




Pawel Kaczmarczyk

 <https://orcid.org/0000-0001-5199-6328>

Department of Economics
Faculty of Economic Sciences and Information Technology
The State University of Applied Sciences in Plock, Poland
p.kaczmarczyk@pwszplock.pl

**Application of the linear ordering methods
in the voivodships research in the field of social media
usage in enterprises in the period 2014-2017**

doi: 10.22367/jem.2018.33.03

Accepted by Editor Ewa Ziemia | Received: January 23, 2018 | Revised: March 14, 2018 |
Accepted: March 20, 2018.

Abstract

Aim/purpose – The aim of this paper is to analyze and compare the development of voivodships in terms of social media usage in enterprises in the period from 2014 to 2017. The aim has been formulated because of the increasingly greater significance of social media in post-industrial enterprises.

Design/methodology/approach – The two types of linear ordering methods were applied, i.e., the method based on the pattern of development (Hellwig's method) and the methods that were non-based on the pattern of development were used. Spearman's rank correlation coefficient ρ and Kendall's rank correlation coefficient τ were used to verify correlations between various rankings. Analysis of the dynamics, spatial visualizations, box plots and polar plots were used in relation to the aggregated measures. In conducted analyses, data from the period 2014-2017 (provided by the Central Statistical Office of Poland) was used. The each year for the period from 2014 to 2017 was analyzed.

Findings – In all rankings (with the use of all types of applied measures and also in all analyzed years) the 1st place was taken by Masovian Voivodship. The distance between Masovian Voivodship and other voivodships was still significant during the analyzed period. The created rankings were similar in terms of statistical significance of computed correlation coefficients in all analyses. The research study results do not indicate a clear dispersion of the level of the analyzed phenomenon between eastern and western voivodships. It was also found that the higher is ICT usage by enterprises in a voivodship, the more common is social media usage by them. There is a clear overall tendency of increase in the phenomenon during the period from 2014 to 2017.

Research implications/limitations – The main implications is that the identified differences between areas can be a basis to assess the social media usage as a specific factor of business development. The research results indicate voivodships that should employ social media more and the highest placed voivodships as well. The results can be regarded as support for the policy of digitization and building a knowledge-based economy.

Originality/value/contribution – The originality of this paper is based on: the created rankings of voivodships in terms of social media usage in enterprises in the period 2014-2017, the comparison and assessment of voivodships in this context, and the identification of change of the social media usage in individual voivodships and in Poland as a whole.

Keywords: social media, integrated marketing communications, voivodships, ordering methods.

JEL Classification: C38, C43, O33.

1. Introduction

The current economic reality is described as post-industrial economy and companies operating in it are described as post-industrial companies. One of characteristic features of post-industrial companies is using information and communication technologies (ICT) to manage and organize their activity. Social media is one of information and communication technologies that are worth paying attention to. At present, they are an important marketing tool. Along with the development of social media, the term of social marketing as a form of online marketing, has been coined (Strauss & Frost, 2009; Reed, 2012).

Social media, referred to also as consumer-generated media, CGM, are still developing in the sphere of the Internet both in terms of the number and type of media. Therefore, the impact they have on customer is also increasing. In comparison to traditional media (as websites, newspapers, and the television), using social media enables companies to gain a number of additional benefits. Among them are: the possibility to strengthen and extend customer relationship, supporting the process of building a brand, targeting a particular type of recipients, faster and more cost-effective access to highly specialized markets, growth in sales. The listed benefits are connected with a different manner of running integrated marketing communications (IMA) (Castronovo & Huang, 2012; Łopacińska, 2014). Marketing in social media requires adopting a completely new manner of communication with the public in the digital environment. Marketing based on social media is not based only on information exchange, but above all on the exchange of points of view and ideas (Barger, Peltier, & Schultz, 2016; Chaffey, 2015; Weber, 2009). It can be noticed that all types of media (including the printed press, radio, TV and photography) lead to a creation of informal societies

interested in particular issues. However, dynamically developing modern technologies made it possible to intensify relations (also in marketing dimension) among informal social groups and provided tools to conduct a dialogue, which is the key element and characteristic of social media distinguishing it from traditional media (Safko & Brake, 2009). Moreover, in the Polish literature, there are publications including linear ordering and cluster analysis effects related to voivodships within the framework of overall ICT usage in enterprises (Kaczmarczyk, 2017; Strożek & Jewczak, 2016a, 2016b; Wierzbicka, 2017). The importance of these contents results from the fact that ICT usage has a clear impact on the development of an enterprise and (in the broad context) ICT contributes to building a knowledge-based economy (Korres, 2016; Paszta, 2010; Picot & Wernick, 2007). Considering the importance of using social media in marketing activities, one can notice the possibility of conducting research only in terms of social media usage in enterprises in individual voivodships, creating rankings and then comparing with the referenced researches concerning Poland.

In connection with the above, the aim of the article is to analyze and evaluate the level of development of voivodships in terms of employment of social media in companies in the period from 2014 to 2017. Using social media is understood as the percentage of companies in which: at least one of analyzed types of social media is used, social networking services are used, blogs and micro-blogs are run, websites enabling to make multimedia available and wiki tools are used (Główny Urząd Statystyczny [GUS], 2014, 2015, 2016, 2017). The methods that were non-based on the pattern of development and method based on the pattern of development were used in the carried out ordering. Array of other statistical methods was also used. The research results constitute rankings of voivodships (in terms of the level of the social media usage) for individual years from the period from 2014 to 2017. The research results provide information on the potential of business development (rooted in social media) and, as a result, the potential of socio-economic development of particular voivodships.

In section 2 of this work the literature review was presented within the framework of two issues. Firstly, the results of linear ordering of voivodships in terms of ICT development, which exist in literature, were described. Secondly, the importance of social media in IMC was considered. Due to the fact that the role of IMC in business activity is increasing, this subsection can be also considered as juxtaposing rationales for the research study. In section 3, the research methodology was included. So, the used linear orderings methods, Spearman's rank correlation coefficient ρ and Kendall's rank correlation coefficient τ were described because of their application in the empirical part of the study. The research findings and discussion were included in section 4. At the end of the

article, the conclusion was set (section 5), which involves the 2 following considerations: research contribution and research implication.

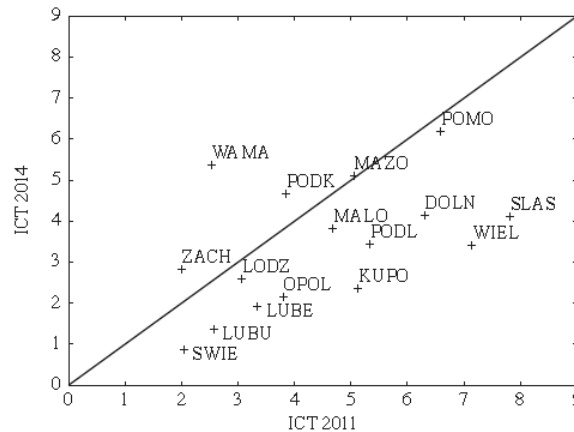
2. Literature review

2.1. Linear ordering of voivodships in terms of information and communication technologies development

In the literature of linear ordering of voivodships in terms of ICT, contents which relate to such issues as knowledge-based economy, information society and new management concepts development are emphasized. This results from the fact that ICT have a crucial influence on implementation of these ideas. That is the reason why ICT development is an important issue.

In one published research work (Strożek & Jewczak, 2016a) and its continuation (Strożek & Jewczak, 2016b), voivodships in terms of the development of ICT was analyzed in the period 2003-2014. The selected results are shown in Figure 1.

Figure 1. Change of values of the index describing ICT: 2014 vs 2011



Note: Explanation of the abbreviations of voivodships was juxtaposed in Appendix 1.

Source: Strożek & Jewczak (2016b, p. 111).

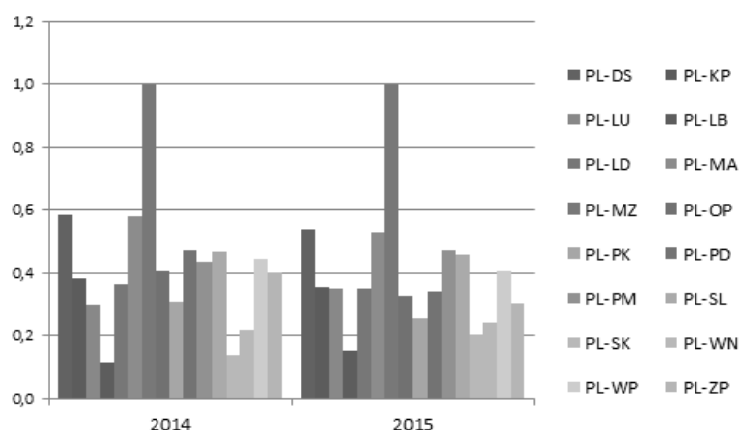
The following voivodships (as relatively advanced regions in terms of the development of ICT in the period 2003-2014) were distinguished: Silesian, Lower Silesian, Pomeranian, Greater Poland, Masovian. In contrast, Lublin, Holy Cross, Lubusz, and Warmian-Masurian Voivodships proved to be the weakest in the ICT development standings. However, in 2014 Warmian-Masurian

Voivodship achieved a high increase (Figure 1). These authors used 7 diagnostic variables to order voivodships in the explored field. The diagnostic variables were: telephone lines per thousand inhabitants; percentage of households equipped with computers; cable television subscribers in relation to the total population; Internet users, the percentage of households with Internet access; software expenditures in industrial enterprises, as a share of Gross Domestic Product; Gross Domestic Product *per capita*; rate of poverty risk.

According to another publication, in which linear ordering of voivodships with respect to the level of information infrastructure was performed, Masovian Voivodship was the leader in 2015. Pomeranian Voivodship was 2nd in this ranking, and Lower Silesian Voivodship was 3rd. Holy Cross Voivodship occupied the lowest position. In the referred study 9 diagnostic variables were used. The diagnostic variables related to the percentage of households (with PCs with Internet access; with mobile phones; satellite or cable television devices) and percentage of companies (using computers; with Internet; with their own websites; receiving orders via computer networks; filling orders via computer networks; using computers in contacts with public administration) (Wierzbicka, 2017).

Results of the next work are as shown in Figure 2 (Kaczmarczyk, 2017).

Figure 2. Course of the d_i measure in the period 2014-2015



Note: Explanation of the abbreviations of voivodships was juxtaposed in Appendix 2.

Source: Adapted from Kaczmarczyk (2017, p. 91).

In this figure, the d_i measure was used. The d_i measure is aggregated measure (composite measure) computed within the framework of the linear ordering method which is based on the pattern of development (Hellwig's method)¹. Ac-

¹ This method has been widely discussed in section 3. Research Methodology and has also been used in the empirical part (4. Research Findings and Discussion).

According to the mentioned work, in 2014 the three first places (in all rankings relating to ICT usage only in enterprises) were taken by the following voivodships: Masovian, Lower Silesian, Lesser Poland. The three last places, on the other hand, were usually taken by the following voivodships: Warmian-Masurian, Holy Cross, Lubusz. In 2015 similar results were obtained, however, the 2nd and 3rd places were occupied by the following voivodships: Lesser Poland, Lower Silesian. The three last places were taken by the same voivodships, which were listed in the rankings in 2014.

Due to the fact that there is a lack of such content as ordering of voivodships in terms of social media usage, the aim of this research work is the analysis of voivodships development in terms of this context. The importance of social media in business activity is increasingly greater and social media usage by enterprises becomes more significant.

2.2. Importance of social media in integrated marketing communications – rationale for the research study

The term social media covers a wide range of channels of communications, described as Web 2.0. Among these numerous social networking services are found, which associate people for example according to their residence, hobbies or problems. Another important channel of social media communications are forums and discussion groups, created at information channels and companies, newspapers and publishers' websites. Another form of online social media, enabling interaction between Internet users are blogs and micro-blogs. Popular social media include also the so-called content communities, which make it possible for Internet users to exchange of video and audio files. The term social-media refers to all of those forms and channels of online communication which enable a dialogue and exchange of information about a particular topic (Meerman, 2010). Table 1 presents selected social media and their aims.

Integrated marketing communications (IMA) are an idea targeted at increasing the efficiency and effectiveness of communication between a company and various target markets. This idea consists in integrating promotional tools and actions used by companies on a large scale. Proper coordination of elements of promotion and other forms of marketing activity results in a more effective communication with customers (Belch & Belch, 2007). If we look at social media from the point of view of a marketing tool, then these media should be treated separately and the communication process in a society should be viewed more broadly. This is because the use of social media in marketing is character-

ized by a wide scope, interaction speed, a rather low cost and the fact that they significantly increase brand awareness, enable entrepreneurs to find suggestions and ideas, contribute to a long-term brand and product loyalty, support e-commerce and improve customer care.

Table 1. Social media tools and their aims

Tool	Aim
Blogs and microblogs	Giving recommendation from one participant of a dialogue to another participant.
Chat rooms	Increasing the quality and efficiency of customer service. Creating the feeling of community. Collecting customers' opinions
YouTube	Distribution of videos
Facebook	Advertising. Creating communities. The willingness to reach a particular group of customers
LinkedIn	Connecting with societies of experts in a particular field
Twitter	Engaging customers. Promotion of conversation
GoogleWave	Increasing cooperation and involvement. Crowdsourcing
Pinterest	Distribution of visual materials (photos, graphics, pictures). Advertising
Instagram	Distribution of photographs above all

Source: Adapted from Castronovo & Huang (2012); Łopacińska (2014); *Social media* (2014).

Referring to the two first advantages, social media make it possible to connect to a wide public and exert influence on consumers more effectively. Activating social mechanisms enables a fast dissemination of information in the global space. This results from the fact that information published in social media can be transferred to other recipients by means of the so-called virus channel, namely by transferring content from one persons to her friends. Therefore, information is disseminated on a large scale. In this manner information can go round the whole world in a matter of just a few hours and inspire traditional media to become more interested in it (Fabianiak-Czerniak, 2012). It follows from research carried out in Poland in 2016 by the Chamber of Digital Technology that 86% of Internet users have an account in at least one of social sites, 65% of whom use social media on a daily basis (Izba Gospodarki Elektronicznej [IGE], 2016).

An important issue for companies using social media for marketing purposes is customer involvement and process by means of which this involvement is stimulated (Chaffey, 2015; Barger et al., 2016). Social media enables their users to co-create, make available and modify the content of a medium in an interac-

tive environment based on the Internet. Customers related to a product, service or idea are more likely to express their opinions by means of social media. As a result of this, customers can observe benefits of a particular product, also by means of using its other users. Each interested party has at any time access to own content and the content of other participants of social media and has a possibility to refer not only to basic content, but also content introduced by others. Consumers tell others about products and services to which they are emotionally attached to so they provides valuable information (Mangold & Faulds, 2009). According to IGE (2016), in 2016 in Poland 61% of social media users shared opinions and information about their purchases and 76% of social media users declared that positive opinions of their friends influence their purchasing decisions. For almost half of users of social media the number of brand fans proves whether it is trustworthy or not.

Companies can use the information posted by customers (including reasons for purchasing products and services by their customers) in order to adapt promotional activities. Social media can be also perceived as a chance for effective activity of research and development departments. These media enable immediate feedback on products in order to make any potential corrections and then accept further challenges. As a result, companies can quickly introduce product or service improvements to adapt them to the preferences of customers.

Taking customers into consideration in the process of product development by means of social media gives companies another benefit. It makes it possible to create relations with customers (long-term brand and product loyalty) which favor strengthening and widening communication between employees, which contributes to internal integration of a company (Łopacińska, 2014).

Social media directly support e-commerce as they enable to pass over one of processes most disliked by consumers, namely registering or logging in to an e-shop. In 2016 in Poland 34% of consumers used the option of logging in to other sites by means of a social media account and the majority of such sites were online shops. Social media is also the space in which actual trade takes place, which is indicated by data of IGE (2016): 38% of social media users declared that they have already used the 'buy now' button and 32% of them made a direct purchase through social media. People who 'like' and observe various brands constitute 60%. So, marketing of social media is a process of winning activity on websites by means of using social sites.

3. Research methodology

Aggregated measures (composite measures) were used in the ordering procedure. The linear ordering is based on the creation of a ranking of compared objects, i.e. this is based on juxtaposition of the objects from the best one to the worst one in the analyzed research context. In all cases, ranking was created from the highest to the lowest value of the particular aggregated variable. The linear ordering methods have wide range applications in economic sciences, for example in research for marketing decisions (Green, Tull, & Albaum, 1988).

Among the methods of determining aggregated measures, there are methods that are non-based on the pattern of development and methods based on the pattern (Panek & Zwierzchowski, 2013). In the empirical part of this paper, both types of methods were used. This approach provided a wider basis for formulating conclusions. The assumption that the variables are equally important (equally weighted) was adopted. There are arguments for this assumption (Aldefender & Blashfield, 1984) and it has often been adopted in another research study (Sneath & Sokal, 1973). All the formulas, which were used to determine values of aggregated measures and to transform values of the characteristic, are specified in Table 2.

Table 2. Applied formulas related to the determination of the aggregated measures

Methods non-based on the pattern of development	Method based on the pattern of development
$s_i = \frac{1}{P} \sum_{j=1}^P x_{ij} \quad i = 1, \dots, n \quad (1)$	$d_i = 1 - \frac{d_{i0}}{d_0} \quad i = 1, 2, \dots, n \quad (5)$
$h_i = \frac{1}{P} \sum_{j=1}^P x_{ij} \quad i = 1, \dots, n \quad (2)$	$d_{i0} = d(x_i, x_0) = \sqrt{\sum_{j=1}^P (x_{ij} - x_{0j})^2} \quad (6)$
$x_{ij} = \frac{x_{ij} - \min_{it} x_{ijt}}{\max_{ijt} x_{ijt} - \min_{ijt} x_{ijt}} \quad (3)$	$d_0 = \bar{d}_0 + 2s_d \quad (7)$
$x_{ij} = \frac{x_{ij}}{\max_{it} x_{ij}} \quad (4)$	$\bar{d}_0 = \frac{1}{m} \sum_{t=1}^l \sum_{i=1}^n d_{i0} \quad (8)$
	$s_d = \sqrt{\frac{1}{m} \sum_{t=1}^l \sum_{i=1}^n (d_{i0} - \bar{d}_0)^2} \quad (9)$
	$x_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j} \quad (10)$
	$X_0 = (x_{01}, x_{02}, \dots, x_{0p}) \quad (11)$
	$x_{0k} = \begin{cases} \max_{it} x_{ijt} & j \in S \\ \min_{it} x_{ijt} & j \notin S \end{cases} \quad (12)$

Source: Adapted from Panek & Zwierzchowski (2013).

In case of methods, which are non-based on the pattern of development, the aggregated measures were calculated using arithmetic means of converted features of the initial set – formulas (1) and (2). The unitarization (3) and the normalization (4) were applied, in order to determine the s_i and h_i measures respectively. Due to the comparative contents of the analysis, in both type of the conversion a fixed basis from the period 2014-2017 was assumed ($\max x_{ijt}; \min x_{ijt}$).

From a range of methods based on the pattern of development, Hellwig's method was used. First, a pattern (ideal) object was selected. This object is also called the upper pole of the set of objects. In the conducted research (in the empirical section of this work), the fixed pattern object from the period 2014-2017 was used. This assumption enabled comparison of results from other years. Then the taxonomic distances from the examined objects to the pattern object were calculated. The calculated distances constituted the values of the aggregate variable. The aggregated measure was determined according to formula (5). The d_i measure is so constructed that the closer to unity is value of this measure, the lower is the distance between the i -th object and a pattern object. The values of the aggregated measure were calculated using the values obtained from formulas (6)-(9). The starting point of the d_i value determination was the conversion of the origin data matrix according to standardization formula (10), with the fixed average and deviation in the period 2014-2017. Following the data conversion, a pattern object P_0 was found. The geometric representation of the pattern object is point X_0 – notation (11). All variables in the research study were stimulants, so the coordinates of the pattern object were chosen on the basis of the first variant in notation (12), i.e. the maximal values of the particular features were assumed as coordinates.

The values of the aggregated measures enable the clustering of objects. In this context, clustering is based on only one variable, the aggregated variable. It is also worth mentioning the rapidly developing geostatistical methods, which are widely used (also in economics) (Zawadzki, 2011). These methods can mainly be used to interpret and forecast (estimate or simulate) the spatial distributions of the studied phenomena. Among these methods there are unique methods, e.g., the cokriking method (Zawadzki, 2003). However, due to the aim of this study, the methodological part and the empirical study were limited to the issues relating only to the linear ordering of voivodships.

In order to receive reliable results, it is worth to prepare several rankings, which will be based on different methods and different assumptions, and then examine them due to the conformity of results (Olszewska & Gudanowska, 2014). This approach was also used in this research study. Thus, Spearman's rank correlation coefficient ρ and Kendall's rank correlation coefficient τ were used to

compare the obtained rankings (Wawrzynek, Bukietyńska, Rusnak, Siedlecka, & Heilpern, 1998). The formulas that were used to calculate correlation coefficients are listed in Table 3.

Table 3. Applied formulas related to the determination of the correlation coefficients

Spearman's rank correlation coefficient	Kendall's rank correlation coefficient
$(X_1, Y_1), (X_2, Y_2), \dots, (X_n, Y_n)$	(13)
$(X_{1:n}, Y_1^*), (X_{2:n}, Y_2^*), \dots, (X_{n:n}, Y_n^*)$	(14)
$X_{1:n} < X_{2:n} < \dots < X_{n:n}$	(15)
$\rho_n = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2 - 1)}$	(16)
$d_i = r(X_i) - r(Y_i)$	(17)
$P\{\rho_n > r_n(\alpha)\} \leq \alpha$	(18)
	$\tau_n = \frac{4 \sum_{i=1}^n S_i}{n(n-1)} - 1$
	(19)
	S_i – number of $(X_{j:n}, Y_j^*), j > i$ where $Y_j^* > Y_i^*$
	$P\{\tau_n > t_n(\alpha)\} \leq \alpha$
	(20)

Source: Adapted from Wawrzynek et al. (1998).

In both methods, each pair of compared aggregated variables was a two-dimensional random variable (X, Y) and the random sample of that variable is expressed in notation (13). The X_i elements were ordered by the growing values as in notation (14), so relationship (15) was fulfilled.

In order to determine Spearman's rank correlation coefficient, $r(X_i)$ ranks were given to the ordered X_i elements. Spearman's rank correlation coefficient was calculated according to formula (16), where the differences between ranks (17) were used. The probability that the empirical value of the coefficient is higher than the critical value (i.e., the probability of the dependence of the variables) can be expressed in notation (18). The value of Kendall's rank correlation coefficient was calculated using formula (19).

4. Research findings and discussion

The linear ordering was carried out on the basis of data from the years 2014-2017. In each analyzed year, the ordered objects were voivodships O_i ($i = 1, 2, \dots, 16$). Diagnostic variables X_j which described the ordered voivodships,

were relative frequencies (empirical probabilities) related to enterprises using a particular type of social media ($j = 1, 2, \dots, 5$). The pre-selected list of the diagnostic variables was as follows: X_1 – enterprises using at least one of the below mentioned social media, X_2 – enterprises using social networking services, X_3 – enterprises having blogs and micro-blogs, X_4 – enterprises using portals enabling multimedia sharing, X_5 – enterprises using Wiki tools.

In order to exam the discriminative possibilities of the pre-selected variables, the descriptive statistics were computed. Thus, the arithmetic mean (AM), standard deviation (SD), coefficient of variation (CV) and coefficient of skewness (CS) were determined for individual years. The values of these statistics were juxtaposed in Table 4.

Table 4. Values of the descriptive statistics

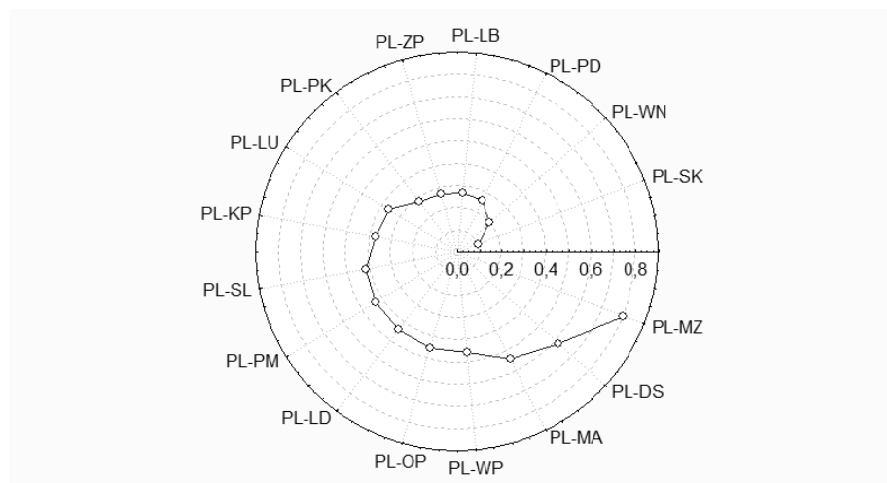
Variable	AM	SD	CV	CS	AM	SD	CV	CS
	2014				2015			
X_1	20.2813	3.3373	0.1646	0.8007	20.5500	3.3435	0.1627	0.5937
X_2	17.0875	3.2133	0.1880	1.1316	18.6000	3.4215	0.1840	0.5305
X_3	2.9875	1.1831	0.3960	-0.3555	3.4438	1.4656	0.4256	1.3560
X_4	7.9938	1.5373	0.1923	0.0943	7.1875	1.5671	0.2180	0.7278
X_5	3.2688	0.8268	0.2529	-0.5075	2.2375	0.9722	0.4345	0.9055
	2016				2017			
X_1	23.3813	4.2010	0.1797	1.2595	25.6188	4.0298	0.1573	-0.5770
X_2	21.6063	4.0977	0.1897	1.5271	24.2500	3.9623	0.1634	-0.6657
X_3	3.6063	1.9292	0.5350	2.1145	3.8250	1.4224	0.3719	0.8476
X_4	7.5500	2.3571	0.3122	1.1954	7.8250	2.0260	0.2589	0.2681
X_5	2.0875	0.6752	0.3234	0.9082	2.0375	0.7788	0.3822	1.1733

Source: Author's own calculation.

The analysis of AM shows that in the case of three variables (i.e., X_1, X_2, X_3), one notices a clear upward tendency. Within the framework of variable X_5 there is a systematic decrease of AM . All variables in all analyzed years were characterized by higher values of CV than the assumed threshold 10%. Therefore, all variables in all individual years for the period from 2014 to 2017 were included in further research. The highest relative dispersion was observed within the framework of variable X_3 . This variable is characterized by the highest value of CV in three years (i.e., 2014, 2015, 2016) for the period 2014-2017. The lowest value of CV (in all years for the analyzed period) was noticed in the case of variable X_1 . The analysis of CS indicates that variables (in the vast majority of the conducted computations) are characterized by right-handed asymmetry, i.e., values lower than AM predominate.

Then, values of aggregated measures were the subject of the research. Five considered variables were treated as stimulants. Rankings were created (by means of three methods) for each year from 2014 to 2017. In order to mark voivodships, ISO 3166-2:PL code, introduced by the International Organization for Standardization, was used (see Appendix 2). Firstly, the aggregated measures were determined by means of the methods that were non-based on the pattern of development. So, the s_i and h_i measures were calculated. The aggregated measure based on the pattern of development was also applied. Therefore, the values of the d_i measure were computed. In each year from 2014 to 2017, the rankings under known values of the mentioned measures were generated. The ranking under the d_i measure is shown as an example (Figure 3).

Figure 3. Ranking of voivodships under the d_i measure in 2017



Note: The ranking was created clockwise. The start point is PL-MZ. Explanation of the abbreviations of voivodships was juxtaposed in Appendix 2.

Source: Author's own calculation.

In all rankings (with the use of all types of the applied measures and in all analyzed years) the 1st place was taken by the PL-MZ voivodship. In 2017, the 2nd and 3rd places were taken by PL-DS and PL-MA, respectively. The results (related to 2nd and 3rd places in 2017) were confirmed by all the computed measures, and these results were the most frequently obtained order of voivodships within the framework of three first places in the period 2014-2017. In 2017, the 14th, 15th and 16th places (i.e., the three last places) were taken by the following voivodships: PL-PD, PL-WN, PL-SK. In the cases of PL-WN, PL-SK, the results were the same with the use of all measures. In terms of the PL-PD voivodship, the examined conformity was noticed with the use of two

measures (h_i and d_i). Within the framework of PL-WN and PL-SK, the results (obtained on the basis of data from 2017) are characterized by the greatest frequency in individual years in the period of 2014-2017. In the period 2014-2016, the PL-PD voivodship took higher places.

The analysis of value of Spearman's rank correlation coefficient ρ and Kendall's rank correlation coefficient τ were conducted in the two following approaches: between various measures within the framework of a particular year in the explored period, and between various years in terms of the same measure (e.g., in terms of the measure h_i between 2014 and 2015, between 2014 and 2016, etc.). All received values of the coefficient indicate that compared rankings in both approaches are correlated. In all comparisons, values of coefficients proved to be statistically significant. In the second approach, the lowest values were obtained within the framework of the h_i measure between the rankings related to 2014 and 2015 ($\rho = 0.5147$, $p = 0.0413$; $\tau = 0.36667$, $p = 0.0476$). Due to the fact that the results are very extensive, presentation was limited to the first approach and only to values of Spearman's rank correlation coefficient ρ (Table 5).

Table 5. Values of Spearman's rank correlation coefficient ρ

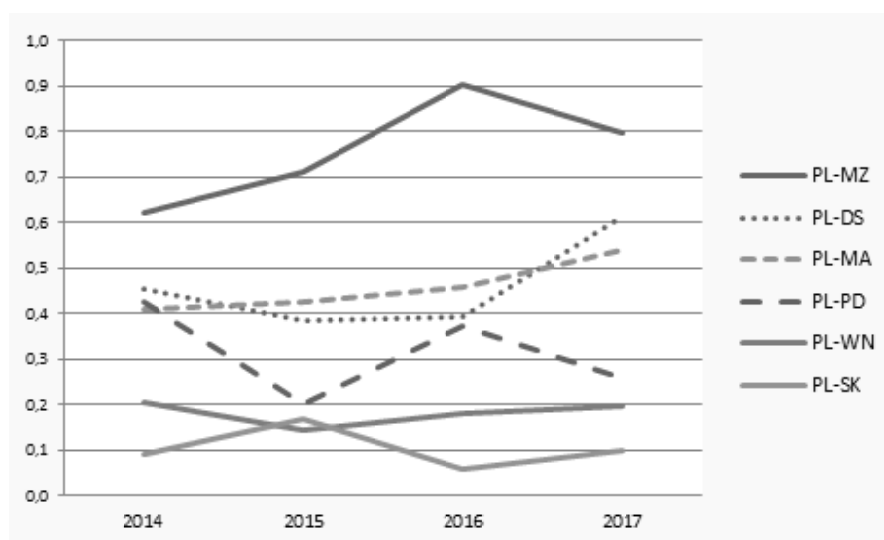
ρ							
2014				2015			
Measure	s_i	h_i	d_i	Measure	s_i	h_i	d_i
s_i	1.0000	0.9971	0.9882	s_i	1.0000	0.9676	0.9912
h_i	0.9971	1.0000	0.9824	h_i	0.9676	1.0000	0.9647
d_i	0.9882	0.9824	1.0000	d_i	0.9912	0.9647	1.0000
2016				2017			
s_i	1.0000	0.9912	0.9941	s_i	1.0000	0.9853	0.9676
h_i	0.9912	1.0000	0.9941	h_i	0.9853	1.0000	0.9882
d_i	0.9941	0.9941	1.0000	d_i	0.9676	0.9882	1.0000

Source: Author's own calculation.

All the values of Spearman's rank correlation coefficient ρ , that were specified in Table 5, are statistical significant ($p < 0.01$). The results of this analysis were confirmed using values of Kendall's rank correlation coefficient τ . The received rankings are very similar to the results of the ordering of voivodships development in overall ICT usage in enterprises (Kaczmarczyk, 2017). In the mentioned research study, 17 variables (related to ICT usage) were involved. Therefore, it can be formulated finding that higher level of voivodships development (within the framework of ICT usage by enterprises) contributes a higher level of social media application by them. The correlation coefficients ρ and τ (for the same year and the same measure) were not lower than 0.8912 and 0.7667 ($p < 0.01$) respectively.

Due to the fact that the d_i measure is characterized by the highest correlation among the compared rankings, this measure was used to create visualization of the course of the phenomenon in the three first and three last voivodships. It is shown in Figure 4.

Figure 4. Course of the d_i measure in the period 2014-2017



Note: Explanation of the abbreviations of voivodships was juxtaposed in Appendix 2.

Source: Author's own elaboration.

This figure refers to the previous discussion about the results of the conducted ordering and shows that there is a significant distance between the development of Masovian Voivodship and other voivodships in terms of the level of the studied phenomenon. All three leading voivodships are also characterized by a clear upward trend of the phenomenon. In the case of the PL-WN voivodship and the PL-SK voivodship neither an upward trend nor a downward tendency can be observed. However, the PL-PD voivodship was characterized by a downward tendency.

Then analysis of the dynamics of the aggregated measures was carried out. The main criterion of the voivodships assessment was the last individual fixed base index (base period was 2014). The three voivodships with the highest index and the three voivodships with the lowest index were juxtaposed in Table 6.

Table 6. Values of the fixed base relative change and the fixed base index

	2014		2015		2016		2017	
	$\Delta_{t/1} \cdot 100$	$i_{t/1} \cdot 100$	$\Delta_{t/1} \cdot 100$	$i_{t/1} \cdot 100$	$\Delta_{t/1} \cdot 100$	$i_{t/1} \cdot 100$	$\Delta_{t/1} \cdot 100$	$i_{t/1} \cdot 100$
PL-LB	–	100.00	–48.79	51.21	189.65%	289.65	132.65	232.65
PL-LU	–	100.00	59.54	159.54	–32.35	67.65	107.89	207.89
PL-LD	–	100.00	–8.26	91.74	32.81	132.81	83.32	183.32
PL-WN	–	100.00	–30.06	69.94	–11.57	88.43	–2.72	97.28
PL-ZP	–	100.00	–23.62	76.38	16.37	116.37	–8.52	91.48
PL-PD	–	100.00	–52.80	47.20	–12.05	87.95	–39.51	60.49

Note: Explanation of the abbreviations of voivodships was juxtaposed in Appendix 2.

Source: Author's own calculation.

The highest results were achieved by the following voivodships: PL-LB, PL-LU, PL-LD. The voivodships: PL-WN, PL-ZP, PL-PD had the lowest results. It is remarkable that only these voivodships (among 16) were characterized by decrease.

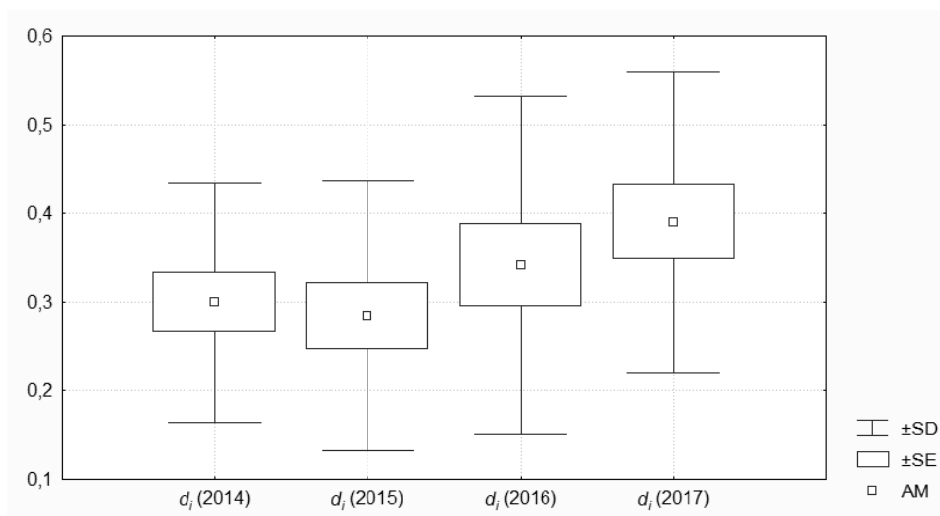
Due to the results of the correlation analysis, the d_i measure was used for the spatial visualization of the course of the phenomenon during the period from 2014 to 2017 (Figure 5). The number of the voivodship position in the ranking is next to the voivodship code. The maps are so constructed that the higher the level of the social media usage in a voivodship, the darker is its color. The maps do not indicate a clear dispersion of the level of the examined field of development between eastern and western voivodships. The observed rankings in the analyzed period and mentioned context can therefore be said to be beneficial.

In order to overall assess change of the analyzed phenomenon during the assumed period, the box-plots were used. These plots enabled observation of the changes in level of the aggregated measures. The applied plots also enabled assessment of the changes of the relative dispersion of the phenomenon. The d_i measure served as an example of the course analysis of the average and dispersion of the explored phenomenon during the period 2014-2017. Therefore, the arithmetic mean (AM), standard deviation (SD), and standard error (SE) were used in Figure 6. The research was extended by box-plots that were drawn up on the basis of the s_i and h_i measure. In all the considered cases, the analogical course of the average and relative dispersion of the aggregated measures was obtained.

Figure 5. Spatial rankings of voivodships under the d_i measure

Source: Author's own elaboration in R programme.

The results (presented in Figure 6) shows that there is an upward tendency in the course of average level of the phenomenon during the period from 2014 to 2017. It is remarkable that in 2017 the higher value of the average is not accompanied by an increase of the standard deviation. This finding suggests that the relative dispersion of the analyzed phenomenon should be lower than in the previous year. The detailed study of CV in 2017 showed that the relative dispersion of the phenomenon was even lower than in 2014 (e.g., the dispersion of the d_i measure was $CV_{2014} = 45.11\%$ and $CV_{2017} = 43.44\%$). Therefore, the observed changes can be considered as beneficial. On the other hand, according to the Eurostat database in 2017, Poland was ranked at the 28th position among countries of the European Union in terms of any social media usage in enterprises. The result was 47 percentage points lower in comparison to that of Malta (which was the leader with a result equal to 74%) and obviously lower in comparison to the average of the European Union.

Figure 6. Box-plot on the basis of the d_i measure

Source: Author's own calculation and elaboration.

5. Conclusions

5.1. Research contribution

The contributions of the paper lie in: the creation of rankings of voivodships in terms of social media usage in enterprises (by the use of aggregated measures) in each year from the period 2014-2017, the comparison and assessment of voivodships in this context, and the identification and assessment of change of the social media usage of particular voivodships and in Poland as a whole.

The main findings relate to the comparison of level of development of analyzed phenomenon in individual voivodships. These findings were also based on the results of a dynamics analysis in the period 2014-2017. The conclusions were supplemented by comparing the obtained results with the index relating to EU countries. Therefore, Masovian Voivodship clearly dominates the other voivodships in terms of social media usage in enterprises. It should be emphasized that in all rankings (with the use of all types of the applied measures and in all analyzed years) the 1st place was taken by Masovian Voivodship. The 2nd and 3rd places were usually taken by Lower Silesian and Lesser Poland Voivodship respectively. In the period 2014-2017, the 15th and 16th places (i.e., the two last places) were taken by Warmian-Masurian and Holy Cross Voivodship respectively. The maps based on the created ranking do not indicate a clear dispersion of the level of the examined field between eastern and western voivodships. In

this context, the observed rankings in the analyzed period and mentioned context can therefore be said to be positive.

It was noticed that there is upward tendency in the course of aggregated measure of 13 voivodships during the period from 2014 to 2017 and clear upward tendency in the average level of the phenomenon during the same period in Poland as a whole. Moreover, it should be indicated that in 2017 the higher value of the average is not accompanied by an increase of the standard deviation. This finding indicates the decrease of the relative dispersion of the analyzed phenomenon in the period 2014-2017. The observed changes can be also assessed as beneficial. However, according to the Eurostat database in 2017, Poland holds a very low place in the ranking of countries of the European Union in terms of any social media usage in enterprises. The result was significantly lower in comparison to the average of the European Union

When it comes to the similarities and differences of the above findings with existing literature findings, it can be noticed that the rankings are very similar to the results of the ordering of voivodships development in overall ICT usage in enterprises (Kaczmarczyk, 2017). It can be concluded on the basis of these similarities that the higher ICT usage by enterprises in a voivodship, the more common is their social media usage. In terms of similarities with literature findings, it can be also remarked that Masovian and Lower Silesian Voivodship are listed among the leading voivodships in terms of information infrastructure (including households and companies) in 2015 (Wierzbicka, 2017) and in the period 2003-2014 (Strożek & Jewczak, 2016a, 2016b). Taking into account the referenced publications, Holy Cross and Warmian-Masurian Voivodship were characterized by the lowest level of the ICT development. Within the framework of differences with the findings of referenced authors, it can be noticed that Pomeranian Voivodship was included by them in the top three in terms of the defined context.

5.2. Research implication

Within the framework of implications for practitioners, it should be emphasized that the results could be treated as a support for central and local authorities. The detected differentiations of social media usage in Poland (and the last place of Poland in the ranking of EU countries in this respect) have been caused by difficulties in the field of financing of ICT development. It can be mentioned here that particular attention should be focused on increasing the efficiency of public-private partnership by reducing the discrepancies in the establishment of priority projects by public administration and private entities. Problems related to: the formal and legal sphere, incentives for investors and inefficient fund

management at the local level should be eliminated. In connection with the low level of social media usage, the research results can be treated as the basis of voivodships that should especially improve their level of the social media usage and reduce the distance to the leading voivodships. This shall serve the development of voivodships in terms of business activity and consequently contribute to socio-economic growth. The implication for entrepreneurs results from the fact that social media contribute to achieving competitive advantages. The results of the research show how the extent of the practice of using social media in marketing activities has been developed and what it is current level of the usage in a particular voivodship. Due to the identified growing tendency of this phenomenon (as well as its current level), the use of social media in business operations becomes a necessity (especially in the best voivodships in this respect).

From the point of view of scientists, the analyses could be useful for researchers dealing with socio-economic potential in the cross-sections of voivodships because social media is a specific factor supporting business development. Due to the fact that the analyses were carried out for each year of the period 2014-2017, the research results are also useful for scientists dealing with the dynamics of the socio-economic potential growth.

5.3. Research limitations and future works

The findings are unique in terms of the comparison of EU countries in the field of the analyzed phenomenon. The social media usage in enterprises in Poland is the lowest in the whole EU. According to GUS reports, in the case of using other types of ICT, the place of Poland is at least higher than the last one. Application of linear ordering methods and other statistical methods (which were implemented in the research study) can also be used to research other countries according to their divisions into administrative units.

When it comes to the limitations of the conducted research, the following aspects can be listed: a limited number of years from which data on the use of social media has been obtained (a greater number of years would enable extending the analysis of dynamics, including the estimation of the econometric model of the synthetic variable over a longer period of time); the explored GUS data were sample survey results (GUS, 2014, 2015, 2016, 2017), which are associated with a certain level of uncertainty; the research is based on data on the voivodships in which the division of enterprises due to size, type of activity and other criteria were not taken into account (i.e., such division in case of data on the voivodships was not provided in GUS reports).

Future researches will consist in repeating analyses (in the same scope) for several subsequent years and checking the nature of changes in the phenomenon over time. It will also enable determination of the level of diversity between western and eastern voivodships, as well as the assessment of distance to EU countries. It also seems interesting to study the analysis of voivodship clusters (i.e., to examine the voivodships structure) and to detect changes in clusters in subsequent years.

Appendix 1. The abbreviations used in Figure 1

Abbreviation	Voivodship
DOLN	Lower Silesian Voivodship
KU PO	Kuyavian-Pomeranian Voivodship
ŁÓDZ	Łódz Voivodship
LUBE	Lublin Voivodship
LUBU	Lubusz Voivodship
MALO	Lesser Poland Voivodship
MAZO	Masovian Voivodship
OPOL	Opole Voivodship
PODK	Subcarpathian Voivodship
PODL	Podlachian Voivodship
POMO	Pomeranian Voivodship
SLAS	Silesian Voivodship
SWIE	Holy Cross Voivodship
WA MA	Warmian-Masurian Voivodship
WIEL	Greater Poland Voivodship
ZACH	West Pomeranian Voivodship

Source: Adapted from Strożek & Jewczak (2016a, 2016b).

Appendix 2. The abbreviations based on the ISO 3166-2:PL code

Abbreviation	Voivodship
PL-DS	Lower Silesian Voivodship
PL-KP	Kuyavian-Pomeranian Voivodship
PL-LB	Lubusz Voivodship
PL-LD	Łódz Voivodship
PL-LU	Lublin Voivodship
PL-MA	Lesser Poland Voivodship
PL-MZ	Masovian Voivodship
PL-OP	Opole Voivodship
PL-PD	Podlachian Voivodship
PL-PK	Subcarpathian Voivodship
PL-PM	Pomeranian Voivodship
PL-SK	Holy Cross Voivodship
PL-SL	Silesian Voivodship
PL-WN	Warmian-Masurian Voivodship
PL-WP	Greater Poland Voivodship
PL-ZP	West Pomeranian Voivodship

Source: Adapted from ISO (2011, p. 59).

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