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Alignment of Business Environment Scanning and IT in Manufacturing Companies. Structural Equation Modeling Approach

The paper aims are to confirm the positive impact of alignment of the process of business environment scanning and information technology on the performance in industrial companies. The results from the survey conducted among 99 small and large businesses will be used for verification. Application of the methods of structural equation modeling will allow for assessment of the effect of each factor on the process of harmonization and the company's performance.

Подтверждено положительное влияние согласованности процесса сканирования деловой среды окружения и информационной технологии на работу промышленных компаний. Для проверки использованы результаты обзора, выполненного по 99 малым и крупным предприятиям. Моделирование с применением методов структуральных уравнений позволяет оценить влияние каждого фактора на процесс гармонизации и показатели работы компании.

Key words: environment scanning, IT, alignment, business performance, structural equation modeling.

Introduction. Strategic alignment has many pseudonyms. It is also termed fit [1], linkage [2], integration or harmony [3]. In all cases, it concerns the integration of one business area and its information technology (IT). Some researchers, for example, Smaczny [4], assert that as IS is pervasive in business, it should not be regarded as separable from business strategy, and therefore the need for alignment does not arise. Yet, strategy in its broadest sense is all about alignment or matching organizational resources (including IT) with environmental threats and opportunities. Indeed, IT management can be conceptualised as a problem of aligning the relationships between the business and IT infrastructure domain [5] in order to take advantage of IT opportunities and capabilities.

Alignment is seen to assist a firm in three ways: by maximising return on IT investment, by helping to achieve competitive advantage through IT, and by providing direction and flexibility to react to new opportunities.

However, the apparent gap between the decision to invest in IT and the realisation of benefits highlights the risk of using IT to initiate new strategies and transform business. Cooperation between the business and the IT department to

maximise investment in technology is vital, and with this in mind, IT investments and business objectives have to be considered together.

Theoretical background. In this study, the main topics under review are business environment scanning (BES), IT, business performance (BP) and the concept of alignment. In the literature many examples can be found confirming significance of the alignment of business strategy and IT strategy as well [6, 7]. It was assumed that the alignment of part strategies of environment scanning and IT implementation is the basis for further activities undertaken on lower levels. Therefore, both theoretical considerations and empirical researches will concern only lower (operational) level of the realization of alignment process.

Business environment scanning. The references are still emphasizing new concepts of observations and acquisition of information about business environment. The authors make attempts to deliver useful methods and tools to be successfully employed for detection of symptoms of changes in the environment as well as for their analyses and assessment. These concepts can be divided into conventional concepts and those supported with IT. Depending on the extent of the environment to be monitored and analysed, the following methods can be used: competitor intelligence [8], competitive intelligence [9], business intelligence [10] and environment monitoring [11]. One of the most efficient solutions among the concepts of system approach is application of e-business Environment Monitoring System [12] or strategic information systems [13].

The list of the factors which can have an impact on scanning of business environment can be very long. The specific nature of each business, the adopted strategy, environment disturbances, financial resources and any personal factors connected with managers and employees (knowledge, experience, vision) might either support monitoring of environment or cause that such actions do not have any effect.

In the light of underlying assumptions, the strategic aspect will be excluded from these analyses, which, according to many scholars, is the most essential for the efficiency of harmonisation process, defined for this level as strategic harmonisation. Switching to operational level, some factors were identified to considerably impact the efficiency of environment scanning and the process of alignment. They include:

- attitude of managers who initiate the processes of scanning,
- definition of information needs by managers,
- clearly defined rules for collection of data and information,
- transparent rules for distribution of data and information within business environment,
- information awareness among observers,
- information climate in a company.

In the context of environment scanning, information needs should be the focus of definition of the scope of scanning, particularly in the sectors of environment where scanning is more extensive. Similarly to the stage of information acquisition, the stage of collecting, processing and then sending data and information in order to make them available to right persons is also essential. Therefore, next two factors will be connected with those aspects.

The last two factors can be defined as ‘informational’. They concern individual behaviour of the observer and that of the company. The significant impact on individual behaviour of the employees is believed to be from information awareness; organizational factors emphasize strong impact of information climate.

Informational awareness denotes employees’ positive attitude to information-related actions and their individual behaviour, according to the conviction which consists in involvement in purposeful searching for information and support to information needs. Information climate in business means creation of the conditions that clearly determine the access to and the scope of information used within a company. The information climate can be assessed on the basis of the implemented infrastructure (collecting, organizing and making available of information as well as its publicizing).

Information technology in scanning. In many companies, IT has become crucial in the support, sustainability and growth of the business. This pervasive use of technology has created a critical dependency on IT that calls for a specific focus on IT governance.

Similarly to the environment scanning variable, the factors connected with IT strategy, or with strategic management of IT were not considered for the IT variable, leaving this area for considerations of strategic alignment. The assumption that IT itself does not generate any value added for the company can be re-confirmed even stronger at the operational level. This value appears as the result of proper management of IT, defined as its supervision. Other factors to be employed for the research model include:

- knowledge of business processes among IT managers;
- knowledge of information needs among managers in other departments;
- level of IT infrastructure in relation to competitors;
- level of communication solutions in processes of environment scanning;
- level of communication solutions in structures inside the company;
- level of integration of information resources in databases.

The importance of cooperation of business managers, responsible for environment scanning, with IT managers was emphasized again, particularly for exchange of information about changes in processes of monitoring and in expectations among information users. A purchase of hardware and software should be made with consideration of opportunities to extend and improve them according

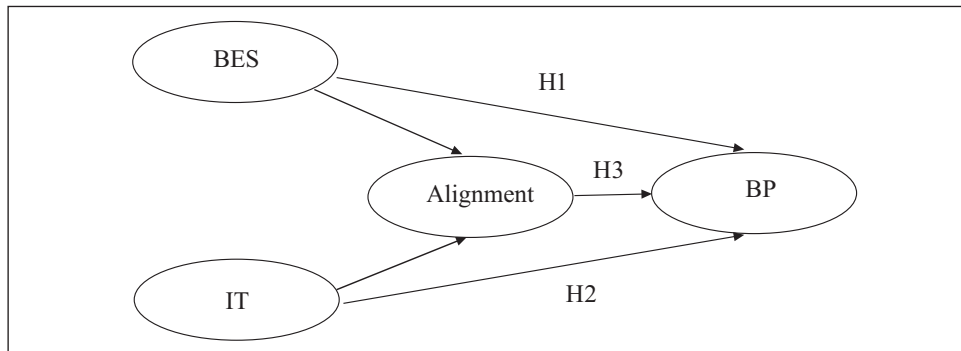


Fig. 1. A conceptual model

to the needs that will appear in the future. The flexibility of the IT infrastructure is also essential.

The factors connected with communication include solutions used for the process of scanning of the environment and communication inside the business. A characteristic feature of IT in businesses is striving for integration of all the resources of information about the business environment in one integrated entirety.

Business performance. The result of the operation of businesses is a complex and multi-aspect concept. Thus, during the assessment of the performance, a variety of factors should be taken into consideration while the answers to the question of how well the company realizes its market and financial goals should be replied. For the assessment of the performance in the investigated company the following factors were used:

- dynamics of sales as compared to the index throughout the branch,
- rise in market share,
- return on sales,
- rise in profits,
- cash flow.

During determination of market performance a dynamics of sales in each company in comparison to the value of this index for the whole branch will be used. Market position of a company can be concluded from the estimated shares of the company in the market. The market performance overview can be extended with the assessment of return on sales in relation to other companies of the same branch.

Financial results are typically assessed on the basis of the level of profits reached by a particular company throughout the year and indexes of cash flow in relation to their competitors.

Research study. Research framework and hypotheses formulation. With this background, a research model to examine the main research hypothesis in this study will be present in Fig. 1.

There are three basic constructs in the model BES, IT and BP. The relationships among the constructs are shown by four hypotheses formulated as follows:

H1: The use of business environment scanning processes positively influences a firm's business performance.

H2: The use of information technology positively influences a firm's business performance.

H3: The alignment between information technology and environment scanning process positively influences a firm's business performance.

A corollary for H3 could be stated in terms of a new hypothesis as follows:

H4: The alignment between BES and IT influences business performance more significantly than does either the ES or IT individually.

Figure 1 presents the proposed conceptual model. Dimensions of BES were created on the basis of the author's own study. The dimensions of BES, IT I BP were presented in Table 1.

Table 1. The items of the survey instrument for constructs BES, IT, BP

Dimensions	Item
Item [BES_1]	Attitude of managers who initiate the processes of monitoring
Item [BES_2]	Definition of information needs by managers
Item [BES_3]	Clearly defined rules for collection of data and information
Item [BES_4]	Transparent rules for distribution of data and information within business environment
Item [BES_5]	Information awareness among observers
Item [BES_6]	Information climate in a company
Item [IT_1]	Knowledge of business processes among IT managers
Item [IT_2]	Knowledge of information needs among managers in other departments
Item [IT_3]	Level of IT infrastructure in relation to competitors
Item [IT_4]	Level of communication solutions in processes of environment monitoring
Item [IT_5]	Level of communication solutions in structures inside the company
Item [IT_6]	Level of integration of information resources in databases
Item [BP_1]	Dynamics of sales as compared to the index throughout the branch
Item [BP_2]	Rise in market share
Item [BP_3]	Return on sales
Item [BP_4]	Rise in profits
Item [BP_5]	Cash flow

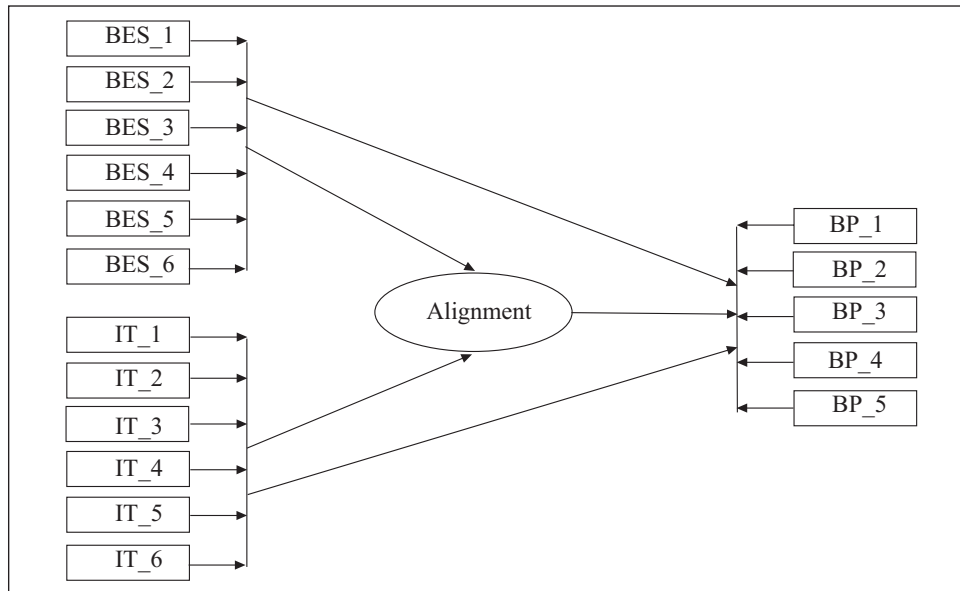


Fig. 2. A bivariate model of alignment between BES and IT

While Fig. 1 presents a conceptual model of the relationships among the three constructs, Fig. 2 presents a dimension-specific (bivariate) view of these constructs. The conceptual model suggests that relationships between constructs are meaningful, whereas the bivariate view suggests that these constructs can be disaggregated into several dimensions and that the relationships among these dimensions can be meaningfully tested [14]. The conceptual model can also be used to verify the structural contingency theory—the overall fit of the model, using structural equation modeling [15]. In this study, both models will be tested.

Data collection. The goal of this study is to investigate the impact of environment scanning and IT alignment for business performance. A questionnaire survey was used to collect data for this study. The questionnaire was first pre-tested with 10 senior executives in companies. Modifications were made and the revised questionnaire was ready for data collection. A 5-point Likert-type scale was selected (highly disagree to highly agree) for the business's environment scanning, IT and business performance.

The survey was conducted by an entity which provides professional market survey services using Computer Assisted Telephone Interviewing technique. A test group was selected randomly with consideration of the following criteria: small and big businesses, manufacturing industry.

Table 2. Respondents' profile (N = 99)

Criterion	Characteristics	Frequency
Number of employees	50—250	49
	>250	50
Type of ownership	Public	17
	Private	82
Source of company's capital	100 % Polish capital	75
	Advantage of Polish capital	10
	100 % foreign capital	6
	Advantage of foreign capital	8
Sales (in milion PLN)	0—40	50
	>40	49

Ninety nine (99) respondents were effectively interviewed.¹ The respondents included senior managers and supervisors from the divisions closely related to the market, i.e. marketing, sales etc.

Data analysis and results. As shown in Table 2, the respondents were from manufacturing industry. More them 70% of respondents are managers or senior management. The high hierarchical level of respondents enhances the validity of results since they are more likely to be familiar with the organization's environment scanning activities and use IT.

Structural equation modeling. The reason why structural equation modeling (SEM) has been applied in many disciplines is its ability to solve research problems related to causal relationship between latent constructs which are measured by observed variables. More about SEM see [16]. The conceptual model in this study has been tested by the use of structural equation modeling. The constructs business's environment scanning, IT and organizational performance are considered as nonobserved or latent variables, measured by specific observed variables (see Table 1).

Fig. 3 presents stages involved in the application of structural equation modeling. SEM method was used according to the algorithm presented in Fig. 3. The first stage encompassed designing of theoretical model, whose outline is presented before Fig. 1 and Fig. 2 present the path diagrams. For model specification, a selection of input matrix type (covariance type was selected) was made

¹ The presented results are a part of the investigations conducted among 180 companies from industrial processing, commerce and transport sectors, carried out by the author at the turn of the year 2008/2009. The entire questionnaire contained 52 questions.

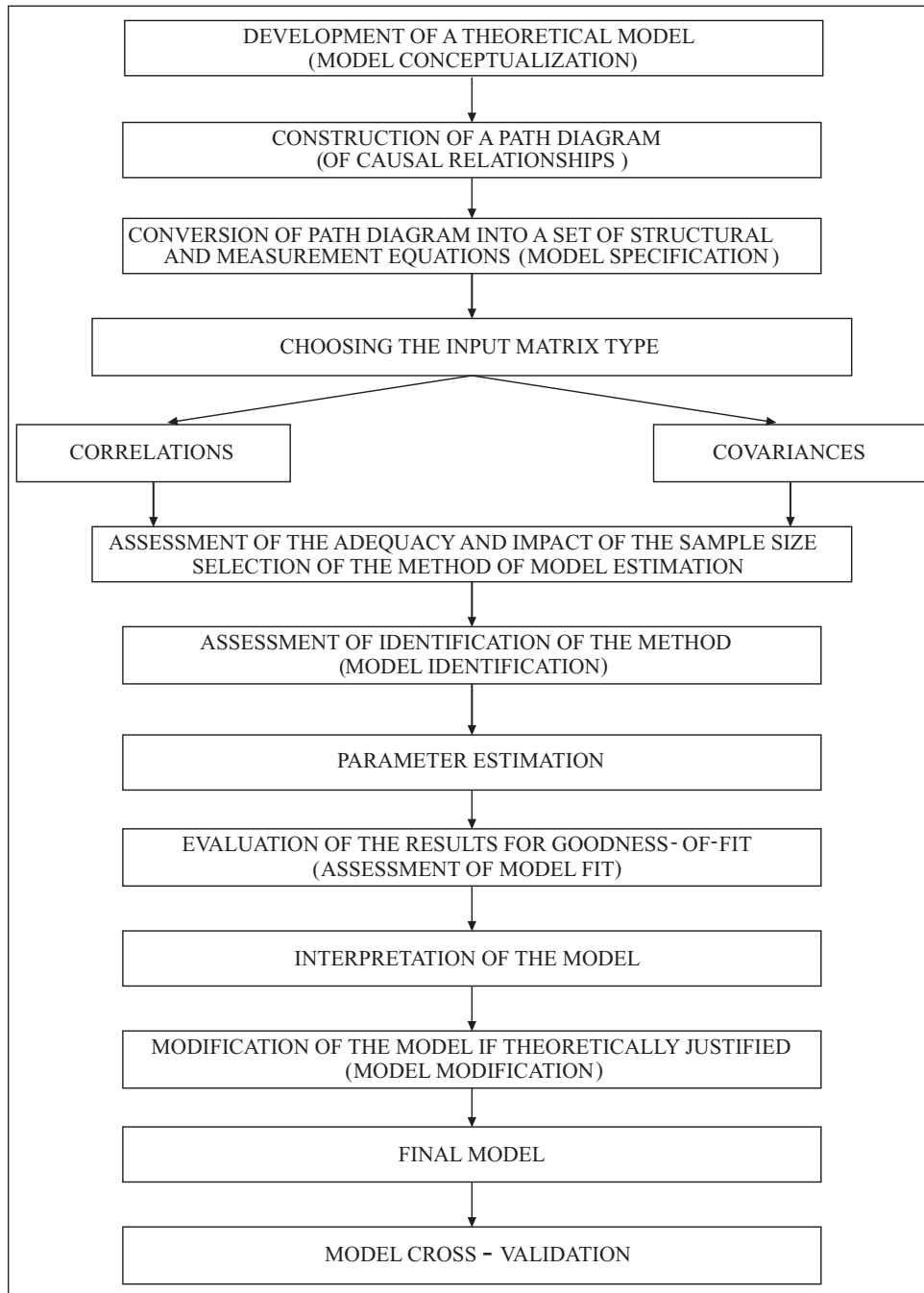


Fig. 3. Stages involved in the application of structural equation modeling [16]

and for further calculations, Statistica software was employed. Fig. 4 presents a structural model. The results of structural equation modeling were presented in Fig. 5. The assessment of goodness-of-fit are presented in Table 3.

Assessment of the measurement model. In this study, the covariance structure models were employed to estimate path coefficients by simultaneously solving the system of equations and accounting for covariance among variables within the model.

In the structural model (Fig. 4) casual relations between variables are expressed by means of the path coefficient. Unknown factors shaping the measuring-error were defined as variables of rest (ϵ_1). First, we examine if the overall model (the measurement model and the structural model) presents a good fit for the data. As noted by Chin and Newsted [17], there is no one agreed goodness of fit measure for structural equation models. Various goodness-of-fit measures are used to compare the estimated population covariance based on the structural equation model with the sample covariance matrix that is calculated from the sample data. As recommended by Kefi [18], I propose to use absolute goodness-of-fit indices to estimate the structural model. Table 3 presents the indices obtained for this model and illustrates how they are compared to the recommended indices and to the saturated model (where all the latent variables are interrelated).

The overall fit indices are good. Therefore, the research model presented in Fig. 4 is plausible in the population. The alignment variable is significantly correlated with both of the two independent variables of the model: business' environment scanning and IT. The path from alignment to business performance is 0.313 ($t = 5.673$). This means that higher levels of alignment lead to higher levels

Table 3. Goodness-of-fit measures

Goodness-of-fit measures	Observed value	Recommended
Chi-square	266.202	—
Degrees of freedom	119	—
Chi-square adjusted	2.237	< 5 [20]
Goodness of fit index	0.876	> 0.9 [18]
Adjusted Goodnes of fit index	0.898	> 0.9 [18]
Root mean square error of approximation (RMSEA)	0.084	< 0.08 [18] > 0.1 rejection of model [21]
RMSEA lower limit of 90% of confidence corridor	0.074	" " "
RMSEA upper limit of 90% of confidence corridor	0.089	" " "

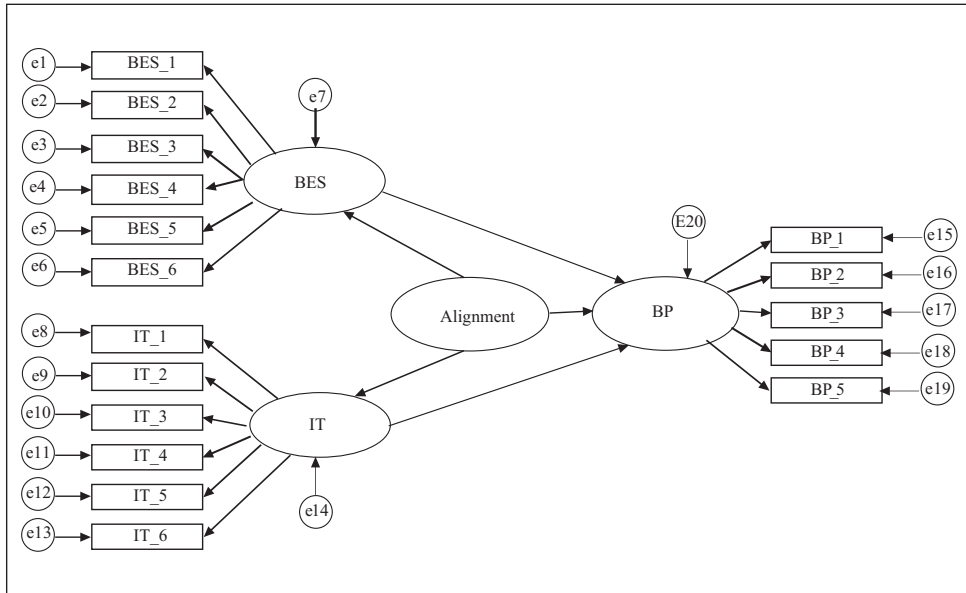


Fig. 4. Structural model

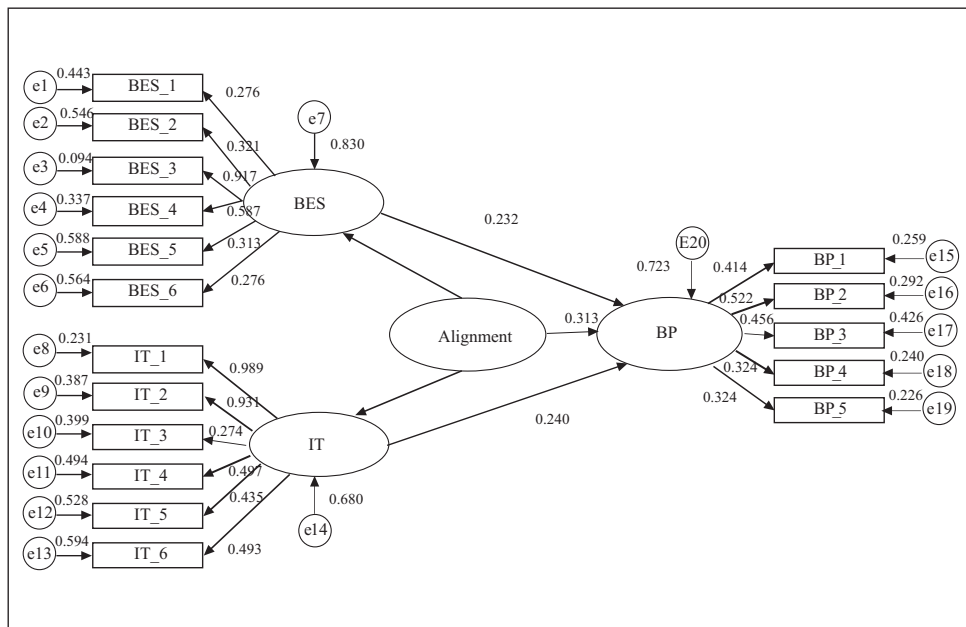


Fig. 5. Results of the structural equation modeling

of business performance. The path from business environment scanning to business performance is 0.232 ($t = 3.375$), and the path from IT to business performance is 0.240 ($t = 3.670$).

Based on the framework presented in Figs 4 and 5, two sets of analyses (based on Statistica software) at the construct and bivariate level were performed for all hypotheses. All t-values were significant at 0.05 level. This indicated that all hypotheses were verified at the construct level.

To gain additional insights, hypotheses testing at the bivariate level were performed. To determine whether two constructs at the bivariate level are related, there is a need to demonstrate that at least one path between dimensions of the two constructs has a path coefficient which is significant [19].

Conclusions. This study proposed a theoretical model adapted from the strategic alignment model of Henderson and Venkatraman [2] and from previous research studies related to the business/IT alignment issue. This model has been modified for business environment scanning and IT and has been tested in the context of manufacturing industry.

It was shown that the influence of the BES and IT harmonization on the company's performance was greater than of every of these factors separately, therefore obtained impact of synergy additionally has effect on the enterprise results. Advices to operations undertaken within the range of those two variables harmonizations (at operational level) can be read from a figure. Comparatively low values were obtained by BES_1 factors (attitude of managers who initiate the processes of monitoring), and BES_5 factors (information awareness among observers) and BES_6 (information climate in a company).

Such results can indicate that the initiation of monitoring activities or creation of informational climate in the enterprise were found as assignments realized at a strategic level, however for the harmonization at the operational level the other factors are important. A significant factor in the monitoring of the environment turned out the factor BES_3 (clearly defined rules for collection of data and information). The great significance was credited also to the factor BES_4 (transparent rules for distribution of data and information within business environment). Both these factors are very strongly related to the utilization of IT solutions in the environment monitoring. Among IT factors as the least significant was indicated IT_3 factor (level of IT infrastructure in relation to competitors), but with the indication that the level of integration of informational resources is important IT_6 (level of integration of information resources in databases).

The great significance was credited for functional solutions of communication (IT_4, IT_5). Maximum values of paths, not only for IT variable, but from among all examined factors, obtained IT_1 factors (knowledge of business processes among IT managers and IT_2 (knowledge of information needs among managers in other departments). It proves the large consciousness of respon-

dents that itself implementation of IT solutions, does not create the value added and that one can obtain it on the condition of IT solutions adaptations to the needs of enterprise. For the BES and IT harmonization the last conclusion seems to be the most essential, and outright decisive about the success of undertaken in this range activities.

Підтверджено позитивний вплив погодженості процесу сканування ділового осередку та інформаційної технології на роботу промислових компаній. Для перевірки використано результати обзору, проведеного на 99 малих та великих підприємствах. Моделювання з використанням методів структуральних рівнянь дозволяє оцінити вплив кожного фактора на процес гармонізації та показники роботи компанії.

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