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# ORGANIZACIJA

Organizacija (Journal of Management, Informatics and Human Resources) is an interdisciplinary peer-reviewed journal which is open to contributions of high quality, from any perspective relevant to the organizational phenomena.

The journal is designed to encourage interest in all matters relating to organizational sciences and is intended to appeal to both the academic and professional community. In particular, journal publishes original articles that advance the empirical, theoretical, and methodological understanding of the theories and concepts of management and organization. The journal welcomes contributions from other scientific disciplines that encourage new conceptualizations in organizational theory and management practice.

We welcome different perspectives of analysis, including the organizations of various sizes and from various branches, units that constitute organizations, and the networks in which organizations are embedded.

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Revija je zasnovana tako, da spodbuja zanimanje za različne vidike v zvezi z organizacijskimi vedami in je namenjena tako akademski kot strokovni skupnosti. Revija objavlja izvirne članke, ki spodbujajo empirično, teoretično in metodološko razumevanje teorij in konceptov managementa in organizacije. Pozdravljamo tudi prispevke iz drugih znanstvenih disciplin, ki spodbujajo nove koncepte v organizacijski teoriji in praksi. Objavljamo članke, ki analizirajo organiziranost z različnih vidikov, so usmerjeni na organizacije različnih velikosti in iz različnih sektorjev, na enote, ki sestavljajo organizacije, in na mreže, v katere so organizacije vpete.

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- management človeških virov (kot so organizacija in razvoj zaposlenih, vodenje, ustvarjanje vrednosti s pomočjo človeških virov, organizacijski pojavi na delovnem mestu itd.);
- vodstveni in podjetniški vidiki izobraževanja;
- poslovni informacijski sistemi (kot so digitalno poslovanje, sistemi za podporo odločanju, poslovna analitika itd.);
- podjetniški inženiring (npr. organizacijsko oblikovanje, upravljanje poslovnih procesov, paradigme preoblikovanja podjetij itd.);
- članki, ki analizirajo organizacijsko uspešnost in prizadevanja za izboljšanje le-te.

## Contents 1/2020

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RESEARCH PAPERS	3	João P. SERRANO, Rúben F. PEREIRA	Improvement of IT Infrastructure Management by Using Configuration Management and Maturity Models: A Systematic Literature Review and a Critical Analysis
	21	Hafezali Iqbal HUSSAIN, Sebastian KOT, Hassanudin Mohd Thas THAKER, Jason J. TURNER	Environmental Reporting and Speed of Adjustment to Target Leverage: Evidence from a Dynamic Regime Switching Model
	37	Milja MARČETA, Štefan BOJNEC	Drivers of Global Competitiveness in the European Union Countries in 2014 and 2017
	53	Jernej BUZETI	Association between Field of Work, Years of Service, and Sickness Absenteeism in Public Administration
	68	Andrej JERMAN, Andrej BERTONCELJ, Gandolfo DOMINICI, Mirjana PEJIĆ BACH, Anita TRNAVČEVIĆ	Conceptual Key Competency Model for Smart Factories in Production Processes
	80	Lucia SVABOVA, Katarina VALASKOVA, Pavol DURANA, Tomas KLIESTIK	Dependency Analysis between Various Profit Measures and Corporate Total Assets for Visegrad Group's Business Entities

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# Improvement of IT Infrastructure Management by Using Configuration Management and Maturity Models: A Systematic Literature Review and a Critical Analysis

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**Background and purpose:** This research aims to investigate which benefits one may expect using Maturity Models in Configuration Management (CM) domain. CM is a support process that helps organizations have better management of their infrastructure. Its importance, in the Information Technology (IT) domain, has increased in recent years, despite this process not being technologically new, and the fact that many organizations implement this process in a haphazard way, which results in it not producing the benefits that it should produce. With the intention of assessing and improving the organizations' IT processes practices and capabilities, MMs have been developed and implemented. However, the application of MM in the CM domain is yet to be explored.

**Design/Methodology/Approach:** Two Systematic Literature Reviews (SLRs) and a Critical Analysis were performed. In sum, 80 scientific articles of the most rated conferences and scientific journals were analyzed and conclusions were drawn.

**Results:** This research concludes that despite the CM process being badly implemented, using a MM this process could decrease operational costs and increase the quality management of the infrastructure.

**Conclusion:** However, no MM has been developed so far for the CM process practices. This MM would be a viable support tool for the IT organizations providers since this would help organizations have a mature CM process and better control of their IT infrastructure. Therefore, the existence of a MM for the CM domain would be a welcome advancement that should be developed in the future.

**Keywords:** *Configuration Management Process, Maturity Models, IT Services Providers, Systematic Literature Review*

## 1 Introduction

Nowadays, it is imperative that IT organizations follow consumer tendencies and wills, with maximum effectiveness and efficiency (Asif, 2016). In fact, IT infrastructures are becoming more organizationally centralized, as these infrastructures are becoming more important, with or-

ganizations being more IT-dependent. This environment increases the importance and essentiality of IT organizations' business development and organization strategies (Ertürk & Vurgun, 2015). As a result of the considerable number of internal dependencies and relations among the systems and services provided by an organization (Vanbrabant & Joosen, 2013), it is making IT infrastructures

more complex and wider. Because of that reason and the increase of IT systems' heterogeneity, the weight of IT infrastructure management is increasing in our society, causing an increase in administration costs (Giese et al. 2010). This crucial environment, where IT performance impacts organization revenue, if not efficiently managed, can "lead to errors and subsequently to failures", determining the difference between profit and loss (Baiôco et al. 2009; Vanbrabant & Joosen, 2013).

In line with the substantial increase of the IT value in organizations is the evolution that it has provided. In an environment where success depends on clients, it is critical to address customer demands and explore new business opportunities. These conditions have allowed significant advances in IT, granting an evolution in IT services, and the satisfaction of internal and external organizational customer requirements (Johnson et al. 2007). The rising number of service providers allowed the increase of their share in the IT market (Levstek et al., 2018). Subsequently, they have naturally become important to the world's economy (Hashmi et al. 2010).

The services are developed and implemented on a sub-jacent IT infrastructure, which may consist of thousands of components, from software to hardware, which requires management in conformity with organizational objectives (Hashmi et al., 2010; Madduri et al., 2007). In this complex universe, where there is a competitive and rigorous market that gives rise to constant technological evolution (Baiôco et al., 2009), not only is the management of infrastructure changes necessary, but also an awareness of the risk and impact that they can impose on the organization (Ali & Kidd, 2013).

Therefore, the necessity to implement a process that would be essential to manage the whole IT infrastructure information has emerged (Madduri et al., 2007). Many solutions to support this kind of task were proposed in order to make a feasible "platform" that allowed the organization's collaborators to manage the infrastructure information and changes (Yang, 2010), which has led to the emergence in recent years of studies on the process of CM and its feasibility.

The importance of the CM process has been growing (Ali & Kidd, 2015), providing clear and fundamental information to all "kinds of performers" in enterprises (Baiôco et al., 2009). In spite of CM being essential to organizations, it is often misunderstood and is not given the proper importance by strategic management (Ali & Kidd, 2013; Shah et al. 2012). This process, if implemented in a careless and inaccurate way, can lead to equipment failures or even service disruptions, hence the increase in costs increase and the decrease in effectiveness in organizations (Choi & Bae, 2001).

With the purpose of assessing organizational practices, organizations have been using MMs (Haes & Grembergen, 2004; Patas et al. 2013), which in the IT industry has grown exponentially due to its importance. Organizations

have applied these models not exclusively for evaluation, but also to "benchmark and to improve their process capabilities" (Proença, 2016).

This research aims to give further insights about the following research question:

- Would the CM domain benefit from the application of MM?

In order to review the CM process and the MM domain over the years and draw conclusions about the possibility of the conjunction of both domains, the Systematical Literature Review (SLR) methodology was adopted.

This research is structured as follows. The next chapter introduces the methodology used to obtain the final articles and a brief introduction is given to the CM and MM domains. Chapter 3 includes a discussion about the necessity to create a MM for the CM process. Finally, in the last chapter, some conclusions of this research are presented.

## 2 Methodology

SLR is a type of literature review and an approach to conducting a rigorous literature review, with the view of collecting data and found evidence in order to draw conclusions about research investigations. The authors Okoli and Schabram (2010) define SLR as "a systematic, explicit and reproducible method for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars, and practitioners". SLR can improve literature reviews by bringing transparency and rigours in numerous ways, with the support of several systematic methods (Mallett et al. 2012).

With the intention of meeting the goals attached to this investigation and with the requirement to explain the "context" and the main concepts of this research, two SLRs were conducted, with the support of the Concept Centric (CC) method. This research is based on the guidelines for conducting a SLR of the author Kitchenham (2004). The steps taken to conduct these reviews are visible in Figure 1.

In order to present the insights generated by the SLR methodology, this research adopted the CC guidelines of Jane Webster and Richard Watson (2002).

### 2.1 Outlining Systematic Literature Review

These SLRs not only have the objective of justifying why the creation of a MM for the CM process is a feasible solution, granting many benefits to the management of an organization, but also the contextualization of the concepts of CM and MM. In order to achieve these objectives two SLRs were individually conducted: for the CM process and MM domain. For each domain, the CC approach was adopted to "centralized" the principal concepts intrinsical-

ly connected with each domain.

To obtain information about these two domains, five electronic repositories were selected: IEEE Online Library, SpringerLink, Elsevier, ACM and ResearchGate. The electronic repositories were the same for both approaches. However, two different keywords were used, for which an explanation lies in the following sections. Further, this review included only English and Portuguese articles and exclusively articles published on Journals or Scientific Magazines and Conferences Proceedings were accepted. Additionally, no date filter was used. Two search strings were used, one for each domain. Even though the keywords were established at this stage, with a view of research structuration it was decided to introduce them in the following sections.

The search process was the same for both domains. Initially a search was carried out with the selected keywords in each repository, without any filter. After that, four filters were created. Nevertheless, all the electronic libraries use different “search approaches”, so a keyword adaptation for each repository was done.

The first filter applies the keywords from the article title, or the abstract or the author’s keywords; In the second one, duplicated articles are removed; In the third filter, articles that are published in lower publications/journals rank are removed. For that reason, two websites, Scimago<sup>1</sup> and Conference Ranks<sup>2</sup>, were used, which provide journals and conferences ranks, respectively. For conferences only A, B, A1, A2, B1 and B2 ranks of ERA and Qualis rankings were accepted. When an article was assessed by both rankings, Qualis prevailed. For journals, only Q1 and Q2 ranks were accepted. Finally, the last stage of filtration was realized by assessing articles’ introductions and con-

clusions. The inclusion criteria of this filter of each domain are explained in the next sub-sections.

## 2.2 Conducting a Systematic Literature Review

As previously mentioned, SLR was divided into two domains and the resulting articles needed to “proceed” through four filters. Both domains filtration process, by each online repository and each filter, are demonstrated in the following sub-sections.

The first filter had the purpose of separating the articles that are exclusively related to both domains of those which just made a reference to these concepts in the body of the article, by just selecting the ones that had the keywords in the title, abstract and author’s keywords. These three article sections were chosen for being the main parts that summarise the article’s content. With this filter it was possible to discard a substantial number of articles.

The second filter had the intention of eliminating the duplicated articles.

In the third filter, 1336 articles were ranked based on their publication, which was in total nearly 890 publications since various articles had the same publication (conference/journal). Consequently, 577 articles’ introduction and conclusion were read and evaluated by each domain inclusion criteria, which resulted in 80 final articles. The final articles divided by each publication rank are shown in Table 1. Articles from conference proceedings were the main contributor, making up 60% of the resulting articles from conferences. It is important to mention that approximately 28% of the final articles are from journals with a Q1 rank.

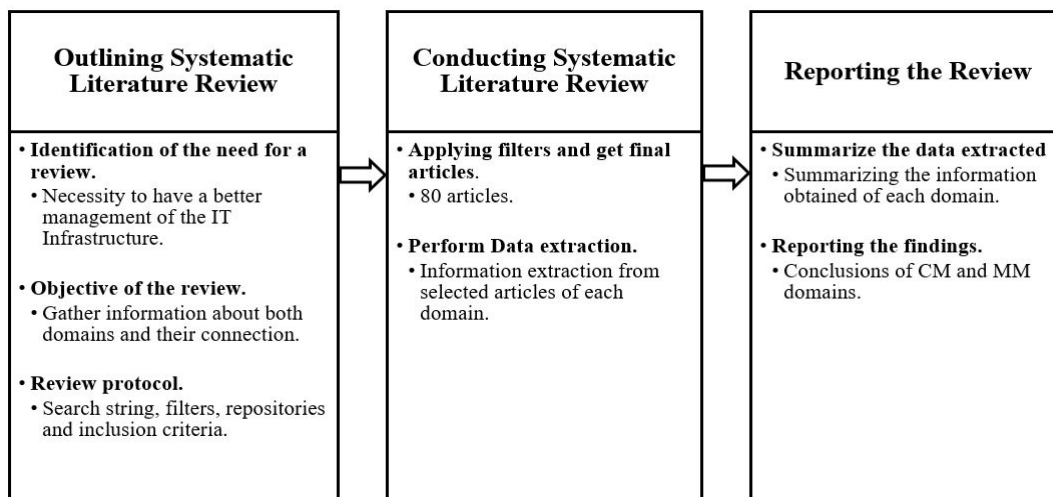


Figure 1: Systematic Literature Review Stages (Adapted from Kitchenham (2004) guidelines)

1 Scimago website: <https://www.scimagojr.com>

2 Conference Ranks website: <http://www.conferencerranks.com/#data>

Table 1: Final Articles by Publication Rank of Both Domains

	Conference rank	Total	Journal rank	Total
ERA	A	5	Q1	22
	B	2	Q2	10
Qualis	A1	8		32
	A2	10		
	B1	13		
	B2	10		
		48		

### 2.2.1 Systematic Literature Review of Configuration Management

The CM domain search had the purpose of finding its main concepts in “generic” domains, but with a focus on the IT services field. Keywords (listed below) were used in all repositories with operators AND and OR, being “Configuration Management” the main keyword. The flow of the entire filtration process can be seen in Figure 2.

*“Configuration Management”*  
AND

*“Maturity Model” OR “Frameworks” OR “Good Management Practices” OR “International Standards” OR “Main Concepts” OR “Barriers” OR “IT Service Management”*

Since ResearchGate is a social network for professionals where it is possible to publish articles, which are

accessible to the entire community, there may be articles from other online libraries. In fact, on ResearchGate four articles from IEEE repository were found, two from ACM and two from SpringerLink that were not found in their own repository with the same keywords, which shows the differences between each repository search approach.

In the last filter, where an evaluation of the article’s introduction and conclusion is realized as mentioned previously, the following inclusion criteria were followed:

- articles, exclusively about CM theme, in any domain, were accepted;
- articles about CM benefits and the problems/risks of a bad process implementation were accepted;
- articles about CM process characteristics were accepted.

Articles that did not meet at least one of these “requirements” were rejected. The comparison number between conference papers and journal articles that fulfil all requisites, is visible in Table 2.

Table 2: Conference Papers vs Journal Articles of Configuration Management Domain

	Total
Conference Papers	18
Scientific Magazines/Journals	12
	30

Table 3: Filtration Process of Configuration Management Domain

	No Filter	1st Filter	2nd Filter	3rd Filter	4th Filter
IEEE	3022	86	81	38	5
ACM	2792	118	67	35	3
SpringerLink	3249	78	78	24	1
ScienceDirect	1755	30	30	19	1
ResearchGate	199	199	140	52	20
Total	11017	511	396	169	30



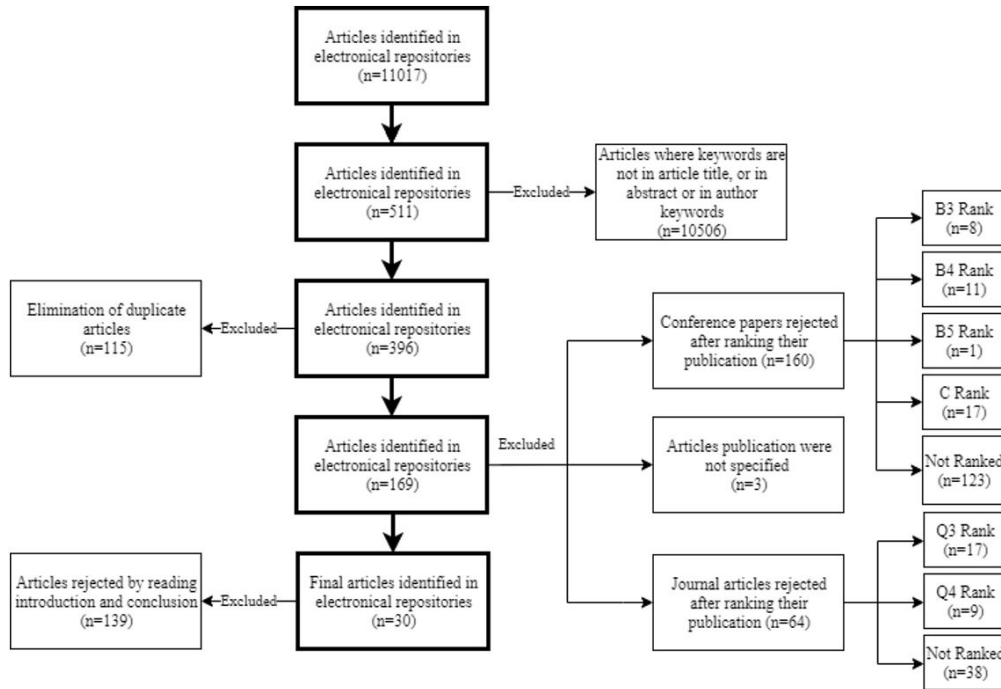


Figure 2: Flow of all Filtration Process of Configuration Management Domain

In sum, it is possible to visualize the filtration process for this domain by each filter and by each repository, in Table 3.

### 2.2.2 Systematic Literature Review of Maturity Model

Following the generic search approach discussed initially in this chapter, on MM domain the focus was not just in the IT domain, but as also in other domains, with a view to finding general benefits and difficulties in this domain. Specific keywords (listed below) for this search were used in all repositories with operators AND and OR, with the “Maturity Model” concept being the main keyword.

“Maturity Model”  
 AND  
 (“IT Frameworks” OR “Best practices” OR “Main Concepts” OR “Benefits” OR  
 “IT Management” OR “Risks”)

In the same way, as in the CM domain research, the articles found in ResearchGate’s repository were added manually and the first filter was not applied in this case. In ResearchGate four articles from SpringerLink and one from IEEE were found, which were not found in their own repositories with the same keywords. Figure 3 shows all the filtration process in MM domain research.

On the last filter, the inclusion criteria were:

- articles about MM in any domain were accepted;
- articles about MM general characteristics were accepted;
- articles about MM benefits of any domain and MM general problems were accepted.

Articles that did not meet at least one of these “requirements” were rejected.

Table 4 shows a comparison between the number of journal articles and conference papers of the filtration result.

With the same view of the CM SLR, in order to have a higher understanding and comprehension of the MM domain filtration process was constructed the Table 5.

Table 4: Conference Papers vs Journal Articles of Maturity Model Domain

	<b>Total</b>
<b>Conference Papers</b>	30
<b>Scientific articles (Scientific Magazines/Journals)</b>	20
	50

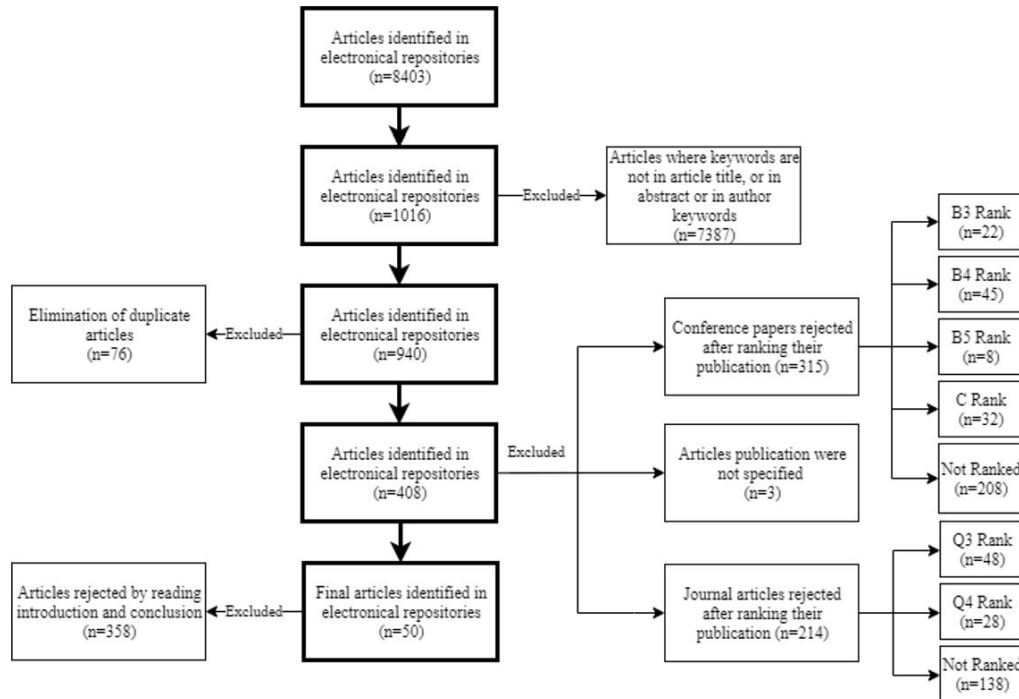


Figure 3: Flow of all Filtration Process of Maturity Model Domain

Table 5: Filtration Process of Maturity Model Domain

	No Filter	1st Filter	2nd Filter	3rd Filter	4th Filter
<b>IEEE</b>	2729	232	231	94	5
<b>ACM</b>	174	54	54	18	6
<b>SpringerLink</b>	2529	126	126	52	12
<b>ScienceDirect</b>	2560	193	193	122	11
<b>ResearchGate</b>	411	411	335	122	16
<b>Total</b>	8403	1016	940	408	50

### 3 Configuration Management

Making important decisions is a critical and decisive point in organizations. These days, ITs are becoming fundamental tools for this type of tasks, allowing organizations to achieve their structural and strategic objectives (Na-Lampang & Vatanawood, 2016), enhancing their indispensability in organizations. Modifications to IT services and IT infrastructure configurations must be managed with extreme caution in order to prevent service interruptions (Johnson et al., 2007). CM is an important support process in the management of any infrastructure that permits an efficient and effective control, promoting critical and important information in any organization division (Baiôco & Garcia, 2010), attending to these configurations changes in a secure way.

Despite the fact that the importance of CM has been in-

creasing in recent years, this process is not technologically new. In the 1950s, during the period of the “arms race”, in order to enhance the production pipeline to reduce the missiles manufacturing time of missiles, the US Department of Defense established CM to control product specifications and deal with alterations during the product life cycle, as well as to create an accessible and conformed documentation. Therefore, with the purpose of having better control and to regulate how projects should be managed, CM standards were developed. CM expanded beyond its industries roots, since “society” started to become aware of the fact that the majority of businesses are comprised of systems with high complexity which suffer constant changes due to their dynamic environment (Ali & Kidd, 2014; Burgess et al. 2005).

CM recognition has been growing (Ali & Kidd, 2015), despite not being a new concept (Ali & Kidd, 2014). It is

a set of actions whose aim is the management of services and product configurations (Aleksic et al. 2010), and to enhance the service provision quality (Hashmi et al., 2010). This process has a big responsibility not just in managing IT assets and its configurations (Lahtela & Jantti, 2010), but also in providing crucial and accurate information about these “components” to organization operators, such as organization collaborators or even to other service management processes (Baiôco et al., 2009). This conceded information permits an image of the constitution of the IT infrastructure, allowing them to identify any change that might affect the systems or the infrastructure, assuring the collaborators of fundamental information in decisions that may be taken (Yang, 2010). In Table 6, the main concepts associated with CM are shown: Configuration, Configuration Item and CM Database.

As previously mentioned, CM provides an infrastructure or service model through “identification, controlling,

maintaining and verification of existing Configuration Items versions” (Baiôco et al., 2009). CM is defined as having several sub-processes: Configuration Item Identification, Configuration Item Control, Configuration Item Verification and Audit, and finally Configuration Item Status Accounting and Reporting (Madduri et al., 2007). CM sub-processes definitions can be seen in Table 7.

Despite the fact that the influence of CM is expanding in the IT Services context (Na-Lampang & Vatanawood, 2016), in this state-of-the-art research, this process was also found in other IT scenarios, being closely related to Engineering Software, the CM concept having been identified in various contexts, such as project management, defined as Project Configuration Management (PCM), and in software development, designated as Software Configuration Management (SCM), for which a brief explanation is given in Table 8.

Table 6: Main Configuration Management Concepts Found

Concepts	Description	References
Configuration	A configuration is frequently referred to as all of the connection of all computer system parts, or a set of items that form a product.	(Aleksic et al., 2010; Calhau & de Almeida Falbo, 2012; Choi & Bae, 2001; Whyte et al. 2016)
Configuration Item	When a configuration product item is under management is called Configuration Item. Configuration Item is defined as “an infrastructure component or an item” that have value to the organization, and are vulnerable to change, with the necessity to be tracked throughout its lifecycle. These items may have different sizes and might be services, incidents, hardware components or even software packages. In several cases, it may well be persons.	(Aleksic et al., 2010; Baiôco et al., 2009; Calhau & de Almeida Falbo, 2012; Giese et al., 2010; Johnson et al., 2007; Lahtela & Jantti, 2010; Na-Lampang & Vatanawood, 2016; Pantoni et al. 2007; Ward et al. 2007; Whyte et al., 2016)
CM Database	Configuration Items and their relations are saved in a database known as CM Database. CM Database is an IT conceptual model with a predominant role in efficient IT service management. This database is an auxiliary valuable tool to perform decisions providing Configuration Items dependencies and links in the business, showing promptly the IT infrastructure details, enhancing the quality and efficiency of IT systems.	(Baiôco et al., 2009; Giese et al., 2010; Johnson et al., 2007; Lahtela & Jantti, 2010; Madduri et al., 2007; Na-Lampang & Vatanawood, 2016; Ward et al., 2007; Yang, 2010)

Table 7: Configuration Management Sub-Processes

Sub-processes	Description	References
Configuration Item Identification	Configuration Item identification is considered as an essential process to the system efficiency, where the identification of the items that will be under tracking will be realized.	(Aleksic et al., 2010; Ali & Kidd, 2013, 2015; Baiô-co et al., 2009; Calhau & de Almeida Falbo, 2012; Fowler, 1996; Madduri et al., 2007; Na-Lampang & Vatanawood, 2016; Ward et al., 2007; Whyte et al., 2016)
Configuration Item Control	Configuration Item control sub-process permits only authorized changes realized to Configuration Items.	
Configuration Item Verification and Audit	This sub-process proceeds to the verification of Configuration Item status and integrity, checking if they are in conformity with organization policies and standards.	
Configuration Item status accounting and reporting	Configuration Item status accounting sub-process, realizes information and historic report of the Configuration Items, guaranteeing the availability of this data to the organization executors.	

Table 8: Configuration Management IT Contexts Found

Contexts	Description	References
SCM	SCM gained particular recognition when Capability Maturity Model was developed, being this process established as a discipline of software development support in teams, which its main function is the accompaniment of the software products development. SCM is a set of principles and practices that are crucial to the software development support, directing the product changes, like programming code (source code), following the software design documentation. SCM comes to support brief software development in a manner that can increase the quality and decrease the development time.	(Buchmann et al. 2013; Choi & Bae, 2001; Conradi & Westfechtel, 1998; Fahmy, Deraman, & Yahaya, 2018; Pala Er & Erbaş, 2010; Pantoni et al., 2007; Park, Kim, & Lee, 2007; Tellioglu, 1996; Wandel et al. 2013; Whyte et al., 2016)
PCM	Since information asset in a project has become a project deliverable, PCM importance has gained some relevance. It is referred to as PCM when is necessary bigger control documentation and deliverable, resulting in better monitoring for project managers in the product lifecycle, that praise the PCM as a significant factor in project management.	(Fowler, 1996; Pantoni et al., 2007; Whyte et al., 2016)

## 4 Maturity Models

As previously mentioned, the technological evolution rendered organizations more IT-dependent, motivating them to improve IT's control and security (Rao & Jamieson, 2003). IT Organizations are growing in a complex way, having the requirement to evaluate their present situation, in order to, in a profitable manner, achieve their strategic objectives and project their future (Reis et al. 2017).

Managing IT practices is crucial to conducting the growing IT business value (Curley et al., 2008). Certifying the effectiveness and efficiency of these practices is an IT strategic management role (Hamel et al. 2013), whose main goal is to "continually improve IT performance with regard to its economic efficiency" (Becker et al. 2009). Hence, enterprises need to evaluate their actual position to in a strategic way, plan their proper investments (Schäffer et al., 2018). However, traditional measures were inadequate and consequently, a new "assessing methodology" emerged known as MM (Karni et al. 2013).

MMs are gradually becoming more important to organizations and any domain (Hammers et al., 2017). This concept began to be recognized 40 years ago (J. V. Carvalho et al., 2017). These models started to emerge when quality management practices were successfully implemented in manufacturing processes (Kwak et al. 2015).

Crosby was one of the pioneers, when in 1979 the structure that is subjacent to the maturity framework was created (Rao & Jamieson, 2003), conceiving a Quality Management Maturity Grid (Nord et al. 2016). His creation contributed significantly to the development of the quality maturity concept (Wang et al. 2016). At the end of the 1980s, the US Government with the intention of evaluating the capabilities of software companies, proposed to Watts Humphrey, to the Software Engineering Institute and to Miter Corporation to solve this task. The result of this task was the well-known Capability Maturity Model (CMM) (Humphrey, 1988). The MM's notoriety grew with the creation of this model (Mettler & Rohner, 2009), which provoked a strong adherence by organizations of

all domains and the attention of the research community (Achi et al., 2016), and diverse models in different domains were created, in construction (Jia et al., 2013), or in project management (Brookes et al. 2014), or even in the agriculture sector (L. Reis et al., 2018). MM is intrinsically associated with three concepts. Their description can be visualized in Table 9.

The author M. Fairchild (2004) defines the MM as “a method for judging whether processes used, and the way they are used, are characteristic of a mature organization”. MMs can be seen as a tool (Curry et al., 2013), used to evaluate the as-is state of an organization (Antunes et al. 2014) and to enhance the organization’s capabilities (Proença et al., 2013). The main idea of the MM concept is, in a succinct manner, to assess the activities behaviour of an organization at a certain number of maturity levels et al. 2009). This assessment is “constructed” by a comparison between a set of criteria and characteristics, provided by a MM, and the organization activities behaviour, shown in a gradual scale (Lã, 2011), assigning a state or a maturity level to an organization capability or a capability

combination (Desharnais & April, 2010).

MM defines an improvement path for the development of these organizational capabilities (Carvalho et al. 2018), displaying the best procedures to obtain a higher level of maturity (Proença & Borbinha, 2018). Although it is not an indispensable requisite to obtain the MM maximum level (Hamel et al., 2013) since each organization has its optimum level, which is defined as “the level that delivers the organization’s strategic objectives most effectively and efficiently”, which does not correspond to the scale’s highest level (Introna et al. 2014). The improvement/implementation path can distinguish the type of MM. The two types of paths are characterized in Table 10.

One of the MM’s main roles is to identify an organization’s weaknesses and strengths (Lahrman et al., 2010) in order to subsequently be able to create a capability improvement path and create a strategic plan for the future (Frick et al., 2013). In the literature, three specific purposes for the use of MMs were found. The description of these three purposes is presented in Table 11.

Table 9: Maturity Model Concepts

Concepts	Description	References
Maturity	Maturity concept has been described as a “state in which an organization is perfectly able to achieve the goals it sets itself”. This concept is recognized as a measure to assess how-well are the organization capabilities. The maturity “component” it may be an object, a system or a person.	(Antunes et al., 2014; Brooks et al. 2015; Cleven et al. 2014; Hammers et al., 2017; Introna et al., 2014; Karni et al., 2013; Mayer & Fagundes, 2009; Mettler & Rohner, 2009; Proença & Borbinha, 2018; Proença et al., 2017, 2018; T. L. Reis et al., 2017; Vezzetti et al. 2014)
Capability	A Capability is characterized as the ability of an organization to produce value. Organizations use their capabilities strategically to improve their “abilities” to another level of efficient and effective.	(Bezerra et al. 2014; Curley et al., 2008; Hauck & Wangenheim, 2011; Karni et al., 2013; Picard et al., 2015; T. L. Reis et al., 2017; Wendler, 2012)
Maturity Levels	Maturity Levels or stages are a sequential path, not just to give an improvement path to organization, but as well as “situate” organization capabilities in a hierarchal level. Maturity Levels are often five, and each one has its procedures to implement in order to achieve that level.	(Antunes et al., 2014; Brooks et al., 2015; J. Carvalho et al., 2018; Cleven et al., 2014; Frick et al. 2013; Introna et al., 2014; Lahrman et al., 2010; Mettler & Rohner, 2009; Nord et al., 2016; Proença & Borbinha, 2018; Serenko et al. 2016; Vezzetti et al., 2014)

Table 10: Types of Improvement/Implementation Path

Paths	Description	References
Staged	The staged model helps an organization to improve its capabilities “as a whole”. To achieve a certain maturity level is required that the organization capabilities are compliance with the characteristics of that level. This model help organizations to characterize the “overall state of the organization’s capabilities”.	(Antunes et al., 2014; Cleven et al., 2014; Finnerty et al. 2017; Karni et al., 2013; Kayaga et al. 2013; Lahrman et al., 2010; Mayer & Fagundes, 2009; Picard et al., 2015)
Continuous	In continuous path is the description of the procedures to improve/evaluate individually each capability of a domain to improve. Each capability can be at different maturity level. This helps the organization to develop and characterize the state of their individual capabilities and abilities.	



Table 11: Maturity Model Specific Purposes

Purposes	Description	References
Descriptive	MM can be used for an as-is situation of an organization, easing a basic assessment of the organization's capabilities. In descriptive purpose, MM is used as a "diagnostic tool".	(Cleven et al., 2014; Finnerty et al., 2017; Kayaga et al., 2013; Pă, 2011; T. L. Reis et al., 2017; Röglinger et al. 2012; Röglinger et al., 2018; Serenko et al., 2016)
Prescriptive	MM has a prescriptive purpose when gives an improvement path to higher maturity level, providing guidelines and measures to an organization.	
Comparative	Comparative purpose permits an organization to benchmark its capabilities in externally and internally way, using a large number of historical data from another organization's assessments.	

## 5 Discussion

As previously mentioned, CM is considered a process with the focus on quality. This process has great benefits, in terms of the identification of changes and the responsibility identification of those who performed them, maintaining the service's quality and integrity (Aleksic et al., 2010). Organizations in the service industry undergo changes frequently, and it is required to have a process that not only controls those changes but also maintains the IT infrastructure control and integrity in order to enhance the service's development and provision.

The CM process, at a developmental level, can be an essential tool in project delivery strategy because it reduces development time and minimizes risk or errors (Ali & Kidd, 2014), which allows a substantial increase in the final product quality (Fowler, 1996). This process can be a core support tool of organization operability by diminishing the delays in development and operations (Ali & Kidd, 2013), not only that, but many of the enterprises implement this process to help in ensuring that the infrastructure is in conformity with the legislation and policies of its environment (Baiôco et al., 2009).

With all the literature review, it can be affirmed that the CM process can "produce" several benefits to an organization. This process intends to reduce the number of quality and conformity problems providing important information and also seeks to increase the capabilities and resources of the organization and reduce the risks. The CM process, being properly implemented and monitored, can "deliver" transparency, integrity and a bigger control to enterprises, increasing the quality of provision service's and client's satisfaction. However, it seems, by observing the number of papers in higher quality journals/conference's proceedings in the CM domain, that has not been given proper importance to this discipline. Moreover, it is defended that this process has not been taken into account by strategic management (Ali & Kidd, 2013).

A bad or inexistent implementation of this process might bring problems such as service failures and defi-

ciencies in performance (Hashmi et al., 2010), leading to an increase in operational costs as well as a decrease in effectiveness, thus leading to the reduction of quality (Choi & Bae, 2001).

It is clear to note that, by comparing the benefits and the losses of a "bad or inexistent implementation" of the CM process and observing the research carried out in this domain, it is important that an organization have a proper implementation of the CM process and an improvement path plan.

In immature organizations, their processes are improvised and implemented in an ad-hoc manner, being difficult to take benefits from these processes. In this sort of organizations, where there is no process improvement plan, it may be a problem to achieve quality products. At the same time, in mature organizations where their processes are constantly updated, these enterprises can obtain quality products and exert more control over their projects and infrastructures (T. L. Reis et al., 2017).

MMs can help immature organizations become more robust and sustainable. These tools support organizations by assessing their process's current state and by defining an improvement path (Achi et al., 2016). This kind of assessment tools assists an organization in adapting to their environment and being more agile (Mettler & Rohner, 2009), helping to find weak and strong "spots" and improving an organization's process quality (Achi et al., 2016). They will ensure low costs and the process's execution in lower time (Hamel et al., 2013).

According to the literature review, MMs are being developed in a wide scope of domains. In the IT domain, these tools contributed to the creation of best practices (Proença et al., 2013), helping the management in IT organizations (Curry et al., 2013). IT management practices are critical to IT business (Curley et al., 2008), so it is becoming necessary to have these practices at their maximum maturity level, depending on the organizations' objectives.

It is believed that the use of best-practices following standards and frameworks in the IT Service domain can bring many benefits to the organization's performance

(Knahl, Bayro-Corrochano, & Hancock, 2013). Several researchers have created MMs to help IT organizations implement important frameworks in their infrastructure, by helping them have a robust and easy control of the overall processes (Pereira & Mira, 2010). In a practical way, some studies, with the realization of questionnaires to organizations that use best practices of frameworks like Capability Maturity Model Integration (CMMI) and Information Technology Infrastructure Library (ITIL), conclude that as processes' maturity levels grows, more benefits and fewer issues organizations will have, such as a positive impact on business performance, an increase in organization profitability and competitive leverage (Marrone & Kolbe, 2010, 2011; Salman, Daim, Raffo, & Dabic, 2018). In another study, the creation of MM for Incident Management process by following several frameworks has received good feedback from experts in the domain (Pereira et al. 2018), which seems that the utilization of frameworks for the creation of a MM could be a preference of IT organizations.

Even though MMs can bring many benefits, the improvement process is slow and it can take years to achieve a superior maturity level and to realize the benefits (Jiang et al. 2004).

Considering the losses that an organization can have by not giving importance to the CM process and the requirement to enhance this process by creating a strategic improvement plan, MM is a viable solution. By observing the benefits and objectives of both domains (CM and MMs) it can be concluded that MM domain complements the CM process by assessing its current state and supporting it through an improvement path, rendering it a robust and mature process. On that premise, the creation of a MM for CM based on frameworks can be an essential tool for an organization, generating many benefits and mitigating the problems of an immature CM process.

Eventually, this research carried out a search for MMs that would address the CM process or other IT processes that would help to justify the necessity of creating this tool,

and two MMs were found (Table 12).

To fulfil the gap of the inexistence of roadmaps that elucidates an organization about their CM process's maturity level, the authors Niknam, Bonnal and Ovtcharova (2013) have created a Configuration Management Maturity Model (CMMM) in the PLM domain. Their MM intends to evaluate the maturity of the CM process in scientific facilities to help them find their own gaps and improve this process. The authors of this model, with state-of-the-art analysis and a study of the current MMs and standards, extracted the critical activities and dimensions of the CM. Subsequently, the authors developed four maturity levels.

In other research, with the requirement of having medical devices conformed with some directives and with the necessity the companies of medical devices produce files of histories with the software components used in the development of these devices, Caffery and Coleman (2007) have developed a MM for the medical device industry. The authors compared the regulations of medical device regulations and the best practices of the CM process domain of the CMMI model. MM is composed of five maturity levels.

These are the MMs created by the scientific research community that are most related to this research scope. Despite the fact that there are already two MMs for the CM, they do not have the scope on IT Services, where there is a domain that is constantly evolving, and its importance is growing. Considering there was no MM for CM process found that solves the problems that every service provider faces every day, the creation of this model can be a contribution to the scientific community, by helping to "add value" to the CM process of the IT providers. This model can support IT organizations by evaluating the CM process and planning an improvement path, which can converge to profit and better control their IT infrastructure.

For better comprehension of the results of this research, a summary is presented in Table 13.

Table 12: MMs Found in the Literature

Articles	Scope	Area	Methodology adopted	Based on	Maturity Levels
(Caffery & Coleman, 2007)	Software	Medical devices industry	Ad-Hoc	CMMI	5
(Niknam, Bonnal, & Ovtcharova, 2013)	Product Life-cycle Management (PLM)	Scientific facilities	Ad-Hoc	CMMI, International Atomic Energy Agency (standards), SPICE-BOOTSTRAP, Project Management Maturity Model, Systems Engineering Capability Model, ISO 9000-3, ISO/IEC 12207, ISO 9001, ISO 10007: 2003, EIA-649-B, MIL-STD-3046	4

Table 13: Summary of Research Results

CM		MM	
Benefits	Problems Found	Benefits	Problems Found
<ul style="list-style-type: none"> <li>• Focus on the service’s quality and integrity;</li> <li>• A process that can manage and identify changes to the IT infrastructure;</li> <li>• Reduces development time and minimizes risks of errors;</li> <li>• Provides important information about the infrastructure to all other processes;</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of high-quality papers (lack of information);</li> <li>• It is not taking into account by the organizations strategic management;</li> <li>• Immature CM process decreases the quality of services.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluates the processes maturity;</li> <li>• Creates an improvement path;</li> <li>• Helps to find weak “spots” and improve the organization’s processes quality;</li> <li>• Ensures a low cost of operational processes;</li> <li>• MMs created by following standards can bring benefits to organizations.</li> </ul>	<ul style="list-style-type: none"> <li>• The improvement process is slow;</li> <li>• Plenty of time for benefits to be seen;</li> </ul>
<p><b>Benefits of the conjunction of both domains</b></p> <ul style="list-style-type: none"> <li>• Creates an improvement path to the CM process;</li> <li>• Evaluates the <i>as-is</i> state of the CM process;</li> <li>• Better knowledge and management of the CM process, which brings a better quality of management and efficiency of the IT infrastructure;</li> <li>• Possibility of mitigating the problems and errors of the bad CM process execution.</li> </ul>			
<p><b>Conclusion</b></p> <p>Two MMs that address the CM practices were found, however, none of those MMs focus on IT Services. This research can represent an opportunity for the development of MM for the CM process.</p>			

## 6 Conclusion

Due to the constant pressures of the market and the environment, such as the reduced costs of operations, but with the requirement of maintaining the same or better quality, organizations need to constantly upgrade themselves by having mature processes, and MMs can serve as an excellent tool to improve organizations’ processes. With the Systematic Literature Review methodology and Concept Centric method, it was possible to explain the CM and MMs concepts and their main characteristics and benefits,

such as their problems and difficulties.

On the CM domain research, the number of result articles was just 30, and some of them are from the 1990s. This demonstrates that, although it is proven that the CM process could be essential for an organization, research done by the scientific community in higher-ranked journals/conferences in this domain and CM recognition is much more underdeveloped than it should be. Different from CM, on MMs research, many articles about the creation of new MMs and their importance in a broad domain variety were found, which reveals the substantial MM importance for an organization.

Still, a brief search of MMs for CM was made and two articles were found. However, any of these MMs address the IT Services domain, which underscores the fact that the development of a MM for the CM would be a feasible and helpful tool for IT Services providers.

Also, this investigation, by comparing the benefits and the utility that a CM would have in the management of an IT organization, concluded that a MM specific for CM would be an essential quality tool for an organization, such as the utilization of frameworks for the development of this kind of utensil.

These reviews will help new researchers to have a knowledge basis to start new research in these domains and can be a support base for the creation of a MM for the CM process.

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## **Izboljšanje upravljanja IT infrastrukture z uporabo upravljanja konfiguracije in zrelostnih modelov: sistematičen pregled literature in kritična analiza**

**Ozadje in namen:** Cilj raziskave je proučiti, katere koristi lahko pričakujemo od uporabe modelov zrelosti (MM) v domeni upravljanja konfiguracije (CM). CM je podporni postopek, ki organizacijam pomaga, da imajo boljše upravljanje svoje infrastrukture. Njegov pomen na področju informacijske tehnologije (IT) se je v zadnjih letih povečal, čeprav ta postopek ni tehnološko nov. Številne organizacije izvajajo CM na neorganiziran in površen način, zato ne prinaša pričakovanih koristi. Z namenom ocenjevanja in izboljšanja praks in zmogljivosti IT v organizacijah so bili razviti in implementirani modeli zrelosti (MM). Uporaba MM v domeni CM še vedno ni ustrezno raziskana.

**Zasnova / metodologija / pristop:** Izvedena sta bila dva sistematična pregleda literature in kritična analiza. V celoti je bilo analiziranih 80 znanstvenih člankov najbolje uveljavljenih konferenc in znanstvenih revij.

**Rezultati:** V tej raziskavi ugotovili, da kljub slabemu izvajanju postopka upravljanja CM, lahko le-ta vseeno zmanjša operativne stroške in poveča kakovost upravljanja informacijske infrastrukture.

**Zaključek:** Do sedaj še ni bil razvit noben MM za prakse postopkov CM. Ta MM bi bil podporno orodje za upravljalce IT organizacij, saj bi s tem organizacijam pomagal do zrelega procesa upravljanja CM in boljšega nadzora nad svojo infrastrukturo IT. Zato bi bil obstoj MM za področje CM dobrodošel napredek, ki ga bi bilo treba razviti v prihodnosti.

**Ključne besede:** *postopek upravljanja konfiguracije, modeli zrelosti, ponudniki IT storitev, sistematični pregled literature.*

# Environmental Reporting and Speed of Adjustment to Target Leverage: Evidence from a Dynamic Regime Switching Model

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**Background and Purpose:** This study investigates the impact of environmental reporting on speed of adjustment and adjustment costs which is evaluated based on the ability of firms to adjust to target leverage level for non-financial firms listed in the Malaysian Stock Exchange (Bursa Malaysia).

**Design/Methodology/ Approach:** The study selects Malaysian firms based on the contracting and political cost of the economy which is seen as a relationship-based economy. This in turn influences a firm's ability to obtain external financing and thus has an important impact on capital structure decisions. In addition, the method employed allows for a direct measure on adjustment cost for firms. The current study utilises a dynamic regime switching model based on the DPF estimator to estimate rate of adjustment to optimal target levels based on the distinction of environmental reporting of public listed firms. The approach allows statistical inferences to control for potential serial correlation, endogeneity and heterogeneity concerns which accounts for firm specific characteristics.

**Results:** The empirical findings suggest voluntary disclosure on environmental reporting increases a firm's ability to access external financing at a cheaper cost as evidenced by a more rapid rate of adjustment. The findings are consistent across differing endogenous and exogenous factors indicating that these firms tend to face lower adjustment costs.

**Conclusion:** The current study provides a direct measure on the ability of firms to adjust to target levels via security issues and repurchases in the capital markets. This in turn is a reflection of perceived riskiness and value from the investors' point of view in an emerging market. Prior studies have focused on environmental reporting and equity risk premiums and have not evaluated the direct impact on firm value given that the trade-off theory of capital structure predicts that firm value is maximised at target i.e. optimal levels of leverage. This study addresses the current gap in the literature by evaluating the impact on firms' value, based on the adjustment cost.

**Keywords:** *Environmental reporting, capital structure, speed of adjustment, DPF estimator, dynamic panel data*



## 1 Introduction

The study aims to understand the practice of voluntary disclosure of environmental information by publicly listed firms in a developing country, through the measurement of the speed of adjustment to optimal leverage levels<sup>1</sup> which is assumed to be the target levels of firms given that managers are working to maximise firm value. The issue of environmental reporting and the broader subject of corporate social responsibility has received attention in the academic and practitioner literature in recent times around disclosing information on waste management, programs for recycling as well as the implementation of environmental controls (Ali et al., 2017; Cho et al., 2015). Disclosure of such information attracts investors' attention given its voluntary nature which is deemed by some to be costly (Michelon et al., 2015). These costs arise mainly from compiling expenditure, given that the nature of information being disclosed is not readily available in accounting systems or the financial reporting infrastructure of most companies (Fernandes et al., 2018; Khlif et al., 2015). By providing commentary around the rationale for disclosing non-mandated information, examining the rate of adjustment to target leverage (i.e. adjustment costs which is implied through the speed of adjustment to optimal levels), the research will be addressing an identified gap in the environmental reporting as well as capital structure literature. Furthermore, the research will be able to provide further insight into the role of relative adjustment costs and its relationship with voluntary disclosure of environmental information in a country where transaction costs are known to be high (Lemma and Negash, 2014; Öztekin, 2015; Öztekin and Flannery, 2012; Ting, 2016).

The rate of adjustment is considered dependent on the ability of firms to adjust to target levels which are reliant on costs of financing i.e. costs incurred to raise capital (including indirect costs) as well as adjustment costs. Disclosure of environmental information which is voluntary in nature may affect a firm's speed of adjustment which is based on the perceived riskiness measure of investors and thus affects adjustment costs (Plumlee et al., 2015). Arguably, firms which are deemed to be socially responsible tend to have the ability to raise equity at cheaper costs i.e. demand a price premium (Hussain et al., 2019). A contrasting trend is observed for firms below target levels where debt issuers with disclosures are seen to adjust at slower rates. It is considered likely that firms with environmental reporting tend to maintain lower levels of leverage given that the voluntary disclosure acts as an additional measure of assessing financial risk which points towards market-imposed discipline (Andrikopoulos et al., 2014; Brammer and Pavelin, 2008). Investigating this area of research and in the context of a developing country like

Malaysia, is particularly interesting given they have a relationship-based economy where contracting and political costs heavily influence financing behaviour (Ebrahim et al., 2014; Hussain et al., 2018; Rajan and Zingales, 1998).

To address the aims of this research the paper is structured as follows: Section 2 provides a brief review of the relevant literature to contextualise the study whilst section 3 provides a description of the data and sample selection process. The empirical model and methodological approach are presented in section 4. Section 5 reports and discusses the results. Section 6 provides concluding remarks on the implications of the findings which improves understanding of the link between voluntary environmental disclosure and the impact on adjustment costs for firms from the perspective of an emerging capital market.

## 2 Literature Review

Studies examining the importance of social financing disclosures have been gaining traction in the literature and stems from the need to emphasize sustainable development. The motivation behind these studies are based on the scarcity of environmental resources, hence the utilisation of these scarce resources needs to be accounted for (Martin-Ortega et al., 2011). Whilst the willingness of firms to disclose the utilisation of these scarce resources has seen some increases over the years (Jose and Lee, 2007), voluntary disclosure is still an area which lacks academic discussion (Kuo and Chen, 2013; Zhang et al., 2016).

The nature of environmental disclosure can be segregated into coercive versus voluntary disclosure (Doshi et al., 2013; Lewis et al., 2014). Coercive disclosure stems from governmental regulations which is mandatory in nature whilst voluntary disclosure is driven by demand from stakeholders as well as internal firm characteristics. Findings in the literature indicate that pressure from stakeholders can lead to increased voluntary disclosure (Lewis et al., 2014). These stakeholders range from environmentally conscious investors, nongovernmental organisations as well as customers (Clarkson et al., 2008). However, these pressures are mainly present in developed countries where international firms tend to attract the attention of stakeholder groups who are well-organised (Aragón-Correa et al., 2016). The scenario in developing countries tends to be markedly different given there is limited interaction with these demanding stakeholders (Md Zaini et al., 2018). Better understanding of the impact of voluntary environmental disclosures on adjustment costs in the context of a developing country and its influence on firm value is therefore important to gain further holistic insight into the value of voluntary environmental reporting.

<sup>1</sup> For empirical purposes, both terms (optimal and target leverage levels) are used interchangeably in the current study

## 2.1 Motivations for Voluntary Environmental Disclosures

There could be a number of plausible motivations behind a firm's voluntary environmental reporting but the most discussed is derived from the concept of organisational legitimacy (Deegan, 2002). The legitimacy view provides four reasons for disclosure. The first is based on the need for the firm to provide information to the 'relevant publics' in order to reduce the legitimacy gap arising from expected impact on firm performance due to changes in environmental concerns (Qian and Schaltegger, 2017). The second explanation is based on the need to change perceptions which are not reflected in actual behaviour and where a firm may in fact be engaged in undesirable practices yet want to promote the image of an environmentally friendly workplace (Alrazi et al., 2015).

The third arises from the intention to detract attention away from public concerns via the use of emotive imagery such as disclosing information on a particular recycling program implemented in an attempt to deflect attention away from pollution caused by production (Fisher et al., 2017). The final justification under organisational legitimacy arises from wanting to alter expectations of stakeholders which may be unrealistic (Bond et al., 2016). These however are not the only reasons, when considering the issue of voluntary environmental reporting, there are also other systematic factors which are related to the firm's characteristics as well as the external environment in which firms operate (Braam et al., 2016).

The view of information asymmetry between insiders and outsiders argues that voluntary disclosure would tend to have an influence on the transparency as well as the accountability of the firm (Birkey et al., 2016). Thus, the motivation behind such voluntary disclosure would be determined by the potential benefit arising from a reduction in information asymmetry versus the costs that would hinder voluntary disclosure (Arena et al., 2015). Emerging countries with unique capital markets would tend to have differing reasons for such voluntary disclosures (Belal et al., 2013). The literature documents that governance in developing markets is weaker given that political and social environment leads to poorer enforcement as well as potential collusion between state and the organisation (Song et al., 2015).

In addition, the ownership and control of listed firms in developing countries tend to be highly concentrated relative to developed markets which are inclined to have greater dispersion of ownership (Lemmon and Lins, 2003). The trend observed in these capital markets has seen the expropriation of wealth at the expense of minority shareholders due to weak governance structures (Claessens and Yortoglu, 2013; La Porta et al., 2000). Such concentration of ownership has also been associated with lower levels of voluntary disclosures (Akhtaruddin et al., 2009). Further-

more, the public awareness of social and environmental issues as well as institutional and regulatory enforcement, tend to be lower in developing countries which reduces the pressure for providing such voluntary disclosures (Xiao et al., 2005).

## 2.2 Adjustment to Target Capital Structure and Firm Value

The irrelevance hypothesis proposes that firm value is independent of capital structure in perfect capital markets (Modigliani and Miller, 1958). In the presence of market imperfections, firms have the incentive to issue debt given the benefit arising from tax deductibility of interest payments (Modigliani and Miller, 1963). Debt issues in imperfect markets however bring about further costs which are weighed against the potential benefits of debt leading to a situation where managers are constantly trading-off to reach an optimal level where firm value is maximised (Ju et al., 2005; Shyam-Sunder and Myers, 1999). This gives rise to the dynamic view of capital structure where firms are constantly attempting to reach optimal leverage levels where the marginal benefits arising from further issues are offset by the marginal costs of increasing leverage levels (Abel, 2018; Hackbarth, Miao and Morellec, 2006).

The trade-off theory explanation of capital structure is therefore based on the ability of firms to adjust to target levels based on the cost of adjustment (Öztekin, 2015; Zhou et al., 2016). As a result, managers are taking into account the cost of adjustment arising from market imperfections which is weighed against the potential benefit of operating at, or close to optimal levels. Deviation from target levels tends to be significant even in the presence of low adjustment costs, such as firms operating in developed financial markets which predicts speed of adjustment which is significantly greater than zero (Chang et al., 2015). In the presence of adjustment costs, it is found that firms exhibit large deviations from target levels with longer half-life (Öztekin, 2015). Firms based in countries with weaker legal and financial market institutions tend to face greater adjustment costs and hence would deviate longer from target levels and lower rates of adjustment (Öztekin and Flannery, 2012).

The presence of optimal or target levels is further validated by managers in developed and developing countries pursuit of target debt ratios (Brounen et al., 2006; Nor et al., 2012). The empirical evidence illustrates that exogenous factors such as macro-economic shocks which influence firms' riskiness as well as variance in cash flows tend to have an impact on speed of adjustment (Cook and Tang, 2010). The risk factor is moderated by information of the capital market with firms operating in markets where there are greater levels of information asymmetry tending to face greater transaction costs (An et al., 2015).

The level of disclosure is also found to be contentious in its impact on capital structure. The rate of adjustment is argued to depend on a firms' endogenous characteristics which leads to heterogeneity across firms (Faulkender et al., 2012). Theoretically, increased voluntary reporting would lead to greater levels of transparency which provides firms with reduced costs of raising capital. Hence firms would be able to adjust at more rapid rates (Yang et al., 2018). The literature however provides conflicting information where there has been evidence showing that voluntary environmental reporting is associated with lower leverage levels (Ahmad et al., 2003). The rationale behind increased disclosure leading to lower levels of leverage is based on the argument that firms with lower levels of leverage are engaging in greater levels of voluntary environmental disclosure as a precautionary measure to assess financial risks. In addition, there have also been arguments indicating that additional voluntary disclosure has no impact on the cost of capital and thus would not directly affect adjustment costs (Bertomeu et al., 2011).

The debate in the current literature indicates that there is a lack of certainty around the impact of voluntary environmental disclosure on a firm's ability to raise capital especially in the context of developing markets. Previous studies neglect the impact of such voluntary disclosures on firm value, rather focusing on risk premiums. This study aims to close this identified gap by measuring the rate of adjustment whilst accounting for heterogeneity (discloser versus non-discloser) which provides an indication of firm value given that firm value is maximised when operating at optimal leverage levels. The study will examine the adjustment costs arising from information asymmetry in the context of the Malaysian capital market given its institutional and financial market characteristics based on a firms' heterogeneity arising from voluntary environmental disclosure.

### 3 Methodology

The classical approach found in the empirical literature to estimate speed of adjustment utilises the lagged dependent based on a partial adjustment model which can be expressed as follows (Öztekin and Flannery, 2012):

$$Leverage_{it} - Leverage_{it-1} = \lambda(Leverage_{it}^* - Leverage_{it-1}) + \varepsilon_{it} \quad (1)$$

The speed of adjustment ( $\lambda$ ) in this approach is given by the distance of the lagged leverage ( $Debt_{it-1}$ ) and the optimal debt ratio which is time variant ( $Leverage_{it}^*$ ). In the event that the coefficient ( $\lambda$ ) = 0, firms do not adjust to optimal levels (leverage changes are random). However, if ( $\lambda$ ) = 1, firms are able to fully and immediately adjust to target levels, hence eliminating deviation from optimal

ratios. At the optimal point (which in the practical sense would be the ultimate target level of leverage for managers who are assumed to be working to maximise shareholders' wealth), firm value is maximised (Warr et al., 2012). The empirical approach would call for rearranging the equation (1) whilst controlling for firm specific characteristics which are related to costs and benefits of debt and equity as well as accounting for unobservable components. Regressing the current leverage against the lagged dependent variable captures the rate of adjustment which eliminates the need to estimate a target leverage level. Thus, the model can be expressed linearly as follows (Öztekin, 2015):

$$Leverage_{it} = (1 - \lambda)Leverage_{it-1} + \lambda\beta X_{it} + \eta_i + \eta_t + \varepsilon_{it} \quad (2)$$

where  $X_{it}$  is a vector of determinants which are firm specific,  $\beta$  is the coefficient vector which includes an intercept,  $\eta_i$  is fixed effects for firms whilst  $\eta_t$  is fixed effects for time. Thus if  $\alpha=1-\lambda$  and  $\gamma=\lambda\beta$ , equation (2) can be rewritten to represent a testable empirical model as follows:

$$Leverage_{it} = \alpha Leverage_{it-1} + \gamma X_{it} + \eta_i + \eta_t + \varepsilon_{it} \quad (3)$$

The expression in equation (3) assumes that the speed of adjustment as well as firm specific factors are time-invariant and constant across groups. However, given that the current study is focusing on the impact of voluntary disclosure of firms on the speed of adjustment, heterogeneity is introduced into the model. The model in equation (3) is therefore extended in order to account for time-variation as well as inter-group variation in estimating the  $\lambda$  parameter to measure the speed of adjustment. This can be achieved by utilising a regime-switching partial adjustment model which allows the variation of both factors (speed of adjustment as well as the importance of firm specific characteristics) over the two regimes (Kareem and Mijbas, 2019). Both regimes can be defined based on disclosing or non-disclosing firms and the models for the differing regimes are as follows:

$$\begin{aligned} Leverage_{it}^{(1)} &= \alpha_1 Leverage_{it-1}^{(1)} + \gamma_1 X_{it}^{(1)} + \eta_{1i} + \eta_{1t} + \varepsilon_{it}^{(1)} \\ Leverage_{it}^{(2)} &= \alpha_2 Leverage_{it-1}^{(2)} + \gamma_2 X_{it}^{(2)} + \eta_{2i} + \eta_{2t} + \varepsilon_{it}^{(2)} \end{aligned} \quad (4), (5)$$

Both models can be rewritten in a single model as follows:

$$\begin{aligned} Leverage_{it} &= RD_1(\alpha_1 Leverage_{it-1} + \gamma_1 X_{it} + \eta_i + \eta_t + \varepsilon_{it}) \\ &+ RD_2(\alpha_2 Leverage_{it-1} + \gamma_2 X_{it} + \eta_i + \eta_t + \varepsilon_{it}) \end{aligned} \quad (6)$$

where  $RD_1$  and  $RD_2$  are two dummies which capture the different regimes and thus are equal to 1 if firm  $i$  is in a particular regime at time  $t$ , and zero otherwise. Therefore, the extended model in equation (6) provides a direct comparison between speed of adjustment to target levels for the differing regimes (in this case firms with and without voluntary environmental disclosures). The equation can be transformed into a simpler form to improve numerical stability as well as provide simplification in testing of statistical significance and is thus implemented in the following form for the empirical analysis in the current study as follows (Halling et al., 2016):

$$\begin{aligned} Leverage_{it} = & \alpha_1 Leverage_{it-1} + (\alpha_2 - \alpha_1) Leverage_{it-1} RD_2 \\ & + \gamma_2 X_{it} + (\gamma_2 - \gamma_1) X_{it} RD_2 + \eta_i + \eta_t + \varepsilon_{it} \end{aligned} \quad (7)$$

The model expressed in equation (7) is dynamic in nature which is time-variant and thus can be referred to as a partial adjustment model based on regime switching. The research notes the argument in the literature that speed of adjustment can be biased in traditional estimation methods due to heterogeneity arising from firm specific differences (Elsas and Florysiak, 2011; Faulkender et al., 2012). The bias arises from the nature of unbalanced panel data used in the current study, heterogeneity which is unobservable, inclusion of lagged leverage as an independent variable to explain leverage and the measurement of the dependent variable which is also a ratio (Flannery and Hankins, 2013). The biasness is overcome in this research by adopting a Tobit estimator which is doubly censored (restricted to range between 0 and 1) and which is referred to as a DPF estimator. The approach allows estimation of results to overcome the issue of mechanical mean reversion as well as the aforementioned biasness as it relies on a latent variable (Elsas and Florysiak, 2015). The estimator is further extended to include firm fixed effects and is robust enough to consider missing observations (Loudermilk, 2007). The model is estimated by assuming that the latent variable, which is unobservable ( $Leverage_{it}^+$ ), evolves based on a dynamic model setting and thus can be expressed as follows:

$$Leverage_{it}^+ = \alpha Leverage_{it-1} \gamma X_{it} + \eta_i + \eta_t + \varepsilon_{it} \quad (8)$$

Based on equation (8),  $Leverage_{it}$  is estimated as the observable dependent variable which is doubly-censored and thus the possible outcomes are expressed as follows:

$$Leverage_{it} = \begin{cases} 0 & \text{if } Leverage_{it}^+ \leq 0 \\ Leverage_{it}^+ & \text{if } 0 < Leverage_{it}^+ < 1 \\ 1 & \text{if } Leverage_{it}^+ \geq 1 \end{cases} \quad (9)$$

In the theoretical sense, the latent unobservable var-

iable ( $Leverage_{it}^+$ ) is treated as its debt capacity which can lie outside the range of 0 to 1 (Elsas and Florysiak, 2015). However, in the empirical model replacements are performed in order to correct errors in observed data given that these values are rarely found in reality. The model expressed in equation (8) is based on the assumption that firm fixed effects ( $\eta_i$ ) which are the unobserved heterogeneity at firm level can be specified. The heterogeneity at firm level is dependent on the mean value of firm specific characteristics  $E(X_i)$  as well as the leverage level in the initial period of observation ( $Leverage_{i0}$ ) and can be expressed as follows:

$$\eta_i = \alpha_0 + \alpha_1 Leverage_{i0} + \alpha_2 E(X_i) + \alpha_i \quad (10)$$

where the error term ( $\alpha_i$ )  $\sim N(0, \sigma_a^2)$ . In the current study, equation (8) is estimated using a Tobit estimator based on the conditions stipulated in equations (9) and (10) utilising the maximum likelihood estimation method.

### 3.1 Data and Variables

Data is obtained from the Thomson Reuters Datastream<sup>3</sup> database for Malaysian firms for the years 2014 to 2018. Industry classifications are divided into 10 categories and reported in the Appendix. In addition, financial firms are eliminated from the sample given that their capital structures tend to lead to bias in estimates of speed of adjustment (Hussain et al., 2019; Mallisa and Kusuma, 2017). Missing values are further dropped from the sample. Winsorizing of all variables at the 1st and 99th percentile was conducted to eliminate the effect of outliers (Gorodutse et al., 2017). The refinement and filtering of data leaves a final sample of 698 firms with a total of 2,619 firm-year observations. The variables utilised in this study are based on common regressors identified for studies in capital structure and presented in Table 1.

Both book debt and market debt ratios are utilised as dependent variables given that these variables are interdependent and the consensus in the literature indicates that both are of concern to managers (DeAngelo and Roll, 2015). This study defines environmental disclosures as any specific sentence in the annual report that provides a discussion on an aspect of the natural environment (Ahmad et al., 2003). This is inclusive of any awards won for

<sup>2</sup> Datastream is a "global financial and macroeconomic data platform providing data on equities, stock market indices, currencies, company fundamentals, fixed income securities and key economic indicators for 175 countries and 60 markets" (European University Institute, 2019, n/p). It can be accessed via institutional subscription at <https://www.thomsonone.com/DirectoryServices/2006-04-01/Web.Public/Login.aspx?brandname=datastream>



Table 1: Definition of Variables

Variable	Description
Book Leverage (BL)	Total debt scaled by book value of total assets
Market Leverage (ML)	Total debt scaled by market value of equity plus book value of debt
Firm Size (SIZE)	Natural log of net sales at 2014 prices
Profitability (PROF)	Earnings Before Interest and Taxes scaled by total assets
Earnings Volatility (VOL)	Standard deviation of EBIT scaled by total assets for the past 3 years
Market-to-Book Ratio (MTB)	Ratio of the book value of total assets less book value of equity plus the market value of equity to book value of total assets
Asset Tangibility (TANG)	Net Property, Plant and Equipment scaled by total assets
Industry Leverage (INDL)	Median leverage (book or market) of the industry

Table 2: Comparison of firm specific characteristics

Variable	Discloser Firms	Non-Discloser firms	T-values (absolute)
BL	0.1488	0.2265	3.96***
ML	0.1836	0.2938	5.26***
SIZE	19.9362	18.9968	1.24
PROF	0.0634	0.0625	0.38
VOL	0.0296	0.0625	4.82***
MTB	1.9928	2.0184	0.63
TANG	0.3240	0.2435	3.25***

Notes: \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively. Source: Author's own

environmental related issues or standards obtained. It was found that 248 firms were classified in the discloser group whilst the balance are categorised as non-disclosers. This indicates that about 38% of firms in Malaysia have some form of voluntary environmental disclosure in their annual reports for the years 2014 to 2018. Comparison of firm specific characteristics are reported in Table 2 for both groups of companies.

In-line with our expectations derived from the empirical literature, we find that the discloser group tends to have lower levels of leverage. Given that their profitability is higher whilst their tangibility levels do not differ significantly, it is clear that the lower borrowing strategy is not influenced by the usual determinants of capital structure. Furthermore, these companies tend to be larger and thus would, in theory, have larger debt capacity. It does point towards the ability of firms to raise equity at cheaper costs relative to the non-discloser group, indicating that investors tend to attach a lower risk premium as a consequence of greater levels of voluntary disclosure. In order to analyse whether this ultimately translates into increased firm value, the current study investigates the rate of adjustment for these firms to reach optimal levels.

## 4 Empirical Results and Discussion

### 4.1 Optimal Leverage Levels

The current study is aimed at measuring the speed of adjustment based on the dynamic regime switching model. This provides a comparative basis for firms in the discloser and non-discloser groups. In order to ensure that parameters are estimated accurately, initial diagnostics were performed based on the panel unit root test to ensure that all regressors applied were stationary. Thus, the panel unit root test was applied for all variables based on three different approaches (Dickey and Fuller, 1979; Im et al., 2003; Levin et al., 2002). Results for the estimations are reported in Table 3 below.

Based on the estimation results reported in Table 3, it can be observed that all regressors are stationary at I (0) which means that the nulls for unit root are rejected. However, further analysis based on the dynamic regime switching model can be applied to estimate the rate of adjustment to optimal levels. The target leverage regressions are then reported in Table 4 below for book and market leverage whilst controlling for firm specific characteristics.



Table 3: Unit Root Test for Panel Data

Variable	IPS T-Stat	LLC T-Stat	ADF Fischer T-Stat
BL	-16.295***	-6.289***	85.962***
ML	-18.256***	-8.624***	96.258***
SIZE	-9.258***	-4.085***	68.962***
PROF	-15.252***	-6.210***	69.263***
VOL	-22.884***	-11.925***	98.928***
MTB	-56.951***	-22.486***	99.622***
TANG	-28.451***	-15.262***	126.325***

Notes: \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively. IPS represent Im, Pesaran and Shin (2003), LLC represent the Levin, Lin & Chu (2002), ADF represent the Dickey and Fuller (1979) panel unit-root test approach respectively. Source: Author's own

Table 4: Speed of Adjustment to Target Leverage

	BL	ML
LEVERAGE <sub>(t-1)</sub>	0.7988*** (0.0926)	0.8025*** (0.1128)
Speed of Adjustment (SOA)	20.12%	19.75%
SIZE	0.0285*** (0.0062)	0.0428*** (0.0096)
PROF	-0.0635*** (0.0155)	-0.0692*** (0.0189)
VOL	-0.0528*** (0.0122)	-0.0635*** (0.0135)
MTB	-0.0825 (0.1428)	-0.1125 (0.1624)
TANG	0.1452*** (0.0486)	0.1624*** (0.0536)
INDL	0.3062*** (0.0625)	0.3825*** (0.0938)
Time Dummies	Yes	Yes
Industry Dummies	Yes	Yes
Adjusted R <sup>2</sup>	0.4028	0.5622

Notes: \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively. Source: Author's own

Based on the estimation results reported in Table 3, it can be observed that all regressors are stationary at I (0) which means that the nulls for unit root are rejected. However, further analysis based on the dynamic regime switching model can be applied to estimate the rate of adjustment to optimal levels. The target leverage regressions are then reported in Table 4 below for book and market leverage whilst controlling for firm specific characteristics.

Consistent with our expectations, column 1 indicates that rate of adjustment for Malaysian firms are indicatively slower than findings reported in developed markets given that transaction costs are known to be high (Ebrahim, 2014).

## 4.2 Discloser versus non-discloser

The main results from the regressing equation (7) is reported in Table 5 below. Column 1 reports the results for book leverage whilst column 2 provides results for market leverage. For the sake of brevity, the firm specific determinants (control variables) are not reported.

Regressions control for firm and year fixed effects which accounts for heterogeneity across firms and which is unobservable. Table 5 reports coefficients whilst robust standard errors are reported in parenthesis (White, 1980). The rate of adjustment is distinguished between discloser and non-discloser by using a Wald-test for differences based on the coefficients estimated on the lagged leverage variable ( $\alpha_1$  and  $\alpha_2$ ). The results indicate that discloser firms are able to adjust to optimal levels at more rapid rates relative to the non-discloser group. The difference indicates that the distinction is economically as well as statistically significant. This holds for both measures, book and market leverage. Thus, it is evident that discloser firms tend to face lower adjustment costs given that investors attach a lower risk premium arising from increased voluntary disclosures in a market characterised by high transaction costs and access to financing are based on relationships.

## 4.3 Endogenous factors: Financing Imbalance and Growth Opportunities

The results could arise due to the firms' financing imbalance which could result from deficits or surpluses in cash flow which in turn lead firms to change their financing mix. This is due to potentially lower adjustment costs as a result of it being 'shared' with transaction costs (Faulkender et al., 2012). Thus, these firms are expected to adjust at more rapid rates. In addition, the sign of the financial imbalance (deficit or surplus) is also expected to impact the speed of adjustment to target levels (Dang and Garrett, 2015). Firms with a financing deficit would be given the opportunity to raise capital in order to reach target levels by issuing debt, equity or a mixture of both given

the pressure to meet their cash flow demands. In contrast, firms with a surplus would not have similar incentives to alter the financing mix given the absence of pressures to resort to external sources of financing. However, the ability of these firms to reach target levels may be considerably higher given that firms facing deficit may encounter lower costs to retire debt/ repurchase equity relative to firms in surplus when issuing financial securities (Dang et al., 2012). Both situations lead to conflicting predictions and thus are analysed in the current study. The results for financial imbalance are reported in panel A of Table 6 below<sup>3</sup>.

In-line with our empirical predictors we found that firms in deficit adjust at more rapid rates relative to firms with a surplus (Dang and Garrett, 2015). The coefficient of the rate of adjustment indicates that discloser firms adjust at more rapid rates to target levels regardless of financing imbalance (i.e. be it in a deficit or surplus). This provides further validation of our results where such voluntary disclosure allows firms to reach optimal leverage levels at more rapid rates and thus maximise firm value to a greater extent.

In addition to financing imbalance, the current study further considers growth opportunities given that high growth firms would also frequently raise external financing which provides firms with the ability to adjust the composition of capital structure and thus reach optimal levels more easily (Belkhir et al., 2016). Low growth firms in contrast would rely on internal funds, and therefore tend to adjust at slower rates given that the nature of adjustment would be limited by internal cash flows. Panel B reports the results for high growth versus low growth firms. In-line with findings in developed markets, high growth firms are able to adjust at more rapid rates (Dang et al., 2012). The distinction between discloser and non-discloser remains constant where discloser firms tend to adjust at significantly more rapid rates relative to the non-discloser group. Thus, the results are valid regardless of financing imbalance and growth opportunities, both of which necessitate firms to raise external financing and hence provide opportunities and incentives for adjustment to target leverage levels.

<sup>3</sup> Financing imbalance is defined as the sum of dividend payment, net investment and changes in working capital minus operating cash flows after interest and taxes (Shyam-Sunder and Myers, 1999). A negative figure indicates a deficit whilst a positive figure indicates surplus firms.

Table 5: Comparing Speed of Adjustment: Discloser versus non-discloser

	<b>BL</b>	<b>ML</b>
Discloser	0.7528*** (0.0825)	0.7622*** (0.0864)
SOA (%)	24.72%	23.78%
Non-Discloser	0.8126*** (0.0968)	0.8306*** (0.0992)
SOA (%)	18.74%	16.94%
Difference SOA (abs.)	5.98%***	6.84%***
Control Variables	Yes	Yes
Time Dummies	Yes	Yes
Industry Dummies	Yes	Yes

Notes: \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively. Source: Author's own

Table 6: Endogenous factors: Controlling for financing imbalance and growth opportunities

	<b>BL</b>	<b>ML</b>	<b>BL</b>	<b>ML</b>
<b>Panel A: Financial Imbalance</b>				
	<b>Deficit Firms</b>		<b>Surplus Firms</b>	
Discloser	0.7256*** (0.0785)	0.7303*** (0.0796)	0.7827*** (0.0979)	0.8025*** (0.1099)
SOA (%)	27.44%	26.97%	21.73%	19.75%
Non-Discloser	0.7893*** (0.1022)	0.8042*** (0.1109)	0.8325*** (0.1244)	0.8622** (0.1528)
SOA (%)	21.07%	19.58%	16.75%	13.78%
Difference SOA (abs.)	6.37%***	7.39%***	4.98***	5.97***
<b>Panel B: Growth Opportunities</b>				
	<b>High Growth Firms</b>		<b>Low Growth Firms</b>	
Discloser	0.7388*** (0.0825)	0.7429*** (0.0864)	0.7805*** (0.0952)	0.8195*** (0.1154)
SOA (%)	26.12%	25.71%	21.95%	18.05%
Non-Discloser	0.7958** (0.1093)	0.8108*** (0.1162)	0.8428*** (0.1422)	0.8523*** (0.1433)
SOA (%)	20.42%	18.92%***	15.72%	14.77%
Difference SOA (abs.)	5.70%***	6.79%***	6.23%***	3.28%**
Control Variables	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes

Notes: \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively. Source: Author's own

#### 4.4 Exogenous factors: Accounting for equity versus debt issuers

The nature of adjustment to target leverage can also be influenced by the security being issued i.e. equity versus debt given that both forms of capital tend to have distinctively differing characteristics. Equity issues are linked to market prices and conditions where managers may be reluctant to issue equities during periods of price suppression and vice-versa (Warusawitharana and Whited, 2015). Debt issues in contrast, are often associated with information asymmetry as well as free cash flows and agency problems (Jensen, 1986; Lewis and Tan, 2016). Thus, in order to evaluate whether equity issuers and debt issuers differ based on the nature of voluntary disclosure, we evaluate the distinction in Table 7. Firms which issue equity in the majority of the years are classified as equity adjusters whilst firms which issue debt in the majority of the years are termed as debt adjusters.

The results indicate that equity issuers tend to adjust at more rapid rates which is in-line with findings in the literature given that bankruptcy costs of exceeding target leverage would weigh-in on adjustment considerations of managers and hence motivate larger equity issues (Drobetz et al., 2015). Despite accounting for the different motivations of debt versus equity issuers, the research found

that discloser firms are able to adjust at more rapid rates relative to their non-discloser counterparts. This indicates that managers of discloser firms are able to reduce their adjustment costs via additional voluntary environmental reporting.

In line with previous research, the study reveals that Malaysian firms with voluntary environmental disclosures tend to have lower levels of leverage and opt for greater levels of equities (Ahmad et al., 2003). The results prove to be counter-intuitive given the argument that leverage levels also act as a visibility measure to investors given that borrowings tend to positively affect voluntary disclosure (Fernandez-Feijoo et al., 2014; Baldini et al., 2018). However, given the nature of the empirical model applied, the measure(s) capture the costs of deviating from target leverage and hence the results indicate that firms with such voluntary disclosures tend to favour equity issues. Furthermore, the nature of capital markets in developing countries tends to provide additional incentives for environmental reporting given the attraction to foreign investors which in turn influences costs of equity financing (Ali et al., 2017; Kuzay and Uyar, 2017). The asymmetric findings from segregating firms which are above and below target levels confirms that the results are not spurious and attributable to mechanical mean reversion as suggested in the literature (Chen and Zhao, 2007).

Table 7: Exogenous Factors: Equity issuers versus debt issuers

	BL	ML	BL	ML
	Equity Issuers		Debt Issuers	
Discloser	0.7325*** (0.0801)	0.7433*** (0.0967)	0.7029*** (0.0695)	0.6825*** (0.0596)
SOA (%)	26.75%	25.67%	29.71%	31.75%
Non-Discloser	0.8044*** (0.1152)	0.8109*** (0.1235)	0.7625*** (0.1036)	0.7235*** (0.0725)
SOA (%)	19.56%	18.91%	23.75%	27.65%
Difference SOA (abs.)	7.19%***	6.76%***	5.96%***	4.10***
Control Variables	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes

Notes: \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively. Source: Author's own

## 5 Conclusions and implications

The study investigated the rate of adjustment for firms based on the voluntary environmental reporting in the Malaysian capital market. The rationale for selecting Malaysia was based on the nature of the economy which tends to be relationship-based (Ebrahim et al., 2014; Rajan and Zingales, 1998), has the presence of high adjustment costs (Bliss and Gul, 2012; Fraser et al., 2006) as well as a lack of institutional and market pressure to motivate such voluntary disclosure (Ahmed Haji, 2013; Ghazali and Weetman, 2006).

Empirical findings indicate that firms in the discloser category are able to adjust at more rapid rates relative to non-discloser groups. These firms tend to be able to reduce their deviation from target levels which indicates lower adjustment costs often associated with developing markets. The findings from this research indicate that firms are aware of the potential benefit arising from such disclosure which is associated with investors perception and hence influences the corresponding risk premiums. Implications provide an incentive for voluntary environmental reporting which allows maximisation of firm value at levels which are closer to optimal debt levels, this is despite considering financing imbalance as well as growth opportunities.

The empirical results confirm that firms adjust to target levels. The rate of adjustment differs for firms based on the disclosure as well as extent of divergence from optimal levels. Examining firms above target levels, reveals that firms with environmental disclosure are able to adjust at more rapid levels relative to firms without such disclosures. This validates the notion that voluntary disclosure via environmental reporting is aimed to operate at optimal levels and thus maximise firm value. For firms below target levels the research reveals that the absence of such disclosures leads to firms adjusting at more rapid rates indicating that the cost of deviating from target leverage levels are lower for firms with disclosure.

The findings provide an alternative explanation of voluntary disclosure which is motivated by capital structure decisions. In this particular instance, societal pressures for voluntary disclosure enhances firm value which is consistent with the managerial aim of maximising shareholders' wealth. Therefore, the findings provide important insight into understanding managerial motivation in voluntary disclosure which is linked to the reduction in adjustment costs and in turn enhances firm values. Thus, the arguments presented in this study point towards managerial actions which impacts firm value based on societal expectations in the context of a developing country and capital market.

The contributions of the research are two-fold. Firstly, the findings indicate that firms in developing countries such as Malaysia, where political and contracting costs influence the ability to raise external financing, tend to benefit from voluntary environmental reporting. The effect is observed in the ability of above target firms to reach target

levels at more rapid rates, whilst allowing firms below target levels to deviate for a longer time, able to correspondingly endure a greater half-life of shocks in borrowings levels. Secondly, the findings indicate the positive impact of voluntary environmental disclosure on maximising firm value. The benefits gained from such voluntary disclosure provides additional risk assessment and management tools for managers to incorporate stakeholders interest whilst ensuring maximisation of shareholders' wealth.

The research however is not without its limitations, with the study limited to a specific country with certain characteristics often associated with developing markets. This was not considered a major limitation as the research specifically wished to investigate the rate of adjustment for firms based on the practice of voluntary environmental reporting in a developing country. That said, for future research, it would be interesting to conduct comparative research among a number of developing countries in ASEAN to observe if similar findings to the ones found in this study are reflected across developing countries. An area of further research would be to include other forms of voluntary disclosures which include governance and social responsibility to evaluate its impact on the rate of adjustment to target leverage which in-turn influences firm value. A further area for future research would be to consider other aspects which could influence a firms' ability to adjust to target levels in order to maximise firm value. These could include present value of bankruptcy costs to opportunity costs of underinvestment as well as the potential for overinvestment. Conducting further research into these areas would provide additional insight and perhaps a more holistic perspective on voluntary environmental disclosures.

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## **Okoljsko poročanje in hitrost prilagajanja ciljnemu vzvodu: ugotovitve iz modela dinamičnega preklopnega režima**

**Ozadje in namen:** Študija preučuje vpliv poročanja o okolju na hitrost prilagajanja in stroške prilagajanja, ki se oceni na podlagi sposobnosti podjetij, da se prilagodijo ciljnemu nivoju finančnega vzvoda za nefinančna podjetja. Nanaša se na podjetja, ki kotirajo na Malezijski borzi (Bursa Malaysia).

**Zasnova / Metodologija / Pristop:** Študija se usmerja na malezijska podjetja na podlagi pogodbene in politične ekonomije stroškov, ki se obravnava kot ekonomija, ki temelji na odnosih. To pa vpliva na sposobnost podjetja za pridobitev zunanjega financiranja in tako pomembno vpliva na odločitve o kapitalski strukturi. Poleg tega uporabljena metoda omogoča neposreden ukrep za prilagoditvene stroške za podjetja. Naša študija uporablja model preklopa dinamičnega režima, ki temelji na DPF ocenjevalniku za oceno stopnje prilagajanja optimalnim ciljnim ravnim na podlagi razlikovanja v poročanju o okolju javnih podjetij, ki kotirajo na borzi. Pristop omogoča statistični sklepni nadzor za morebitne serijske korelacije, endogenosti in heterogenosti, ki predstavljajo posebne lastnosti firme.

**Rezultati:** Empirične ugotovitve kažejo, da prostovoljno razkritje poročanja o okolju poveča sposobnost podjetja za dostop do zunanjega financiranja po nižjih stroških, na kar kaže hitrejša prilagoditev. Ugotovitve so skladne v različnih endogenih in eksogenih dejavnikih, kar kaže, da se ta podjetja soočajo z nižjimi stroški prilagoditve.

**Zaključek:** Študija ponuja neposredno merilo sposobnosti podjetij, da se prilagodijo ciljnim stopnjam z varnostnimi vprašanji in odkupi na kapitalskih trgih. To je odraz zaznane tveganosti in vrednosti z vidika vlagateljev na razvijajočem se trgu. Predhodne študije so se osredotočale na okoljsko poročanje in premije na lastniške rizike in niso ovrednotile neposrednega vpliva na vrednost podjetja, glede na to, da teorija kompromisne kapitalske strukture predvideva, da se vrednost podjetja poveča na ciljne, tj. optimalne ravni finančnega vzvoda. Študija obravnava trenutno vrzel v literaturi s tem, ko ocenjuje vpliv na vrednost podjetij na podlagi stroškov prilagoditve.

**Ključne besede:** *okoljsko poročanje, struktura kapitala, hitrost prilagajanja, ocenjevalec DPF, dinamični podatki*



# Drivers of Global Competitiveness in the European Union Countries in 2014 and 2017

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**Background and Purpose:** The main purpose of this study is to find the key drivers of Global Competitiveness Index (GCI) in the European Union (EU-28) countries from the aspect of country's global competitiveness: institutions, macroeconomic environment, infrastructure, higher education, market effectiveness, market size, technological readiness, innovation and business sophistication.

**Methodology:** This paper investigates global competitiveness of the EU-28 countries with the use of GCI in the periods 2014-2015 and 2017-2018. The correlation analysis and regression analysis are applied for testing the set two hypotheses.

**Results:** The empirical results confirmed our hypotheses that GCI is particularly significantly positively correlated with innovation and business sophistication, and universities-industry collaboration in researches, and clusters development.

**Conclusion:** The paper contributes to the literature of global competitiveness, by examining the relationship of sub-indexes of competitiveness of the EU-28 countries, pointing out the influence of universities-industries collaboration in researches and cluster development with geographic concentration of companies. The results and findings can be relevant for science, economic and research policy, and managerial practices that enhance innovation and business sophistication for research in collaboration of companies, universities, higher education institutions, and decision makers. The implications of this study can be important for better understanding of drivers of the EU-28 countries global competitiveness.

**Keywords:** *competitiveness, economic activities, global competitiveness index, innovation*

## 1 Introduction

Global competitiveness of countries is a set of institution, policies and factors, which determine level of country productivity (World Economic Forum – WEF, 2009). This means that for global competitive economic system is important quality of institution, which has to be ensured by national instruments, and namely legal infrastructure, laws, regulations, legal titles and stable monetary policy.

Strategic target of the Lisbon strategy for the European Union (EU) was that Europe would become the most competitive, dynamic and on knowledge based economy

in the world, with more and better work places, bigger social cohesion and considering environment (European Commission, 2010, 2).

Europe has to be capable to compete with numerous emerging economies in the global market such as BRIC (Brasil, Russia, India, and China) countries. The importance of competitiveness is significantly increasing, not only for the companies, but for countries and nations. Globalisation usually means absorbing and expansion all over the world. The international trade was expanded by 73% from the year 1999 to the year 2009 (European Commission, 2010). This can be a reason why there is countries

interest to attract inflow of capital that they can accelerate economic development, to raise living standards or to gain and retain growth of gross domestic product (GDP). Different institutions have developed different methods to measure competitiveness.

The purpose of this paper is to analyse Global Competitiveness Index (GCI), to find out its main drivers and to analyse the EU-28 countries from the global competitiveness aspect. Focus is on factors of GCI according to WEF (2014, 2017) for the EU-28 countries: institutions and institutional environment, macroeconomic environment, development of infrastructure, higher education, market effectiveness, market size, technological readiness, innovation and business sophistication. Due to heterogeneity of the EU-28 countries, there are different phases in their developments and factors that influence on global competitiveness achievement. For this reason, we include GDP per capita to find out the key drivers of global competitiveness. The main idea is to check correlation between GCI and level of economic development measured by GDP per capita, and other selected elements, which construct GCI. These evidences can be important for government competitiveness policy.

Therefore, this paper aims to analyse relationship between indicators of sub-index and GCI, e.g. business sophistication and innovation, and influence of collaboration between companies and universities-industries in researches, and clusters development with geographical concentration of companies in the EU-28 countries. We aim to answer on the following three research questions:

- Is there a significant correlation between three pillar groups of sub-index variables and GCI?
- What is the relationship between three pillar groups of sub-index variables of GCI and competitiveness?
- What is the influence of collaboration between universities-industries in researches and clusters development on competitiveness in the EU-28 countries?

The rest of the paper is organized as follows: in the next section are presented theoretical basis and review of the literature. The following sections present description of variables included in the empirical analysis and the empirical results of the statistical analysis of indicators with the discussion of the results. Final section concludes and derives main findings with policy and practical implications.

## 2 Literature review and hypotheses development

Smith (1776) studied competitiveness and developed theory of absolute comparative advantages based at low cost production. Ricardo (1962) developed concept of relative comparative advantages in international trade or com-

parative advantages that come from differences in labour productivity. New competitiveness theories, neoclassical theories and new factor endowments theories were developed. Modern theory Heckscher-Ohlin-Samuelson and competitive advantage of country is definite with endowments of production factors, instead of production costs (Sheppard, 2011). Among new theories is new economic geography (Krugman, 1998).

Krugman (1994) on one side contradicts national competitiveness as “dangerous obsession” out of a reason, that causes unsuitable arrangement of sources and leads to protectionism or trade war. On the other side, connecting economy on world scale potentially strengthens agglomeration of economy and specialization (Krugman, 1998).

Satsysk (2015) shows that modern university can be globally competitive in the case when it is provided with opportunities for engaging its talented researchers, teachers and students with sufficient quantity and quality of material/financial resources, infrastructural base and with effective governing/management model. In terms of limited resources, institutional and financial government support are aiming at modernization of university.

In the literature we can encounter different definitions of territorial, national and regional competitiveness. Based on OECD (Garelli, 2002), competitiveness of nations is a stage, in which country can in circumstances of free and open market produce goods and services, which fulfil international standards on market, preserve and at the same time expand income of their own population for a long term. Reaching competitiveness is important at country level.

Porter (1998) argued that competitive advantages, geographical integration of industry or industrial clusters are vitally important. Porter (1990) emphasized indirect effects that can play geographical agglomeration of clusters in particular field for strengthening of competitive advantages. Clusters and geographical concentration among interactive companies, specialized suppliers, service providers and with them related industries and institutions can play important role on an individual area, which can compete, but can also cooperate (Porter, 2000).

Innovation can be one of the most important determinants of competitiveness (Kovačič, 2007; Shamout, 2019). Smaller countries can through clusters and updated strategies achieve that their relatively smaller country size becomes advantage (Pitelis, 2008). In this regards dynamic industrial policy of cluster developments is important in the EU-28 countries.

Reduction of unemployment can be linked to fostering small and medium enterprises development, changes on labour market, the educational system and the entrepreneurship activities (Gričar et al., 2019; Južnik Rotar et al., 2019). These factors became more important for competitiveness in recent years. Nekrep, Boršič and Strašek (2018) indicated the link between expenditures for research and development (R&D expressed in % GDP) and labour pro-

ductivity based on observed data for the EU member states in the period 1995-2013.

Liberalization of the economy can be important factor for international competitiveness (Fagerberg, 1988), new technologies, and innovations (Fagerberg et al., 2007). The process of trade liberalization can rise possibilities for expanding import and export for similar products, and thus encourage growth inside branch trade (Bojnec & Novak, 2005).

Cross-sectional innovation platform can create a symbiosis between the university, the economy, and local communities that manage innovation activities and technologies to increase competitiveness (Gjelsvik, 2018).

A special attention is to consider quality of institutional environment and particularly the role of rules and legal infrastructure that can effect on a business location, such as elimination of limitations on setting-up firms and shops, factors mobility, and attraction of foreign direct investment (FDI) (Bojnec & Fertó, 2017; 2018). In addition, the percentage of population of a certain age with finished tertiary education can be important for global competitiveness. The number of bachelors from the tertiary education in the EU countries has increased. Tertiary education expansion has had positive effects for incomes and wellbeing of individuals and for growth of economies (Čepar & Bojnec, 2008, 2010; Čepar, 2009, 27). Knowledge-based economies in rapidly changing markets require organisation and strategies to effectively use knowledge and skills (Kareem & Mijbas, 2019). Many countries have increased their national competitiveness such as Israel, the Netherlands, Finland, and Germany, driven by education and skilled labour contributing to high level of productivity and investments in R&D, which further promotes innovative world-class clusters development (Paraušić et al., 2014).

Camagni (2008) argues that institutions, rules and norms create conditions for reduction of market transaction costs. They can provide warranty for contracts and obligations enforcements, and can help to resolve company's problems related to conflicts of interests and monopoly power. They can create favourable business climate that is beneficial for local companies and can improve attractiveness for external companies and investors. Petryle (2016) examined the relationship between the GCI and GDP growth of countries during the period 2006-2015. It was found that there is a weak or no relationship in the EU-27 countries plus Norway, Switzerland, Iceland, the United States, and the Russian Federation.

The WEF methodology is the most known system of a country's competitiveness assessment. The datasets are gathered from survey information comparing development and competitiveness between countries in the following

areas: institutions, infrastructure, macro environment, health care and education, higher education, effectiveness of market, size of market, technological condition, innovation and business sophistication. Since 2005 the WEF analysis of competitiveness are based on the GCI as a tool, which measures microeconomic and macroeconomic foundations of competitiveness of the country (WEF, 2014, 4–5). The GCI is calculated as a cogent average of different components (factors), which measure specific aspects of competitiveness.

The GCI has passed a whole picture of territorial competitiveness by countries. Therefore, the GCI is aggregated umbrella index, which is composed from three sub-indices of competitiveness development phases: (I) basic competitiveness requirements (factor driven), (II) efficiency enhancers (efficiency-driven), and (III) innovations and business sophistication (innovation-driven).

If it is an efficiency-driven country, then GDP, inflation rate, trade, labour productivity, and costs are important determinants of competitiveness, while for innovation-driven country the determinants of competitiveness are GDP, inflation, tax rate, FDI, trade, and cost (Rusu & Roman, 2018).

WEF defines different countries groups that are arranged based on the level of economic development measured by GDP per capita: low, middle, and high income countries. In addition, as an important criterion referred to amount of mineral resources exported in entire export considering development phases in a way of competition and country categories in the phase of transition.

## 2.1 Hypotheses

Following previous literature and in accordance with aims of our study, we set the following two hypotheses (H):

H1: Relationship exists between the level of the EU-28 countries competitiveness and indicators of innovation and business sophistication, but weak correlation exists between the EU-28 countries competitiveness and sub-indices of other two pillar groups (basic conditions and efficiency enhancers).

H2: University-industry collaboration in researches and clusters development with geographical concentration of companies have statistical distinctive influence on national competitiveness in the EU-28 countries.

Empirical studies (Dima et al., 2018) have indicated that the highest correlation is between the GCI and R&D expenditure as a % of GDP (0.8257), a result that indicates a very strong positive relationship between innovation and competitiveness.

1 Some companies have an 'employee first' policy, with a basic premise that contented or happy employees perform better. South West Airlines is a well-known example. In such companies, serious demands are made on employees and strict selection procedures are in place, and teams are responsible for performance. It is far from a free-floating culture.

Parašić et al. (2014) argues that the coefficient of a simple linear correlation indicates that there is a strong positive correlation in the sample between state cluster development in a country and its national competitiveness.

While studies indicated some similarities and differences in results, in general there is expected positive impacts of the analysed variables on global competitiveness, including for the EU-28 countries.

### 3 Data and Methodology

The collected publicly available secondary data are used in the empirical analyses. The source of data is WEF (2014, 2017) and data from Eurostat (2014 and 2017) for GDP per capita for the EU-28 countries. Due to the differences in the level of economic development between the EU-28 countries GDP per capita is included to check correlation between GCI and the level of economic development measured by GDP per capita, and other selected elements, as an additional control indicator in the analysis. For global country's competitiveness evaluation, the GCI is used. The GCI is constructed from indicators, which are evaluated based on scale from 1 to 7. We used 40 variables. The applied methodology was empirical the analysis of indica-

tors: institutions, macroeconomic environment, development of infrastructure, higher education, market effectiveness, market size, technological readiness, innovation, and business sophistication. We used correlation and regression analyses to test the hypotheses. The Pearson's correlation coefficient is applied to investigate the relationship between GCI and indicators of country's global competitiveness. Furthermore, the regression analysis is applied for validation of tested models and their assessed fittings. The IBM SPSS software was used for the data analyses.

## 4 Drivers of global competitiveness

### 4.1 Basic requirements and global competitiveness

Indicators of basic requirements are referred to quality of institutions or institutional management, macroeconomic environment, infrastructure, health care, and basic education (WEF, 2014). In addition to basic competitiveness requirements, there are included the following drivers of global competitiveness (Table 1):

Table 1 presents the analysed basic requirement variables and their expected a positive or a negative sign of correlation coefficient with GCI.

Table 1: Expected sign of correlation between GCI and basic requirements

Variables of basic requirements	Sign of correlation
Property rights and intellectual property – owners are not willing to invest their company shares in improvement and maintenance of their assets, if their ownerships on intellectual property rights are not protected, <i>propert, intel. prop.</i>	+
Corruption – means dishonesty at treatment of public orders, lack of visibility and reliability, inability to assure suitable services for business sector and political dependence of judiciary, what causes substantial economic costs to companies and slowdown process of economic development, <i>corruption</i>	+
Government regulation – government attitude to market and freedom is very important, as exaggerated bureaucracy can negatively effect on operation effectiveness, <i>gov. reg.</i>	+
Legal framework in setting disputes, legal and judicial system for company in which individual, companies and governments communicate, because they are important for creating wealth, <i>leg. dis.</i>	+
Quality of roads, ports, airports, <i>qual road, qual port, qualia airport</i>	+

Source: WEF (2014, 2017) Country economy profiles, 99-104.

Table 1: Expected sign of correlation between GCI and basic requirements (continued)

Fixed telephone lines and per 100 inhabitants – the number of working landline telephone, <i>tel. fix</i>	+
Mobile telephone per 100 inhabitants – the number of subscription to a public mobile telephone service, <i>tel. mob.</i>	+
Government debt – is consisted from all obligations, which demand payment or interest payments and is connected to main debtor to creditor relations, <i>gov. debt</i>	+
Budget – government balance, public finance balance as a percentage of net lending (+) / net borrowing (–) and is calculated as public finance salary minus expenses, <i>budget</i>	+
Savings-gross national savings as a percentage of GDP, joint national savings are defined as public and private savings and as a percentage of nominal GDP, <i>savings</i>	+
Inflation – influences changes in living standard through changes in prices, <i>inflation</i>	–
Primary school enrolment – is a stage, which suits child relationship (as it is described in national educational system), who are enrolled to school in population of official schooling age, <i>primarysch</i>	+
Rating creditable of country –as assessing the probability of sovereign debt default, <i>rating</i>	+

Source: WEF (2014, 2017) Country economy profiles, 99-104.

## 4.2 Efficiency enhancers and global competitiveness

To test the relationship between global competitiveness and **efficiency enhancers**, Table 2 presents the sub-index efficiency enhancers variables that are based on WEF (2014). It is expected that these variables can be important in correlation with GDP per capita with an influence on GCI. Therefore, we check our assumption with expected theoretically positive signs of correlations.

## 4.3 Innovation and business sophistication and global competitiveness

Innovation and business sophistication give signs of specialization and contribute to a bigger effectiveness in production of goods and services and increases quality of business performance, especially in mutual relationships, for example clusters development with geographical concentration of companies. Innovation means competence for innovations, knowledge and labour force experiences, technological innovations, namely availability of technological products, scientists, and patents.

Important indicators are value chains (companies of trade and production), clusters development and innovations. Clusters development with geographical concentration of companies can be linked with transactions and collaboration between companies, development of com-

munication technologies, social and cultural relationships between research institutions and universities.

Table 3 presents expected signs on correlation between innovation and business sophistication variables and GCI. Focus is on researches, universities-industries collaboration in researches and clusters development, in correlation with GCI. Clusters development stage can positively influence on GCI as well as can geographical concentration of companies increase productivity of domestic competitors and increase rivalry.

## 5 Empirical Analysis and Results

With correlation analysis is investigated the relationships between GCI and their explanatory variables for the EU-28 countries. The GCI and explanatory indicators – basic requirements, efficiency enhancers, and innovation and business sophistication indicators – are taken from the WEF reports (2014-2015 and 2017-2018). The validation of the set two hypotheses is assessed by the applied regression and correlation analyses. The variables are grouped into three sub-index pillars. To evaluate the validation of the model it is used the regression analysis and correlation analysis, which are based on 56 observations, and assessed is the validation of the model for the EU-28 countries.



Table 2: Expected sign of correlation between GCI and variables of efficiency enhancers

Variables of efficiency enhancers	Sign of correlation
Import in % of GDP, <i>import/GDP</i>	+
GDP per capita at standard of purchasing power parity (in PPP), <i>gdpp</i>	+
Secondary education, share of enrolment in higher education ISCED 2, ISCED 3, <i>second.educ</i>	+
Tertiary education, enrolment in %, share of enrolment in tertiary education level ISCED 5, 6, <i>tert.educ (in %)</i>	+
Quality of educational system, <i>qual. educ</i>	+
Intensity of local competition, <i>loc. compet.</i>	+
Availability of technology – in what scope they are technologies available in country, <i>tech.avail</i>	+
Absorption of technologies, in what range company accepts new technologies, <i>absorb. tech</i>	+
Direct investments and technological transfers, in what extent FDI brings new technologies, <i>nti-transf</i>	+
Internet users, (in %), <i>internet</i>	+
Gross domestic product GDP (in PPP), valued in standards of PPP in billions of dollars, <i>GDP</i>	+
Domestic market, index of size of local market, aggregate value of GDP in value of import of goods and services minus value of export of goods and services, <i>dom. market</i>	+
Foreign market, index of size of foreign market is valued as aggregate value of export of goods, <i>foreign. market</i>	+
Export in % of GDP, <i>export/GDP</i>	+
Import in % of GDP, <i>import/GDP</i>	+

Source: WEF (2014, 2017) Country economy profiles, 99-104.

Table 3: Expected sign of correlation between GCI and variables of innovation and business sophistication

Variables of innovation and business sophistication	Sign of correlation
GDP per capita at standard of PPP, <i>gdpp</i>	+
State of clusters development – geographical concentration of companies, suppliers, producers, <i>cluster develop</i>	+
Value chains breadth – companies trade and production, <i>chain</i>	+
Innovation capacity, to what extent do companies have the capacity to innovate - <i>capac. of inov.</i>	+
Quality of research institutions assesses the prevalence and standing of private and public research institutions, <i>qual. of research</i>	+
Expenses for research in companies, to what extent do companies invest in research and development, expenditure on research and development (R&D) as a percentage of GDP, <i>expenses for research</i>	+
Universities-industry collaboration in researches, to what extent do business and universities collaborate on research and development (R&D), <i>univind</i>	+
Government procurement of technological products, to what extent do government purchasing decisions foster innovation, <i>gov.proc.</i>	+
Availability of scientists, <i>scientists</i>	+
Number of registered patents, <i>patent</i>	+

Source: WEF (2014, 2017) Country economy profiles, 99-104.

### 5.1 Correlation analysis between GCI and basic requirement variables

Table 4 presents correlation coefficients between two pair of variables. Our focus is on the correlation coefficients with the GCI. Correlation coefficient points on the relationship between pair of individual variables. Higher correlation coefficient means stronger relationship, which can be positive or negative.

Among higher positive correlation between chosen variables, these are: intellectual property, clean of corruption, governmental regulation, legal framework in disputes, resolving disagreements, and infrastructure quality.

Table 4 presents the Pearson correlation coefficients for 17 considered basic requirements variables and their pairs of correlation with GCI. The highest correlation coefficients are with the following variables with the GCI: intellectual property (0.88), property rights (0.90), corruption (0.86), legal framework in disputes (0.83), quality of roads (0.73), rating (0.84), and primary education (0.76). GDP per capita also shows high correlation with GCI (0.67) as well as government regulation (0.63).

It is interesting to note that 9 variables are most appropriate drivers of GCI, because correlation coefficient is over 0.4. Finally, the correlations between the GCI and some variables are very low: quality of ports and quality of air, mobile and fixed telephone lines, budget, savings, inflation, and government debt.

### 5.2 Correlation analysis between GCI and efficiency enhancers variables

Table 5 presents correlation coefficients between selected efficiency enhancers variables and GCI. The highest correlation coefficients for GCI are with the following variables: technological absorption (0.94), availability or accessibility of technology (0.93), quality of educational system (0.84), local competitiveness (0.80), and secondary

education (0.76). It is interesting to note that GDP per capita also shows high correlation with GCI (0.67) as well as domestic markets (0.62), and foreign markets (0.77).

In all other cases the correlation coefficients between GCI and investigated variables are less than 0.5 or very low. For example, indicators of tertiary education do not affect significantly on GCI (0.43). It is surprisingly that variable enrolment into tertiary education has correlation coefficient with GDP per capita only 0.07, and internet users they also show on very low correlation with GCI (0.12). There is a negative correlation coefficient between tertiary education and variables of import/GDP. There exists also very low correlation between GCI and variables of export/GDP and internet users (0.12).

A correlation coefficient is lower between GCI and the share of import/GDP (0.19), and between GDP per capita and the share of export/GDP (0.21).

### 5.3 Correlation analysis between GCI and innovation and business sophistication variables

Table 6 presents correlation coefficients between GCI and selected innovation and business sophistication variables. There is a strong correlation of GCI with all included variables, namely with GDP per capita (0.64), with clusters development (0.82), with chains (0.85), with capacity of innovations (0.91), with research expenses (0.94), with collaboration of companies and universities-industries collaboration in researches (0.89), and with patent of suppliers (0.86). However, the correlation coefficient is lower with availability of scientists (0.48). In addition, there is a strong correlation between variables of chains and development of clusters (0.89). If the cluster development is evolving and local suppliers are collaborating, then proportionately the role chains is increasing.

To sum up, innovation and business sophistication variables are strongly correlated with GCI than with variables of the other two sub-indexes.

Table 4: Correlation matrix between Global Competitiveness Index (GCI) and basic requirement variables for the EU-28 countries, data for 2014 and 2017

Pearson Correlation Coefficients																		
	Global index competitiveness, GCI	GDP per capita, <i>gdpp</i>	property rights, <i>prop-ertyr</i>	intellectual property, <i>intell. prop</i>	corruption	government regulation, <i>gov.reg</i>	legal framework	quality of road, <i>qualr</i>	quality of port, <i>qualp</i>	quality of airport, <i>qualair</i>	mobile telephone, <i>elmob</i>	fixed telephone, <i>telfix</i>	budget	saving	inflation	government debt, <i>gov.debt</i>	rating creditable, rating	primary school, <i>primarsch</i>
Global index competitiveness, <i>GCI</i>	1.000	.609*	.907*	.888*	.893*	.632*	.830*	.732*	.252	.300	.220	.307	.134	.436	.230	.083	.841*	.831*
GDP per capita, <i>gdpp</i>	.609*	1.000	.726*	.736*	.704*	.403	.674*	.562*	.064	.101	.162	.441	.169	.212	.053	-.006	.622*	.323
property rights, <i>prop-ertyr</i>	.907*	.726*	1.000	.969*	.944*	.719	.922	.720*	.326	.371	.304	.159	.466	.306	.285	.054	.829*	.627*
intellectual property, <i>intell. prop</i>	.888*	.736*	.969*	1.000	.927*	.674*	.614	.927*	.307	.352	.064	.197	.450	.285	.124	.124	.806*	.617
corruption	.893*	.704*	.944*	.927*	1.000	1.000	.614	.740*	.169	.213	.233	.295	.323	.148	.013	.619	.765*	.646*
government regulation, <i>gov.reg</i>	.632*	.403	.719*	.674*	1.000	1.000	1.000	.752	.817	.752	.752	.752	.752	.785	-.068	-.129	.619	.388
legal framework	.830*	.674*	.922	.883*	.871*	.752	1.000	.643*	.339	.378	.203	.293	.294	.325	.254	.458	.622*	.458
quality of road, <i>qualr</i>	.732*	.562*	.720*	.730	.740*	.415	1.000	1.000	.174	.215	.104	.104	.154	.154	.370	.548*	.622*	.622*
quality of port, <i>qualp</i>	.252	.064	.326	.307	.339	.796*	1.000	1.000	1.000	.998	.998	.998	.998	.998	.360	.360	.115	.115
quality of airport, <i>qualair</i>	.300	.101	.371	.352	.378	.796*	1.000	.998	1.000	.998	.998	.998	.998	.994	.394	.394	.158	.158
mobile telephone, <i>elmob</i>	.220	.162	.304	.088	.304	.104	.480	.339	.213	.295	.295	.295	.295	.295	.067	.067	.362	.362
fixed telephone, <i>telfix</i>	.307	.441	.304	.339	.307	.203	.254	.293	.293	.293	.293	.293	.293	.293	.110	.110	.324	.324
budget	.134	.169	.159	.197	.134	.183	.183	.183	.183	.183	.183	.183	.183	.183	.254	.254	.096	.096
saving	.436	.212	.466	.450	.323	.843*	.464	.239	.944	.949*	-.625	-.260	.341	1.000	.940	.547	.248	.248
inflation	.230	.053	.306	.285	.148	.785	.325	.154	.998	.994*	-.750	-.351	.284	1.000	.940	.352	.090	.090
government debt, <i>gov.debt</i>	.083	-.006	.054	.124	.013	-.068	.370	.075	.093	.093	-.120	.410	-.306	-.052	.058	1.000	.238	.316
rating creditable, rating	.841*	.622*	.829*	.806*	.765*	.619	.548*	.360	.394	.394	.067	.110	.254	.547	.352	-.238	1.000	.516
primary school, <i>primarsch</i>	.831*	.323	.627*	.617	.646*	.388	.458	.622*	.115	.158	.362	.324	-.096	.248	.090	.316	1.000	1.000

\*\*Statistically significant at 5% significance level. Source: Authors' calculations

Table 5: Correlation matrix between Global Competitiveness Index (GCI) and efficiency enhancers variables for the EU-28 countries, data for 2014 and 2017

	Global index competitiveness GCI	GDP per capita <i>gdpp</i>	Secondary education <i>second. edu</i>	Tertiary education <i>tert. educ</i>	quality of education <i>qual. educ</i>	import/GDP	Local compet, <i>loc comp.</i>	Availability of technology, <i>tech. avail.</i>	Absorption of technologies, <i>absorb. tech.</i>	Direct investments-technology <i>nti-transf</i>	Internet users <i>internet</i>	domestic market	foreign market	export/GDP
Global index competitiveness, <i>GCI</i>	1.000	.673*	.764	.431	.842*	.199	.803*	.931*	.940*	.799*	.121	.627*	.777*	.214
GDP per capita, <i>gdpp</i>	.673*	1.000	.460	.075	.662*	.340	.430	.635*	.650*	.558*	.600*	.321	.456	.406
secondary education, <i>second. edu</i>	.764*	.460	1.000	.582	.646*	.140	.583*	.749*	.708*	.659*	-.022	.495	.617*	.154
tertiary education, <i>tert. educ</i>	.431	.075*	.582*	1.000	.315	-.169	.377	.411	.402	.219	-.392	.390	.406	-.170
quality of education, <i>qual. educ.</i>	.842*	.662*	.646*	.315	1.000	.229	.630*	.828*	.851*	.678*	.098*	.464	.464	.229
import/GDP	.199	.340	.140	-.169	1.000	1.000	.349	.270	.269	.481	.501	-.341	.014	.984*
Local competition, <i>loc comp.</i>	.803*	.430	.583*	.377	.630	.349	1.000	.808	.819*	.776*	.066	.464	.663*	.322
availability of technology, <i>tech. avail.</i>	.931*	.635*	.749*	.411	.828*	.270	.808*	1.000	.967	.802*	.157	.491	.658*	.277
absorption of technologies, <i>absorb. tech.</i>	.940*	.650*	.708*	.402	.851	.269	.819*	.967	1.000	.821*	.151	.466	.638*	.275
direct investments- technology, <i>nti-transf</i>	.799*	.558*	.659*	.219	.678*	.481	.776*	.802*	.821*	1.000	.214	.407	.645*	.489
Internet users, <i>internet</i>	.121	.600*	-.022	-.392	.098*	.501	.066	.157	.151	.214	1.000	-.192	-.053	.538
Domestic market, <i>dom. market</i>	.627*	.321	.495	.390	.330	-.341	.464	.491	.466	.407	-.192	1.000	.924*	-.295
Foreign market, <i>foreign. market</i>	.777*	.456	.617*	.406	.464	.014	.663*	.658*	.638*	.645*	-.053	.924	1.000	.063
export/GDP	.214	.406	.154	-.170	.229	.984*	.322	.277	.275	.489	.538*	-.295	.063	1.000

\*\*Statistically significant at 5% significance level. Source: Authors' calculations

Table 6: Correlation matrix between GCI and innovation and business sophistication variables for the EU-28 countries, data for 2014 and 2017

	Pearson correlation coefficients										
	Global index competitiveness GCI	GDP per capita <i>gdpp</i>	state of clusters development, <i>cluster develop.</i>	value chains breadth <i>chain</i>	Innovation capacity innovation <i>capac. inov.</i>	quality of research institutions <i>qual. research</i>	expenses for research in companies, <i>expens. research</i>	universities-industry collaboration in researches <i>univind</i>	govern. procurement technology, <i>gov proc.</i>	availability of scientists <i>scients</i>	number registered patents, <i>patent</i>
Global index competitiveness, GCI	1.000	.641*	.828*	.857*	.918*	.872*	.943*	.890*	.742*	.489	.867*
GDP per capita, <i>gdpp</i>	.641*	1.000	.659*	.640*	.665*	.517*	.674*	.602*	.620*	.306	.561*
state of clusters development <i>cluster develop</i>	.828*	.659*	1.000	.896*	.828*	.770*	.828*	.801*	.667*	.540*	.717*
value chains breadth, <i>chain</i>	.857*	.640*	.896*	1.000	.855*	.765*	1.000	.855*	.584*	.566*	.788*
innovation capacity, <i>capac. inov</i>	.918*	.665*	.828*	.855*	1.000	.825*	1.000	.813*	.950*	.445	.791*
quality of research institutions <i>qual. research</i>	.872*	.517*	.770*	.765*	.825*	1.000	.854*	.901*	.593*	.518*	.724*
expenses for research in companies, <i>expens. research</i>	.943*	.674*	.828*	.874*	.950*	.854*	1.000	.855*	.676*	.496	.867*
universities-industry collaboration in researches <i>univind</i>	.890*	.602*	.801*	.764*	.813*	.901*	.855*	1.000	.746*	.559*	.777*
government procurement technology, <i>gov proc.</i>	.742*	.620*	.667*	.584*	.663*	.593*	.676*	.746*	1.000	.362	.614*
availability of scientists, <i>scients</i>	.489	.306	.540*	.566*	.445	.518*	.496	.559*	.362	1.000	.557*
number of registered patents, <i>patent</i>	.867*	.561*	.717*	.788*	.791*	.724*	.867*	.777*	.614*	.557*	1.000

\*\*Statistically significant at 5% significance level. Source: Authors' calculations



### 5.4 Regression Analysis

The aim of the linear regression analysis is to determine the association between the GCI and two explanatory variables for cluster development with geographical concentration of companies, and universities-industries collaboration. Regression analysis is limited to only two variables and we want to test the hypotheses. We used partial regression analysis when we selected only one explanatory variable. Thus future studies could be focused on multiple explanatory variables of GCI in regression analysis. Data for the analysed variables are obtained from WEF (2014) and WEF (2017).

The variables are grouped into two pillars (11th and 12th) innovation and business sophistication. Explanatory variables were selected individually because universities define the competitiveness of technological innovation, while the clusters development with geographical concentration defines the competitiveness of non-technological innovation.

The regression analysis is based on 56 observations, which correspond to EU-28 country observations for the

two analysed years 2014 and 2017.

Table 7 presents the GCI association with companies and universities-industries collaboration in researches. Determination coefficient  $R^2 = 0.793$  shows that 79% of GCI variability is explained with companies and universities-industry collaboration in researches variable.

Coefficient of correlation ( $R = 0.891$ ) suggests on a strong linear relationship between companies and universities-industry collaboration in researches and GCI.

Table 8 presents the analysis of variance (ANOVA). At a significance level less than 1% ( $p = 0.000$ ), the explanatory variable universities-industry collaboration in researches is statistically significant.

F-test shows that there is a linear dependence between variables ( $F = 203.222$ ), and variable is statistically highly significant. If the p-value is less than the critical significance level ( $p < 0.005$ ), then sample data provides sufficient evidence to conclude that the regression model fits the data.

Furthermore, Table 9 presents regression coefficients with t-test and p-value, and statistic characteristics of the regression model.

Table 7: Model Summary

Model Summary <sup>b</sup>									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.891 <sup>a</sup>	0.793	0.789	0.22681	0.793	203.222	1	53	0.000
a. Predictors: (Constant). Universeind									
b. Dependent Variable: GCI									

Table 8: ANOVA

ANOVA <sup>a</sup>						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	10.455	1	10.455	203.222	0.000 <sup>b</sup>
	Residual	2.727	53	0.051		
	Total	13.181	54			
a. Dependent Variable: GCI						
b. Predictors: (Constant). Universeind						

Table 9: Regression Coefficients

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t-test	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.679	0.151		17.735	0.000
	Universeind	0.495	0.035	0.891	14.256	0.000

a. Dependent Variable: GCI

The regression line value is  $GCI = 2.679 + 0.495 \text{ universeind}$ . If companies and universities-industry collaboration in researches increases for 1 scale, then GCI increases by 0.495 scale, ceteris paribus. Table 10 shows to what extent GCI is associated with clusters development with geographical concentration of companies. Coefficient of correlation ( $R = 0.831$ ) shows a linear relationship between clusters development and GCI. Coefficient of determination ( $R^2 = 0.69$ ) shows that regression model fits the data: 69% of variability in GCI is explained with clusters development with geographical concentration of companies. Higher cluster development values are associated with higher GCI.

ANOVA with F-test shows that clusters development with geographical concentration of companies is statistically significant at 1% level ( $p < 0.001$ ) (Table 11).

The research hypothesis about the existence of strong positive correlation between GCI and clusters development with geographical concentration of companies can be accepted. This is further confirmed by statistically significant regression coefficient (Table 12).

Regression line value is:  $GCI = 2.534 + 0.533 \text{ cluster}$ . The regression equation shows that the regression coefficient that is pertained to cluster development variable is 0.533. If clusters development with geographical concentration of companies increases by 1 scale, then GCI increases by 0.533 scale of GCI, ceteris paribus.

Table 10: Model Summary

Model Summary <sup>b</sup>									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.831 <sup>a</sup>	0.690	0.684	0.27766	0.690	117.971	1	53	0.000

a. Predictors: (Constant). Cluster  
b. Dependent Variable: GCI

Table 11: ANOVA

ANOVA <sup>a</sup>						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	9.095	1	9.095	117.971	0.000 <sup>b</sup>
	Residual	4.086	53	0.077		
	Total	13.181	54			

a. Dependent Variable: GCI  
b. Predictors: (Constant). Cluster

Table 12: Regression Coefficients

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t-test	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.534	0.211		12.018	0.000
	Cluster	0.533	0.049	0.831	10.861	0.000

a. Dependent Variable: GCI

## 6 Discussion

The correlation coefficients between three sub-indexes variables – basic requirements, efficiency enhancers, and innovation and business sophistication – and GCI for the EU-28 countries indicated a positive correlation. The stronger positive correlation of GCI is with innovation and business sophistication sub-index than other two sub-indexes. Some variables of the sub-index basic requirements have a weak correlation such as quality of port and quality of air, mobile and fixed telephone lines, budget, savings, inflation, and government debt. In addition, a lower correlation between GCI and sub-index of efficiency enhancers is for export/GDP, import/GDP, and internet users. While there are differences in the results, all three groups of sub-indexes variables are in a significantly positive correlation with GCI. This implies that improvements in basic requirements, efficiency enhancers, and innovation and business sophistication are crucial to increase GCI.

The validity of the H1 cannot be rejected on the importance of the innovation and business sophistication sub-index for GCI. In addition, the regression analysis confirmed the H2 on the importance of universities-industries collaboration in researches and cluster development for GCI (p-value is less than the critical significance level,  $p < 0.005$ ).

To increase global competitiveness, a greater focus should be given to the importance of innovation and business sophistication at different levels. In addition, global competitiveness can be improved through universities-industries collaboration in researches, which supported the networking approaches in ongoing funding of research in some of the EU-28 countries to contribute to rise of global competitiveness.

The relevance of our study is that rises awareness for policy and decision makers on the importance of drivers of global competitiveness and possible ways for improving the EU-28 country's global competitiveness. It can be relevant for science, policy formation and managerial practices, that enhance innovation and business sophistication in relation to research and collaboration of companies and

universities-industry, research institution management, and policy of higher education that create knowledge and training.

The scientific contribution of the study is that developed relationships between three pillar groups of sub-indexes variables of GCI and competitiveness. The paper contributes to the literature of global competitiveness, by examining the role sub-indexes of competitiveness for global competitiveness of the EU-28 countries, pointing out the influence of universities-industry collaboration in research and cluster development with geographic concentration of companies. Our results are consistent with Rusu and Roman (2018) on the relationships between the sub-indexes of competitiveness and GCI. Paraušić et al. (2014) found that cluster development and innovation and business sophistication can have a significant influence on national competitiveness in emerging markets and developing countries.

Therefore, cluster developments and universities-industries collaboration in researches can have important role in the improving global competitiveness for the EU-28 countries, but it can also require well targeted investments in uncertain global environment.

## 7 Conclusion

The paper contributes to analyses of drivers of global competitiveness. Different drivers can explain global competitiveness in the EU-28 countries. To investigate this research question, we have applied the correlation and regression analyses in the years 2014 and 2017. There exists strong correlation especially between the GCI and expenses for research, innovation capacity, universities-industries collaboration in researches, and patents. All these is related to investments, organization and management of R&D, and innovation and business sophistication activities. The relationships between GCI and variables in the sub-index of innovation and business sophistication are stronger than in other two groups of sub-indexes for basic requirements and efficiency enhancers. In the third group of indicators for innovation and business sophistication, there is a strong

correlation of the GCI with cluster development, capacity of innovations, chain value, with quality of research institution, with research expenses, with universities-industries collaboration in researches, government procurement, and with patent of suppliers. It is interesting, that very low correlation is found only with availability of scientists and engineers.

The regression analysis confirmed H1: Relationship exists between the level of the EU-28 countries competitiveness and indicators of innovation and business sophistication, but weak relationship exists between the EU-28 countries competitiveness and sub-indexes of other two pillars groups (basic requirements and efficiency enhancers). Therefore, H1 cannot be rejected, because the existence of strong relationship between the level of GCI in the EU-28 countries and the third group of indicators of sub-index, i.e., innovation and business sophistication. Improvements in innovation and business sophistication can lead to increases in GCI.

The statistical analysis showed that clusters development with geographic concentration of companies and universities-industry collaboration in researches have strong positive influence on the GCI. The regression analysis confirmed H2: University-industry collaboration in researches and clusters development with geographical concentration of companies are statistically significant drivers of the GCI in the EU-28 countries.

Therefore, global competitiveness of the EU-28 countries can be improved by widespread clusters development with geographical concentration of companies and other drivers of innovation and business sophistication on the international market, as well as with improved universities-industry collaboration in researches. This can have policy implications for science and universities, innovation and business sophistication, and managerial practices for doing business in companies.

Our study has more limitations. The analysis is limited to two WEF data calculations/reports in 2014 (2014-2015) and in 2017 (2017-2018) with comparable indicators. Among study limitations, the study investigated only two variables in the regression analysis. Therefore, an issue for further research is to expand analysis with investigation of dynamics in longer time-frame in the multivariate analysis. The correlation and regression analyses are limited to the sub-indexes of GCI. In addition, the regression analysis is limited to partial analysis of two explanatory variables, the companies and universities-industry collaboration in researches, and clusters development with geographic concentration of companies for the two analysed years. In the future research, first, the panel data analysis for more years can be applied. Second, the model specification can be extended on variables of higher education. Finally, it could be applied cluster analysis for three groups of the EU-28 countries according to the stage of WEF development. As the EU-28 countries are at different stages of WEF development, individual factors can have different

meanings for the competitiveness of individual countries. Therefore, an issue for research in future is to introduce the heterogeneity of the EU-28 countries.

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### Dejavniki globalne konkurenčnosti v državah Evropske unije v letih 2014 in 2017

**Ozadje in namen:** Glavni namen raziskave je ugotoviti ključne dejavnike globalnega indeksa konkurenčnosti (GCI) v državah Evropske unije (EU-28) z vidika globalne konkurenčnosti države: institucije, makroekonomsko okolje, infrastruktura, visoko šolstvo, učinkovitost trga, velikost trga, tehnološka pripravljenost, inovacije in poslovna prefinjenost.

**Metodologija:** Članek raziskuje globalno konkurenčnost držav EU-28 z uporabo GCI v obdobjih 2014–2015 in 2017–2018. Korelacijska analiza in regresijska analiza se uporabljata za testiranje postavljenih dveh hipotez.

**Rezultati:** Empirični rezultati so potrdili postavljeni hipotezi, da je GCI zelo pomembno pozitivno povezan z inovacijami in poslovno sofisticiranostjo, sodelovanjem med univerzami in industrijo v raziskavah in z razvojem grozdov.

**Zaključek:** Raziskava prispeva k literaturi o svetovni konkurenčnosti s preučevanjem razmerja podindeksov konkurenčnosti držav EU-28. Poudarja na vpliv sodelovanja univerz in industrije pri raziskavah in razvoju grozdov z geografsko koncentracijo podjetij. Rezultati in ugotovitve so lahko pomembni za znanost, ekonomsko in raziskovalno politiko ter vodstvene prakse, ki povečujejo inovativnost in poslovno prefinjenost raziskav v sodelovanju podjetij, univerz, visokošolskih zavodov in odločevalcev. Implikacije raziskave so lahko pomembne za boljše razumevanje dejavnikov globalne konkurenčnosti držav EU-28.

**Ključne besede:** konkurenčnost, gospodarske dejavnosti, indeks globalne konkurenčnosti, inovacije

# Association between Field of Work, Years of Service, and Sickness Absenteeism in Public Administration

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**Background and Purpose:** Statistics of sickness absenteeism in public administration in Slovenia is considerably higher (7.1% in 2018) than the percentage that applies for the whole of Slovenia (4.5% in 2018). The data also shows a similar pattern in the public sector in other countries. According to that, the main purpose of our research is to investigate the connection between fields of work, years of service, and sickness absenteeism in public administration in Slovenia.

**Methodology:** Research data was collected with the help of an online questionnaire, which was designed for empirical research and consisted of several sets of questions. The collected data was processed using the SPSS statistical program.

**Results:** The research was conducted in 2015 in public administration institutions, and 3,220 employees from public administration were included in our research sample. The results of the research show that there is a statistically significant connection between sickness absenteeism in public administration and years of service and the field of work of employees in public administration.

**Conclusion:** The survey helps us to understand the connection between sickness absenteeism and years of service and field of work of employees in public administration. With regard to the results, it would be reasonable to adopt measures focused on groups of employees in public administration (older employees with a greater length of service, employed officials and professional-technical public employees) where sickness absence may be reduced. Sickness absenteeism in these groups of employees could be reduced by providing employees better leadership and conditions for satisfaction in the workplace.

**Keywords:** *sickness absenteeism, public administration, years of service, field of work*

## 1 Introduction

An organisation is a social formation of employees, and in every social situation there are daily relationships between employees and other factors in the working environment. Employees also react differently to social situations in the working environment: some of them adapt to factors of influence (poor relationships with managers, increased workload, stress) and accept them, while others can face difficulties. The consequences of the latter can often also be reflected in sickness absenteeism, in other words the

temporary absence of employees from work because of sickness or injury, or because they are caring for family members (Buzeti, Bilban and Stare, 2015).

Employees may be absent from work due to annual leave, their own health problems, health problems of family members, training, etc. The latter indicates that absenteeism is a complex and multidimensional segment that requires accurate and correct discourse. This article focuses on the part of employee absenteeism, as demonstrated by sickness absenteeism. In the opinion of Toth (1999, p. 20), we understand the concept of sickness absenteeism as meaning lost working days, or time in which an employ-

ee is temporarily unable to work because of sickness or injury.

The focus on studying the connection between field of work, years of service, and sickness absenteeism in public administration is motivated particularly by the fact that it is possible to find, on the basis of statistical data of the National Institute for Public Health (hereinafter as: NIJZ), that the share of sickness absenteeism in public administration is considerably higher than the percentage that applies for all sickness absenteeism in Slovenia. Sickness absenteeism is rather high in public organisations compared to private organisations (Løkke and Krøtel, 2019; NIJZ, 2019; Løkke, 2014; Coffey, Dugdill and Tattersall, 2009). In Slovenia, the duration of an individual case of sickness absence in the private sector is longer than in the public sector; nevertheless, individual employees in the public sector take sick leave more often in a year, which consequently leads to more days of sick leave per employee (NIJZ, 2019). The next reason for studying is connected to the fact that we were interested in whether years of service in the organisation of employment and the field of work (work position), have influence on sickness absenteeism.

Based on NIJZ data (2014–2018), we found that the greatest percentage of lost calendar days in public administration due to sickness absenteeism in the period compared, was recorded in 2018, i.e. 7.1%, and the lowest percentage in 2014, i.e. 6%. It is interesting, however, that since 2014, the number of lost calendar days has been constantly increasing in public administration in Slovenia.

There are many different factors that influence sickness absenteeism. With the purpose to discover whether there is association between sickness absenteeism in public administration, years of service by public employees, and the field of work (work position), we made a decision to study the state, and check the connections, with the help of obtained research data and its analysis.

The main purpose of the article is to analyse the connection between sickness absenteeism in public administration, years of service, and the field of work (work position) of employees in public administration, and to present the aspect of sensibility of taking into consideration years of service and work position of employees in the context of sickness absenteeism in public administration. We have decided to analyse the two variables, i.e. the years of service and field of work, in relation to sickness absence, because we were interested in whether in Slovenia there is any association between the years of service and sickness absenteeism in public administration like it is the case in some other studies (Hum Wee et al., 2019; Løkke Nielsen, 2008). We found no research on how the field of work is associated with sickness absenteeism in public administration; therefore we wanted to explore the association ourselves.

## 2 Review of theory

Absenteeism is one of the oldest and most researched phenomena in the history of human resource management and organisational behaviour (Forte, 2017; Patton and Johns, 2012). Absenteeism is a complex and multifactorial phenomenon, influenced by various interrelated factors (Nguyen, Groth and Johnson, 2013; Elshout et al., 2013). Definitions of sickness absenteeism vary (Schmid et al., 2017; Nielsen & Daniels, 2016; Shapira-Lishchinsky & Raftar-Ozery, 2016; Fitzgerald et al., 2016; Schouten, 2016; Buzeti et al., 2016, Halbesleben et al., 2014; Løkke, Eskildsen and Jensen, 2007;). Sickness absenteeism was defined as temporary paid leave from work due to any (i.e. work-related and non-work-related) injury or illness (Schouten, 2016, p. 302). In our article, sickness absenteeism is treated as all those cases “where employees are absent from work due to personal illness or injury or to care for family members, their absence is treated as temporary from a temporal point of view” (Buzeti et al., 2016, p. 24).

Sickness absenteeism may be attributable to many different factors, including lifestyle factors, demographic and socio-economic characteristics, etc. (Fitzgerald et al., 2016). An individual may have greater influence on some factors, and can prevent or limit them, whereas their influence on some factors is smaller or cannot be defined at all. If we take into account that for the occurrence of sickness absenteeism, a person and work are needed, it is sensible to define the influence of certain demographic characteristics, which are linked to an individual in a working environment, on sickness absenteeism. If we take into consideration characteristics that are connected to an individual, we discover that it is possible to find, in association with sickness absenteeism, that (Hum Wee et al., 2019; Lyszczarz, 2019; Buzeti, 2015; Løkke, 2014; De Paola, Scoppa and Pupo, 2014; Løkke Nielsen, 2008, pp. 1333–1335; Løkke, Eskildsen and Jensen, 2007, pp. 20–28; Allebeck and Mastakaasa, 2004; Ones, Viswiesvaran and Schmidt, 2003, pp. 20–21; Evans and Palmer, 2000, pp. 20–23; Rhodes and Steers 1990) years of service, age, gender, and education, are important factors affecting sickness absenteeism.

Considering the fact that we are focused on the connection between years of service, field of work (work position), and sickness absenteeism in our article, we have found that the research shows that years of service, or the influence of a period of employment on sickness absenteeism, can sometimes be detected, while in other cases it cannot be. Løkke Nielsen (2008, p. 1334) presents a general thesis that if sickness absenteeism is the result of dissatisfaction with the work situation, all those employees with more years of service are less absent from work compared to those with fewer years of service. Contrary to the previous justification, it is also possible to see another perspective, i.e. that employees with more years of

service may face fewer career opportunities and fewer possibilities for employment in another organisation. The latter may lead to dissatisfaction, and a consequence of that can also be absence from work. In the framework of her research, Løkke Nielsen (2008) did not confirm the influence of years of service on sickness absenteeism.

In the research about sickness absenteeism in the Italian public sector, it was established that “the probability of being absent increases with tenure” (De Paola, Scoppa and Pupo, 2014). On the contrary, Winkelmann (1996) discovered in his research, and confirmed that there is a connection between high seniority and low absenteeism. In one of her researches, Løkke (2014) confirmed the connection between sickness absenteeism and years of service, but the results were not the same in both models that were compared. In the first model, she discovered that the probability for sickness absenteeism is smaller for up to 10 years of service, and then it increases. In the second model, she discovered that the probability for sickness absenteeism decreases with more years of service. Overall, seniority influences sickness absenteeism, both in terms of the quality of the person–environment fit, and also in terms of end-of-career frustration (Løkke, 2014). In the research of Rosenblatt, Shapira-Lishchinsky and Shiron (2010), “although seniority was not directly related to absence, the results showed that in high levels of seniority (5 years and above), the negative relationship between a caring ethical climate and absence frequency was weaker than in lower levels of seniority (3 years and below).”

In the framework of understanding the connection between the field of work and sickness absenteeism, it is reasonable to consider that employees with leading positions are absent from work less often than those employees who do not have leading positions (Løkke Nielsen, 2008; Buzeti, 2015). Kristensen and others (Løkke Nielsen, 2008, p. 1336) explain that it is possible to detect, in case absence from work of the leading personnel has been high, that other employees are also more absent from work. Often, employees in the leading fields of work and related leading work positions, are better valued. It is therefore reasonable to understand the following working position, also in relation to the salary and, as the research shows, “workers are less absent if they enjoy a higher salary, a higher relative salary, and are employed at a higher hierarchical level” (Pfeifer, 2010, p. 69). The research by King et al. (2013) shows that managers were less absent from work than professional workers. Their research results show that the lowest level of sickness absence in the past year is attributable to managerial staff. Shorter sick leave (up to 14 days) was most commonly used by professional workers. Employees who perform routine and repetitive (the same) jobs with a low level of autonomy and responsibility, and a low possibility to make and create decisions, are more inclined to be absent from work (Evans and Palmer, 2000, p.25). As a result, from the conducted research, we can see that seniority and field of work

(work position) are important factors, and correlate in understanding and interpreting the phenomenon of sickness absenteeism.

## 3 Methods

### 3.1 Procedure and Participants

Prior to collecting data, we tested our questionnaire among employees in public administration, and in accordance with our findings in the process of evaluation of its reliability and validity, we adapted it correspondingly. We decided on the next step, because we wanted to (1) prepare a quality and useful questionnaire, and (2) check the initially designed questions/statements. When testing the originally designed questionnaire, it was discovered that there was ambiguity in some questions and statements, which was removed from the final version of the questionnaire.

Research data was collected with the help of an online questionnaire, which was created with the Ika online tool. We included employees of public administration in our research, which is hereby treated as all those organisations that are part of the process of decision-making about public matters, or participate in the management of public matters. Our research therefore included employees of the Ministries and the authorities in their composition, levels of government, administrative units, (city) municipalities, and holders of public authorisations. Holders of public authorisations are natural and legal persons, and among those that we classify as public administration are public agencies, public funds, and some public institutions (e.g. Pension and Disability Insurance Institute of Slovenia, Employment Service of Slovenia, Social Work Centres, etc.), and chambers with compulsory membership (Tičar and Rakar, 2011).

We carried out research in Slovenian public administration that took place in February 2015. In our research, we gathered answers/data from 3,220 respondents in public administration, which represents an 8.1% share of the entire population of employees in public administration. Table 1 shows the distribution of employees by the type of organisation and number of employees in public administration in Slovenia.

The sample in our research included 69.7% of employees in public administration, 11.1% of employees in local self-government, and 19% of employees of holders of public authorisations. The largest share in the structure of the sample from our research is represented by officials (58.9%), professional-technical personnel (26.7%), and a little less than a tenth of respondents (9.1%) are officials in leading positions (heads) of organisational units, with up to 30 direct subordinates. The remaining fields of work in the entire structure of the sample represent shares that are smaller than 2%. A little more than three quarters of those

sampled were female (76.1%) and nearly a third (23.9%) were male. The majority of respondents or employees who cooperated in this research were 35 to 44 years old (36.9%) or 45 to 54 years old (34.7%).

In this article, we treat officials as those public employees who perform public tasks for authorities. Public tasks for authorities are tasks that are directly connected with enforcement of authority, or protection of the public interest. Public officials who perform supporting tasks are professional-technical public employees. Supporting tasks are tasks in the field of personnel management and material-financial operation, financial and similar tasks, and other tasks that must be performed for the smooth op-

eration of public tasks of the authority (ZJU, Article 23). We treat officials in leading positions in this article as all those (ZJU, Article 80) who perform authorisations for leading, coordinating, and organising work. According to the law (ZJU, Article 80), the positions are: general director, secretary general and heads of organisational units at the ministries, director and heads of organisational units in authorities within the ministry, head of administrative units, heads of organisational units in administrative units, director and heads of organisational units in levels of government, director and heads of organisational units in the management of local communities.

Table 1: Distribution of employees by the type of organisation and number of employees in public administration in Slovenia.

Type of public administration organisation	Participants (sample)		Number of employees in public administration in Slovenia	
	f	%	f	%
State administration	2,230	69.7%	29,295	73.7%
Local administration	354	11.1%	4,825	12.1%
Holders of public authorities	609	19.2%	5,603	14.1%
<b>Total public administration</b>	<b>3,200</b>		<b>39,723</b>	

### 3.2 Measures

SA questionnaire was designed for the empirical research, and consisted of several sets of questions (see appendix). To collect data about the connection between field of work, years of service, and sickness absenteeism in public administration, two sets of questions were designed for the questionnaire, i.e.:

- *the first set of questions* (“General demographic data”); comprises six short questions of open and closed type, which refer to the socio-demographic characteristics of the respondents, such as organisation of employment, their field of work, gender, year of birth (age), level of education, years of service in the organisation of current employment.
- *the second set of questions* (“Sickness absence”); addresses sickness absenteeism. There are six short questions of open and closed type, which check the existence of sickness absences from work in the past 12 months, reasons for them, and frequency of sickness absences from work in the past 12 months, expressed as the number of days and the number of sets of absences (“how many times”). The first four short open questions verified the frequency of absence from work in the last 12 months, expressed in the number of days and the number of absences, as

well as the reasons for those absences. We used the methodology used by Ybema et al. (2010). The approach has also been used in other recent studies to determine the correlation of health absenteeism with other factors. Questions five and six in the second set of questions are the closed type of questions (“Yes” or “No”). “Yes”, in relation to question five, means “Yes, I have been absent, despite was being able to carry out work tasks”. “No” means “No, I have not been absent, despite was being able to carry out work tasks”. “Yes”, in relation to question six, means “Yes, I have performed my work tasks despite being ill or injured”. “No” means “No, I have not performed my work tasks due to being ill or injured”.

As mentioned above, the survey was carried out in February 2015, but the percentage of lost calendar days in public administration in Slovenia due to sickness absenteeism has been increasing every year since 2014. Although our survey was conducted in 2015, we can conclude from the NIJZ (2019) statistical data, that the percentage of sickness absenteeism in public administration is increasing year by year; therefore, we consider that the results of the research are relevant and important, even today, for the understanding of the sickness absenteeism of employees in the Slovenian public administration.



## 4 Results

### 4.1 Connection between Field of Work, Years of Service, and Sickness Absenteeism in Public Administration

In the context of establishing whether seniority of employees in public administration in the current employment organisation affects sickness absenteeism in public administration, we created four classes of the years of service, variable for the purpose of analysis, i.e.:

- first class: up to 10 years of service in the organisation;
- second class: 10 to 19 years of service in the organisation;
- third class: 20 to 29 years of service in the organisation;
- fourth class: 30 years and more of service in the organisation;

Based on the analysis of the research results, it was discovered that the respondents characteristically differ in the overall length of duration of sickness absenteeism in the past 12 months, according to the years of service (Table 2) ( $\chi^2 = 39.04$ ;  $p < 0.01$ ). Respondents with up to 10 years of service were absent from work for the least number of days (8.05 days), while respondents with over 30 years of service were absent from work for the largest number of days (10.27 days). Respondents with 10 to 19 years of service were slightly less absent from work than the respondents with over 30 years of service (9.71 days), and respondents with 20 to 29 years of service were absent from work even less (9.35 days).

Based on the results from Table 2, we can see that the existence of statistically significant differences by years of service is also shown in the length of sickness absenteeism due to caring for or illness of a dependant family member ( $\chi^2=141.94$ ;  $p<0.01$ ), with a rule that length of sickness absenteeism decreases while seniority increases. The length of sickness absenteeism due to their own illness or injury increases with years of service; however, differences between groups are not statistically significant ( $\chi^2 = 3.58$ ;  $p > 0.05$ ).

Table 2: Descriptive statistics of the number of days of absence, and the results of Kruskal-Wallis test by years of service and by an individual reason for temporary absence.

	YEARS OF SERVICE	N	AM	SD	Kruskal-Wallis test		
					$\chi^2$	df	P
care for or illness of dependent family member	up to 10 years	530	4.19	7.95	141.94	3	0.000
	10–19 years	562	3.51	7.19			
	20–29 years	320	1.42	3.88			
	30 years and more	145	0.10	0.67			
own illness or injury (at or outside work)	up to 10 years	707	6.15	14.27	3.58	3	0.311
	10–19 years	763	8.77	21.39			
	20–29 years	545	8.87	21.26			
	30 years and more	258	10.55	26.16			
mental pressure and stress in the working environment (also due to the behaviour of leaders)	up to 10 years	303	1.77	8.64	5.08	3	0.166
	10–19 years	348	1.13	7.25			
	20–29 years	269	2.06	13.97			
	30 years and more	148	0.34	1.87			
other reason for absence, which is not related to illness, injuries or pressure	up to 10 years	297	0.79	4.79	5.93	3	0.115
	10–19 years	338	0.86	5.61			
	20–29 years	259	0.36	2.33			
	30 years and more	147	0.74	4.39			
TOTAL	up to 10 years	913	8.05	16.09	13.97	3	0.003
	10–19 years	963	9.71	20.91			
	20–29 years	635	9.35	22.87			
	30 years and more	282	10.27	25.37			

N – number of answers; AM – arithmetic mean; SD – standard deviation; df – degrees of freedom; p – level of statistical significance

Table 3: A series of post-hoc tests (Mann-Whitney U test) between pairs of classes of years of service, in relation to the number of days of temporary absence

up to 10 years – 10–19 years		up to 10 years – 20–29 years		up to 10 years – 30 years and more		10–19 years – 20–29 years		10–19 years – 30 years and more		20–29 years – 30 years and more	
U	p	U	p	U	p	U	p	U	p	U	P
care for or illness of dependent family member											
139968	0.061	61278	0.000	20432	0.000	70143	0.000	23796	0.000	18507	0.000
TOTAL											
433468	0.590	276196	0.101	113569	0.002	288065	0.042	119049	0.001	83308	0.074

U – value of Mann-Whitney test; p – statistical significance

A series of post-hoc tests (Table 3) shows that respondents differ from each other by their seniority statistically significantly, in relation to days of sickness absence in the last 12 months due to caring for or illness of a dependent family member, where the only exceptions are groups of respondents with up to 10 years of service and between 10 and 19 years of service, where statistically significant differences could not be confirmed. By the total length of sickness absence in the past 12 months (Table 3), there are statistically significant differences between respondents with the fewest years of service (up to 10 years and between 10 and 19 years), and those with the most years of service (30 years and more), while at the same time, there is a statistical difference between groups of respondents with 10 to 19 years of service and 20 to 29 years of service.

Respondents statistically significantly differ also in the number of total sets of sickness absence (Table 4) in the last 12 months ( $\chi^2 = 61.81$ ;  $p < 0.01$ ), according to their years of service in the current organisation of employment. Respondents with up to 10 years of service were most notably absent from work (1.8 times), but by increasing the years of service, the number of sets of sickness absence decreases; respondents with over 30 years of service were absent from work more than half as many times (0.8 times) than those with the fewest years of service.

Differences between the number of sets of sickness absence due to caring for or illness of a dependent family member ( $\chi^2 = 146.11$ ;  $p < 0.01$ ) and their own illness or injury ( $\chi^2 = 20.43$ ;  $p < 0.01$ ), are also statistically significant (Table 4), where the number of sets of absences decreases by the increasing years of service. The existence of statistically significant differences between groups by years of service also shows in other reasons for absence, which are not connected to illness, injuries, or pressure ( $\chi^2 = 9.4$ ;  $p < 0.05$ ), due to which respondents with 10 to 19 years of service are absent the most times (0.2 times), whereas respondents with 20 to 29 years are absent the fewest times (0.05 times).

Next, we noted that (Table 5) the respondents statistically significantly differ from each other by their years of service in the total number of sets of sickness absence in the past 12 months, and at the same time in absence due to caring for or illness of a dependent family member, except for the groups of respondents with up to 10 years of service and between 10 and 19 years of service, where statistically significant differences could not be confirmed. By the number of sets of sickness absence in the past 12 months due to their own illness or injury, there are statistically significant differences between respondents with the most years of service (30 years or more) and the remaining groups of respondents, while at the same time, there is a statistical difference between groups of respondents with the fewest years of service (up to 10 years) and from 20 to 29 years of service.

For the number of sets of sickness absence due to other reasons for absence, there are statistically significant differences (Table 5) only between respondents who have up to 10 years of service and respondents who have between 20 to 29 years of service, while at the same time, there are statistically significant differences between the first group, and respondents with the most years of service (30 years or more).

Based on the results of the research about the connection between years of service with sickness absenteeism, we noticed a trend of less frequent (number of sets) sickness absence by increasing years of service, which mostly shows in sickness absence due to caring for or illness of a dependent family member, and due to their own illness or injury. On the other hand, the total number of days of sickness absence increases with increasing years of service, which is mostly true of absences from work due to their own illness or injury, although the number of days of sickness absence due to caring for or illness of a dependent family member decreases with increasing years of service.

Table 4: Descriptive statistics of the number of sets of sickness absence and the results of Kruskal-Wallis test by years of service and by individual reason for sickness absence

	YEARS OF SERVICE	N	AM	SD	Kruskal-Wallis test		
					$\chi^2$	df	P
care for or illness of dependent family member	up to 10 years	526	1.51	2.67	146.11	3	0.000
	10–19 years	561	1.26	2.04			
	20–29 years	316	0.52	1.35			
	30 years and more	145	0.09	0.66			
own illness or injury (at or outside work)	up to 10 years	700	1.04	1.23	20.43	3	0.000
	10–19 years	756	1.01	1.51			
	20–29 years	539	0.97	1.32			
	30 years and more	253	0.74	1.13			
mental pressure and stress in the working environment (also due to the behaviour of leaders)	up to 10 years	303	0.20	1.00	4.85	3	0.183
	10–19 years	348	0.16	0.61			
	20–29 years	268	0.15	0.62			
	30 years and more	148	0.09	0.46			
other reason for absence, which is not related to illness, injuries, or pressure	up to 10 years	298	0.17	0.66	9.40	3	0.024
	10–19 years	338	0.21	1.07			
	20–29 years	257	0.05	0.28			
	30 years and more	146	0.10	0.59			
TOTAL	up to 10 years	912	1.79	2.68	61.81	3	0.000
	10–19 years	961	1.66	2.46			
	20–29 years	631	1.17	1.79			
	30 years and more	278	0.82	1.46			

N – number of answers; AM – arithmetic mean; SD – standard deviation; df – degrees of freedom; p – level of statistical significance

Table 5: A series of post-hoc tests (Mann-Whitney U test) between pairs of classes of years of service, in relation to the number of sets of absence

up to 34 years – 35–44 years		up to 34 years – 45–54 years		up to 34 years – 55 years and more		35–44 years – 45–54 years		35–44 years – 55 years and more		45–54 years – 55 years and more	
U	p	U	p	U	p	U	p	U	p	U	p
care for or illness of dependent family member											
139145	0.076	58839	0.000	20639	0.000	67607	0.000	23980	0.000	18559	0.000
own illness or injury (at or outside work)											
253185	0.130	176569	0.040	72951	0.000	199072	0.452	82593	0.000	60744	0.007
other reason for absence, which is not related to illness, injuries, or pressure											
49146	0.264	36161	0.010	20478	0.027	42118	0.110	23843	0.146	18686	0.839
TOTAL											
425953	0.275	248231	0.000	94692	0.000	270018	0.000	102967	0.000	76518	0.001

U – value of Mann-Whitney test; p – statistical significance

## 4.2 Connection between field of work and sickness absenteeism in public administration

In the research analysis, we checked whether there are statistically significant differences between respondents in relation to their field of work in the number of days and sets of sickness absenteeism in the past 12 months. Based on the data shown in Table 6, we found that officials (9.6 days on average) and professional-technical officials (9.5 days) were absent from work for the longest period of time, whereas officials in leading positions were absent for the shortest period of time (6.2 days). *There are statistically significant differences between respondents about the number of days of sickness absenteeism in relation to the field of work, in the total number of days of sickness absence ( $\chi^2 = 30.52$ ;  $p < 0.01$ ), where officials and professional-technical personnel are statistically significantly more absent from work for a longer period of time than officials in leading positions, i.e. for more than three working days on average.*

Statistically significant differences in the length of sickness absence have also appeared (Table 6) in sickness absence due to caring for or illness of a dependent family member ( $\chi^2 = 30.55$ ;  $p < 0.01$ ), which is why officials and professional-technical public employees were on average absent from work at least 2.7 times as long as officials in leading positions. Officials and professional-technical

personnel are statistically significantly absent from work longer than officials in leading positions due to their own illness or injury ( $\chi^2 = 26.58$ ;  $p < 0.01$ ) and due to mental pressure and stress in the working environment ( $\chi^2 = 7.92$ ;  $p < 0.05$ ).

Similarly to the analysis of days of sickness absenteeism by individual work areas, it is also evident from the analysis of the number of sets of sickness absence (Table 7) that officials and professional-technical personnel were statistically significantly several times more often absent from work than officials in the leading positions ( $\chi^2 = 27.86$ ;  $p < 0.01$ ), where there were no statistically significant differences between the first two groups of interviewees. On average, professional-technical personnel were absent from work 1.63 times, and officials were only slightly less absent (1.58 times), while officials in the leading positions were statistically absent from work fewer times (0.9 times). The latter is true, both in sickness absenteeism due to caring for or illness of a family member ( $\chi^2 = 25.44$ ;  $p < 0.01$ ), as well as their own illness or injury ( $\chi^2 = 27$ ;  $p < 0.01$ ) and due to mental pressure and stress in the working environment ( $\chi^2 = 7.53$ ;  $p < 0.05$ ).

As was already pointed out between the groups of respondents employed in official and professional-technical positions, there are no statistically significant differences (Table 8), while the latter are shown in the comparison of both groups with a group of officials in leading positions.

Table 6: Descriptive statistics of the number of days of absence and the results of Kruskal-Wallis test by field of work and by individual reason for sickness absenteeism.

	FIELD OF WORK	N	AM	SD	Kruskal-Wallis test		
					$\chi^2$	df	<i>p</i>
care for or illness of dependent family member	PTP	440	3.35	7.33	30.55	2	0.000
	OFF	900	3.26	6.91			
	OMP	214	1.21	3.64			
own illness or injury (at or outside work)	PTP	627	8.48	20.29	26.58	2	0.000
	OFF	1335	8.65	20.63			
	OMP	305	5.59	17.29			
mental pressure and stress in the working environment (also due to the behaviour of leaders)	PTP	295	1.28	7.91	7.92	2	0.019
	OFF	597	1.70	10.11			
	OMP	173	0.84	9.18			
other reason for absence, which is not related to illness, injuries, or pressure	PTP	284	0.72	5.41	1.85	2	0.396
	OFF	579	0.77	4.65			
	OMP	175	0.43	2.24			
TOTAL	PTP	776	9.51	20.07	30.52	2	0.000
	OFF	1657	9.62	21.22			
	OMP	354	6.17	17.55			

N – number of answers; AM – arithmetic mean; SD – standard deviation; df – degrees of freedom; *p* – level of statistical significance; PTP – professional-technical personnel; OFF – officials; OMP – officials, managerial position

Table 7: Descriptive statistics of the number of sets of absence and the results of Kruskal-Wallis test by field of work, and by an individual reason for temporary absence.

	FIELD OF WORK	N	AM	SD	Kruskal-Wallis test		
					$\chi^2$	df	<i>p</i>
care for or illness of dependent family member	PTP	436	1.19	2.58	25.44	2	0.000
	OFF	894	1.17	2.07			
	OMP	215	0.51	1.16			
own illness or injury (at or outside work)	PTP	620	1.04	1.45	27.00	2	0.000
	OFF	1318	1.03	1.37			
	OMP	304	0.64	0.90			
mental pressure and stress in the working environment (also due to the behaviour of leaders)	PTP	295	0.21	1.04	7.53	2	0.023
	OFF	596	0.17	0.63			
	OMP	173	0.05	0.26			
other reason for absence, which is not related to illness, injuries, or pressure	PTP	284	0.11	0.58	1.71	2	0.425
	OFF	577	0.19	0.91			
	OMP	175	0.06	0.30			
TOTAL	PTP	772	1.63	2.75	27.86	2	0.000
	OFF	1650	1.58	2.29			
	OMP	354	0.91	1.33			

N – number of answers; AM – arithmetic mean; SD – standard deviation; df – Degrees of Freedom; *p* – level of statistical significance; PTP – professional-technical personnel; OFF – officials; OMP – officials, managerial position

Table 8: A series of post-hoc tests (Mann-Whitney *U* test) between pairs of fields of work, in relation to the number of days and the number of sets of absence.

		PTP–U		PTP–OMP		U–OMP	
		<i>U</i>	<i>p</i>	<i>U</i>	<i>p</i>	<i>U</i>	<i>p</i>
care for or illness of dependent family member	number of days	196061	0.742	37848	0.000	76290	0.000
	number of sets	193754	0.844	38461	0.000	78031	0.000
own illness or injury (at or outside work)	number of days	414859	0.745	79768	0.000	166971	0.000
	number of sets	399567	0.404	79767	0.000	164463	0.000
mental pressure and stress in the working environment (also due to the behaviour of leaders)	number of days	87205	0.651	23973	0.015	48104	0.005
	number of sets	87459	0.809	23967	0.015	48134	0.006
TOTAL	number of days	639595	0.832	114068	0.000	241382	0.000
	number of sets	630522	0.677	115231	0.000	242957	0.000

*U* – value of Mann-Whitney test; *p* – statistical significance; PTP – professional-technical personnel; OMP – officials, managerial position



## 5 Discussion

In the framework of studying, and the research that has been carried out, it was discovered that there is a statistically significant connection on sickness absenteeism in public administration with years of service, as well as the field of work of employees. We discovered that those with fewer years of service, measured in the number of days, have less sickness absence than those with more years of service. The last result of the research is similar to the findings of the research that was carried out in the Italian public sector, and where it was established that sickness absenteeism increases with the seniority of employees (De Paola, Scoppa and Pupo, 2014). The reverse trend related to the number of days of absence of employees from work can be detected when measuring sickness absenteeism in the number of sets (how many times) of sickness absenteeism. At this point, we discovered that by increasing seniority, the number of sets of sickness absence decreases. This means that those with fewer years of service are more often absent from work due to sickness than those with more years of service.

In this framework, it is reasonable to explain that Lokke Nielsen (2008, p. 1334) notes that if sickness absenteeism is the result of dissatisfaction with the work situation, employees with higher seniority may face fewer career opportunities and fewer possibilities for employment in another organisation. The latter may lead to dissatisfaction, and a consequence of that is also their higher rate of sickness absenteeism.

In case we consider the context of this explanation of the results of our research about the connection between sickness absenteeism and years of service, the results in public administration could also be interpreted in a way that with employees with more years of service, there is an occurrence of possible disappointment or limited possibilities for promotion, in relation to the career system in public administration – a consequence of that is also their dissatisfaction, which can be seen in an increased number of sickness absences.

Explaining the research results about the connection between seniority and sickness absenteeism can also be interpreted in such manner that it is sensible to understand seniority in close connection with the age of employees. Originating from that, a result of this kind, if it is also explained through age, meets the expectations. Evans and Palmer (2000, p. 21) explain that it is typical of the young that they are absent more often, but for a shorter period of time than older employees, and the older ones are less absent in terms of frequency; however, within individual absences they are absent for more days than the young, in particularly after age 50. At the same time, we can understand the result of the connection between years of service and sickness absenteeism through the prism of health and well-being of employees, and the ability of the human or-

ganism to become empowered or recover, because when growing older, the human organism needs more time for recovery.

There is also an interesting research result in the field of the connection between the field of work of employees in the organisation and sickness absenteeism in public administration. We discovered that there is a statistically significant connection, i.e. officials and the professional-technical personnel are statistically for a longer time and more often absent from work than officials in leading positions (leading personnel). This means that heads are absent for fewer days and less often than employees that are being led by them. This can be understood as beneficial and encouraging if the results are interpreted from the viewpoint of “an example and culture of work by leading personnel”. The leading personnel (are supposed to) represent an example for cultural behaviour of employees, and even culture (ethics) that is present in the area of sickness absenteeism and is very important, because it was discovered that in cases where employees perceive that the leading personnel are missing from work (even unjustifiably), they quickly take such a manner of behaviour or adopt such practices for themselves. The result that the officials in leading positions are absent from work fewer times than officials and professional-technical public employees can be understood through the spectre of greater responsibility and diligence of the leading personnel, in order to regulate things in the work collective. The easiest way to arrange the latter is if the leading personnel are present in the working environment, because this will enable them to solve any problems in the working environment quickly.

It is interesting that officials and professional-technical public employees are absent from work at least 2.7 times longer than officials in leading positions, due to caring for or illness of a dependent family member. These research results can be understood and interpreted in the direction that officials and professional-technical public employees decide faster and easier for absence from work to care for or support family members than the leading personnel. These findings of our research we can understand in a way as Kozjek and Ferjan (2015, p. 13) explain in their research. The results in their research show that participants on managerial workplaces evaluated more highly:

- the possibilities of an individual to access infrastructure for the basic health needs of safety at workplace,
- the level of protection of an individual from large changes in working conditions by the current employer,
- the possibilities of an individual to have safe working conditions, which also enable well-being in the workplace, the possibilities of an individual to have work-life balance, understanding enabling an individual to satisfy family needs,
- the possibilities of an individual to have resources for a decent life (such as income, the regulation of

- minimum wage),  
• the possibilities of an individual to have opportunities for wages coordination and indexation.

In the context of understanding the results of the performed research, we have established that, based on self-assessment of the respondents of the research, there is a prevailing state in public administration that, in relation to seniority, officials in the leading positions are absent from work fewer days and fewer times than other public employees.

## 6 Conclusion

In the working environment, employees and employers face different challenges. Challenges are usually even harder if there are factors in the working environment that can directly or indirectly interrupt or undermine work activities. One of those phenomena is sickness absenteeism. Even sickness absenteeism is often understood as a negative occurrence, and it is reasonable to understand and to detect important messages for employees, employers, and the state in this phenomenon. With the occurrence of sickness absenteeism, employers can receive important messages about whether they should engage more in certain areas or sort things out. The latter means that, in such cases, it is reasonable for the employer to make a so-called “self-reflection” of the state in the working environment, and adopt measures to improve the future state. It is interesting that in some cases, employees also decide for a sickness absence because they cannot stand the working environment anymore, and need to retreat into a healthier and safer environment to revitalise and empower themselves, before returning to the working process. The reasons for sickness absenteeism vary and should be explained as such, taking into consideration that the factors for absence from work are very much intertwined.

Sickness absenteeism in public administration in Slovenia is, according to statistical indicators, recorded in a higher percentage (7.1% in 2018) than the percentage that applies for the whole of Slovenia (4.5% in 2018), and that was one of the reasons why we conducted this research in Slovenian public administration. The purpose of this research was to find out whether there is the connection between number of years of service, the field of work (work position), and sickness absenteeism in public administration. The results of the research confirmed the preliminary assumptions that it will be possible to confirm these influences. It was indeed established that there is a statistically significant influence between sickness absenteeism, years of service, and field of work (work position) of employees in public administration. Those with fewer years of service are absent from work for less time than those with more years of service. Employees in leading official positions are absent from work less often and for

a fewer number of days than the group of officials and professional-technical public employees.

The research represents one of the first presentations of its kind about the connection between some demographic factors of employees in public administration and sickness absenteeism, by individual reasons in public administration in Slovenia. Such findings of our research, which are presented in the article, represent an important contribution to understanding certain correlations and characteristics that are related to sickness absenteeism in public administration. At this point, it should not be overlooked that such findings are important, also because we identified some (socio)demographic characteristics of employees, and gained an insight into certain (personal and business) characteristics of employees in public administration that are most often absent from work. The latter represents a contribution to the identification of the groups of employees, on which attention should be placed to reduce the proportion of sickness absence. This mainly involves employees who do not occupy managerial posts, and employees with a greater length of service (older employees). Given that in recent years, increased attention has been devoted to the management of older employees, the results of our research also need to be understood in this respect; moreover, in order to reduce sickness absenteeism in public administration, solutions should be sought, with ongoing measures in the field of care for older employees (e.g. measures to improve the health and vitality of older employees, fair treatment and fair appreciation of older employees, relationships between generations in the work environment, etc.). Ybema et al. (2016, p. 645) explain that it is important for organizations that older employees remain healthy. If organizations treat their employees in a just way this signals that all employees are valued, which may improve the health of employees and the functioning of the organization. The study by Ybema et al. (2016) suggests that organizations may reduce sickness absence among their older employees by investments. They also suggest that a fair treatment and a fair appreciation of older employees are such an important solutions. A fair treatment of employees can prevent productivity loss and sickness absence, whereas lack of appreciation and unfair procedures may lead to productivity loss and sickness absence. Relationships at work may erode as a result of (long term) sickness absence. This could lead to a vicious circle in which lower organizational justice further increases sickness absence of older employees (Ybema, Meer, & Leijten, 2016, p. 653). These should also be considered by the state and HR departments by drawing up measures to reduce sickness absenteeism of older employees in public administration.

Sickness absenteeism in connection with officials and professional-technical public employees in public administration could be reduced by assigning them greater responsibility related to work and activities in the work environment and provide them better leaders and conditions

for satisfaction in the workplace. The study of Van Dierendonck (2002) suggests that giving employees responsibilities reduces sickness absenteeism. The leaders of employees have an important role also in connection with sickness absence. Boudreau et al. (1993) showed in their study that employees who are less satisfied with their supervisor tend to be absent more. Elshout et al. (2013) suggest that organizations and employees may have benefits from the leaders who have the transformational leadership style. This may result in better employee satisfaction and lower sickness absenteeism. The transformational leadership style is also highly recommended by Van Dierendonck (2002). According to Zhu et al. (2005) specific human resource management practices can have a positive effect on employee performance, motivation, skills, abilities, and knowledge, thus reducing sickness absenteeism. One of the key factors in creating this effect is leader with his own leadership style. Elshout et al. (2013) explain that employees who are more satisfied with their job and their supervisor will be more committed to the organization and call in sick less often. Munch-Hansen et al. (2009) found a decrease in average sickness absence with increasing satisfaction with psychosocial work conditions. Kozjek and Ferjan (2015, p. 19) explain that employees on managerial workplaces are enabled functional flexibility, more often than those on non-managerial workplaces, which is often associated with better opportunities in regarding economic security (better payment), workplace security, job skills security and combination security. Therefore, organizations need to be aware that their employees have good opportunities with regard to economic, income, workplace, work and combination security.

The results of our survey show just a few aspects of how field of work and years of service have an effect on sickness absenteeism in public administration. Nevertheless, numerous other factors (e.g. gender, age, relationship between employees and managerial staff, working conditions, health of employees, etc.), which affect the sound understanding of sickness absenteeism, need to be considered in understanding sickness absenteeism. In drawing up and implementing the survey in public administration, we encountered some limitations and difficulties. The latter relate mainly to the sensitivity of the area we have studied, and the large number of surveys conducted in public administration in Slovenia in recent years. However, we are extremely pleased with the response of the participants. The limitations also relate to the fact that the survey was only conducted in public administration, and not in the whole public sector or in the private sector. To this end, it would be reasonable to extend the survey to the whole public and private sector, and also abroad, over the coming years. By expanding the survey to include employees in the whole public and private sector, we would gain an in-depth insight into the understanding of sickness absence. Moreover, we could broaden the survey by posing questions to employees with more than 20 years of

service, relating to the way the employers care for them in the work environment, and the measures implemented in connection with employee health care. As regards the employees with less than 20 years of service, it would be worth examining how they were introduced to the work environment, and what is the quality of their relationship with managerial staff and other employees.

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## Povezanost delovnega področja in delovne dobe z zdravstvenim absentizmom v javni upravi

**Ozadnje in namen:** Statistični podatki kažejo, da je zdravstveni absentizem v javni upravi v Sloveniji bistveno višji (7,1% v letu 2018) od odstotka, ki velja za celotno Slovenijo (4,5% v letu 2018). Podatki prav tako kažejo podoben vzorec tudi v javnem sektorju v drugih državah. Glede na tovrstne statistične podatke je glavni namen naše raziskave povezan s proučevanjem povezanosti delovnega področja in delovne dobe zaposlenih z zdravstvenim absentizmom v javni upravi.

**Metodologija:** Podatki raziskave so bili zbrani s pomočjo spletnega anketnega vprašalnika, ki je bil zasnovan z namenom izvedbe empirične raziskave in je bil sestavljen iz več sklopov vprašanj. Zbrani podatki so bili obdelani v statističnem programu SPSS.

**Rezultati:** Raziskava je bila izvedena leta 2015 v organizacijah javne uprave in v naš vzorec raziskave je bilo vključenih 3.220 zaposlenih v javni upravi. Rezultati raziskave kažejo, da obstaja statistično pomembna povezanost med zdravstvenim absentizmom v javni upravi in delovnim področjem ter delovno dobo zaposlenih v javni upravi.

**Zaključek:** Raziskava nam pomaga razumeti povezavo zdravstvenega absentizma z delovnim področjem in delovno dobo zaposlenih v javni upravi. Glede na rezultate raziskave bi bilo smiselno sprejeti ukrepe, ki so bolj osredotočeni na skupine zaposlenih v javni upravi (starejši zaposleni z daljšo delovno dobo in zaposlene uradnike ter strokovno-tehnične javne uslužbenke) pri katerih se lahko zmanjša zdravstveni absentizem. Zdravstveni absentizem v teh skupinah zaposlenih bi lahko zmanjšali z zagotavljanjem boljših vodij in zagotavljanjem dobrih pogojev za zadovoljstvo na delovnem mestu.

**Gljučne besede:** zdravstveni absentizem, javna uprava, delovna doba, delovno področje



## Appendix: Questionnaire

### General (demographic) data

Gender: • male • female

Education:

- Secondary education
- Tertiary education
- Tertiary education (former)
- Bachelor
- University education (former)
- University education
- Residency
- Master (former)
- Master
- Doctorate

Year of birth: \_\_\_\_\_

Organisation of employment:

- State administration
- Local administration
- Holders of public authorities

Duration of employment in the organisation of current employment:

\_\_\_\_\_ years, \_\_\_\_\_ months

Work area: \_\_\_\_\_

Sickness absence:

1. How many DAYS and HOW MANY TIMES have you been absent in the past 12 months due to taking care of a dependent family member?
  - a. Number of DAYS: \_\_\_\_\_
  - b. Number of OCCASIONS: \_\_\_\_\_
2. How many DAYS and HOW MANY TIMES have you been absent in the past 12 months due to illness or injury (work or non-work related)?
  - a. Number of DAYS: \_\_\_\_\_
  - b. Number of OCCASIONS: \_\_\_\_\_
3. How many DAYS and HOW MANY TIMES have you been absent in the past 12 months due to pressure or stress in the working environment (also due to leader behaviour)
  - a. Number of DAYS: \_\_\_\_\_
  - b. Number of OCCASIONS: \_\_\_\_\_
4. How many DAYS and HOW MANY TIMES have you been absent in the past 12 months due to reasons not related to sickness, injury, pressure, stress, etc.?
  - a. Number of DAYS: \_\_\_\_\_
  - b. Number of OCCASIONS: \_\_\_\_\_
5. In the past 12 months, have you been temporarily absent from work (due to sickness, injury, family member care) despite being able to carry out work tasks?
  - a. YES
  - b. NO
6. In the past 12 months, have you performed your work tasks despite being ill or injured (and thus being eligible for taking sick leave) because you felt and knew that you must carry out these tasks?
  - a. YES
  - b. NO

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# Conceptual Key Competency Model for Smart Factories in Production Processes

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**Background and Purpose:** The aim of the study is to develop a conceptual key competency model for smart factories in production processes, focused on the automotive industry, as innovation and continuous development in this industry are at the forefront and represent the key to its long-term success.

**Methodology:** For the purpose of the research, we used a semi-structured interview as a method of data collection. Participants were segmented into three homogeneous groups, which are industry experts, university professors and secondary education teachers, and government experts. In order to analyse the qualitative data, we used the method of content analysis.

**Results:** Based on the analysis of the data collected by structured interviews, we identified the key competencies that workers in smart factories in the automotive industry will need. The key competencies are technical skills, ICT skills, innovation and creativity, openness to learning, ability to accept and adapt to change, and various soft skills.

**Conclusion:** Our research provides insights for managers working in organisations that are transformed by Industry 4.0. For instance, human resource managers can use our results to study what competencies potential candidates need to perform well on the job, particularly in regards to planning future job profiles in regards related to production processes. Moreover, they can design competency models in a way that is coherent with the trends of Industry 4.0. Educational policy makers should design curricula that develop mentioned competencies. In the future, the results presented here can be compared and contrasted with findings obtained by applying other empirical methods.

**Keywords:** *competencies, conceptual key competency model, smart factory, Industry 4.0, automotive industry*

## 1 Introduction

Recent technological developments, such as sensors, cyber systems, the Internet of Things and smart networks, will affect every area of our lives. This development is called the “fourth industrial revolution” (Gilchrist, 2016), also known as “Industrie 4.0” or “Industry 4.0”, “smart manufacturing”, “industrial internet” or “integrated industry” (Hofmann & Rüsçh, 2017). Germany was the first to use the phrase in 2011 and referred to it as a high-tech strategy for industry (Mosconi, 2014; Prifti et al., 2017) and

the Internet of Things (IoT), Internet of Services (IoS), cyber-physical systems, blockchain technologies, big data and hyperconnectivity (Hitpass & Astudillo, 2019).

An important aspect of Industry 4.0 is robotics, which incorporates mechatronics and computing systems, whereby machines can process data and communicate with other machines or humans, through a wireless network known as the Internet of Things (IoT) (Nader, Jameela, & Jawhar, 2008; Roblek, Meško, & Krapež, 2016). For this reason, many companies have connected several kinds of “smart” sensors with different digital devices (Arsenijević et al., 2019). These machines will both generate and col-

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lect data, which with the addition of artificial intelligence could mean that humans will no longer be needed to carry out repetitive and simple tasks. This would be due to machines being able to carry out all of these tasks more efficiently (Rifkin, 1995; Kane et al., 2015; Hungerland et al., 2015; World Economic Forum, 2018).

Industry 4.0 has already revolutionized the supply chain, among other things, as real-time sensing and transfer of data, combined with the computational capabilities of machine learning algorithms. This has enabled advanced planning and scheduling of cyber-physical systems (CPS), as well as customer relationship management (CRM) and enterprise resource planning (ERP) systems (Govindan et al., 2018; Lai et al., 2018). These smart upgrades to the supply chain have already shown positive results in regards to tracking commodity flow, monitoring data concerning warehouse and store inventories, gathering data about orders for items, delivery reliability and customer satisfaction (Brettel et al., 2014; Kache et al., 2015). Technologies will not only be used for working with machinery, but will also be used for integrated product and service offerings focused on customer satisfaction (Lee, Kao, & Yang, 2014, Lee et al., 2015).

Industry 4.0 will have significant impact on our working environments (Bagnoli et al., 2019) by transforming manufacturing, sales, maintenance work and the process of purchasing from an organisation. This will occur because of the implementation of smart manufacturing and maintenance systems with high levels of integration and automation with different automation solutions such as Robotic Process Automation (Šimek & Šperka, 2019). Smart systems will also be present in various kinds of business processes that are not directly related to manufacturing (Kompetenzaufbau, 2016). This will have far-reaching implications for the creation of business value, business models, further services, and the organisation of work (Kagermann et al., 2013; Bertonecel et al., 2018). Consequently, employees will face work processes and business models that have been reshaped, as well as new technologies for day-to-day tasks (Kompetenzaufbau, 2019). The model of work organisation will be transformed by the disruptive nature of emerging technologies and changed structures for communication and collaboration (Zinn, 2015).

The Industry 4.0 market will grow from 66.67 billion USD in 2016 to 152.31 billion USD or even as much as 214 billion USD in 2022; by 2030, it has been predicted to grow to as high a value as 1 trillion USD (MarketsAndResearch, 2017; Wood, 2018). If the predicted exponential growth turns out to be accurate, then the number of required personnel in the industry will increase, driving the need for HR professionals, managers, and other decision-makers. In order to attract such experts, human resources professionals should be well versed in the terminology of Industry 4.0 and methods for finding the perfect candidates for the new jobs.

Because of the aforementioned fast-paced technological changes occurring in industry, many educational programs and workers will not provide the necessary competencies required for the upcoming needs. That will force production organisations to increase flexibility, efficiency and quality (Zhang et al., 2017), as well as the creation of new employee structures, qualifications, and competencies (Kane et al., 2015; Macurova et al., 2017). For this reason, we have raised the following research questions:

RQ1: According to the interpretation of the participants of the study, what is the expected change in the competencies that will be needed in the production processes at the automotive smart factory in the future (by 2030)?

RQ2: What key competencies do employees need to develop for the successful introduction of smart factories in the automotive industry?

It is important to know and understand new competencies of employees introduced by the concept of Industry 4.0. This is especially true for the automotive industry, which is among the most prominent sectors of Industry 4.0. As part of the qualitative research, we focused on identifying the key competencies of employees in production processes, which will play a key role in bridging the gap between existing (established) production process management concepts and a new paradigm for managing high technology processes, within the framework of Industry 4.0. Technological developments and other changes in the environment bring about crucial changes in this field as well and play a key role in the progress (Enke et al., 2018). Prioritizing the transformation of classic factories into smart factories is to determine the new competencies of employees.

The aim of this study was also the development of a conceptual model of key competencies in production processes, which will enable a more efficient and effective introduction of changes in the field of human resources in smart factories in the automotive industry.

## 2 Literature review

Numerous research disciplines, including psychology, education, organisational management, human resources, and information systems, have examined the concept of competencies (Prifti et al., 2017), in an environment of knowledge economy (Ženko et al., 2017). The first definition of competency was given by McClelland (1973), who defined it as “a personal characteristic or set of habits leading to more effective or better performance”. A definition of competency that is more comprehensive and more frequently used was formulated by Spencer and Spencer (1993, 9): “competency is an underlying characteristic of an individual that is causally related to criterion-referenced effective and/or superior performance in a job or situation”.

Competency studies are mostly following one of three

approaches that were developed independently (Le Deist & Winterton, 2005). The behavioural approach focuses on attributes that go beyond cognitive abilities, such as self-awareness, self-regulation, and social skills (McClelland, 1973; Boyatzis, 1982). This approach argues that competencies are essentially behavioural, unlike personality or intelligence, and that they can be learned through education and development. The functional approach focuses on competencies as requirements for successful completion of the task by limiting the competency mandate to the skills and knowledge required to perform the task (Frank, 1991;). An integrated/multidimensional approach describes competencies as a collection of specific competencies that the individual needs and the organisational skills required at the organisation level to achieve the desired results (Straka, 2004).

Competencies can be defined as the sum of knowledge, skills, and experience that a person can use in the event of a new or unexpected situation (Kauffeld, 2016). It is situation-dependent behaviour, seen in the moment and by the response of an individual through his social context (Kauffeld, 2016). The most important is that competencies are variable and that they allow an employee to contribute actively to the new and complex tasks, for example, in the didactic concept in higher education systems (Kauffeld, 2006; Erpenbeck & Von Rosenstiel, 2007). Daily (working) life competencies are needed to search for solutions in unprecedented situations autonomously. In terms of work, competencies can be divided into four main categories: professional competencies (e.g., knowledge of processes), methodological competencies (e.g., techniques for structuring themselves), and social competencies (e.g., socially relevant behaviour in interactions) and personal competencies (e.g., strategies for self-control, e.g., self-reflection) (Erpenbeck & Von Rosenstiel, 2007).

Key competencies are competencies that are important for an individual in different areas of life (Rychen & Salganik, 2003). These competencies are not domain-specific, but they represent a broader context of a set of skills, understanding, knowledge and personal characteristics that have been proved important (Barth et al., 2007; Kotzab et al., 2018). Key competencies largely extend responsibility to enable continuous learning of other specific competencies (Leoni, 2012).

Competencies play an important role in the development of appropriate skills, understanding, knowledge, and personal characteristics, which allow the employee to achieve the desired results. To adapt to rapid changes and increased need for creativity, the competencies that individuals acquire through traditional education are no longer sufficient. For this reason, the need to determine the key competencies of employees is necessary. There are quite a few reasons for studying key competencies. As an example, Boštjančič (2011, 25) states that, by determining key competencies, it is possible to formulate criteria for individual jobs, which fully reflect the actual skill needs

of the job. This can be done by determining the competencies required for particular jobs, as well as facilitating the recognition of individual characteristics of personnel and their impact on work efficiency and performance. In addition, managers in production organisations can more easily manage the risks that occur during the transition, if they recognize the necessary competencies of staff at the factories of the future in sufficient time (Kremer, 2014).

Some researchers have identified competencies that will be relevant in the future. Some of the findings are listed below. According to Prifti et al. (2017), 68 competencies are important for Industry 4.0: deciding and initiating action, leading and supervising, working with people, adhering to principles and values, relating and networking, persuading and influencing, presenting and communicating information, writing and reporting, applying expertise and technology, analysing, learning and researching, creating and innovating, formulating strategies and concepts, planning and organizing, delivering results and meeting customer expectations, following instructions and procedures, adapting and responding to change, persuading and influencing, achieving personal work goals and objectives, and entrepreneurial and commercial thinking. According to Erol et al. (2016), competencies of the future are lifelong dedication to learning, social, personal, decision-making and leadership competencies that involve complex interaction within a society as a whole, individual groups within that society and the work environment, as well as competencies that allow for a critical perspective on technological progress and research. Other competencies include a thorough understanding of the software and hardware components of upcoming and existing technology, in regards to manufacturing and other practical applications, as well as an ability to use this understanding in practice, for example, practical experience using various machine-learning algorithms (Erol et al., 2016). Hecklau et al. (2017) published another research with an overview and analysis of twelve studies of employees' competencies needed for Industry 4.0. They found out that the most critical competencies are communication and cooperation (especially working in business ecosystems on virtual platforms), coding competence (IT competence), complex problem solving, process understanding, interdisciplinary competence, and creativity.

Modern business conditions pose challenges for employees, as they are constantly pressured to improve work performance and work results. Due to constant changes in the market and in the environment, competency profiles are quickly outdated, resulting in a need for a partial or full revision of a competency model.

The competency model consists of the desired competencies for a specific task and may include a description of individual competencies (Markus, Cooper-Thomas, & Allpress, 2005). These lists may contain different levels of detail and describe the relationship between competencies.

Many competency models have been developed over the years. For example, Erpenbeck and Rosenstiel (2007) offer a model with the separation of competencies into four categories: personal, social/interpersonal, fact-related, and domain competencies. Nippa and Egeling (2009) use the second classification by separating competencies into the meta, domain, method, and social competencies.

A competency model, according to CEB Inc. (as it has been formally known SHL) company's universal competency framework (CEB SHL UCF), offers a universal framework of competencies and is based on a variety of competitive approaches from research and practice. It offers a behavioural approach to modelling competencies by focusing on an individual and taking into account the competencies of a behavioural nature, which means that an individual can learn and accept them and is not based on personality. As a framework, it provides a structure and overview of competencies by integrating them into descriptive categories. This framework can be used to develop competency models that represent a descriptive and simplified view of competencies as a specific phenomenon that needs to be analysed. SHL UCF is widely used in practice, and many companies use it to describe their competency models for specific jobs and it is composed of three hierarchical levels: the "Big Eight", the dimension of competencies and competency constraints (Prifti et al., 2017).

Pecina and Sladek (2017) find that one of the critical issues to be considered within Industry 4.0 and smart factories is the analysis of workers' competencies. Similarly, Imran and Kantola (2019) consider it crucial to determine the competencies for new job profiles at factories. Thus far, the technical aspect of development has been discussed in the subject of Industry 4.0, as well as smart factories, and the field of management and "soft factors" is very. This aspect is neglected primarily in the field of scientific research, but is increasingly dealt with in reports by leading consultants, such as McKinsey, Deloitte, Accenture, and the Boston Consulting Group (Vacek, 2016).

The research is focused on understanding and exploring the key competencies in Industry 4.0. After the review of research literature, key competencies for Industry 4.0 were perceived as a rather unexplored area and worthy of in-depth scientific analysis. Research on this topic is scarce and is based mainly on secondary sources, while empirical research is rare.

### 3 Methodology

The research uses qualitative methods to inquire about the perceived relevant competencies of Industry 4.0 job profiles, specifically within the automotive sector. The purpose of this research is not to measure phenomenon occurring at automotive smart factories or to replicate results or generalize them. Instead, the purpose is that of social

constructivism, where 'social constructions' are seen as power relations, marginalized groups, understandings, interpretations and meanings, among other things, are at the core of such research. Creswell (2007), and Caelli, Ray and Mill (2003) talk more in-depth about the differences of ontological and epistemological assumptions when talking about the similarities and differences of qualitative and quantitative research. Creswell (2007) also presents five main traditions, from case studies to grounded theories.

The automotive industry is one of the largest and most important industry in the world. Bilas, Franc and Arbanas (2013) mention that on an economic scale, according to OICA (French: Organisation internationale des constructeurs d'automobiles), the automotive industry could be considered the world's sixth largest economy. Innovative technological development and advanced technologies are key in the automotive industry's success and ability to be able to provide approximately one in nine jobs in developed countries, while also being one of the largest employers worldwide. The automotive market is becoming increasingly global, whereby changes throughout the world, regardless of the country of origin, are dictating new guidelines, rates of operation and supply chains (Erenda et al., 2018). The automotive industry in Slovenia contributed 10 percent of GDP and employs more than 24,000 people. Most robots in the industry are used in South Korea, especially in the automotive industry. Slovenia is one of the countries with a high share of robots in the automotive industry since last year, notes the International Society for Robotics (IFR) (Slovenska avtomobilska industrija vedno bolj robotizirana, 2019).

#### 3.1 Sample

To achieve the goal of creating a conceptual model of key competencies, related to production processes in the Slovenian automotive industry, several interviews with experts were conducted. The research was carried out using the semi-structured interview method. To enhance the credibility of the qualitative interview method, data source triangulation was used, which enables a more comprehensive (broader) view of the problem under study (Vogrinč, 2008). This was done by including industry experts, university professors, and government experts.

As it is usually the case for exploratory studies, the sampling procedures lead to purposive or quota samples. In the case of this study, a purposive sample was designed, meaning that the research problems have been explored from the perspective of three key groups: policymakers, industry representatives and experts (university professors). These groups were identified as 'the most knowledgeable yet diverse informants' (Merriam, 2002)' who can provide in-depth insight into the research problem. These representatives/participants know about the topic the most. The first group was selected from the member-



ship of ACS. Management at the ACS was asked which out of the 80 companies was most active and advanced factories in its field. We also added an additional criterion, where we looked for companies larger than 10 employees, because processes and business models differ because of the size of the company. For the selection of the participants in the second group, we looked at Cobiss data base to identify Slovenian researchers/professors who write on the topic. Perhaps the easiest selection was for a group of policymakers – people from the ministries etc., as we asked different ministries for the names and contacts of persons who are in charge of Industry 4.0 in a direct or indirect way. The general criterion for selection was; they need to be the most recognized people in their area.

Participants were segmented into three homogeneous groups (Galletta, 2013), which are:

- *Industry experts* (six participants) are senior executives involved in the projects of transforming traditional factories into smart factories. These executive must be employed at a large Slovenian manufacturing organisations, whose main activity is the automotive industry. In addition, they must be members of the Slovenian Automotive Cluster (ACS) and operate according to the Industry 4.0 paradigm.
- *University professors and secondary education teachers*, whose research and teaching is focused on the competencies and Industry 4.0 in general (within the framework of smart factories). The second group of participants in the study was composed of six experts. Three of them were from the business faculties from different universities in Slovenia and three of them from higher education institutions.
- *Government experts* employed at the Ministry of Economic Development and Technology, Ministry of Science, Education and Sports and the Ministry of Infrastructure. Three policy makers participated in the research and comprised the group of ‘Government experts’.

### 3.2 Method of data collection

For the purpose of the research, we used a semi-structured interview as a method of data collection. Interviewees explained the purpose and course of the research. Participants were asked about their perception of expected

change in the competencies that will be needed in the production processes, and key competencies that will be needed by employees for the successful introduction of smart factories in the automotive industry. We recorded the interviews, made transcripts later, and further processed by content analysis. Interview lasted on average 45 minutes.

### 3.3 Data analysis

In order to analyse the qualitative data collected by in-depth interviews, we used the method of content analysis, which is a well-established, empirically based method that allows the structuring of the qualitative data (in our example, the text of the transcripts of interviews of the participants of the research). The method of content analysis is a research method, more precisely an empirically based method, which is used mostly in social sciences (Neuendorf, 2016).

## 4 Result and discussion

The content analysis was started with the reduction or the regulation of data. Reduction levels were followed by the organisation and processing of data, which was an organised process of discovering the meaning of the text by selecting and combining data (terms and categories) that enabled conclusions and their presentation with the final phase (Lamut & Macur, 2012). The data were coded by two researchers independently. In case that their coding was substantially different, a third researcher was involved in order to resolve disputes and hence increase inter-reliability of coding. Assigned codes are presented in Table 1.

Based on the experts’ answers, it is possible to conclude that existing competencies will be upgraded with new knowledge, and will be developed in a wider and complex manner. Highly skilled workers will be needed, who will master increasingly complex tasks. New competencies will be focused more on the creativity and soft skills and a stronger accent to the integration of various skills and areas of expertise will be provided.

A structured analysis presented in Table 2 was conducted, in order to collect data needed to answer the second research question (RQ2). The aim was to identify the key competencies needed by employees for the successful operation of smart factories in the automotive industry.

Table 1: Participants' opinions on changes in future competencies.

<i>Number</i>	<i>Selected quotations</i>	<i>Assigned code/ category</i>
Quotation 1	<i>“Existing competencies will be upgraded with knowledge of existing and new technologies and competencies related to automation, data capture, and processing of these”</i>	existing competencies will be upgraded
Quotation 2	<i>»Competencies will develop to become more complex and wider, with emphasis on combining technical and communication sciences. The creativity and the ability to exploit the high potential of available technologies, the ability to critically look at workable applications and find ideas for improvement will also be challenging the leadership of highly educated, specialist researchers, which will need to be combined into an effective team with organisational skills and leadership skills, including specialists in a particular field.”</i>	creativity and soft skills
Quotation 3	<i>“Workers will have to master information technology, use modern devices, and decide independently and quickly. The demand will be for highly skilled workers who will master increasingly complex tasks. The need for workers for simple work will be reduced. It will also be important to master databases since we will have access to ever-increasing amounts of data. The needs for social skills, communication, leadership, coordination, creativity, and control of emotional intelligence will be emphasized.”</i>	integration of various skills and areas of expertise
Quotation 4	<i>“...that you are capable of learning and upgrade skills.”</i>	existing competencies will be upgraded
Quotation 5	<i>“Employees will have to be able to solve complex tasks and upgrade their knowledge.”</i>	existing competencies will be upgraded
Quotation 6	<i>“More flexibility, ability to innovate and be creative will be needed in the future.”</i>	creativity and soft skills
Quotation 7	<i>“The competencies of the future will differ from today's competencies, and more emphasis will be placed on the innovation and creativity, people will need to have more knowledge and be able to be trained continuously and acquire new knowledge.”</i>	creativity and soft skills
Quotation 8	<i>“... because technology basically does not think, definitely creativity of employees will be important.”</i>	creativity and soft skills
Quotation 9	<i>“In any case, we should not ignore the fact that Industry 5.0 will come to life by 2030, but it will be different from Industry 4.0. This industry introduces the so-called participating robots into production processes. These are robots that will be technologically capable of working with people in production processes. So it will be a so called communication with the machine.”</i>	communication with the machine
Quotation 10	<i>“The competencies of the future are unlikely to be much different from the competencies that are desirable now, but the knowledge will change - something will be outdated, and a lot will be new knowledge. And the fact that we are still learning precisely certain knowledge in schools is bad - they should have been taught to think, create, innovate, polemise ... These are the competencies of the present and will be the competencies of the future.”</i>	creativity and soft skills
Quotation 11	<i>“Basic competencies will include flexibility, open thinking of employees, specialization in certain technical fields, and readiness to innovate ...”</i>	creativity and soft skills
Quotation 12	<i>“In addition to a high level of technical knowledge, teamwork competencies will be needed, rapid problem solving, responsiveness and adaptation to change will be in high demand, which, in my opinion, will be even more intense...”</i>	creativity and soft skills

Table 2: Key competencies identified by industry experts, university professors, and government experts.

Group of experts / Sector	Key competencies
Ministry expert / Government	Flexibility, openness
Ministry expert / Government	Openness, programming
Ministry expert / Government	Technical skills
Chamber of commerce / Government	I am sure that an important profession in the automotive industry will become an engineer of the mechatronics car. These will be experts who will know about mechanical engineering, electronics, information technology, computer science, etc.
University professor / Education	Cooperation with robots
University professor / Education	Openness to learning (this is a very important characteristic) and paying attention to the signals from the environment
University professor / Education	Technology literacy
Secondary school professor / Education	In particular, competencies in the field of ICT, digital technologies, as well as coordination, management and monitoring of processes.
Secondary school professor / Education	However, if I go back to the competencies to be developed, this is communication because of ICT technology, is moving or changing, and then the knowledge of foreign languages, the ability to solve problems, critical and analytical thinking, etc. is very important.
Automotive industry expert / Private	In particular, competencies in ICT, digital technologies, as well as coordination, management and monitoring of processes
Automotive industry expert / Private	Openness to change, multilingualism, technological competencies, knowledge of ICT technologies, use and sharing of technological devices, soft skills (leadership, motivation, understanding, etc.).
Automotive industry expert / Private	They are all critical. The “mind” of the factory and its smartness alone do not guarantee competitiveness.
Automotive industry expert / Private	Technical knowledge
Automotive industry expert / Private	Ability to accept and adapt to changes

Source: Authors work

The key competencies mentioned by the ministry participants of the study are **technical skills**, which include various technical knowledge, such as knowledge of ICT technologies, mechanical engineering, electronics, and computer science (such as programming), openness to changes, flexibility, curiosity, critical and analytical thinking, and multilingualism. The Chamber of commerce expert believes that within the automotive industry knowledge of mechatronics, i.e., knowledge of mechanical engineering, electronics, information technology, computer science will be key to becoming a mechatronic expert for car development. In addition, the government representatives believe that **ICT skills** will be needed in the upcoming fourth industrial revolution. This is reflected in the fact that there will be an increase in machine operators, software maintenance, and hardware maintenance jobs in the future, all of which require programming and

technical skills (Lorenz et al., 2015; Hecklau et al., 2016). While a decrease will be seen in repetitive, routine, and physically demanding jobs, in contrast, skill sets related to **innovation and creativity**, requiring flexibility and openness, such as openness to receiving a higher level of education, flexible responses, openness and flexibility in problem-solving, as well as openness to complexity, will increasingly be needed (Lorenz et al., 2015; Hecklau et al., 2016). This is also reflected in the answers we received from secondary education experts.

The educational organisations representatives believe that **openness to learning** is essential. In addition, they believe that cooperation with robots and technological literacy will be a key competency. This makes sense, as smart manufacturing will include the continuous information flow and exchange between humans and machines (C2M), while at other times with machine to machine communi-

cation (M2M) (Cooper & James, 2009; Greengard, 2015; Roblek et al., 2016). Experts in secondary education also concur those such competencies in ICT and digital technologies will be needed. These attitudes are also shared by the experts from the private sector. The management and monitoring of cyber-physical systems (ICT and digital technologies, i.e., the systems connecting real and virtual environments, which includes the use of the Internet of things) will play a critical role in a key competency profiles.

The private sector representatives also added that the ability to **accept and adapt to change** would be important. Segal (2018) states that some argue that the future will not be so much about jobs being lost or gained, so much as it will about the restructuring of jobs; employees will need to adapt to new technology, such as they have had to in the previous industrial revolutions. For those that cannot adapt to these changes, policies will need to be put in place so that those individuals can live decent lives. For those that believe that the pace of big data analysis and associated technologies is growing too quickly, policies can also help slow things down, in order to ease the stress, which will be encountered when the workforce will need to adapt to these new digital technologies.

Finally, various **soft skills** were mentioned by the private sector experts, who believes that skills other than technical will be important, as smart technology alone does not guarantee competitiveness. Some of the soft skills that were stated by the interviewees include multilingualism, leadership, motivation and understanding, and environmental awareness.

Based on the research results, we have developed a key competency model (Figure 1), which includes various sets of skills and personal characteristics. Two groups of competencies are identified: operational knowledge and personality characteristics. Operational knowledge is fostered by technical literacy, ICT literacy, innovation and creativity. On the other hand, personality characteristics relevant in Industry 4.0 environment are soft skills, openness to learning, and flexibility and adaptation to change. Key competencies were developed by experts from three sectors: the government, the education sector and the private sector. Education sector experts proposed two groups of competencies: openness to learning, and innovation and creativity. Government experts proposed three groups of skills: innovation and creativity, ICT literacy, and technical literacy. Private sector experts proposed two groups of skills: soft skills and flexibility / adaptation to change.

These results indicate that government experts are mostly oriented towards the improvement of productivity by the new technologies; education experts are mostly oriented towards new knowledge that could lead to creativity and innovation of services and products; and finally, the private sector experts are focused mostly on the characteristics that fosters workers' effectiveness, such as soft skills, and adaptation to change.

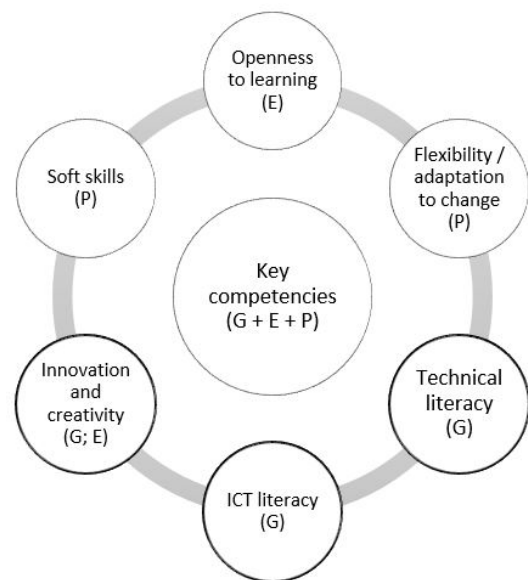


Figure 1: Conceptual key competency model

It is crucial for organisations to formulate an appropriate strategy to support their planning in relation to the upcoming development of Industry 4.0 (Ivanov et al., 2016). Strategic design requires an exhaustive strategic plan from organisations to visualize the steps towards a digital production organisation – a smart factory (Sarvari et al., 2018). Planning is an essential component of creating and delivering strategy and innovation in several organisations; therefore, in order to ensure success in the digital transformation process within Industry 4.0, a strategic transformation plan is indispensable (Vogel-Heuser & Hess, 2016). Understanding the specific features of the transition to Industry 4.0 in the field of HR competencies is a prerequisite for the development of a strategic plan.

## 5 Conclusion

This research is an exploratory study into future competencies. There is no abundance of publications on this topic in relation to smart factories in the automotive industry, and the field, to our knowledge, has not been explored in Slovenia. Here we study the automotive industry, because it is a global industry, affected by a large number of competitive manufacturers striving to develop smart factories. To study the case, we chose the automotive industry in Slovenia. It is known that the countries with the greatest potential in Industry 4.0 (Germany, Singapore, South Korea and Japan) (Liu, 2019) also have a high degree of modernization in the manufacturing industry, but Slovenia, in the context of smart manufacturing research, is a Europe-



an Union Member State with high industrial potential. It is economically tied to countries from the aforementioned group, with Germany at the head (Industry 4.0 and Europe 2017). This means that as a direct partner it participates in the development of Industry 4.0, as there are no borders to the business process model; companies (production organisations) tend to have branches, production and other organisational units outside the country of the holder of the production organisation. Slovenia has the advantage that, due to its high levels of education and technological advancement, it is highly represented in the automotive industry, which is far advanced in implementation of the Industry 4.0 philosophy. The Slovenian manufacturing organisations in the automotive industry, which were also included in our research, are the first to announce investments in the construction of their smart factories or are the winners of numerous awards for innovation.

Results of our study can be utilized by different stakeholders, i. e. top managers, HR professionals and secondary and higher education institutions policy makers. They could provide strategic managers in the manufacturing sector research a new strategic approach to introducing personnel changes needed for Industry 4.0 organisations.

A conceptual competencies model could provide human resource strategic managers with information about experts' opinions of future competencies needed to adapt to changes in production processes at manufacturing organisations. Educational policy makers should design curricula that develop competencies such as ICT literacy, and to cover activities that are needed to develop soft skills like innovation, creativity, openness to learning, and flexibility and adaptation to change.

The limitation of the study is not so much an issue of methodology, but has more to do with human bias. For example, qualitative data are collected with interviews with humans and analysed by humans, which can lead to different interpretations of the same data. As such a qualitative study is inherently biased from an analytical perspective, since it does not possess ways of quantitatively measuring and interpreting the data, however at the same time it does provide us with a rich source of information that cannot be attained with quantitative methods. Nonetheless, the study could have benefited from using more than one methodology, for example, a Delphi study could have been conducted with experts from the field of Industry 4.0 and smart manufacturing, in order to reduce bias of our study.

We believe that future studies will make comparisons and eventually measure, for example, the impact of specific competencies on productivity, innovation etc. in 4.0 industry. Yet, the first identification of perceived future job profiles and competencies needs to be done. For Slovenia, this empirical study sheds light on what 4.0 industry needs.

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## Konceptualni model ključnih kompetenc v proizvodnih procesih pametnih tovarn

**Ozadnje in namen:** Namen raziskave je oblikovati konceptualni model ključnih kompetenc v proizvodnih procesih pametnih tovarn. V raziskavi smo se osredotočili na proučevanje avtomobilske industrije, saj sta inovativnost in nenehni razvoj v tej industriji v ospredju in predstavljata ključ dolgoročne uspešnosti panoge.

**Metodologija:** Podatke smo zbrali s pomočjo metode polstrukturiranega intervjuja. Vzorec udeležencev raziskave je namenski, vključeval je tri homogene skupine strokovnjakov, to so poznavalci teme iz industrije, izobraževanja in ministrstev. Za analizo kvalitativnih podatkov smo uporabili metodo analize vsebine.

**Rezultati:** Na podlagi analize podatkov smo opredelili ključne kompetence, ki jih bodo delavci v proizvodnih procesih pametnih tovarn avtomobilske industrije potrebovali. Ključne kompetence so tehnične znanja in spretnosti, IKT znanja, inovativnost in ustvarjalnost, odprtost za učenje ter sposobnost sprejemanja in prilagajanja spremembam.

**Zaključek:** Rezultati naše raziskave nudijo vpogled za managerje, ki delajo v organizacijah, na katere močno vplivajo spremembe, ki jih prinaša Industrija 4.0. Strokovnjaki na kadrovskem področju lahko pridobijo koristne informacije za načrtovanje bodočih delovnih mest v proizvodnih procesih glede kompetenc, ki jih bodo zaposleni potrebovali za svoje delo. Poleg tega lahko oblikujejo kompetenčne modele na način, ki je skladen s trendi Industrije 4.0. Oblikovalci izobraževalne politike bi morali oblikovati učne načrte, ki razvijajo omenjene kompetence. Za nadaljnja raziskovanja predlagamo, da se predstavljene rezultate primerja z ugotovitvami, pridobljenimi z drugimi empiričnimi metodami.

**Ključne besede:** kompetence, konceptualni model ključnih kompetenc, pametna tovarna, Industrija 4.0, avtomobilska industrija

# Dependency Analysis Between Various Profit Measures and Corporate Total Assets for Visegrad Group's Business Entities

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**Background and Purpose:** Models of identifying and predicting earnings management in companies by using accruals are in general based on the dependence between total assets of companies and various profit measures. In this paper, we focused on an initial dependency analysis between these business indicators in the Visegrad group's business entities. We explore the mentioned relationships, verify, and quantify the strength of the dependencies between earnings levels of companies (in terms of economic evaluation of the return on business capital in absolute terms) and the value of their total assets (i.e. business capital tied in the assets without its further classification and analysis).

**Methodology:** We use descriptive statistics as well as a correlation analysis based on the real business data on almost 300 thousand companies in the V4 countries from the Amadeus database, covering the period from 2013 to 2017. Finally, we use a comparative analysis to identify disproportion among the results that were found out for each of the analysed countries.

**Results:** The analysis showed that Slovak companies have the average values of profit measures and total assets comparable to Hungarian companies. Czech and Polish companies have several times higher average values of profit measures and also of total assets than Slovak and Hungarian companies. The analysis of the development of the profit measures and the total assets of the companies over the years showed significant differences across the four countries during the period covered by this study.

**Conclusion:** The analysis of relationships between total assets of the companies and their profit measures showed that the strength of these dependencies among countries is very similar, and over the years, these results did not change. The results of this study can be further used in the creation of the earnings management model in enterprises, both in Slovakia and in other V4 countries.

**Keywords:** *profit measures; total assets; earnings management; correlation*

## 1 Introduction

Earnings management (EM) is currently discussed but also controversial and at the same time very promising topic in the field of finance and financial management of companies (Stolowy and Breton, 2000). The main subject of this topic is corporate profits. Earnings management is a kind

of management that uses accounting techniques to meet the executives' needs for earnings (Chen, 2010). When preparing an enterprise's financial statements, business managers have legal opportunities as well as the incentive to implement to a certain extent their own judgment and subjective estimates in order to satisfy their own needs and the needs of the company (Kral and Janoskova, 2015,



Kramarova et al., 2014). This consequently leads to opportunistic management reporting profits. Information gain value, therefore, becomes for users of financial statements questionable (Lev, 2018). These reasons are behind the fact that the topic of earnings management has become more prevalent in many companies and is in recent years in the interest of scientists and economists in several countries (Popescu Ljungholm, 2018).

The most reliable models of identifying and predicting earnings management are models of discretionary accruals (Beslic et al., 2015) Accordingly, the financial accounting literature has made efforts to identify the determinants of earnings management behaviour in various industries (Mellado-Cid et al., 2019). In Slovakia, no studies have been published directly on this topic yet and a similar situation is in neighbouring Czech Republic and Hungary. Our work in the future will lead to the creation of a complex model of earnings management for companies in Slovakia and also other countries, where we will deal with various earnings levels as model output variables and total assets as an input variable. This is why we focused in this study on companies in Visegrad Group (V4) countries and the main aim of this study is to explore relationships and verify dependencies between various earnings levels of companies and the value of total assets of the companies in V4. Finding the dependencies and analyzing the mutual relation between profits gained and corporate total assets may be helpful in determining the limitations of what can be perceived as manipulation with earnings in specific national environments. The contribution of the paper lies in the use of the real database on almost 300 thousand companies in the V4 countries. The main purpose of the study is to quantify the strength of the dependency between the earnings of the companies and their total assets and to analyze the significance of these relationships. This analysis is based on the use of statistical methods and procedures. Its output provides insight into the main statistical characteristics of the various profit levels and total assets of the companies over the years covered by this study, and mainly, the quantification of the strength of relationships among these companies' indicators.

Our study consists of four main parts. The introduction highlights the main aspects of the study and a literature review of the current state of this topic. The second part briefly describes the statistical methods used in this study and the data used for this analysis. The third part presents the results of the study. The conclusion summarizes the results and indicates further possible directions of the research in this field.

## 2 Literature review

As the first model to identify the presence of Earnings Management in companies, the Hepworth (1953) model

is considered. The author of this study finds smoothing as a reasonable and wise action, serving managers to smooth their income by using specific means (Saeidi, 2012). Moreover, the author has documented various tactics that can be used to transfer net profit to subsequent accounting periods. But this study does not consider a way to detect this transferring of the profits. Among the first studies, focusing on the detection of earnings management in the company, belong for example the studies of Gordon (1964); Dopuch and Drake (1966); Archibald (1967). These studies are based on a time series. Gordon et al. (1966) were the first who used mathematical modelling for the testing of the balancing profit. As a breakthrough study on this issue, the study of Jones (1991) is considered. The author analysed the earnings management using a two-step model based on time series data. In the subsequent years, several authors tried to modify the model of Jones by supplementing, omitting or modification of the variables, for example, Key (1997), Kasznik (1999), McNichols (2000), Kothari et al. (2005).

Since then, the interest of scientists in this topic has grown significantly. Gim et al. (2019) examined, whether franchising as a firm characteristic causes any meaningful differences in the earnings management behaviour of restaurant firms. The results of their study show that franchise restaurants are generally more inclined towards earnings management, mainly during their growth phase. Mellado-Cid et al. (2019) studied the relationship between the stock options' volatility and real earnings management in the company. The authors hypothesised that earnings management cause uncertainty in the value of a firm's common stock and really found the association between them, especially in put options. The study of Liu et al. (2018) aimed at investigating the effects of short selling on a firm's executive compensation and earnings management. Their analysis showed that the executives of the short-selling firms justify their excess compensation by improving the pay-performance sensitivity, through the real earnings management. The authors found that there is a more significant change in real earnings management in short-selling firms. In the study of Darrough et al. (2017), the authors examine whether managers shift income-decreasing special items to discontinued operations. They found that managers really tend to classification-shift asset write-downs to discontinued operations. Jia and Zhou (2019) in their study empirically examined the effect of cross-listing on earnings management and its economic consequences in companies in China. They considered both accrual-based earnings management and real earnings management and the results of the study reveal that accrual-based earnings management can maintain debt contract efficiency and real earnings management plays a role in signalling better performance. Jacoby et al. (2016) in their study explored the relationship between corporate financial distress and earnings management using a sample of politically affiliated private firms in China and also



examined the effects of political affiliation and regional development on this relation. Their findings suggest that financially distressed firms use earnings management more than financially healthy firms. They also found that political affiliation weakens the association between financial distress of the company and small positive earnings management.

In Slovakia, but also in the neighbouring Czech Republic and Hungary, this topic is in the scientific community still new. Some authors from Slovakia have mentioned earnings management in their studies, for example, Saxunova (2015), Vagner (2015), Paksiova (2017). But their studies are not dedicated to this issue and do not deal with it deeper. Similarly, in the Czech Republic, there are several studies that mention earnings management, for example, Prochazka (2017), Jiraskova and Molin (2015), but these do not focus deeply on the issue of earnings management. In Hungary, the situation is very similar. There are a few studies that mentioned earnings management, such as Markus et al. (1998), Olah et al. (2017a), Olah et al. (2017b), but these studies are not focused on earnings management directly. In Poland, the situation is quite different. In the past few years, several Polish authors have been dealing with the topic of earnings management. For example, Lizinska and Czapiewski (2018) studied discretionary accruals in Polish companies and their correlation with subsequent long-term market value for initial public offerings made before the financial crisis. The authors consider their conclusions to be robust with respect to the latest innovations in proxies for the topic of earnings management. Di Narzo et al. (2018) in their study used data from France, Germany, Italy and the UK to investigate how the ability to detect earnings manipulations through accruals models are affected by the use of different industry classifications. Their analyses showed that enlarging the industry classification reduces the probability of discovering earnings manipulations.

### 3 Methodology and data

In this study, we focus on the analysis of different levels of corporate profits in the V4 countries and their relationship with the total assets of the company. In this relationship, the models of earnings management identification using the accruals are based (Fogarassy, 2018). The value of corporate assets points to the total capital strength of a company (absolute indicator); different levels of corporate profit used in the study are then the absolute expression of their profitability (absolute indicators).

For the analysis, we use data on real companies from the V4 from the Amadeus, a database of comparable financial information for public and private companies across Europe. Amadeus contains comprehensive information on around 21 million European companies (Bureau Van Dijk, 2019). Overall, the dataset used in this study contains data

about 299,355 companies. The number of companies, included in the database, from individual countries of V4 is shown in the following table.

Table 2: Frequencies of companies in the database

Country	Frequency	Percent
Czech Republic	34,970	11.7
Hungary	177,756	59.4
Poland	32,251	10.8
Slovakia	54,378	18.2
Total	299,355	100.0

Source: Own elaboration

We have data on companies from 2013 to 2017, which was at the moment of writing this study the latest possible data from companies' financial statements. The database contains, among other characteristics of the companies, values of eight different profit measures (6 absolute indicators, 2 ratio indicators) and the value of total assets of companies. Although absolute indicators have limited explanatory power in the financial analysis (preference is given to ratio indicators) (Kicova and Kramarova, 2013), the primary identification of the relationship between assets and profit levels is a logical and de facto "gateway" for identifying earnings management. (Kramarova et al., 2020)

For variables, we use the following designation and method of calculation, shown in Table 2. In the table, we provide the calculation method as it is provided by the database Amadeus.

As a weakness of the Amadeus database, we consider the fact that it does not contain all the necessary data, or that the data it provides is very limited. Specifically, for example, it does not include data from all items in the profit and loss account of enterprises. This fact, for example, limited the explanatory power of our findings in case of the indirect relationship between the assets and the identified loss resulting from financial activities in case of some countries (see Table 6). We believe that this may be related to using of credit forms of financing i.e. with the interest payment process (de facto with the price of credit forms of financing and the rate of their use in overall process of assets financing) or with reported foreign exchange losses. However, despite the weaknesses of the Amadeus database, it is very high quality and extensive database. We consider the data there to be very valuable, as data from several countries allow international comparisons of companies or the creation of international models.

In the first step of processing the database, we focused on the existence of outliers that might skew the results of

Table 2: Variables in the database

Variable	Label
PLBT	Profit / loss before tax = Operating profit + financial profit
PL	Profit/loss for period = Net income for the Year. Before deduction of Minority interests if any (Profit after taxation + Extraordinary and other profit).
PLAT	Profit / loss after tax = Profit before taxation - Taxation
OPPL	EBIT (Earnings before interest and taxes, Operating profit/loss) = All operating revenues - all operating expenses (Gross profit-Other operating expenses)
EBTA	EBITDA (Earnings before interest, taxes, depreciation and amortization charges) = Operating profit + Depreciation
FIPL	Financial profit/loss = (Financial revenue-Financial expenses) = (All financial revenues such as interest, incomes from shares, etc.) – (All financial expenses such as interest charges, write-off financial assets)
ETMA	EBIT margin = (EBIT / Operating revenue) * 100
EBMA	EBITDA margin = EBITDA / Operating revenue) * 100
TA	Total assets = Total assets (Fixed assets + Current assets)

Source: Own elaboration

the analysis. As our database is a multidimensional set, we focused on multivariate outliers and to identify them, we chose the Mahalanobis distance. This metric measures the multidimensional distance of each observation from the group centroid. The advantage of Mahalanobis distance is its insensitivity to the change in the scale of variables. According to Tabachnick and Fidell (2007), the procedure for detecting multidimensional extreme values is as follows. We will use a linear regression method, where all variables that we have in the database, are used as explanatory variables. Based on this, we calculate the value of Mahalanobis distance for each statistical unit and its realization of individual independent variables. To verify this, we create the variable  $P_{MD}$  defined using the  $\chi^2$ -distribution and the Mahalanobis distance by

$$P_{MD} = 1 - CDF_{\chi^2}(MD, Df), \quad (1)$$

where  $CDF_{\chi^2}$  is the cumulative distribution function of the random variable with  $\chi^2$ -distribution,  $Df$  is the number of independent variables in the linear regression model and  $MD$  is the Mahalanobis distance defined for  $i$ -th observation by

$$MD_i = \sqrt{(x_i - \bar{x})' s^{-1} (x_i - \bar{x})}, \quad (2)$$

where:  $x_i$  is the  $i$ -th statistical unit values vector,  $\bar{x}$  is a

sample centroid, that is, a vector of sample means,  $s$  is a sample covariance matrix. The  $P_{MD}$  variable is used to identify multivariate outliers. If it holds

$$P_{MD} < 0.001, \quad (3)$$

this indicates that the unit is a multi-dimensional outlier with respect to the other units in the file. A value of 0.001 is recommended by Tabachnick and Fidell (2013). By sequencing the statistical file according to the decreasing Mahalanobis distance, we can see whether some cases tend to appear as multivariate outliers because its distance values are higher than with other companies. Companies that are based on this analysis proved to be multivariate outliers, were subsequently excluded from our database from further analysis. These multivariate outliers were examined in each group of companies, defined by the country.

To characterize groups of companies in every of V4 countries, statistical descriptive characteristics will be used (Popp et al., 2018). For each variable, we list the mean, standard deviation, median, minimum and maximum values. These characteristics can be used to compare groups of companies in individual Visegrad countries and also to monitor the development of the value of the various profit measures of companies over the years (Olah et al., 2019). To compare the means of profit measures of the companies and also means of total assets during the years, we conducted Friedman's nonparametric test (Bin et al., 2018). This test is an alternative to the ANOVA test

for related samples. Friedman's test is also an alternative to the Wilcoxon's test. Wilcoxon's test serves in case of two related samples and Friedman's test is suitable if there are at least 3 related samples. This test detects whether the median values of profit measures and also total assets of companies in individual years (and in the V4 countries) differ significantly.

To analyze the dependencies between profit measures and total assets of the companies, we use Pearson's correlation coefficient, which is a measure of the linear relationship between two quantitative variables. In determining the degree of dependence, we will proceed from the following scale (Ratner, 2009):

- weak correlation, if  $0 < |r| < 0.3$ ,
- moderate correlation, if  $0.3 \leq |r| < 0.7$ ,
- strong correlation, if  $0.7 \leq |r| < 1$ .

In addition to the value of the correlation coefficient, we always list the p-value of the test of its statistical significance, based on which we identify the correlations between total assets and various profit measures that are statistically significant and the ones that are not (Valaskova et al., 2018).

## 4 Results

Analysis of the presence of multivariate outliers in files has shown that some enterprises are significantly different from other enterprises in a given country by their values. We defined the variable  $P_{MD}$  according to equation (1), while the Mahalanobis distance was calculated according to (2). Subsequently, under rule (3), we have identified for every company whether it is considered to be a multivariate outlier or not. This analysis showed the numbers of multivariate outliers in each country (Table 3). The percentage of excluded companies in each country is between 2.1% and 3.9%.

After this analysis, 291,426 companies remained in our database, 7,934 companies were marked as multivariate outliers. Outlying companies account for 2.72% of all companies. These companies were excluded from further analysis.

In the next step, we focused on the descriptive characteristics of various profit measures as well as their total assets. These characteristics were calculated separately for companies in each country and separately for each of the years 2013 to 2017. For brevity, we present the characteristics of all the variables of companies in individual countries in 2017 (Table 4).

Next, we compared individual profit measures, as well as total assets of the companies, over the years 2013 to 2017 using available data. We verified the existence of significant differences between the median values of variables using the Friedman test with the null hypothesis that there were no significant differences between the median val-

ues of variables over the years. Table 5 shows an example of the output of Friedman's test for the total assets of the companies in Slovakia.

We performed this test for each of the profit measures as well as for total assets. The results of all tests in all countries and for all variables are the same: the mentioned zero hypothesis was rejected, so that values of profits and total assets of companies in V4 countries have changed significantly over the years.

Furthermore, we analysed the relationship between profit measures and the total assets of the companies. The strength of the linear dependence between the individual profit measure and the total assets of the companies was quantified using the Pearson's correlation coefficient (Tretyak, 2018). Moreover, the value of the correlation coefficient is always supplemented by the p-value of its significance test with the null hypothesis that this relationship is statistically insignificant. The values of the correlation coefficients together with the p-values of their significance tests are shown in Table 6.

For brevity, we again present only outputs from this analysis from 2017. For the other years included in the study, the results of the correlation analysis are very similar. We used color highlighting of the correlation degrees in the table. Using the red data bars we marked the comparison of the correlation strengths for each profit measure (i.e. the correlation coefficient between total assets and the given profit measure among the V4 countries is compared in each row of the table). In this way, we compared individual profit measures among the countries. At the same time, we used cell coloring and font colors to indicate the strength of the dependence. We used a three-stage scale, where: the yellow color indicates a weak linear dependence (i.e., a correlation coefficient of (-0.3;0.3)); green indicates moderate dependence (i.e. correlation coefficient (0.3;0.8) or (-0.8;-0.3), respectively) and finally, red indicates strong dependence (i.e. correlation of (0.8;1), or (-1;-0.8)). In this way, we can immediately visually determine the strength of dependence between a given profit measure and the total assets of companies in a given country.

According to the p-value of the significance tests of the correlation coefficient (always the second row of the profit indicator in Table 6 above), we can see that the linear dependence between EBITDA margin and total assets in 2017 is insignificant. Also, the linear relationship between EBIT margin and total assets is insignificant for Slovak companies, but according to other correlation coefficients we see that even in other V4 countries, linear relationships in this pair of variables are weak. Other correlations are statistically significant. Depending on the values and signs of the correlation coefficients themselves, we can assess the strength of linear relationships between profit measure and total assets, as well as the direction of this dependence.

From 2013 to 2016, which we also analysed in this study, the results of the correlation analysis are very similar. For the sake of brevity, we do not list them in full.

Table 3: Frequencies of multivariate outliers

Country	non-outliers		outliers		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Czech Republic	33,620	96.1	1,350	3.9	34,970	100.0
Hungary	173,982	97.9	3,774	2.1	177,756	100.0
Poland	31,052	96.3	1,199	3.7	32,251	100.0
Slovakia	52,767	97.0	1,611	3.0	54,378	100.0

Source: Own elaboration

Table 4: Characteristics of profit measures (in thousand EUR) of companies in 2017 in V4 group countries

Country / Variable 2017		P/L before tax	P/L for period	P/L after tax	EBIT	EBITDA	Financial P/L	EBIT margin	EBITDA margin	Total assets
Czech Republic	Min	-23458.3	-23444.4	-23444.4	-24138.8	-22085.7	-24006.3	-93.1	-99.6	0.0
	Max	170884.7	138677.5	138677.5	131839.4	215999.5	39045.3	100.0	97.3	1037890.0
	Mean	264.1	214.0	213.7	281.0	444.2	-16.9	15.4	7.9	3898.7
	St. Dev	1432.6	1184.5	1184.4	1311.5	1901.2	372.9	21.0	17.1	12901.8
Hungary	Min	-25561.5	-25562.9	-25562.9	-9058.6	-8446.2	-25546.2	-99.2	-100.0	0.0
	Max	431594.5	408991.0	408991.0	444994.2	515849.1	19948.0	100.0	99.6	546026.1
	Mean	51.5	47.4	47.4	52.7	75.4	-1.1	14.4	8.5	577.5
	St.Dev	1274.3	1221.4	1221.4	1272.9	1543.0	106.6	23.2	22.3	3101.3
Poland	Min	-19446.1	-20380.0	-20380.0	-29470.5	-15492.8	-24746.3	-89.3	-99.1	1.2
	Max	106013.2	83675.7	82890.3	109203.5	377481.5	46636.7	99.7	91.4	14449806.6
	Mean	388.5	330.3	330.2	410.1	628.4	-21.5	9.1	5.8	6471.1
	St. Dev	1593.1	1354.5	1337.6	1590.8	3072.4	452.8	13.5	12.0	86371.2
Slovakia	Min	-13866.9	-13869.8	-13869.8	-13731.0	-4100.9	-5244.4	-96.4	-99.9	0.1
	Max	101206.0	79512.0	79512.0	98113.0	156003.0	9462.1	100.0	98.7	1578716.0
	Mean	64.0	47.5	47.6	71.9	126.8	-7.8	16.8	7.4	1131.3
	St.Dev	638.5	483.8	484.4	636.8	910.9	80.8	22.1	19.7	8397.9

Source: Own elaboration

Table 5: Friedman's test for homogeneity of medians of total assets of companies in Slovakia

Hypothesis Test Summary			
Null Hypothesis	Test	Sig.	Decision
The distributions of Total assets 2017, Total assets 2016, Total assets 2015, Total assets 2014 and Total assets 2013 are the same	Related Samples Friedman's Two-Way Analysis of Variance by Ranks	0.000	Reject the null hypothesis

Source: Own elaboration

Table 6: Correlations of profit measures and total assets of the V4 enterprises in 2017

Variable 2017	Correlation	Czech Republic	Hungary	Poland	Slovakia
		Correlation with Total assets 2017			
P/L before tax	Pearson Correlation	0.686	0.463	0.257	0.750
	p-value	0.000	0.000	0.000	0.000
P/L for period	Pearson Correlation	0.677	0.453	0.220	0.773
	p-value	0.000	0.000	0.000	0.000
P/L after tax	Pearson Correlation	0.677	0.453	0.216	0.773
	p-value	0.000	0.000	0.000	0.000
EBIT	Pearson Correlation	0.705	0.504	0.100	0.749
	p-value	0.000	0.000	0.000	0.000
EBITDA	Pearson Correlation	0.811	0.655	0.844	0.874
	p-value	0.000	0.000	0.000	0.000
Finacial P/L	Pearson Correlation	0.164	-0.039	0.560	-0.018
	p-value	0.000	0.000	0.000	0.000
EBIT margin	Pearson Correlation	0.034	0.018	0.023	0.000
	p-value	0.000	0.000	0.000	0.994
EBITDA margin	Pearson Correlation	0.032	0.014	0.004	0.000
	p-value	0.000	0.000	0.446	0.912

Source: Own elaboration

## 5 Discussion and conclusion

In the study, we focus on the analysis of various profit measures of companies in Visegrad group countries in the years 2013-2017. We examined the characteristics of individual profit measures, their differences within V4 countries, their evolution over time and their relationship with total assets of the company. We based on generally known premise that the effective use of a capital tied in company assets, in other words, the effective use of assets, is a prerequisite for generating corporate profits, while corporate profits we quantified mainly as absolute values of the various profit measures (e.g. EAT, EBT, EBIT, EBITDA etc.). The findings point to the fact that the greatest capital strength (on average) was characteristic for Polish companies in all analysed years. On the contrary, the smallest amount of capital tied in assets was found in the case of Hungarian enterprises, again for all periods analysed.

The analysis of average values of profit measures among the countries showed that Slovak companies have all these values comparable to Hungarian companies and at the same time several times lower than Polish and Czech companies. Polish companies achieve the highest average profit measures. Similar results were for the total assets of the companies, where the lowest average value is achieved by Hungarian companies, followed by Slovak companies. Again, the companies in the Czech Republic

and Poland have several times higher average values of total assets. Based on this we deduce that on average companies in the Czech Republic and Poland are characterized by a higher capital strength than companies in Slovakia and Hungary (the origin of capital in terms of ownership was not examined in the study). We also looked at whether the individual profit measures and the total assets of the companies were significantly different over the years included in this study. Using Friedman's test, we found that all of the companies' profit measures differed significantly across the four countries during the whole period 2013-2017 included in this study.

Subsequently, the analysis of relationships between total assets of the companies and individual profit measures showed that the strength of dependence among the V4 countries is very similar, and over the years, these results did not change. Total assets of the companies are overwhelmingly the most correlated with EBIT, EBITDA and then with Profit / loss before tax, Profit / loss for period and Profit / loss after tax. Negative correlation is only between Financial profit / loss and total assets of companies in Hungary and Slovakia, although according to the value of the correlation coefficient, it is a very weak correlation. However, this negative correlation is closely related to the fact that the mean values of this variable were negative for companies in all four countries (Table 4). This may be caused by the character of the financial profit/loss, which



is calculated as a difference between the financial revenues (e.g. sale of securities, financial operations) and financial expenses (e.g. paid interests for loans, exchange losses). Due to the underdeveloped capital market of most of the V4 countries, it is evident that in most companies the financial expenses exceed the financial revenues causing the negative mean values of this variable. However, like any other profitability ratio, also the financial profit/loss provides important information as it quantifies the level of financial profit an enterprise may generate considering the level of corporate total assets. Thus, the impact of the financial profit/loss indicator on the sign of correlation with the Total assets of the companies should be more focused on further research.

In the case of Slovak companies, except the relationship between Financial profit / loss and EBIT margin with Total assets, there are always strong correlations between individual profit measure and total assets of the companies. The weakest correlated are profit measures and Total assets of the companies in Poland.

If we focus on the strength of dependence between individual profit measures and Total assets, we can conclude that total assets have the following linear relationship with profit measures:

- **in the Czech Republic:**
  - a weak linear relationship with Financial profit / loss, EBIT margin and EBITDA margin;
  - a moderate linear relationship with Profit / loss before tax, Profit / loss for period and Profit / loss after tax;
  - a strong linear relationship with EBIT and EBITDA.
- **in Hungary:**
  - a weak linear relationship with Financial profit / loss, EBIT margin and EBITDA margin;
  - a moderate linear relationship with the other profit measures.
- **in Poland:**
  - a moderate linear relationship with Financial profit / loss;
  - a strong linear relationship with EBITDA;
  - a weak linear relationship with the others.
- **in Slovakia:**
  - a weak linear relationship with Financial profit / loss, EBIT margin and EBITDA margin;
  - a strong linear relationship with the other profit measures.

If we compare between the countries, we find that in the case of significantly correlated profit measures, the strongest dependencies are found in Slovakia, followed by the second Czech Republic. We would call these relationships very similar and indicate stronger to moderate dependencies between total assets and other profit measures (with the exception of the last two/three profit mea-

asures in Table 5, for which a linear relationship is very weak). Slightly weaker relationships were quantified in Hungarian enterprises and weakest are the correlations in Polish enterprises. In this comparison, Poland is the only country that differs from the other three V4 countries, and this applies to the Total assets of enterprises with all profit measures except EBITDA. This result follows the conclusions in Svabova et al. (2019), where it was found that the average EBITDA of enterprises, except from the couple Czech Republic - Poland, differs significantly in each pair of V4 countries, which also could have an impact on our differences in correlations with the Total assets of corporations. The mentioned study also found that in the Financial profit/loss, except for the couple Poland - Slovakia, the average values are not significantly different across countries. Again, this may affect the strength of the relationship of this profit measure with the total assets of enterprises identified in this study. In the case of the Financial profit/loss, this correlation is similar across countries, with the exception of Polish companies. Concretely, in the case of the Financial profit/loss measure, Polish companies show the strongest (namely, moderate and the only one positive) correlation with total assets. This is followed by Hungarian companies where this relationship is weak and indirect. In this case, the Czech and Slovak companies achieve also similar results, where the relationship is very weak and indirect. From this mathematical measure of dependence between financial profit/loss and total assets, it can be concluded that a change in one indicator has only a small (negative) effect on the change in the other. However, it should be borne in mind, that the Pearson correlation coefficient is only a measure of the linear dependence between variables. In this case, the dependence may be of a different, more complex type, which also follows from the economic interpretation of the profit measures.

The source for these similarities and also differences among the values of earning levels of the companies in V4 countries arises not only from the economic situation in these companies but also from the economic situation in the countries. Recalling the main indicators of the V4 countries, for example, the annual rates of change in GDP in 2017 were similar in all V4 countries, varying from 3.4 % in Slovakia to 4.6 % in Poland. Moreover, the distribution of gross value added by the section is very similar in all four of these countries. The annual rate of change in the volume of industrial production and volume of retail trade turnover was also similar in 2017. The volume of export and import was very similar in Slovakia and Hungary and also in the Czech Republic and Poland, the volume of import was very similar (Main Indicators of the Visegrad Group Countries, 2018) The difference of Polish enterprises from other countries can also be partly explained by the fact that in Poland the publication of accounting data is voluntary for enterprises. Thus, only those enterprises that voluntarily provided this data are included in the sample, not all enterprises, as in the other three countries. The

calculated average values, and related other values, may, therefore, be biased by the effect of this self-selection.

All the results described were interpreted from the values calculated from the 2017 indicators. Similarly as in the year 2017, in the years 2013 to 2016, which we also analyzed in this study, the correlation analysis showed that the Total assets of the company are the weakest correlated with Financial profit / loss, EBIT margin and EBITDA margin. At the same time, the weakest correlation of profit measures with Total assets are mainly in Polish companies.

To summarize, all the results obtained from the characteristics of individual profit measures as well as total assets, the comparison of their values over the years and the correlation analysis between profit measures and total assets will be further used for the development of an econometric model of dependence, showing the connection between variables and for the creation of the earnings management model in enterprises, both in Slovakia and in other V4 countries.

One of the limitations of the study is given by the recording and recalculating policy of the financial indicators in the Amadeus database - among the V4 countries, only Slovakia uses Euros as the official currency. Other countries, Poland, Hungary, and the Czech Republic still use their national currencies (zloty, forint, and Czech crowns). The values are converted into Euros using the exchange rate for the conversion. However, this exchange rate has changed over the years. The year-on-year comparison of absolute rates is therefore also affected by this exchange rate and its changes over the years, which was not taken into account when determining the significance of the differences in this study. At the same time, we consider the weakness of this study to be the fact that in the case of correlation analysis, we did not take into account the existence of relationships between individual profit measures. In our next study, we would like to focus on the relationships between individual variables and then the relationships between total assets and profit measures of the companies quantified using partial coefficients of multiple correlation. Also, the negative (indirect) result of the linear relationship between total assets and Financial profit / loss should be further examined.

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## **Analiza odvisnosti med različnimi merami dobička in skupnimi sredstvi podjetij za poslovne subjekte Višegradske skupine**

**Ozadnje in namen:** Modeli določanja in napovedovanja upravljanja dobička v podjetjih z uporabo nastanka poslovnega dogodka na splošno temeljijo na odvisnosti med celotnim premoženjem podjetij in različnimi profitnimi merami. V tem prispevku smo se osredotočili na začetno analizo odvisnosti med temi kazalniki poslovanja v poslovnih subjektih držav Višegradske skupine. Preučujemo omenjena razmerja, preverjamo in količinsko opredelimo moč odvisnosti med stopnjami dobička podjetij (v smislu absolutnega ekonomskega vrednotenja donosa na poslovni kapital) in vrednostjo njihovega skupnega premoženja (tj. poslovnega kapitala, povezanega v sredstva brez njegove nadaljnje razvrstitve in analize).

**Metodologija:** Uporabljamo opisno statistiko in korelacijsko analizo, ki temelji na dejanskih poslovnih podatkih o skoraj 300 tisoč podjetjih v državah V4 iz baze Amadeus, ki zajemajo obdobje od leta 2013 do 2017. Primerjalno analizo smo uporabili za ugotavljanje nesorazmerje med rezultati, ki so bili ugotovljeni za vsako analizirano državo.

**Rezultati:** Analiza je pokazala, da imajo slovaška podjetja povprečne vrednosti mer za dobiček in skupna sredstva, primerljiva z madžarskimi podjetji. Češka in poljska podjetja imajo nekajkrat višje povprečne vrednosti mer za dobiček in tudi celotno premoženje kot slovaška in madžarska podjetja. Analiza razvoja profitnih ukrepov in celotnega premoženja podjetij v letih je pokazala pomembne razlike v štirih državah v obdobju, ki ga zajema ta študija.

**Zaključek:** Analiza razmerij med celotnim premoženjem podjetij in njihovimi profitnimi ukrepi je pokazala, da je moč teh odvisnosti med državami zelo podobna, z leti pa se ti rezultati niso spreminjali. Rezultate te študije je mogoče nadalje uporabiti pri oblikovanju modela upravljanja zaslužka v podjetjih, tako na Slovaškem kot v drugih državah V4.

**Ključne besede:** ukrepi za dobiček, bilančna vsota, upravljanje dohodka, korelacija



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## CONTENTS - 1/2020

<b>João P. SERRANO, Rúben F. PEREIRA</b> Improvement of IT Infrastructure Management by Using Configuration Management and Maturity Models: A Systematic Literature Review and a Critical Analysis	3
<b>Hafezali Iqbal HUSSAIN, Sebastian KOT, Hassanudin Mohd Thas THAKER, Jason J. TURNER</b> Environmental Reporting and Speed of Adjustment to Target Leverage: Evidence from a Dynamic Regime Switching Model	21
<b>Milja MARČETA, Štefan BOJNEC</b> Drivers of Global Competitiveness in the European Union Countries in 2014 and 2017	37
<b>Jernej BUZETI</b> Association between Field of Work, Years of Service, and Sickness Absenteeism in Public Administration	53
<b>Andrej JERMAN, Andrej BERTONCELJ, Gandolfo DOMINICI, Mirjana PEJIĆ BACH, Anita TRNAVČEVIĆ</b> Conceptual Key Competency Model for Smart Factories in Production Processes	68
<b>Lucia SVABOVA, Katarina VALASKOVA, Pavol DURANA, Tomas KLIESTIK</b> Dependency Analysis between Various Profit Measures and Corporate Total Assets for Visegrad Group's Business Entities	80