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ASSESSMENT OF THE IT PROFESSIONALS AND COMPETENCE NEEDS OF COMPANIES IN THE BUDAPEST AND WESTERN TRANSDANUBIAN REGIONS, AND HIGHER EDUCATION OUTPUT

Theses of doctoral (PhD) dissertation

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1. Antecedents of the Research, set goals, hypotheses

Nowadays businesses are faced with daunting challenges resulting from digitalisation, the development of information technology and Industry 4.0. Ever keener market competition makes IT investments and the development of information systems unavoidable. At the same time, the lack of IT professionals poses an escalating problem.

The aim of this thesis is to highlight the factors influencing the demand for IT professionals, and to compare the requirements defined by enterprises for IT professionals to meet in terms of their skill sets and the outcome competencies students graduating from tertiary education possess.

The aims of the author in the dissertation:

- Presentation of domestic and international literature related to the topic.
- Summary analysis of the output competencies of IT training in higher education.
- Assessing the factors influencing the need for IT specialists and competencies in enterprises based on empirical research.
- Investigation of the relationship between company size, region affiliation, IT development and IT needs. The author also sought answers to the question of whether the use of IT services influences the need for specialists.

– Comparison of the company's competency ranking for IT jobs and the IT training output.

As for the antecedents of the research, several years of research and publications on the topic by the author belong here.

The assumptions examined in the dissertation are as follows:

H1: The design of the IR and the type of IT service used determine the need for IT professionals.

H2: The proliferation of cloud-based services is being slowed by businesses' lack of knowledge about this type of IT service.

H3: Belonging to a region determines the IT development and IT professional needs of companies

H4: IT development determines whether an IT professional is needed or which team of professionals.

H5: Companies' competency needs for IT professionals vary from job to job.

2. Content and method of research

The author of the dissertation wanted to base her scientific research on the theoretical background, the applied research methods and practical experience. The processing of the extensive domestic and international literature provided a suitable background for the explanation of the

practical part of the research, for finding and interpreting the connections.

The aim of the author is to assess the need for IT specialists and competencies among domestic enterprises. To achieve this, she conducted primary research among Hungarian companies. The research also aimed at the impact of company size on the need for IT professionals. In order to achieve this, a weighted, stratified sampling was carried out in the first round on the basis of the CSO database, taking into account the company size categories and the number of companies by regions. The selection was made from EMIS 'database of more than 60,000 companies, based on random numbers defined in Excel. Data collection was carried out in several rounds using an online self-administered questionnaire. One of the biggest advantages of the solution is that the order of the questions can be controlled based on the answers of the respondent, thus increasing the efficiency of self-completion. Nor can it be overlooked that it is a cheap and fast method of data collection. However, in the case of the online survey, the willingness to fill in is very low, and a repeated request has been made to increase it. The applicability of the questionnaire, developed as a Google Form, was ensured by the soundness of the literature and the trial filling in with familiar companies and professionals prior to the collection of data online. Based on the feedback, newer and newer versions of the questionnaire have been developed to eliminate interpretation and structural problems. The final version was sent in an invitation email

to the businesses selected in the sample. The online questionnaire data collection took place in several rounds in 2018. The analysis of the receipts showed that the sample size and the random selection of the elements allow statistical analyses to be carried out and general conclusions to be drawn, but examining the territorial distribution, it became clear that no country-wide findings could be made. Thus, it was expedient to truncate and narrow the sample to the Budapest and Western Transdanubia regions. In order to increase the number of responses, a telephone survey with an interviewer was conducted in 2019 instead of the self-completion method of online questionnaires. The system for selecting the sample elements remained the same as before, only the scope was not limited to the whole country but to the two regions.

After the questionnaire survey and the elimination of incomplete questionnaires, the analysis was carried out on a sample of 140 items.

To test the hypotheses, the author performed an analysis of the collected data using the SPSS program. As a first step, the database was created, with which the variables were defined at the same time.

Statistical methods used:

The validity of the hypotheses for categorical variables can be examined by Crosstabs analysis. It makes it possible to present the relationship between the ordinal and nominal variables, the association relationship and to

examine the distribution of the combined frequencies. The minimum requirement in the SPSS for a cross-tabulation based on two criteria is that the number of cells with an expected frequency of less than 5 should not exceed 20%. In the tests, this condition was met, so the tests could be interpreted. Pearson's Chi-square (χ^2) value can be used to show whether there is a significant relationship between the variables. The tightness of the relationship is measured by the Cramer V index (0 to 1). The closer its value is to one, the closer the relationship between the variables. The lambda index can be used to measure the extent to which an independent variable can predict a dependent variable, expressed as a percentage. The Adjusted Residual (AR) value calculated during the Cross-Table analysis shows the attraction repulsion between the variables and the strength of the relationship in the case of a significant relationship. If AR is greater than or equal to 2, the variables attract each other, if less than minus 2, they repel each other.

In the course of the research, the questionnaire also included questions on which the surveyed companies could mark on a 5-level Likert scale to what extent they agreed with the statement. The evaluation ranged from total rejection to full acceptance. A higher score means a more favourable judgment, a positive attitude. Non-parametric tests can be used for statistical analysis of the Likert scale as an ordinal scale. With Kendall's tau-b rank correlation coefficient, we can analyse the correlations of the data on the rank scale. The indicator can be used to

examine the attitudes of the sampled companies towards the statements made. Instead of Likert values, rankings can be formed to calculate the values of the statistics. The Kendall agreement index is used to compare the similarity of several rankings.

If we calculate an aggregation or average of several elements of the Likert scales for the same topic, the values obtained can be considered to be at the interval scale level. The frequency of the Likert scale is approximately normally distributed. One-way analysis of variance (ANOVA) can be used between the nominal, categorized variables and the metric variables, which examines the difference between the means of the populations included in the study by analysing the variances. A t-test can be performed to detect the difference. The relationship between categorical (independent) and metric (dependent) variables can be analysed by an F-test. The application of the indicators assumes the standard deviation homogeneity outside the normal distribution, the fulfilment of which can be examined with the Levene's test.

Based on the number of systems used by the enterprises, a metric variable can be formed in the questionnaire, which allowed the application of an additional parametric test. Correlation analysis can also be performed to examine the relationship between two metric variables to make statements about the strength and direction of the relationship between the explanatory and outcome variables.

For the joint analysis of the factors influencing the need for IT specialists, a logistic regression analysis was also implemented in the dissertation, which estimates the effects of several metric and categorical explanatory (independent) variables on the categorical explained (dependent) variable. The model examines the probability of an event occurring. The rate of success, the so-called "odds ratio" (Agresti, 2006). The logistic regression model uses the so-called "Maximum likelihood method" to try to maximize the hit rate when the value is most likely to occur. The variable explained during the analysis has only two values. In the case of a dichotomous variable, binary logistic regression can be used. The model makes it possible to fall into the category for new cases. The normal distribution of the variables is not required for the calculation of the indicator in SPSS, but the condition is a sample of at least 60 elements and independence between the data, multicollinearity, which conditions were met. The classification table contains the goodness of the classification of the model and the distribution of the actual and estimated values, which can be interpreted as a special cross-table. Only the constant (Block 0) is displayed first, and then the total hit ratio of the fitted model (Block 1) that includes the variables is shown. The variables were included in the study using a joint method (Method = Enter). The correctness of the fit can be checked with the Hosmer-Lemeshow test. Based on the observed and estimated probabilities, the null hypothesis fits the model. H_0 is acceptable if there is no significant difference, so the calculated value is higher than the

standard significance level (5%). The favourability of the model can also be examined with R^2-type indicators - Cox and Snell R^2 and Nagelkerke R^2. If the calculated value is between 0 and 1, the fitted model can be used. The higher the value of the pointer (the closer it is to 1), the better the fit.

3. Research results

Based on the results calculated from the sample, it can be stated that the larger a company, the more typical and necessary the application of Integrated Corporate Governance Systems covering horizontal and vertical processes, for the development and operation of which IT specialists are required.

Thesis 1: Based on the results, it can be stated that the statement made in the first part of the hypothesis, that there is a connection between IR design and the need for IT professionals, has been confirmed. Especially in the case of in-house development, a positive direction can be observed, while in the case of i.e. "box systems" a negative direction (attraction-repulsion) can be observed. The second part of the hypothesis, which assumes a relationship between the use of IT services and the need for IT specialists, was not confirmed on the basis of the indicators of the Cross-Table Analysis.

Thesis 2: As a result of the analysis, it can be stated that the assessment is favourable and the attitude is positive in the group of companies using and not using the cloud-

based service. Both small and large businesses know and accept this type of IT service, but evaluate it realistically and critically.

Thesis 3: Based on the sample, no difference can be established between the IT development and the need for IT specialists of the companies in the studied regions.

Thesis 4: Based on the results, it can be stated that the more advanced the developed IR (the more characteristic the horizontal and vertical integration), the more the need for IT professionals arises. However, the type and integration of the system developed at the company does not affect whether a system developer, an operator, or both groups of professionals are needed.

Thesis 5: It can be stated that companies do not have enough knowledge to compile a set of profession-specific competencies when setting job-related expectations. Rather, generalization and the formulation of core competencies are typical.

4. New and innovative research results

The topic of the dissertation is novel as it provides a complex analysis of the factors influencing IT professional demand, and no professional literature is available that would have adapted this approach. It partly aims to identify relationships between corporate size, regional location, level of IT development (type and sophistication

of the information system), the employment of IT services and the demand for IT professionals.

By conducting an online questionnaire survey, the author confirmed that corporate size, the level of IT development and the way the information system is structured all determine if there is a need for an IT professional. The sample suggests that regional location and the employment of IT services do not have an impact on the need for IT professionals. These are novel findings.

In the dissertation, corporate competency requirements towards IT professionals were surveyed by doing empirical research. The author collated these requirements with the competencies possessed by IT professionals graduating from tertiary education and pinpointed the differences between the two.

The dissertation points out the fact that the respondents were unable to relate specific skill sets to IT professionals. Instead, they tend to define general competency requirements for all professionals.

In the author's opinion, the unavailability of a domestic IT profile that would include competency recommendations specific to categories of jobs generates problems both for IT education and companies.

Based on primary and secondary research, the author designed a model ICT profile for the analysed groups of professionals, which can be interpreted as a new finding.

The questionnaire survey included canvassing corporate attitude to cloud-based services too. Having interpreted the findings, the author concluded that, regardless of their use of cloud-based services, companies consider these services positively and have a positive attitude to them. Large and small enterprises alike are aware and approve of this type of IT service but have a realistic and critical attitude to it. This can also be regarded as a novel finding.

5. Conclusions and recommendations

Nowadays, the biggest obstacle to productivity growth, technological development and innovation of companies is the shortage of manpower, particularly IT specialists. It has been repeated to the point of boredom in the literature and in the media that education needs to be aligned with corporate needs. The common denominator, which is the basis for balancing the labour market, is competence. Businesses also use this measurement system to express their required professional needs and expectations for their issued students. Therefore, the focus of the dissertation is on the competence test for a special field of professionals, the group of IT professionals. The related area covered by the analysis is the exploration of corporate factors influencing the need for IT professionals. Based on the results of the literature and empirical research, theses were defined. It can be stated that the need for IT is mostly influenced by the size of the company and the development of IR. The use of IT services, including cloud services, is not significantly related to the need for IT

professionals. However, there is a link with professional groups. Unfortunately, the size of the database used in the research did not allow for a detailed analysis of the relationship. It would be advisable to carry out further surveys, which would allow an analysis to be carried out on a larger sample.

The author compared the need for corporate competencies for IT professionals with the output competencies for IT training. On both sides, the formulation of generous, common expectations can be established. This is a barrier to matching job-specific competency needs. The current situation is exacerbated by the lack of domestic ICT profiles. Thus, the same responsibilities appear under different names as labour market demand. For this reason, it is not possible to offer jobs to professionals who appear on the output side of IT training. Based on the domestic and international literature, a possible ICT profile system related to two IT jobs was outlined in the dissertation. Which, if further developed, would offer a complete solution for both enterprises and training institutions. In order to assess the needs of the company, it is recommended to implement a wider and more competent data collection. Which would serve as a basis for the development of the profile model.

6. The author's publications related to the topic of the dissertation

Nagyné, Halász Zsuzsanna; Gubán, Miklós (2019): Informatikai alkalmazások és IT-szakemberigény összefüggései a magyarországi vállalkozások körében. JELENKORI TÁRSADALMI ÉS GAZDASÁGI FOLYAMATOK 14: 2 pp. 163-180.; 18 p.

Nagyné, Halász Zsuzsanna (2019): Az IT szakemberigény vizsgálata a vállalati szférában. LOGISZTIKA - INFORMATIKA - MENEDZSMENT 4: 1 pp. 5-14.; 10 p.

Zsuzsanna, Nagyné Halász; Balázs, Jámbor; Miklós, Gubán (2019): Factors influencing the need of companies for IT specialists. KÖZGAZDÁSZ FÓRUM / FORUM ON ECONOMICS AND BUSINESS 21: 137 pp. 50-79. 30 p.

Nagyné, Halász Zsuzsanna; Gubán, Miklós (2019): IT szakmák és kompetenciák a felsőoktatás szemszögéből LOGISZTIKA - INFORMATIKA - MENEDZSMENT 3: 1 pp. 102-115.; 14 p.

Nagyné, Halász Zsuzsanna; Gubán, Miklós; Koloszár, László (2018): Az informatikusképzés a felsőoktatásban. GIKOF JOURNAL: A NEUMANN JÁNOS SZÁMÍTÓGÉP-TUDOMÁNYI TÁRSASÁG GAZDASÁGINFORMATIKAI KUTATÁSI ÉS OKTATÁSI FÓRUM SZAKMAI SZERVEZET SZAKFOLYÓIRATA-: 11 pp. 40-50.; 11 p.

Nagyné, Halász Zsuzsanna; Gubán, Miklós; Koloszár, László (2017): Az informatikusképzés a felsőoktatásban. In: Bacsárdi, László; Bencsik, Gergely; Pödör, Zoltán (szerk.) OGIK'2017 Országos Gazdaságinformatikai Konferencia: Az előadások összefoglalói. Győr, Magyarország: Alexander Alapítvány a Jövő Értelmiségéért (2017) 108 p. pp. 56-57.; 2 p.

Nagyné, Halász Zsuzsanna; Gubán, Miklós (2016): Az információs rendszer és fogalomrendszere. In: Csillag, Sára (szerk.) Alkalmazott tudományok III. fóruma: Konferenciakötet. Budapest, Magyarország: Budapesti Gazdasági Egyetem (BGE) 993 p.; pp. 525-537.; 12 p.

Nagyné, Halász Zsuzsanna (2016): Információs rendszer alkalmazások irodalomkutatása. LOGISZTIKA - INFORMATIKA - MENEDZSMENT 1: 1 pp. 75-83. 9 p.