

PHD DISSERTATION THESES

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AGRICULTURE AND LIFE SCIENCES**

**EMPLOYEE DATA LITERACY AND
DATA-BASED DECISION SUPPORT IN
THE MEDIUM-SIZED AND LARGE
ENTERPRISE SECTOR OF HUNGARY**

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1. ANTECEDENTS AND OBJECTIVES OF THE RESEARCH

The operation of business organisations is realized through the decisions of their leaders. Effectiveness cannot be reached without providing a decision support function of adequate quality, which should be based on providing information extracted from a range of data. The production and communication of accurate, relevant and up-to-date information represents value. According to HANNON (2005), data is the heart of enterprises, so appropriate decisions cannot be made without turning it into information.

A number of studies deal with data and its role in the basis of decision-making. Nowadays, the importance of data-based analyses is increasing; more and more organisations are turning their attention to advanced data processing and analysis (BERNDTSSON et al. 2018). This phenomenon is induced by the need for rapid responses to an ever-changing competitive environment, which enhances the role of decision support functions. Data-driven (or data-centric) enterprises perform extensive data collection, processing, and analysis to increase efficiency (PATIL 2011). These are characterized by decision-making mechanisms where facts supported by data take precedence over opinions, and data-based information is given an even more prominent role. With this approach, corporate performance can be improved and a competitive advantage can be achieved (WATSON 2016). With the help of business analysis, managers can make fact-based decisions and possess a better overview of operations. This can be achieved through data, information technology, statistical analysis, quantitative methods and mathematical or computer-based models (DAVENPORT - HARRIS 2007).

Thus, research of the role of data in decision support is extensive; however, the question rarely arises as to whether we can utilize data properly, whether it fulfills its purpose, and whether it can be utilised during decision-making. Research on the human aspects of decision support is incomplete: while the literature is diverse on decision support methodologies, new data collection and processing methods, and ICT tools, their returns and implementations, there is less focus on human resources behind the creation, development and maintaining of corporate information systems.

At present, working with, interpreting and utilizing data is no longer limited to a selected number of professions. All corporate (white-collar) professionals are required to be capable of working with data; it is especially important for decision-makers to properly understand and use the information that can be extracted from data (PRYOR - DONNELLY 2009, DAVENPORT - KIM 2013). The significance of corporate information systems, the application of advanced analytical methods and the difficulties of satisfying decision support needs with adequate quality all indicate the importance of making the preparedness of business stakeholders measurable and evaluable. Data literacy is the ability to understand, manage, use and critically evaluate data (QIN - D'IGNAZIO 2010, CALZADA - MARZAL 2013). Businesses need data-literate employees who can understand, process, and utilize data with abstraction and critical thinking abilities (GUNTER 2007).

1.1. The Significance and Topicality of the Subject

According to CSATH (2011), in the 21st century, the success of any given society is increasingly determined by the human factor. A well-trained body of staff can be the key to the success of any organisation. This is especially true for the design and operation of an information system with a decision support function. SPENDER (1996) states that an enterprise can be successful and competitive when it is able, and has adequate knowledge to collect, process and use relevant data. Human aspects are critical to the corporate information system.

BERSIN and ZAO-SANDERS (2020) argue that businesses accumulate more data at present than they have at any given time before; however, according to Forrester, 60-73% of corporate data mass is never analysed nor utilized (GUALTIERI - YUHANNA 2016).

I believe that familiarity and the examination of data literacy is key to the effectiveness of the corporate decision support function. This is supported by the fact that this concept includes skills such as recognizing the need for information, as well as defining, finding, evaluating and organising the

information needed to deal with a particular problem (KOLTAY 2016, ALA 1989).

According to the results of a recent, large-scale international survey of the data literacy skills of business decision-makers, enterprise-level data literacy skills are generally deficient. Only 24% of respondents were absolutely sure that they properly understand, manage, use or (critically) evaluate data they come into contact with during the course of their work. Top executives were not confident either, as 32% interpreted data only at a basic level. This leads to the conclusion that the degree to which they use data to achieve their goals and to base decisions on, is less than ideal. Relying on data increases professional credibility. 94% of respondents who work with data in their jobs said that the use of data helped them perform better, while 82% of them said that data literacy increased their reliability and credibility at their workplace (CENSUSWIDE-QLIK 2018).

Another international study found that the appreciation of the importance of data is not reflected in employees' attitudes toward data. Three-quarters of the employees surveyed, 74% of them to be exact, reported feeling overwhelmed or feeling unwell when they had to work with data. This also had a negative impact on their performance, with 36% looking for a different solution where possible so as not to have to work with data, and 14% trying to avoid such tasks altogether. All this poses a serious challenge to organisations (OPINIUM-QLIK-ACCENTURE 2020).

In summary, the significance and topicality of the subject comes from the fact that there is a significant contradiction between desired data-based operations and the data literacy and data-related attitudes of employees and managers.

1.2. Research Objectives

In order to conduct this research, I formulated two main objectives:

C1: Detailed understanding of the data literacy skills of medium-sized and large companies in Hungary regarding the interpretation, processing, analysis, visualization and presentation of data. Respondents' attitudes toward data should also be examined.

C2: Mapping the challenges of data-based decision support in Hungarian enterprises. Investigating the relationship between resources spent on data collection, data processing, competent staff, and IT support systems and the success of data-driven decision support.

1.3. Hypotheses

H1: The majority of white-collar employees in mid-sized and large domestic companies often or always have to work with data as part of their job, regardless of the size of the company.

The topicality and relevance of the subject of this research can be justified by proving the assumption that performing various data-related tasks is an integral part of the work conducted by the group of employees defined in the hypothesis. By proving the hypothesis, we can conclude that special attention should be paid to data literacy as a skill.

H2: Those with high data literacy skills work more intensively with data and are able to participate in a wider range of data-related activities.

By defining high data literacy skills, it becomes possible to examine whether there is a difference between the frequency and nature of performing data-related activities depending on the level of data literacy. If the hypothesis is proven, it can be concluded that organisations take advantage of high data literacy skills and rely significantly on this ability of their employees.

H3: Higher levels of data literacy contribute significantly to the sense of success experienced by white-collar employees of medium-sized and large companies in Hungary.

According to the hypothesis, those who put more value on their own data literacy are also more successful in their work. In light of this, data literacy can be interpreted as a success factor and an important employee competence for white-collar staff of all medium-sized and large companies in Hungary.

H4: Those working for large companies put more value on their data literacy compared to those working for medium-sized companies.

I hypothesise that due to the greater breadth and complexity of large enterprise processes and the increased number of organisational levels, white-collar staff of large enterprises generally possess more potent data literacy. I attribute this hypothetical difference to be enforced by the peculiarities that come with the larger size.

H5: The more resources an organisation devotes to the systematic collection and use of data, the more successful it is in data-driven decision support.

My fifth hypothesis no longer refers to the individual level but that of enterprises (organisations). I make the assumption that the amount of resources allocated to the development of corporate information systems correlates with the success of data-driven operation and data-based decision support.

H6: The way in which organisational decision support is conducted shapes the jobs required to operate corporate information systems.

In my opinion, the peculiarities of organisational decision support and the way data-based decision support is conducted (typically reports prepared in an ad hoc manner; statements prepared by field experts or automated through regular reports) require different levels of preparation from human resources operating the company's information system, which also manifests in the existence of a range of positions within the organisation.

H7: The way in which organisational decision support is conducted places different demands on information systems, thus providing a way to define the types of information systems that support more data-intensive managerial decision-making.

Similarly to Hypothesis H6, I assume that the way data-based decision support works influences the types of information systems that serve corporate information systems in organisations.

H8: The way in which organisational decision support is conducted determines the range of factors that can pose a challenge to an organisation in the field of data-based decision support.

I hypothesise that data-driven decision support implemented in different ways poses different challenges to an organisation. By identifying these, proposals aimed at improving the quality of corporate information systems can be clarified, and measures taken can prove to be more effective.

2. MATERIALS AND METHODS

According to MAJOROS (2011), “Scientific research is nothing more than a conscious, systematic cognitive practice that enables us to learn and map the world’s novelties, and thus puts the tools in one’s hand to help one cope with unusual problems and situations.” According to TOMCSÁNYI (2000), the goal of creating knowledge, i.e. scientific research, is to solve a practical or theoretical problem, to develop a field or discipline, or to prove suitability for scientific work with some kind of study.

2.1. Implementation of the Research

Throughout the implementation of my research, I have strived to ensure that the entire process is characterized by compliance with the criteria of planning and scientificity. Based on the guidelines of MAJOROS (2011) and SCIPIONE (1994), I compiled these necessary steps to carry out my research:

1. Defining the objectives of the research, identifying the research problem.
2. Preparing a research plan.
3. Exploration and study of secondary sources of domestic and international research literature.
4. Setting up hypotheses.
5. Selection of test methods, determination of test sample.
6. Preparation for primary data collection.
7. Primary data collection.
8. Data evaluation by statistical and other methods, analysis.
9. Comparing results with hypotheses.
10. Conclusions and proposals, formulation of novel scientific results.

Methodology for Setting up Hypotheses

According to FALUS (1993), “a hypothesis is a statement that expresses the researcher’s assumptions about the variables in the problem and their relationship.” LÁZÁR's (2009) definition states, "a hypothesis is a statement that we have not yet accepted or rejected by means of proof." In summary,

hypotheses can be interpreted as clear, concrete, precise statements and recordings of assumptions. The formulation of hypotheses is important, as a hypothesis gives direction to the research process, defines the central problem of the research, enhances objectivity, provides research participants with an overview of how to approach the research problem and assists the researcher in data collection by providing a subject for said data collection that needs to be supported or refuted (LENGYELNÉ 2012).

I took the requirements for setting up hypotheses into account, according to which they should be explanatory, clear, concise, not trivial, describe the relationship of the variables accurately, be susceptible to be justified or rejected by feasible methods and expectations, and rely on existing knowledge and answer initial problems (SZÚCS 2008).

Presentation of the Empirical Research

This empirical research focuses on an online questionnaire survey I conducted. Primary data collection was essential for the examination of the topic, considering that no research on data literacy for medium-sized and large companies has been conducted in Hungary before. For this reason, I specifically wanted to conduct domestic research, which was also in line with my research possibilities. I developed my data request between January and April 2020 after having reviewed international research literature and foreign secondary data on the topic, and having set up my hypotheses. When preparing the questionnaire, I focused on the following criteria:

- based on the answers to the survey, my hypotheses should be susceptible to be justified or rejected;
- the questions of the survey should be clear so that misunderstandings can be avoided;
- I should ask only the required amount of questions;
- questions and answers should be professionally impeccable;
- the questionnaire should be structured and logical;
- participants should hold an interest in its completion.

In January 2020, after reviewing the relevant research literature and studying secondary research on the subject, I was able to formulate my research hypotheses. Following this, I started preparing a survey, during which I took into account the methodological recommendations of HÉRA and LIGETI (2017). As I wanted to gain an answer to respondents' attitudes toward data, I used a Likert scale for several questions, as this method was developed by Rensis Likert primarily for studies alike this one (BERTRAM 2014). I formulated statements that - according to the methodology - had to be evaluated on a five-point (or seven-point) scale between two extremes (ZERÉNYI 2016). One extreme shows total denial in all cases, the other total agreement. As there are an odd number of choices, the middle element signifies neutrality. In addition to the scales, I included clear, closed-ended questions.

Using thus developed questionnaire, I conducted a 30-respondent pilot survey (where respondents were relevant to the subject matter). I analysed the results obtained through this pilot survey and asked the participants about their experiences with it. Based on the responses and interviews they provided, I modified several elements of the questionnaire. One of the most important changes was that I replaced odd number Likert scales with even number ones. The reason behind this was to induce a forced choice (RÓZSA et al. 2006). The aim of the questionnaire was to have quantifiable, quantitative data on the surveyed subjects, which then could be analysed using mathematical-statistical methods. Thus, reliable and generalizable results could be achieved for the population as a whole (LEHOTA 2001). The survey was conducted online, time-wise based on the cross-section of the research, i.e. it was based on a single sample.

Regarding the test sample

During the process of sampling, I followed the steps of MAJOROS (2011):

- I first defined the population;
- I determined the method of sampling;
- the size of the sample;

- then I performed the sampling;
- and finally reviewed the results.

The target of the survey was white-collar employees of medium-sized and large domestic enterprises. As a list of the entirety of possible subjects was not available, an internet-based survey on high-access, independent platforms provided the best solution for random sampling. I made sure that the call to fill in the questionnaire was displayed on platforms that were completely independent of the topic discussed and of my person; accessing it was made as generally available as possible, not limited to any social group or class.

When determining the sample size, I optimized it by looking for a sample with the minimum number of items that still contained a professionally acceptable standard error. I made the assumption that the distribution of the criteria within the population and the sample was approximately normal. Since the planned sample size did not exceed 10% of the population, I calculated the standard error using the following formula:

$$s. e. p = \sqrt{\frac{p \cdot (1 - p)}{n - 1}},$$

In this formula, “p” stands for the ratio of a variable within the sample and n stands for the number of sample elements. Choosing a 95% confidence level, the value of “z” is 1.96:

$$p_{1,2} = p \pm 1,96 \cdot \sqrt{\frac{p \cdot (1 - p)}{n - 1}}$$

For a sample of 400 items, if the value of the sample statistic (ratio) is 50%, the accuracy level will be +/- 4.9%, which becomes the maximum error. I set this item number as the goal to be achieved.

A worldwide issue with research is the decrease of respondents' willingness and enthusiasm, which does not escape Hungary either (PINTÉR-KÁTAY 2010). Regardless, my experience was very positive, the topic aroused great

interest among respondents. This is evidenced, on the one hand, by the large proportion of people interested in the research report (about half of the respondents voluntarily provided their e-mail address to receive results) and, on the other hand, by the surprisingly high number of inquiries via the e-mail address I have provided within the call to participation. All this has provided motivation and momentum during this stage of the research.

This general interest could also be the reason why a total of about 539 responses were received, of which 409 met the criteria. 122 responses were related to micro- or small-sized enterprises, and 8 respondents were blue collar workers; they fell outside the research target group so their answers could not be utilised. Participants from micro and small enterprises provided their e-mail addresses to an even higher proportion, so it is reasonable to assume that although I clarified the objectives in the introduction to the questionnaire, the primary reason for completing the survey may have been interest in the results.

After the survey period, the sample was analysed from several points of view. Based on the data of the Central Statistical Office (KSH 2018), I determined the proportion of employees in large and medium-sized enterprises, which I compared with the proportions displayed within the sample. The proportion of medium-sized and large enterprises is almost exactly the same within the sample and in national economy. Similarly to the size of the enterprises, I also compared the distribution of respondents by consolidated economic branches to the data of the Central Statistical Office (KSH, 2018). The comparison was based on KSH (2017), according to which:

- Branch „A”: agriculture;
- Branches „B”-„E”: industry;
- „F”: building industry;
- „G”-„S”: consolidated industry of services.

Values do not differ significantly from the data published by KSH (KSH 2018); agriculture and industry appear to be somewhat under-represented within the sample, but the fact that these industries require more manual labour should be taken into account, which was not included in my sample. I also analysed the sample taking into account the number of years of work

experience the respondents have had. I hypothesised that it could distort the sample if certain groups (such as inexperienced workers or veterans) represented dominant numbers among respondents. However, all ages were represented in the sample, and there was no significant disproportion in work experience. I also examined the positions of the respondents: out of the 409 respondents who were relevant to the research, 272 were white-collar subordinate employees, 113 were middle managers and 24 were executives and top-level managers.

Considering the above information, we can conclude that the sample is adequately representative of the population in question, its margin of error remains below 5%, and its test confidence interval is 95%. The test sample is suitable for drawing conclusions about the formulated hypotheses. The findings will be reliable and valid.

2.2. Methodology

I summarised and evaluated the results of my primary data collection using Microsoft Excel and the IBM SPSS statistical software package. I used diagrams and tables to illustrate the results. To examine the correlations, I used several mathematical statistical methodologies:

- descriptive statistics;
- hypothesis testing;
 - t-test;
 - chi-square test;
 - Mann-Whitney test;
- testing the measure of association;
 - Cramer's V measure;
 - calculating correlation;
- clustering: K-means centroid clustering.

In order to achieve the goals formulated at the beginning of this research, I chose mathematical statistical methods suitable for testing the hypotheses assigned to those goals, as shown in Table 1.

Table 1: Hypotheses and statistical methods used to verify them

Hypotheses	Applied statistical methods
H1: The majority of white-collar employees in mid-sized and large domestic companies often or always have to work with data as part of their job, regardless of the size of the company.	Descriptive statistics: averages, frequency Mann-Whitney nonparametric test
H2: Those with high data literacy skills work more intensively with data and are able to participate in a wider range of data-related activities.	Descriptive statistics: averages, frequency K-means centroid clustering Mann-Whitney nonparametric test Chi-square test
H3: Higher levels of data literacy contribute significantly to the sense of success experienced by white-collar employees of medium-sized and large companies in Hungary.	Descriptive statistics: averages, frequency Calculating correlation
H4: Those working for large companies put more value on their data literacy compared to those working for medium-sized companies.	Descriptive statistics: averages, frequency T-test Chi-square test
H5: The more resources an organisation devotes to the systematic collection and use of data, the more successful it is in data-driven decision support.	Descriptive statistics: averages, frequency Chi-square test Testing the measure of association: Cramer's V measure
H6: The way in which organisational decision support is conducted shapes the jobs required to operate corporate information systems.	Descriptive statistics: averages, frequency K-means centroid clustering Chi-square test
H7: The way in which organisational decision support is conducted places different demands on information systems, thus providing a way to define the types of information systems that support more data-intensive managerial decision-making.	Descriptive statistics: averages, frequency K-means centroid clustering Chi-square test
H8: The way in which organisational decision support is conducted determines the range of factors that can pose a challenge to an organisation in the field of data-based decision support.	Descriptive statistics: averages, frequency K-means centroid clustering Chi-square test

Source: own work

3. RESULTS AND DISCUSSION

H1: The majority of white-collar employees in mid-sized and large domestic companies often or always have to work with data as part of their job, regardless of the size of the company.

Result of hypothesis test: hypothesis **accepted.**

Based on international research, data-based decision-making and a data-driven approach have become key motifs of business (LIQUETE 2012). All corporate (white-collar) employees must be capable of performing tasks affected by data during their work, and it is crucial for decision-makers to properly understand and use the information that can be generated from such data (PRYOR - DONNELLY 2009, DAVENPORT - KIM 2013). Businesses accumulate more data at present than they have at any given time before, so they need more and more employees who can interpret and utilize data (BERSIN - ZAO-SANDERS 2020). Large-scale, international research also confirms that the use of data is very extensive, such as the 9,000-participant cross-country survey commissioned by Companies Qlik and Accenture in September 2019 (OPINIUM-QLIK-ACCENTURE 2020).

Thesis 1

For employees of medium-sized and large domestic companies, working with data has now become unavoidable and an integral part of the workflow.

My research among white-collar employees of domestic, medium-sized and large companies confirms the findings of international literature. About 68.9 percent of respondents always, and an additional 29.8 percent often work with data at work. I proved that this phenomenon is independent of company size, so it is simultaneously true for medium-sized and large companies in Hungary.

H2: Those with high data literacy skills work more intensively with data and are able to participate in a wider range of data-related activities.

Result of hypothesis test: hypothesis **accepted**.

My survey identified nine types of data-related activities. The extent of these tasks and processes is well shown by the fact that out of these nine types of activities, the respondents performed 6.14 types on average.

Those with high data literacy skills will benefit from their knowledge by performing activities related to data of a higher qualification and of a wider range, compared to normal. I defined data literacy skills as high where individuals had the best evaluation in at least 60% of the measurement variables, having achieved at least 54 of the 60 points available. Based on my primary research, 20.5% of the respondents proved to be highly skilled in data literacy, which was also in line with the results of relevant international research.

Thesis 2

Those with high data literacy skills are significantly more likely to engage in data-related activities. Organisations rely on data literacy competence, which is shown by the fact that individuals with higher data literacy skills participate in a wider range of data-related activities.

Although data-related work is generally very common, those with high data literacy skills perform data-related activities significantly more often. I have demonstrated that those with higher data literacy skills performed a wide range of data-related activities in a significantly higher proportion.

H3: Higher levels of data literacy contribute significantly to the sense of success experienced by white-collar employees of medium-sized and large companies in Hungary.

Result of hypothesis test: hypothesis **accepted**.

By now we have proven that data-related work has become unavoidable at our time, and that the knowledge of those with high data literacy skills are utilised extensively by organisations. For this reason, I considered it important to examine whether there is a correlation between high data literacy skills and a sense of success at work. An international survey of more than 7,000 people provided a good basis for this, according to which 85% of the respondents with high data literacy skills claimed to perform very well at their workplaces, while this was only 54% for the other respondents. 94% of those working with data said that using data helped them to perform better at work (CENSUSWIDE-QLIK 2018).

Thesis 3

The higher an employee's data literacy skills are, the more successful they feel at performing their job. The more time a given employee has spent at his or her workplace, the stronger the association is between his/her sense of success and his/her level of data literacy.

I used mathematical statistical analyses to prove that there is a significant relationship between these two factors; the value of the correlation coefficient is 0.393. This result supports the hypothesis that data literacy has an effect on the sense of success experienced during work. The time spent at a given workplace and the amount of experience gained in a given position reinforces this relationship: the value of the correlation coefficient is 0.376 for 0-2 years, 0.398 for 3-10 years, and 0.404 for 10 years. The success of white-collar employees of medium-sized and large domestic enterprises is influenced by their data literacy level. This skill plays an important role in performance at work and carrying out workplace tasks successfully.

H4: Those working for large companies put more value on their data literacy compared to those working for medium-sized companies.

Result of hypothesis test: hypothesis **rejected**.

Prior to exploring the results of my primary data collection, I assumed that those working for large companies have, on average, slightly better data literacy skills than their peers in medium-sized companies. I based this assumption on the presence of larger, longer and multi-stakeholder processes, the typically multi-level hierarchical structure, the scope of the resulting data provision and reporting functions, and organisations with more functional structures.

I expected that these factors would force a higher level of pursuit of data-related activities. Among the international research literature I reviewed, I did not find any examples for the examination of data literacy skills by firm size. The results did not support my assumption: the average score of data literacy was 48.55 for medium-sized enterprises, while it was only minimally higher for large enterprises, 48.74.

Thesis 4

There is no significant difference between medium-sized and large Hungarian companies when it comes to the data literacy skills of their human resources, nor between the types of data-related activities their employees perform.

I used statistical analysis to prove that by company size, there was no difference between the data literacy of the respondents from medium-sized and large companies. By further calculations (in order to confirm this statement) I came to the conclusion that there is no significant difference by data-related activity type either. In other words, there is no activity type that is performed significantly more often depending on the company size.

H5: The more resources an organisation devotes to the systematic collection and use of data, the more successful it is in data-driven decision support.

Result of hypothesis test: hypothesis **accepted**.

MCAFEE et al. (2012) found that the more data-based or data-driven a company was, the better their objectively measurable financial and operational results were. According to GROVER et al. (2018), data-driven decision-making can lead to the following benefits: improved decision-making processes, increased transparency, the introduction of potential new products or services, and learning about previously unknown customer or market characteristics.

Advanced analyses can only be implemented with a corporate information system of adequate quality. FRANKS (2014) and ANDERSON (2015) both emphasize the need to develop a type of data-centric corporate culture in order to place the best decision support opportunities at the service of organisational interests.

Thesis 5

The more resources a company devotes to the systematic collection and use of data, the more successful its data-based decision-making, and the more advanced its data-based decision support methods become.

Having approached the issue from several directions, I proved that investing an increased amount of human resources will result in more successful data-based decision-making and data-driven operations. According to the statistical results, more human resources invested are an indicator of a higher quality corporate information system. Decision support based on ad hoc statements does not refer to a mature corporate information system; the emergence of field experts indicates thoughtful, well-formalised decision support, while automated regular reports indicate well-developed human, ICT and procedural skills.

H6: The way in which organisational decision support is conducted shapes the jobs required to operate corporate information systems.

Result of hypothesis test: hypothesis **accepted**.

My literature review has confirmed the importance of human aspects. The success of any given society is increasingly determined by the human factor (CSATH 2011). This is particularly relevant to the design and operation of information systems with decision support functions. SPENDER (1996) concludes that an enterprise can only be successful and competitive if it is able, and has adequate knowledge to collect, process and use relevant data. Nowadays, the role of data-based analysis is gaining in value, as an increasing number of organisations are turning their attention to advanced data processing and analysis (BERNDTSSON et al. 2018). I assumed that the more jobs a company offers related to data processing and decision support, the more value that company places on data-based decision support.

Thesis 6

There is a significant correlation between methods of data-based decision support and clusters based on data-related jobs. The way in which organisational decision support is conducted affects the positions required to operate a corporate information system.

Using statistical methods, I proved that the way in which organisational decision support is conducted affects the positions required to operate a corporate information system. Where data-based decision support is characterised by automated, regular reports, there will likely be several types of positions that serve the operation of the information system. Based on the results of the K-means centroid clustering used for the analysis, the higher the number of jobs with a higher cluster mean value within a cluster, the more advanced the method of data-based decision support will be. This also means that the human aspects of the corporate information system have a fundamental impact on the success of data-driven operations.

H7: The way in which organisational decision support is conducted places different demands on information systems, thus providing a way to define the types of information systems that support more data-intensive managerial decision-making.

Result of hypothesis test: hypothesis **accepted.**

Relevant domestic and international literature confirms that the elements of information and communication technology have become an immanent part of corporate information systems. PEPPARD and WARD (2016) argue that most organisations today, without exception, in all economic sectors, are fundamentally dependent on their information systems. There is a constant influx of information technology innovations within the corporate sphere, which moulds and shapes businesses (LAUDON - LAUDON 2015). PEARLSON et al. (2019) view information systems as critical resources that can influence business opportunities and strategies. Similar to the correlation study of data-related jobs and the mode of data-based decision support, I sought an answer to how the existence of different types of information systems influences the evaluation of data-based decision support. The existence of information systems provides an opportunity to form a good approximation of the organisation's ICT support (independent of industry and organisation size).

Thesis 7

A correlation can be established between the method of data-based decision support and the clusters formed on the basis of the information systems implemented within organisations. The way organisational decision support is conducted places different demands on information systems, thus the types of information systems that support higher-level managerial decision-making can be defined.

I have statistically demonstrated that with a higher level of data-based decision support, the range of different ICT solutions needed for managerial decision-making with complex data needs increases.

H8: The way in which organisational decision support is conducted determines the range of factors that can pose a challenge to an organisation in the field of data-based decision support.

Result of hypothesis test: hypothesis **accepted**.

I have devoted a separate chapter to the challenges of decision support within my literature review, drawing extensively from international and domestic research (3.3.). I listed the difficulties surrounding the introduction of information systems, the problems of applying ICT solutions and the difficulties of the day-to-day operation of corporate information systems. I paid particular attention to research on managerial preparedness and attitude, given that the guidance and commitment of leadership fundamentally influence the quality of decision support. In my primary research, I examined the factors hindering data-based decision-making; first in general, then separated by the method of data-based decision-making and data-based decision support. The original hypothesis did not prove to be correct in general, so I rejected it. The purpose of my knowledge acquisition was to determine whether organisations implementing more advanced decision support face problems different from those operating in a less data-driven way.

Thesis 8

A correlation can be established between the method of data-based decision support and clusters of challenging factors during data-based decision support, which statistically proves that the method of organisational decision support determines the range of factors that challenge the organisation in the field of data-based decision support.

Organisations that typically operate a decision support function based on automated, regular reporting judge challenging factors differently compared to those that have company information systems based on reports prepared ad hoc or by field experts. Depending on the evaluation of data-driven decision-making, the extent to which decision-makers' ability to interpret data can pose a problem varies. Most of those who gave the worst rating to data-based decision-making marked "decision-maker cannot interpret data" as the source

of the issue. The same statement was the least mentioned among those who gave a good or the best rating to data-based decision making.

As summarized in Table 2, with the exception of one hypothesis, I accepted my initial assumptions.

Table 2: Results of hypothesis tests - summary table

Hypotheses	Result of hypothesis test
H1: The majority of white-collar employees in mid-sized and large domestic companies often or always have to work with data as part of their job, regardless of the size of the company.	Hypothesis accepted .
H2: Those with high data literacy skills work more intensively with data and are able to participate in a wider range of data-related activities.	Hypothesis accepted .
H3: Higher levels of data literacy contribute significantly to the sense of success experienced by white-collar employees of medium-sized and large companies in Hungary.	Hypothesis accepted .
H4: Those working for large companies put more value on their data literacy compared to those working for medium-sized companies.	Hypothesis rejected .
H5: The more resources an organisation devotes to the systematic collection and use of data, the more successful it is in data-driven decision support.	Hypothesis accepted .
H6: The way in which organisational decision support is conducted shapes the jobs required to operate corporate information systems.	Hypothesis accepted .
H7: The way in which organisational decision support is conducted places different demands on information systems, thus providing a way to define the types of information systems that support more data-intensive managerial decision-making.	Hypothesis accepted .
H8: The way in which organisational decision support is conducted determines the range of factors that can pose a challenge to an organisation in the field of data-based decision support.	Hypothesis accepted .

Source: own work

4. CONCLUSION AND PROPOSALS

4.1. Conclusions Based on the Results of This Research

In addition to an extensive literature review, my own primary research supported the fact that white-collar employees of medium-sized and large companies in Hungary have to work with data on a daily basis. This result supports the subject of my dissertation, according to which - since data-related activities have become unavoidable in the area this study focused on – special attention should be paid to the subjects’ attitudes and abilities regarding data. All this is covered by the concept of data literacy, which in short stands for the ability to understand, process and use data.

Measuring this kind of ability, it became clear that those with high data literacy skills were more likely to deal with data in a statistically verifiable way, and to participate more in various data-related activities, including activities with a higher contributed value, such as reporting or analysis. From this we can conclude that businesses, whether consciously or not, take advantage of and rely heavily on human resources with high data literacy skills. This is also confirmed by the fact that the higher the data literacy skills of an employee are, the more successful he/she feels while performing his/her job. This is further enhanced by the fact that the strength of the correlation increases in proportion to the time spent at a given workplace. Since data-related activities are constant, data literacy can be an important measure of work performance. Improving this skill does not only help achieve the goals of the organisation, but also improves employees’ sense of success.

Data literacy is a visibly important virtue, a skill that white-collar employees of medium-sized and large domestic companies need in order to perform tasks entrusted to them. However, it is also necessary to examine how data literacy can be interpreted at a corporate level. Using analyses, I proved that there is no significant difference between medium-sized and large Hungarian companies when it comes to the data literacy skills of their human resources, nor between the types of data-related activities their employees perform. Thus, proposals and conclusions can be formulated regardless of company size.

By increasing the resources devoted to corporate information systems, the quality of decision support functions can be improved: the more resources an organisation devotes to collecting and using data, the more successful its data-based decision support is. The resources devoted can be human, ICT, or procedural resources of the corporate information system. I found that the method of organisational decision support affects the positions required to operate a corporate information system. Where data-based decision support is characterised by automated, regular reports, there will likely be several types of positions that serve the operation of the information system. This also means that the human aspects of a corporate information system have a fundamental impact on the success of data-driven operations. I have proved that the method of organisational decision support poses different expectations for information systems, thus the types of information systems that support managerial decision-making with higher data requirements can be determined. I have statistically demonstrated that with a higher level of data-based decision support, the range of different ICT solutions needed for managerial decision-making with complex data needs increases.

Organisations that typically operate a decision support function based on automated, regular reporting judge challenging factors differently compared to those that have company information systems based on reports prepared ad hoc or by field experts. In connection with the examination of factors hindering the operation of data-based operation, it can be concluded that, depending on the evaluation of data-based decision-making, sources of issues should be weighted differently. We can observe that moving from less to more advanced, the mention of issues decreases overall. The importance of human factors is also indicated by the fact that as data-based decision-making is strengthened, the readiness of decision-makers becomes less of an issue.

Corporate-level studies also confirm the results already demonstrated at an individual level, supporting the importance of data literacy. Hence, developing this skill is in the interest of both individual and business. This correlation system is illustrated in Figure 1.

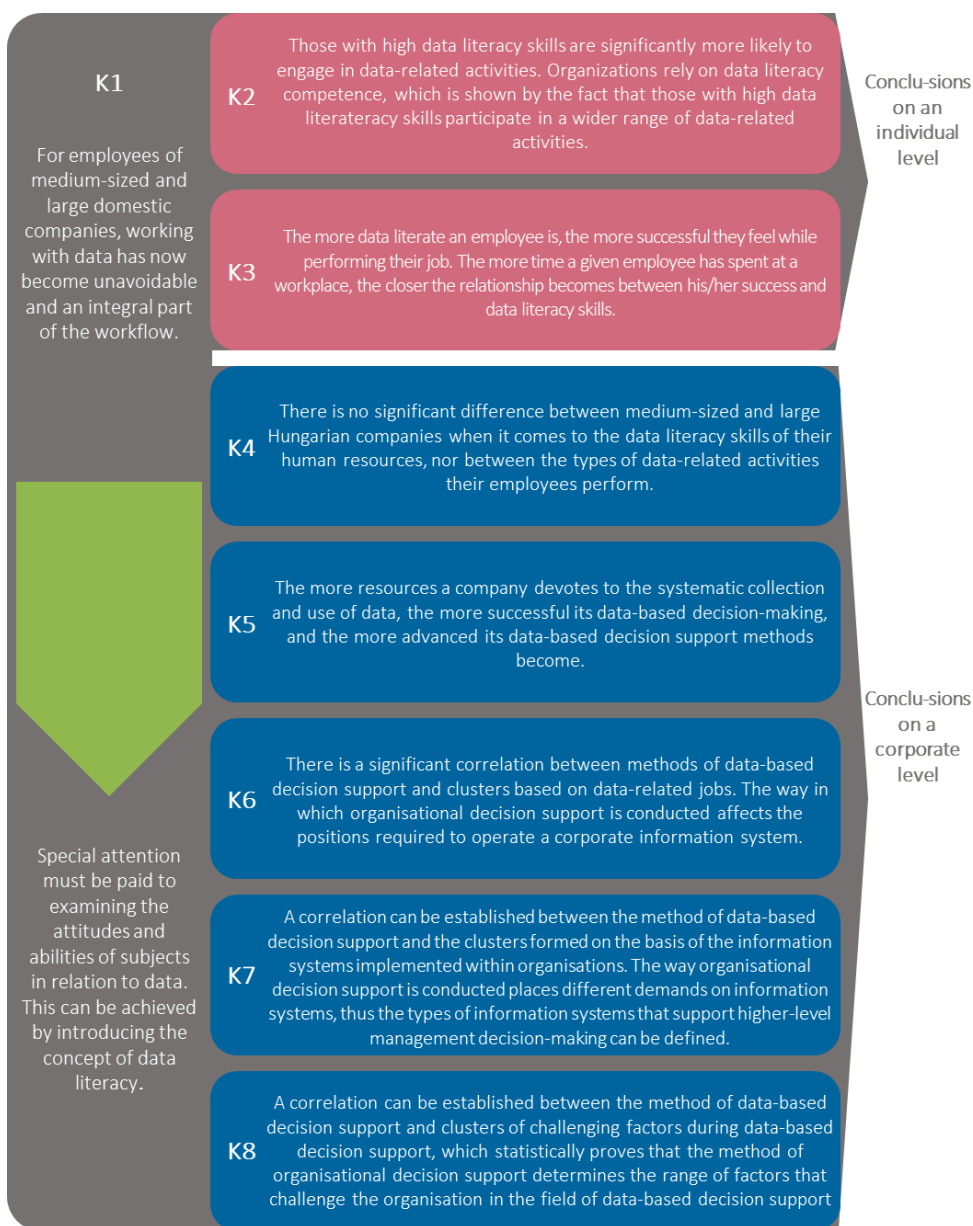


Figure 1: Logical connections of conclusions drawn from the results

Source: own work

4.2. Proposals

Proposals for utilizing the knowledge gained in the field of data literacy

Knowing the significance of data literacy, its impact on an individual's sense of success and on a company's information system, it is recommended for decision-makers of an organisation to assess the current state of organisational data literacy.

Proposed process:

1. Definition of data literacy survey respondents:
 - a. organisation-wide;
 - b. participants in the main process selected as pilots.
2. Predefining measuring points, performing measurements describing the current situation:
 - a. descriptive of data quality;
 - b. quantifying lead times;
 - c. indicators describing the characteristics of report-making and their measurement.
3. Assessment of data literacy:
 - a. based on self-declaration;
 - b. a survey supplemented by a test that takes into account company specifics.
4. Evaluation of results.
5. Preparation of an action plan based on the results:
 - a. implementation of trainings;
 - b. considering incoming proposals, implementing them as needed.
6. Reassessment based on previously defined measurement points to determine effectiveness.

Proposals for further research

Considering that apart from this survey, no research has been carried out in Hungary examining data literacy skills, the novelty of the subject provides

many additional research opportunities. Below are proposals for further research directions.

1. Case study of an organisation implementing a data literacy program
2. Identification of organisational conditions required for the application of advanced analytical methodologies
3. The situation and significance of data literacy in education
4. Examining the labour market situation of individuals with high data literacy skills

5. NEW SCIENTIFIC FINDINGS

Before preparing my dissertation, I set two main objectives. The first was aimed at getting to know the data literacy skills of medium-sized and large domestic companies in detail, while the second was at mapping the correlation between data literacy and data-based decision support. I formulated my hypotheses in accordance with these objectives, and to test them, in addition to domestic and international literature review, I also performed primary, empirical research. As a result of secondary and primary research and the first data collection and mathematical statistical analysis regarding data literacy in Hungary, new scientific results were found, which I will present in groups.

Synthesis of research literature

1. Precise definition of the corporate information systems and their components.

Relying on recognized international and domestic research literature, I clarified the concept and elements of corporate information systems. The concept cannot be interpreted as a purely IT solution, but as a complex set of tools to support management. Their elements are human (societal), information and communication technology (ICT) components and processes. I illustrated the interaction between these three elements in a visual model using existing research literature. I have collected and systematically explored the aspects that make organisational decision support difficult, so that it becomes possible to have a comprehensive overview of the obstacles to data-driven operation.

2. Exploring the yet unknown practical significance of data literacy in Hungary.

Hungarian literature on data literacy is rather limited, and the practical significance of the concept has so far escaped the attention of researchers. Following precise conceptual definitions, I have collected results from large-scale, international research that was suitable for drawing attention to the phenomenon underlying the concept, as well as for confirming the topicality of the subject. Although I did not come

across Hungary-based research on data literacy, I have collected results relevant to Hungary from border areas, which confirmed the relevance of the research objectives.

Data literacy as an individual competence

3. High data literacy skills affect employee responsibilities.

I have demonstrated that those with high data literacy skills are significantly more likely to perform data-related activities and are more likely to participate in a wide range of data-related tasks compared to those with low data literacy skills. This means that companies rely on the high data literacy skills of their employees to perform data-related tasks in ways more intensive and extensive.

4. An employee's sense of success is affected by his/her data literacy skills.

I have substantiated with statistical analyses that the more data literate an employee is, the more successful they feel while performing their job. The more time a given employee has spent at a workplace, the closer the relationship becomes between his/her success and data literacy skills.

5. The data literacy skills of employees of medium-sized and large domestic enterprises do not differ significantly.

There is no significant difference between medium-sized and large Hungarian companies when it comes to the data literacy skills of their human resources, nor between the types of data-related activities their employees perform. This result is significant for measures to improve data literacy.

The importance of data literacy in decision support

6. The way in which organisational decision support is conducted places different demands on information systems and influences the jobs required for the operation of corporate information systems.

The way in which organisational decision support is conducted places different demands on information systems, thus providing a way to define the types of information systems that support more data-intensive managerial decision-making. I have statistically demonstrated that the higher the level of data-based decision support, the wider the range of the different ICT solutions needed become in order to meet complex data needs for managerial decision-making. Similarly to information systems, the methods of organisational decision support affect the positions required to operate a corporate information system. Where data-based decision support is characterised by automated, regular reports, there will likely be several types of positions that serve the operation of the information system. These positions presuppose high data literacy skills.

7. The way organisational decision support is conducted determines the range of factors that challenge the organisation in the field of data-based decision support.

Organisations that typically operate a decision support function based on automated, regular reporting judge challenging factors differently compared to those that have company information systems based on reports prepared ad hoc or by field experts. For those having rated data-based decision-making higher, the number issues mentioned regarding data-driven operations were reduced, the weight of issues rearranged. A remarkable result is that with the strengthening of data-based decision-making, the readiness of decision-makers is becoming less of a problem, which can be explained on the one hand by the increase in data literacy among decision-makers and on the other hand by the quality of produced decision-making materials.

6. ACADEMIC LITERATURE RELATED TO THE SUBJECT OF THIS DISSERTATION

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