	-0,455**
CC04	0,501**	-0,510**	-0,525**	-0,276*	-0,629**	**CC47**	0,266*	-0,274*	-0,277*	-0,188	-0,381**
CC05	0,18	-0,209	-0,196	0,054	-0,427**	**CC48**	-0,056	0,022	0,1	0,005	-0,227*
CC06	0,277*	-0,302**	-0,235*	-0,096	-0,450**	**CC49**	0,112	-0,138	-0,129	-0,038	-0,375**
CC07	0,432**	-0,419**	-0,543**	-0,329**	-0,498**	**CC50**	0,251*	-0,253*	-0,322**	-0,240*	-0,416**
CC08	0,491**	-0,461**	-0,619**	-0,525**	-0,485**	**CC51**	0,387**	-0,392**	-0,383**	-0,367**	-0,497**
CC09	0,304**	-0,319**	-0,260*	-0,193	-0,398**	**CC52**	0,507**	-0,493**	-0,567**	-0,292*	-0,465**
CC10	0,144	-0,164	-0,219	0,002	-0,418**	**CC53**	0,550**	-0,543**	-0,497**	-0,510**	-0,485**
CC11	0,212	-0,252*	-0,002	-0,157	-0,330**	**CC54**	0,399**	-0,405**	-0,375**	-0,235*	-0,432**
CC12	0,191	-0,226*	-0,062	-0,079	-0,347**	**CC55**	0,551**	-0,571**	-0,493**	-0,195	-0,630**
CC13	0,341**	-0,381**	-0,236*	0,02	-0,503**	**CC56**	0,584**	-0,613**	-0,537**	-0,246*	-0,779**
CC14	0,484**	-0,508**	-0,227*	-0,273*	-0,358**	**CC57**	0,662**	-0,673**	-0,568**	-0,446**	-0,671**
CC15	0,529**	-0,547**	-0,453**	-0,241*	-0,581**	**CC58**	0,428**	-0,426**	-0,500**	-0,105	-0,467**
CC16	0,645**	-0,674**	-0,322**	-0,379**	-0,485**	**CC59**	0,605**	-0,614**	-0,594**	-0,277*	-0,655**
CC17	0,538**	-0,582**	-0,295**	-0,211	-0,597**	**CC60**	0,346**	-0,383**	-0,340**	0,077	-0,599**
CC18	0,398**	-0,435**	-0,203	-0,147	-0,464**	**CC61**	0,261*	-0,275*	-0,256*	-0,117	-0,376**
CC19	0,504**	-0,518**	-0,365**	-0,249*	-0,436**	**CC62**	0,280*	-0,316**	-0,265*	0,054	-0,537**
CC20	0,410**	-0,451**	-0,197	-0,306**	-0,543**	**CC63**	0,198	-0,226*	-0,136	-0,106	-0,382**
CC21	0,278*	-0,334**	-0,071	-0,17	-0,538**	**CC64**	0,374**	-0,409**	-0,323**	0,004	-0,566**
CC22	0,384**	-0,403**	-0,332**	-0,091	-0,450**	**CC65**	0,172	-0,162	-0,238*	-0,182	-0,205
CC23	0,400**	-0,422**	-0,379**	-0,239*	-0,588**	**CC66**	0,227*	-0,213	-0,302**	-0,304**	-0,265*
CC24	0,309**	-0,324**	-0,232*	-0,339**	-0,413**	**CC67**	0,296**	-0,295**	-0,351**	-0,278*	-0,414**
CC25	0,083	-0,097	-0,131	-0,223	-0,356**	**CC68**	0,348**	-0,335**	-0,466**	-0,319**	-0,437**
CC26	0,333**	-0,356**	-0,288*	-0,188	-0,494**	**CC69**	0,503**	-0,508**	-0,488**	-0,326**	-0,553**
CC27	0,125	-0,152	-0,147	-0,089	-0,432**	**CC70**	0,064	-0,064	-0,06	-0,216	-0,127
CC28	0.04	-0,069	-0,03	-0,053	-0,323**	**CC71**	0,381**	-0,393**	-0,356**	-0,295**	-0,498**
CC29	0.173	-0,201	-0,215	-0,051	-0,495**	**CC72**	0,302**	-0,303**	-0,271*	-0,388**	-0,358**
CC30	0,471**	-0,485**	-0,469**	-0,192	-0, 585**	**CC73**	0,317**	-0,303**	-0,254*	-0,590**	-0,252*
CC31	0,367**	-0,384**	-0,358**	-0,121	-0,496**	**CC74**	0,07	-0,047	-0,076	-0,475**	-0,017
CC32	0,265*	-0,298**	-0,282*	0,008	-0,560**	**CC75**	-0,087	0,108	0,045	-0,319**	0,096
CC33	0,406**	-0,423**	-0,477**	-0,029	-0,600**	**CC76**	-0,005	0,008	0,019	-0,405**	-0,104
CC34	0,524**	-0,542**	-0,418**	-0,276*	-0,548**	**CC77**	0,194	-0,18	-0,237*	-0,356**	-0,217
CC35	0,448**	-0,468**	-0,461**	-0,141	-0,621**	**CC78**	0,300**	-0,269*	-0,319**	-0,490**	-0,151
CC36	0,446**	-0,456**	-0,408**	-0,283*	-0,508**	**CC79**	0,103	-0,108	-0,028	-0,307**	-0,134
CC37	0,457**	-0,455**	-0,398**	-0,397**	-0,411**	**CC80**	0,128	-0,104	-0,239*	-0,407**	-0,179
CC38	0,575**	-0,612**	-0,411**	-0,098	-0,628**	**CC83**	0,466**	-0,440**	-0,508**	-0,435**	-0,341**
CC39	0,442**	-0,457**	-0,435**	-0,078	-0,520**	**CC84**	-0,207	0,227*	0,08	-0,22	0,095
CC40	0,346**	-0,369**	-0,382**	0,026	-0,548**	**CC86**	0,427**	-0,380**	-0,502**	-0,703**	-0,264*
CC41	0,389**	-0,399**	-0,387**	-0,091	-0,443**	**CC87**	0,270*	-0,219	-0,421**	-0,575**	-0,149
CC42	0,368**	-0,374**	-0,423**	-0,199	-0,504**	**CC88**	0,400**	-0,358**	-0,487**	-0,679**	-0,298**
CC43	0,367**	-0,382**	-0,394**	-0,008	-0,486**						

3.3. Regression analysis

We analysed the influence of polyvalence professionals, our central research factor, using the regression analysis. We were looking for less subjective independent variables that can best explain the influence of polyvalence professionals on the efficiency of the product development process. We used hierarchical regression analysis and the processing method of adding variables to the regression model known as the forward selection method.

The first hypothesis (H1) that we tested was: *»There is a positive relation between the number of tasks performed in a single execution of the process and the matching rate of competency polyvalence defined by the process task requirements. The higher the rate, the greater the number of tasks executed within the process. «*

It is typical for the product development process to be a process intensive above all in creativity and information. The key characteristic is that many tasks can be repeated several times, searching for new solutions and error correction, which occurs when carrying out new ideas and solutions of any kind (in design, construction or technology). According to the data obtained in this research, there exist substantial differences within the framework of this indicator between the best and the worst process. The bivariate correlation analysis between the CC variable (the difference between the assessment of an individual competency and its importance for the product development process) and the selected indicator shows us a statistically important positive correlation.

The result of this regression analysis shows us that we can, with the help of eleven independent variables, explain 84 % of the variance of the number of tasks performed in a single repetition of the process. The value F for the entire model is 4,980 (p=0,029). The statistically positive relation was seen with the following variables: CC24 (when forming a copy of the last, try to transfer the main lines from the drawings using (2D/3D) CAD tools, last bank and the PDM system) (ß=0,244; p=0,004), CC41 (preparation of the technological procedure of the model and the product on the basis of a construction drawing and technological procedure using CAD, PDM and ERP information tools; follow the standardized procedures (REFA, WORKFACTOR, MTM (method-time-measurement)) and strive to correct the errors) (ß=0,191; p=0,006), CC53 (search for the best financing conditions for the execution of the orders received based on the financial analyses of the orders received, the cash flow balance, information on customer credit and the purchasing conditions of the suppliers) (ß=0,298; p=0,000), CC57 (standardise the last in accordance with the general standards and taking into consideration the recommendations of the supplier) (ß=0,435; p=0,000), CC68 (using technological rationalization, correct the causes of errors and promptly rationalise the product with regard to the tripartite test) (ß=0,241; p=0,001), CC73 (continuous investment of personal efforts and energy, the ability to raise motivation in colleagues so as to achieve the business plans) (ß=0,412; p=0,000) and CC86 (know how to open new communication routes and offer concise key information to the employees) (ß=0,177; p=0,035).

A negative statistical relation in the regression model was seen with: CC25 (using the PDM system when opening the model's folder; striving for orderliness when it comes to the technical documentation of the process) (ß=-0,452; p=0,000), CC48 (using modern tools (CAD/CAM) and robot technology when constructing plans for tools) (ß=-0,160; p=0,029), CC75 (knowing the principles and dynamics of changes, being an impetus for changes, quick adaptation to continuous changes) (ß=-0,384; p=0,000) and CC77 (accepting decisions and also being active in the segments where the benefits are obvious but the success is risky, always be informed about the success risks and manage them well (ß=-0,249; p=0,003)).

We have ascertained that there exists a positive relation between the polyvalence professionals and the number of tasks performed in a single repetition of the process, thus accepting hypothesis H1.

Hypothesis 2: »There is a negative relation between the matching rate of the competency polyvalence defined by the process tasks requirements, the number of participants in the process and the number of tasks in the process. The higher the rate, the lower the relation between the number of participants and the number of executed tasks within the process. «

The relation between the number of participants and the number of tasks performed in the process shows us the number of transfers between the different performers of the tasks. According to the business process reengineering theory for each transfer between different performer there occurs a waiting time and the time of transfer, consequently accumulating more time within the process and causing increased expenses. The companies differed greatly in this indicator of efficiency. The company which performed worst had the indicator value at 0,305, while the company performing best had it at 0,176. The bivariate correlation analysis shows us a strongly negative statistical relation, mostly with a high level of trust (p=0,01) for the majority of variables and the indicator. The result of the regression analysis shows us that, with the help of eleven independent variables, we can explain 85,1 % of the variance of the number employees and the number of tasks performed in the process. The value F for the entire model is 12,426 (p=0,001).

The variables where a negative statistical relation was seen are: CC07 (using analysis and group techniques for the selection of ideas (value analysis, Delphi, etc.), making decisions based on the feelings and opinions of colleagues in the team, searching for consensual solutions) (ß=-0,241; p=0,002), CC16 (using the ERP system for preparing a plan for creating a group of lasts, including the suppliers in a joint search for a final solution) (ß=-0,297; p=0,000), CC57 (standardization of the last in accordance with the general standards and taking into consideration the recommendations of the supplier) (ß=-0,261; p=0,002), CC73 (continuous investment of personal efforts and energy, the ability to arouse a great deal of motivation in the employees so as to achieve the business plans) (ß=-0,526; p=0,000) and the total years of service of the assessed participants (ß=-0,273; p=0,001).

Because of the too high factor of trust we cannot consider the CC41 variable (prepare the technological procedure of the model and product on the basis of the construction drawing and the technological procedure of the prototype using the CAD, PDM and ERP information tools; following the standardised procedures (REFA, WORKFACTOR, MTM (method-time-measurement)) and striving to correct the causes of errors) as statistically significant (ß=-0,101; p=0,141). The same can be said for the CC86 variable (knowing how to open new communication routes and provide colleagues with concise key information (ß=-0,115; p=0,181), although both of them show a negative correlation.

The variables that show a positive relation in this model are: CC25 (using the PDM system when opening the model's folder; striving for orderliness when it comes to the technical documentation of the process) (ß=0,236; p=0,002), CC75 (knowing the principles and the dynamics of changes, be a driving force of change while constantly adapting to continuous changes (ß=0,372; p=0,000)) and CC77 (accepting decisions and also being active in the segments where the benefits are obvious but the success is risky, always be informed about the success risks and manage them well (ß=0,255; p=0,003)). The influence on the first variable is explained by the fact that only one company has the PDM system implemented. Consequently this means that the said competence was assessed as relatively insignificant. A positive relation is shown with the total years of service of the employees within the company (ß=0,376; p=0,000), which we can understand as a decrease in the productivity of employees working for the same company over a long period.

Therefore, we can ascertain that companies are more efficient when they employ more employees with several developed competencies and a higher level of polyvalence. Directly, this means a more adaptable process, lower process costs and a better final outcome. We have ascertained that there exists a strong negative statistical relation between the polyvalence professionals, the relation between the number of employees and the number of tasks performed in the process, thus accepting hypothesis H2.

Hypothesis 3: »There is a negative relation between the time needed for executing the process and the matching rate of competency polyvalence defined by the process tasks requirements. The higher the rate, the shorter the time needed for executing the process. «

We slightly adapted the time needed for executing the process for the purposes of development and defined it as the time between the creation of an idea and the start of the production, measured in months. In comparison with the frequency of execution of tasks in a given time unit, the time needed for executing the process can define the ability of the company to realize a new idea. The correlation analysis between the competencies and the indicator shows a statistically negative relation in entirety with a very high factor of trust (p=0,01). The result of the regression analysis shows us how, using ten independent variables, we can explain 86 % of the variance of the time needed for executing the process, i.e. the time needed from the creation of the idea to the start of the production. The value F for the entire model is 4,477 (p=0,038) between all ten variables.

The more pronounced competencies are supposed to have a greater influence towards a shorter period of time for executing the process, contributing substantially to its greater efficiency. The variables showing a statistically negative relation obtained in the regression model are: CC08 (using different analyses, professional sources (magazines, Internet), tools and methods for forming market limitations (price, repetition, novelty on the market, etc.), understanding the limitations as market borders where we wish to be the best (ß=-0,527; p=0,000), CC38 (choosing the prototypes in accordance with the business objectives of the company, deciding on the basis of the feelings and opinions of other colleagues in the team and the recommendations (selection) of customers, make a good selection to contribute to the business success of the company) (ß=-0,115; p=0,035), CC45 (using the code system of the company, as well as the PDM and EPR tools for assigning a code to a particular product), ensure order when entering data into the company information system (ß=-0,352; p=0,00), CC57 (standardise the last in accordance with the general standards and taking into consideration the recommendations of the supplier) (ß=-0,190; p=0,005), CC68 (using technological rationalization, correct the causes of errors and promptly rationalise the product with regard to the tripartite test) (ß=-0,219; p=0,004) and CC87 (understand work as a value, work always as the primary concern, strive to impart motivation to work, praise well performed work) (ß=-0,322; p=0,000).

Because of the high level of trust (p=0,235) and the influence of the CC41 variable (prepare the technological procedure of the model and the product on the basis of the construction drawing and the technological procedure of the prototype by using CAD, PDM and ERP information tools; following the standardised procedures (REFA, WORKFACTOR, MTM (method-time-measurement)) and striving to correct the causes of errors) on the time needed for execution of the process, we cannot use it as statistically valid.

A positive relation was seen with these variables: CC10 (following the changes in social values and psychological features of the customer target groups and their successful transfer to the products, first explain the broader business (professional) motive when implementing a new task (idea) (ß=0,258; p=0,001)), CC46 (strive to avoid losing important information about the model by using full completion of the model's folder in the PDM system) (ß=0,416; p=0,000) and CC75 (knowing the principles and the dynamics of change, being the impetus of change, quick adaptation to constant changes) (ß=0,384; p=0,000).

We have ascertained that there exists a negative relation between the time needed for executing the process and polyvalence between the competencies and task requirements within the process, thus accepting hypothesis H3.

Hypothesis 4: »There is a negative relation between the number of messages within the process and the matching rate of competency polyvalence defined by the process tasks requirements. The higher the rate, the lower the number of messages within the process. «

The information intensity is best measured by measuring the number of messages (usually in the form of formalised messages/documents). The indicator shows the number of various messages within the process. Because every message needs a production process, the criteria shows us the importance of the process in relation to the other processes. The main characteristic of process development is the generation of data and messages, which is why a relatively high number of messages occur within the product development process.

The correlation analysis between the competencies and the indicator shows the statistically significant relation between those competencies, which is the reason for creating new messages, i.e. transferring any messages. The result of the regression analysis shows us that, with the help of eleven independent variables, we can explain as much as 89,1 % of the variance between the relation of the number of employees and the number of process tasks. The value F for the entire model is 7,384 (p=0,009) between all eleven variables.

Among the variables listed in the regression model, there is a statistically negative relation in: CC24 (when forming a copy of the last, try to transfer the main lines from the drawings using (2D/3D) CAD tools, last bank and the PDM system) (ß=-0,531; p=0,000), CC51 (to pick up the right quality of materials, checking provided lines and technological procedures by use of CAD and PDM tools, to maximize the use of materials and lower the costs) (ß=-0,341; p=0,000), CC53 (form financial analyses of orders acquired using the cash flow balance, information on customer credit standing and supply conditions of the suppliers; looking for the best conditions for financing the execution of the acquired orders) (ß=-0,427; p=0,000), CC57 (standardise the last in accordance with the general standards and taking into consideration the recommendations of the supplier) (ß=-0,269; p=0,000), CC86 (know how to open new communication routes and offer concise key information to the employees) (ß=-0,354; p=0,000) and the total years of service on the same work place of the assessed employees (ß=-0,216; p=0,001).

The variables showing a positive value are: CC05 (quickly find the most proper solution for the custumer's needs and fast acquiring of new (different) methods, techniques and tools, combining numerous solutions in a whole) (ß=0,284; p=0,000), CC28 (developing the forms using 2D CAD tools, looking for rational use of materials, trying to be flexible and providing a quick response.) (ß=0,329; p=0,002), CC32 (to complete the model folder using PDM system, striving for tidy technical documentation in the process for a quick performance doing changes and adoptions.) (ß=0,166; p=0,029), CC55 (preparing footwear delivery plan for custumers using proper information systems (ERP), considering custumers' wishes and trying to ascertain the optimal selling conditions.) (ß=0,240; p=0,002), CC62 (to perform the corrections in technological documentation on the basis of analysis and previous test using proper 2D/3D CAD systems) (ß=0,175; p=0,014). We can also notice a positive correlation with the total years of service (ß=0,221; p=0,002) and the level of formal education of the assessed employees (ß=0,170; p=0,009).

On the basis of the regression analysis we have ascertained that the negative statistical relation is very significant for those variables, explaining the biggest share of variance in the regression model. Content-wise, these competencies are necessary for communication and information transfer. We can conclude that there exists a negative relation between the number of messages within the process and competence polyvalence and the requirements for tasks within the process, thus accepting hypothesis H4.

Hypothesis 5: »There is a negative relation between the frequency of errors, i.e. causing standstills in the process and the matching rate of competency polyvalence defined by the process tasks requirements. The higher the rate, the lower the number of errors, i.e. standstills within the process.«

The frequency of errors during process execution leads directly to process standstill and a repeated partial execution. This indicator is particularly important for the product development process, because the higher the number of mistakes and consequent standstills the more time and other sources are accumulated within the process, meaning higher costs and longer delays before the expected realization. Among the companies we noted important differences in the success at solving this problem. With the help of a correlation analysis we can ascertain that there exists a statistically important negative relation between the competencies and this indicator, which shows a high level of trust with most competencies.

We have noted a statistically important negative relation with three of the variables, which explains the biggest share of variance in the regression model. The regression analysis shows that, with the help of six independent variables, we can explain as much as 81,6 % of the variance in the number of standstills within the process. The value F for the entire model is 10,291 (p=0,002) among all six variables.

CC38 (choosing prototypes in accordance with the business objectives of the company; deciding on the basis of the feelings and opinions of other colleagues within the team, as well as the recommendations (selection) of the customers; contributing to the business success of the company with a good selection) (ß=-0,339; p=0,000), CC53 (form financial analyses of orders acquired using the cash flow balance, information on customer credit standing and supply conditions of the suppliers; looking for the best conditions for financing the execution of the acquired orders) (ß=-0,387; p=0,000), CC56 (repair the lasts with the help of a 3D CAD tool and taking into consideration the notes from the technologists; striving to correct errors and taking into consideration the possibilities for technological realizations) (ß=-0,436; p=0,000) and CC68 (endeavour to correct the causes of mistakes in the technological rationalization; the timely rationalization of the product regarding the tripartite test (ß=-0,417; p=0,000).

A positive relation can be seen with two variables: CC52 (forming the price lists in accordance with the business policy of the company, directed at the customer; using pre-calculated target prices and suitable tools) (ß=0,301; p=0,002) and CC75 (knowing the principles of changes, being the driving force behind change, rapid adaptation to continuous changes) (ß=0,334; p=0,000).

We can ascertain that there exists a negative relation between the frequency of errors, i.e. causing standstills in the process, and competency polyvalence and the requirements for tasks to be performed within the process, thus accepting hypothesis H5.

4. Discussion

In the last few decades changes in markets and technologies have occurred due to the increasing importance of the product development process. [9] see this trend as an increase in international competition, diversification and market demands, as well as rapid changes in technology. New product technologies in the field of materials and production have the potential to significantly change the character of business operations and the nature of competition [14]. Although technological and market changes can never be fully supervised, a pro-active process in the product development process influences the competitive success, adaptability and renewal of an organisation [7]. To develop new highly technological products, a company needs the contribution of numerous and deeply specialised competencies [32]. Therefore, when it comes to organisation of the product development process, the majority of companies choose the so-called multidisciplinary development teams on the basis of process-oriented company organisation [32].

A successful development team is well-informed on current production technologies, as well as on the ways of organising a product development process. The current state of production technology is changing so fast that, when introducing a new product into the production process, the company needs to change the existing process, if not to develop a completely new one [37]. Therefore, the need for competencies assigns two important roles to the operational group [32]: 1) It is a source of competencies needed for R&D for new product development and 2) It serves as a learning mechanism for individual team members. Each organisation has a limited number of human resources [26, 29].

Technological development has brought about possibilities for the automation of working tasks. Therefore, we have fewer and fewer classical workers performing routine tasks and instead there is an increasing number of experts and polyvalence professionals with special knowledge – i.e. knowledge workers. We are thus faced with non-routine creative work performed by knowledge workers, which furthermore cannot be automated. Flexibility, ability to react, innovation, and anticipation are only few of numerous parameters that must be integrated in the product development process by management. These changes have again placed the human at the core of the company [18]. Professionals – with their implicit cognitive and decision-making capacities

Table 4. Explanatory model of the influence of the research factors on the efficiency of the product development process. (The model shown presents the calculated values of ß coefficients of the influence of competencies (CC), social demographic factors (SDF), internal factors (IF), factors from the narrower external environment (NEE) and factors from the broader external environment (BEE) on the efficiency of the product development process.

Tablica 4. Pojašnjeni model utjecaja istraživanih faktora na efektivnost procesa razvoja proizvoda. (Model prikazuje kalkulirane vrijednosti ß koeficijenata utjecaja kompetencija (CC), socijalno demografskih faktora (SDF), unutrašnjih faktora (IF), faktora bližnjeg vanjskog okruženja (NEE) i faktora šireg vanjskog okruženja (BEE).

	CC05	CC07	CC08	CC10	CC16	CC24	CC25	CC28	CC32
H1	0	0	0	0	0	0,244	-0,452	0	0
H2	0	-0,241	0	0	-0,279	0	0,236	0	0
H3	0	0	-0,527	0,258	0	0	0	0	0
H4	0.284	0	0	0	0	-0,531	0	0,329	0,166
H5	0	0	0	0	0	0	0	0	0
	CC38	**CC41**	**CC45**	**CC46**	**CC48**	**CC51**	**CC52**	**CC53**	**CC55**
H1	0	0,191	0	0	-0,16	0	0	0,298	0
H2	0	0	0	0	0	0	0	0	0
H3	-0,155	0	-0,352	0,416	0	0	0	0	0
H4	0	0	0	0	0	-0,341	0	-0,427	0,24
H5	-0,339	0	0	0	0	0	0,301	-0,387	0
	CC56	**CC57**	**CC62**	**CC68**	**CC73**	**CC75**	**CC77**	**CC86**	**CC87**
H1	0	0,435	0	0,241	0,412	-0,384	-0,249	0,177	0
H2	0	-0,261	0	0	-0,526	0,372	0,255	0	0
H3	0	-0,19	0	-0,219	0	0,384	0	0	-0,322
H4	0	-0,269	0,175	0	0	0	0	-0,354	0
H5	-0,436	0	0	-0,417	0	0,334	0	0	0

– represent a key element of industrial performance [5]. Formal company organisation is thus replaced by company culture, promoting problem solving abilities, allowing quick response to market demands, adaptability and ensuring perfect quality for the customer. A company must encourage employees in innovation and creativity [8]. The 'soft' factors are becoming the key factors in a company, taking the lead over equipment, machines, technology and capacities. Claiming that a professional is the most important resource and that the employees are the biggest company asset, assigns a strategic value to human resources [1-2].

Companies have realized that success in today's business world is inseparably connected not just with searching for answers to questions of what we can expect from the employees = results (objectives, tasks, roles, standards of business success), but also with the definition of how this can be achieved = behaviour (by fulfilling or exceeding the required competencies = knowledge, skills, motivation, personal traits) [15]. Companies that perform cross-trainings and have professionals with more and better developed variable competencies are better equipped to meet changing customer demands in shorter times, which in return increase their competitiveness (Hale, 1998). Therefore, companies have been focusing on their core competencies [1, 13]. To summarise, the key requirement for a successful company's business is to do the right things in the right manner and at the right time [27]. Our main question which we are addressing in this paper is how the professionals with more and better developed competencies (polyvalence professionals) can increase the product development process efficiency.

The most important authors in the field of creating competency models have developed their own models in order to better define the general leadership behaviour that is expected in their cultures. Many of them have invested in creating numerous additional models that are connected with work or roles [6, 11, 24, 33, 38, 40-41]. These models define 10 to 25 key competencies that successful leaders must develop and demonstrate in their companies. Intagliata and Ulrich (2000) list five key reasons as to why these approaches failed to achieve the desired results: 1) The competencies were focused more on behaviour than on results; 2) The competencies were too general; 3) The competencies were connected with the past and not with the present; 4) Not enough attention was paid to the application of the competencies; 5) The competency models belong more to the human resources than to line management.

[31] describes competencies in his theory on competency development based on processes in autonomy conditions, fluctuation, chaos, redundancy and

the necessary variety. Competencies were used at various stages for broadening the knowledge of individuals, sharing "silent" knowledge, conceptualization, excuses and providing knowledge through networks for the end users in order to obtain feedback information, which then serves as new specific knowledge. Nonaka focuses his theory on interdisciplinary teams. From the point of business processes however, [28] investigated the factors that influence successful implementation of organisational changes with respect to human resources. The author's assumption, based on a study of six selected companies, is that the more successful companies invest more resources into training of their employees, who must develop new skills because of technological changes to perform successfully in teams. Furthermore, the author ascertains that the more successful companies have adapted their human resources functions to the new demands from an external and internal company's environment.

In addition, [45] ascertains that to achieve success in the product development process, companies need to implement product programs into their business strategies, while at the same time taking into consideration risks, opportunities and resource limitations. In his study the author primarily focuses on two fields: a) Modelling the process of decision-making between the stages of intermittent check-ups and b) Dynamic allocation of heterogeneous sources within the product development process. The result of the research is a stochastic decision-making model, formed on the basis of the Mark chain. [44] mostly investigated the field of risk management, which could enable management to improve on their existing product development process. The author studied the influence of various criteria, i.e. indicators with which management can more successfully accept decisions concerning product development process.

The proposed human resource modelling, which we have used for our study is close to that developed by Pourcel, Gourc and Jia [5]. The competence concept is linked to the activity, task, and human resources. Our study is based on the assumption that new technologies and their support allow a significantly higher level of autonomy and multitasking for polyvalence professionals within the process. The key criteria how much of individual tasks to assign is based on the work plan for each professional. With their competencies, professionals influence achieving business goals and efficiency of product development process. From this point of view, the contingency theory of adaptation to the environment is important, which suggests that a company management should adapt to the unforeseeable tasks in order to achieve efficiency in their business operations [4].

We show that polyvalence professionals who have relatively permanent predispositions for competitive advantage must fulfil these conditions: they must give a positive value to the company, which is not easy to create; they must be unique or rare among the competition; they must be hard to imitate and not have any substitute regarding the professionals available to the competition. Furthermore, we call attention to the changing of the basic foundations of competitiveness (the key source of future competitive advantages), which leads to the increasing importance of key competencies. More permanent competitive advantages will stem from key competencies, their identification, use, development and renewal. Only by achieving a higher rate between the polyvalence professionals and the requested competencies of the product development process will it be possible to fully realize the synergic effects of this rate (Kamoche, Bratton, 1999). Nevertheless, we must not forget that the polyvalence professionals do not create value *per se* – they are only efficient if they create value on the market.

The key presumption of the source-based company is that its competitive advantages (i.e. above average work results) stem from the processes of learning at work: the ability of the organisation to learn, to learn quicker than the competition and the ability to efficiently apply the knowledge acquired within the business process [23]. In this way, the training, education, development and mobilization of human resources is becoming vital, if not a key component of strategic human resources management. The researchers [23] have ascertained the positive influences of a high level of awareness of the self-efficiency and functioning of employees in work teams.

Through analysis we came to the conclusion that there exists a statistically significant relation among the selected indicators of process efficiency and the 88 competencies. Furthermore, we ascertained that the competencies within the regression models as a rule do not explain the very high percentage of variance, for they prove to be a very important factor that influences the product development process efficiency. If we compare the results obtained from the regression analysis with those of the correlation analysis, we can again conclude that the polyvalence professionals are an important factor that has a significant influence on product development efficiency. In addition, we found that a higher matching rate between the polyvalence professionals and the defined requirements for performing tasks especially influences:

- the time needed to materialize an idea – with a shorter period companies can respond to customer needs with a new product quicker;
- higher staff efficiency – consequently, this directly influences the costs of the workforce when developing a product and indirectly leads to shorter development times, reduced information intensity in the process and, at the same time, brings a greater danger from losing one or more of the employees

that are working on the product development;
- a lower number of messages created within the process, which leads to a less intensive information overload;
- a larger number of tasks executed in a single repetition of the process – directly this means fewer errors within the product development process and less development costs regarding the materials. Indirectly, this contributes to a shorter period between creating an idea to its realization in production;
- fewer process standstills – this has the most direct influence on the time needed to develop a product – fewer standstills for the company mean a quicker entry onto the market regarding their customers and the competition.

One important conclusion of this study is that companies will have to develop a company model that involves a detailed and dedicated modelling of polyvalence professionals and which is also oriented towards increasing process efficiency. It is based on a medium level of complexity for human resource modelling, higher than usual models but allowing practical use for efficiency estimation. It specifically links common qualitative aspects of the human entity (competence model) to quantitative efficiency estimation.

The tested competence approach has some limitations. In industrial engineering several studies have tried to formalize the human impact on efficiency by trying to model competencies that characterize the individual intrinsically, and in terms of his/her learning capacities and social behaviour. Although the competence concept estimates personality traits of the human resources [3, 20, 22], it does not allow their classification and evaluation according to criteria beyond simply professional competencies. The collective dimension must be enriched by adding cohesion factors more than a simple relational aspect. This dimension is studied by [42] and allows estimation of a professional's integration in team work. These various concepts can always be classified, but the evaluation and formalization of their links within the competencies is a more ambitious objective.

Our study has also some limitations. The first limitation is a very complex mix of methods, which were used. To make and analyse the eEPC models of product development process from every company took enormous amount of time, because we had to model it during a real time execution of the process in all five companies. Next the time consuming method were interviews with professionals, because we had to record all the competencies that are used in the product development process. The following step was to test and value all the competencies from the aspect of every process task, because on the basis of this step, we received the competencies which are significant for the product development process in the footwear industry. The last time consuming method which we used was a 360-degree assessment procedure for all 76 professionals, which means we had to make 304 surveys just to evaluate the professionals. another limitation is that we investigated only five companies in one industry, especially because the methods were resource consuming. That is also the main reason why we could not investigate more companies from other industries, especially from those which are technologically more sophisticated, where products are made with higher added value.

Studies about modelling human resource capacities and their work behaviour as well as their impact on product development process efficiency are essential to develop pertinent decision-making support tools. To summarise our study, a company with more polyvalent professionals, i.e. professionals with more and better developed competencies in the product development process, has fewer problems harmonizing their activities. It also achieves more easily their planned business direction. Finally, it offers a better range of products than its competition. Therefore, such a company may be both financially and economically successful.

Appendix

CC01	Systematically accompanying the market and focused market groups, to prepare market analysis with the use of appropriate sources and tools, to have the ability for successful interpretation of the customer's need including them in new products.
CC02	To accompany and know competition, to prepare the market analysis including the best known solutions in own products, to have a long-term vision of market development.
CC03	To prepare own sales analysis and production of previous seasons with the use of appropriate information support, to strive for lowering the share of unsuccessful products and refunds.
CC04	To have an ability to define business objectives and company's tactics, to prepare operative plan knowing the market, financial, technological and HRM limitations of the company.
CC05	Quickly find the most proper solution for the customer's need and fast acquiring of new (different) methods, techniques and tools, combining numerous solutions in a whole.

CC06	To identify itself with customer needs together with co-workers, searching for ideas with the use of group methods (Brainstorming, etc.), to react with enthusiasm to co-workers creativeness and have the ability to trigger creative excitement in the team.
CC07	Using analysis and group techniques for the selections of ideas (value analysis, Delphi, etc.), making decisions based on the feelings and opinions of the colleagues in the team, searching for consensual solutions.
CC08	Using different analyses, professional sources (magazines, Internet), tools and methods for forming market limitations (price, repetition, novelty on the market, etc.), understanding the limitations as market borders where we wish to be the best.
CC09	To have a feeling for aesthetic designing of new models/products according to new fashion trends, to be well versed in his profession knowing the latest innovations.
CC10	Following changes in social values and psychological features of the customer target groups and their successful transfer to the products, first explain the broader business (professional) motive when carrying out a new task (idea).
CC11	With highly aesthetic approach and with the use of 2D/3D CAD tools have the ability to design and realize own creativity and constantly define new/different concepts/models.
CC12	To be very dynamic in the activities of ideas selection, making decisions on the basis of analyses, trusting co-workers` opinions, to strive for selection of market realizable ideas, to have fast orientation among different operational problem/tasks.
CC13	To design the new group of shoe models as a business challenge, according to the company's market offer and with the use of appropriate information support.
CC14	To prepare the concept of the shoe collection according to the company's business goals, to include co-workers for successful presentation with the use of contemporary presentation tools, to strive for knowing the whole development process.
CC15	To prepare successful shoe collection concept with the use of proper scorecards according to target market groups, simultaneously trying to solve higher level of different tasks/problems.
CC16	Using the ERP system for preparing a plan for creating a group of lasts, including suppliers in a joint search for a final solution.
CC17	To check the production plan of a group of lasts with the use of ERP system, trying to discover the reasons, which requires plan corrections.
CC18	To correct the production plan of a group of lasts according to previously discovered reasons, to be effective and economical.
CC19	To prepare a detailed product calculation with the use of information support (PDM, Excel) and methods (target costing, activity based costing), according to the view of the customer and trying to find cost effective solutions.
CC20	To design the last with the use of (2D/3D) CAD tools and electronic last's database, wish to achieve good final shoe design.
CC21	To design the sole and heel with the use of (2D/3D) CAD tools and wish to achieve good final shoe design.
CC22	To define material with knowledge and experiences, also trying to find good quality and price performance material according to final product requests together with suppliers.
CC23	To choose decorations and subsidiary material with use of (2D/3D) CAD tools, searching for aesthetic completion of final shoe image according to basic model (product) lines.
CC24	When forming a copy of the last, try to transfer the main lines from the drawings using (2D/3D) CAD tools, last bank and the PDM system.
CC25	Using the PDM system when opening the model's folder; striving for orderliness when it comes to the technical documentation of the process.
CC26	To prepare technological procedures using CAD/PDM tools and REFA, WORKFACTOR, MTM (method-time-measurement) methods, trying to find rational manufacturing possibilities and maximal quality.
CC27	Using CAD/CAM tools for last prototyping, following the model design and trying to consider anatomical limitations.
CC28	Developing forms using 2D CAD tools, looking for rational use of materials, trying to be flexible and providing a quick response.
CC29	To make the mould according to technological and constructional recommendations using CAD/CAM tools (cutter).
CC30	By BOM preparation maximally consider technological and constructional limitations and trying rapidly and rationally to enter the corrections using the CAD and PDM tools.
CC31	Constantly accompany the development and sales offer of new materials, innovative and cost effective solutions trying to build the prototypes.
CC32	To complete the model folder using PDM system, striving for tidy technical documentation in the process for a quick performance doing changes and adaptions.
CC33	To use the robots and robotic tools for prototype (sample) making and to check the technological/construction documentation and material adequacy.

CC34	To test the prototype using various methods and focus groups, to check the suitability of the product and trying to find ways for economical rationalization of the product.
CC35	To find prototype defects with various tests, trying to find causes for remarks and claims reduction, not to avoid the "grey zones", but trying to signalize them.
CC36	To check the last form according to the previous tests and trying to find possible ways for rationalization and defect elimination.
CC37	Through last corrections using the prescribed tools and procedures (loading, grinding...), fully cooperate with the supplier and consider his solutions and proposals.
CC38	Choosing prototypes in accordance with the business objectives of the company, to make decisions on own feelings and opinions of other colleagues in team and the recommendations (selection) of customers, make a good selection to contribute to the business success of the company.
CC39	To define model colour variants according to base model lines and fashion tendencies. To integrate suppliers and fashion designer, to rely on own aesthetic feeling, to create product collections which will fully satisfy custumer's needs and wishes.
CC40	To prepare BOM of model and article on the basis of construction using CAD, PDM and ERP tools, trying to find economically and quality suitable component parts, striving for rationality.
CC41	Preparation of the technological procedure of the model and the product on a construction drawing and technological procedure using CAD, PDM and ERP information tools; follow the standardized procedures (REFA, WORKFACTOR, MTM (method-time-measurement)) and strive to correct the errors.
CC42	For successful presentation of model colour variants incorporate co-workers using contemporary presentations tools, trying to get immediate feedback from customers.
CC43	To incorporate the most important customers and company management into selection of model colour variants, following the voice of the customer.
CC44	Correcting colour variants using 2D/3D tools, enhancing the possibilities for market realizations of each variant.
CC45	Using the code system of the company, as well as the PDM and ERP tools for assigning a code to a particular product, ensure order when entering data into the company information system.
CC46	Strive to avoid losing important information about the model by using full completion of the model's folder in the PDM system.
CC47	Integrating suppliers and sales representatives in sample plan preparation, using information support (ERP system), assuring in time supply of materials and prerequisites for later manufacturing without interruptions.
CC48	Using modern tools (CAD/CAM) and robot technology when constructing plans for tools.
CC49	Using integrated information support (sending digital cutting plans and guidelines) ordering tools, looking for reliable, quality and economically acceptable solutions making tools.
CC50	Trying to find possibilities for rationalization of technological procedures, striving for innovative solutions, setting time standards with use of CAD and PDM tools and valid standards.
CC51	To pick up the right quality of materials, checking provided lines and technological procedures by use of CAD and PDM tools, to maximize the use of materials and lower the costs.
CC52	Search for the best financial conditions for execution of orders received based on the financial analyses of the orders received, the cash flow balance, and information on customer credit and purchasing conditions of the suppliers.
CC53	Form financial analyses of orders acquired using the cash flow balance, information on customer credit standing and supply conditions of the suppliers; looking for best conditions for financing the execution of the acquired orders.
CC54	To skid on prediction of fashion specialist and own feeling assessing potential chances of model realization with successful judgement trying to keep previous achievements and launch them first on the market in next season.
CC55	Preparing footwear delivery plan for customers using proper information systems (ERP), considering customers' wishes and trying to ascertain the best selling conditions.
CC56	Repair the lasts with the help of a 3D CAD tool and considering notes from the technologists; striving to correct errors and considering the possibilities for technological realizations.
CC57	Standardize the last in accordance with the general standards and consider recommendations of the supplier.
CC58	To confirm change of material considering suggestions of customers and suppliers, trying to contribute to even better product sales realization.
CC59	To prepare specification of materials according to subgroups considering proposals and conditions of suppliers, trying to assure best manufacturing conditions.
CC60	To prepare production plan according to the subgroups including suppliers responsible for manufacturing in the company, to use suitable information support (ERP), trying to assure best manufacturing conditions.
CC61	To develop product series using 2D CAD and PDM tools, trying to develop the scope of foot numbers, which will cover the best selling numbers and will not deform basic lines of a model.
CC62	To perform the corrections in technological documentation on the basis of analysis and previous test using proper 2D/3D CAD systems.

CC63	To perform the corrections in construction documentation on the basis of analysis and previous test using proper 2D/3D CAD systems.
CC64	To supplement the bill of material according to corrections using PDM and ERP information support, trying to hold basic order and perfection of documentation.
CC65	By preparing instructions for instructors trying to use technical documentation, standards and norms, strive to minimize induction times and scraps in production.
CC66	To monitor compliance of technological documentation, instructions and qualifications of production masters by three pair test production, every time trying to eliminate mistakes and defects.
CC67	By rationalization of construction trying to eliminate the causes of errors and rationalize the materials on the product according to analyses of three pair test production.
CC68	Using technological rationalization, correct causes of errors and promptly rationalize the product regarding the tripartite test.
CC69	To form order of last series with supplier and chief of production, to strive for maximum quality and rational scope of number of lasts in production.
CC70	To form order of tools (set up procedures on cutting machine) together with supplier and chief of production, to strive for maximum usage of materials.
CC71	To prepare the documentation for series production with use of PDM and ERP information support, to strive for perfection with intention of achieving shorter implementation time and maximum quality.
CC72	Effectively using different approaches and techniques of communication, encouraging devotedness and achievment from co-workers to have things done according to the plan and above.
CC73	Continuous investment of personal efforts and energy, the ability to raise motivation in colleagues to achieve the business plans.
CC74	To develop and support strong spirit of cooperation among nearest co-workers and widely across the company.
CC75	Knowing the principles and dynamics of changes, being an impetus for changes, quick adaptation to continuous changes.
CC76	Constantly achieving planed objectives in planed time period. Always have things done and strive for cost efficiency.
CC77	Accepting decisions and also being active in the segments where the benefits are obvious but the success is risky always be informed about the success risks and manage them well.
CC78	To show fully understanding of business challenges and cases that influence the relationships with internal and external customers in a global view.
CC79	Setting up demanding objectives, 100 % fulfillment of promises, excellence in everything we do, speed, honesty, ethics, respect and stimulation, self initiation, ambition, faith and affiliation carrying out objectives and company's tactics.
CC80	To be aware of co-responsibility for development of co-workers, to take care for own and their development of competencies, be as a coach.
CC81	To create good and friendship based relations with co-workers and business partners, having close contacts also at informal occasions and at home.
CC82	Constantly switching own attention from one problem/task to another problem/task.
CC83	Quickly and often making decisions with important consequences.
CC84	Making decisions on the basis of actual work and organizational procedures and on the basis of authorization which is harmonized with the responsibility level.
CC85	Making decisions on the basis of incomplete information and in uncertain cases.
CC86	Know how to open new communication routes and offer concise key information to the employees.
CC87	Understand work as a value, work always as the primary concern, strive to impart motivation to work, praise well performed work.
CC88	Prepare well in advance for common team activities, especially to choose the main and extra tasks.

REFERENCES

[1] BARCLAY, I. and PORTER, K.: *Benchmarking best practice in SMEs for growth*, Int. J. Technology Management, 33, 2/3 (2006), 234–254.

[2] BARON, J.N. and KREPS, D.M.: *Strategic human resources*, Frameworks for general managers, John Wiley & Sons, Inc., New York, 1999.

[3] BARRICK, M.R.; MOUNT, M.K.: *The big five personality dimensions and job performance: a meta-analysis*, Personnel Psychology, 44, 1 (1991), 1–26.

[4] BARTLETT, C.A.: *Managing across Borders – The transnational Solution*, Harvard Business School Review, 1997.

[5] BENNOUR, M.; CRESTANI, D.: *Using competencies in performance estimation: From the activity to the process*, Computers in Industry, 58 (2007), 151–163.

[6] BOYATZIS, R.E.: *The competent manager: A model for effective performance*, Wiley Sons, New York, 1982.

[7] BROWN, S.L. and EISENHARDT, K. M.: *Product development: past research, present findings and future directions*, Academy and management review, 20, 3 (1995), 343-78.

[8] CAMPBELL, D.F.J. and GÜTTEL, W.H.: *Knowledge production of firms: research networks and the 'scientification' of business R&D*, Int. J. Technology Management, 31, 1/2 (2005), 152–175.

[9] CLARK, K.B. and WHEELWRIGHT, S. C.: *Managing new product and process development*, Harvard business school press, Boston, 1993.

[10] DESCHAMPS, J. P.: *Product Juggernauts - how companies mobilize to generate a stream of market winners*; Harvard Business School Press, Boston, Massachusetts, 1995.

[11] DUBOIS, D.: *The competency case book*, Amherst, MA, HRD Press, 1998.

[12] HAMEL, G.: *Reinvent your company*, Fortune 141 (12), June 12 2000, Time Inc, Time & Life Building Rockefeller Centre, New York, 2000.

[13] HAMEL, G. and PRAHALAD, C. K.: *Competing for the future*. Boston: Harvard Business School Press, 1994.

[14] HÄNNINEN, S.: *The 'perfect technology syndrome': sources, consequences and solutions*, Int. J. Technology Management, 39, 1/2 (2007), 20–32.

[15] HARZALLAH, M.: *Mode´lisation des Aspects Organisationnels pour la Re´organisation d'Entreprise Industrielles*, PhD Thesis, Universite´ de Metz, France, 2000.

[16] INTAGLIATA, J. and ULRICH, D.: *Leveraging leadership competencies to produce leadership brand: Creating distinctiveness by focusing on strategy and results*, Human resource planning, (2000), 12-23.

[17] JACOBSON, I.; ERICSON, M.; JACOBSON, A.: *The object advantage business process reengineering with object technology. Addison-Wesley*, Greenwich USA, 1995.

[18] JEREB, E.; RAJKOVIČ, U.; RAJKOVIČ, V.: *A hierarchical multi-attribute system approach to personnel selection*. Int. j. sel. assess. (Print), 13, 3 (2005), 198-205.

[19] KAPLAN, S. R. and NORTON, P. D.: *Balanced Scorecard: Translating strategy into action*, Random House, 1996.

[20] KEMBEL, J.: ROLE play—personalities in action, Life Change Partners, Northwest Learning Associates, Incorporated: Tucson, Arizona, U.S.A, 1996.

[21] KERN, T.; ROBLEK, M.; MAYER, J. and URH, B.: *Business processes and human resources competence profiles* in: KHOSROWPOUR, Mehdi (ed.), Information Resources Management Association, International Conference, San Diego, California, USA, May 15-18, 2005. Managing modern organizations with information technology, Hershey: Idea Group, 2005.

[22] KOLBE, K.: *Pure Instinct*, Random House, New York, 2004.

[23] LÓPEZ, S.P.; PEÓN, J.M.M. and ORDÁS, C.J.V.: *The organisational context of learning: an empirical analysis*, Int. J. Technology Management, 35, 1/2/3/4 (2006), 196–223.

[24] LUCIA, A. D. and LEPSINGER, R.: *The art and science of competency models, Pinpointing critical success factors in organizations*, Jossey Bass Pfeiffer, San Francisco, 1999.

[25] HARZALLAH, M.; VERNADAT, F.: *Human resource competency management in enterprise engineering*, in: Proceedings of the IFAC Word Congress '99, Beijing, (1999), 181–186.

[26] MACKENZIE, K. D.: *A theory of group structures*, Gordon& Breach, New York, 1976.

[27] MEGLIČ, J.; PAGON, M.; KERN, T.: *Polyvalence of human resources in product development process* Organizacija, Kranj, 38, 7 (2005), 338-346.

[28] METHCHICK, R. H.: *An investigation into the use of human resources factors to support business process reengineering implementation*, Dissertation, Rensselaer Polytechnic Institute, 1999.

[29] MILLER, G. A.: *The magical number seven, plus or minus two: Some limits on our capacity for processing information*, Psychological Review, 63, 2 (1956), 81-97.

[30] MORGAN, G.: *Images of Organization*, SAGE Publications, 1997.

[31] NONAKA, I.: *A dynamic theory of organizational knowledge creation*, Organization science 5, (1994) 1, 14-37.

[32] ÖSTERLUND, J.: *Providing competence to the product development project: A conflict between Fragmentary learning and holistic use*, Systems research and behavioural science, (1999), 41-55.

[33] PARRY, S.R.: *The quest for competencies: Training*, July, (1996), 48-56.

[34] PENY, A. James.: *Exploring Differential Item Functioning* in a 360-Degree Assessment: Rater Source and Method of Delivery, Organizational Research Methods, 6, 1 (2003), 61-79.

[35] PETERS, T.: *The Circle of Innovation: You Can't Shrink Your Way to Greatness*, First Vintage Edition, USA, 1999.

[36] PIETERSEN, W.G.: *Strategic Learning, A Leadership for creating and implementing breakthrough strategies*, Columbia business school, 2001.

[37] PRIEST, J.W. and SANCHEZ, J.M.: *Product development and design for manufacturing - A collaborative approach to producibility and reliability*; Marcel Dekker, Inc., New York, 2001.

[38] RAELIN, J.A.; COLIDGE, A.S.: *From generic to organic competencies*, Human resource planning, Spring, (1996), 24-33.

[39] SCHEER, A. W.: *Business Process Engineering – Reference Models For Industrial Enterprises*, Second completely revised and enlarged edition, Spring – Verlag Heidelberg Barclay, I. and Porter, K. (2006) 'Benchmarking best practice in SMEs for growth', Int. J. Technology Management, 33, 2/3 (1994), 234–254.

[40] SPENCER, L.M. and SPENCER, S.M.: *Competence at work: Models for superior performance*, John Wiley & Sons. New York, 1993.

[41] SPENCER, L.M.; MCCLELLAND, D.C. and SPENCER, S.M.: *Competency assessment methods: History and state of the art*, Paper presented at the American Psychological Association Annual Conference, Boston, 1990.

[42] STEVENS, M.J.; CAMPION, M.A.: *The knowledge, skill, and ability requirements for teamwork: implication for human resource management*, Journal of Management, 20, 2 (1994), 503–530.

[43] TIDD, J.; BESSANT, J. and PAVITT, K.: *Managing Innovation*, Chichester, Wiley, 2001.

[44] UNGER, W.D.: *Product development process design: improving development response to market, technical and regulatory risks, dissertation*, Massachusetts Institute of Technology, 2003.

[45] WANG, Y.: *Dynamic management and resource allocation in new product development projects*, Dissertation, Boston University, 2001.