Management, Enterprise and Benchmarking in the 21st Century
Budapest, 2017

Digital Presence Index for the Examination of Small and Medium-sized Businesses

Miklós Hornyák

University of Pécs, Faculty of Business and Economics

hornyakm@ktk.pte.hu

Abstract: With the spreading of the infocommunication technologies (ICT), the use thereof is becoming an increasingly important aspect of the competitiveness of businesses. With the deeper integration of these technologies, the corporate processes can be extended outside the boundaries of the given business [10]. The entry level of this process is the realization of online presence, the most obvious manifestation of which is the maintenance of a company website. Through the analysis thereof, the measurement of the competitiveness of the given business can be supported [13]. The analysis can be performed through technology and content-based approaches, but in both cases the identification and then the analysis of the websites requires significant human labour, which can be automatized with IT support [3] [15]. The technology-based approach places the emphasis on the examination of measurable values related to the website (e.g. the number, type of objects), thus it does not deal with the issues of design and usability [2]. In the course of our research we created a model for the examination of the online presence of small and medium-sized businesses. Through the technology-based, automated analysis of the websites we created a complex index (WebIX) consisting of three components which are also complex in themselves (speed, complexity, connection). In the research, we calculated the WebIX indicator through the automated, technical analysis of the hundreds of businesses included in Szerb's HSMB database. Our aim, through the examination of a connection between the location of the businesses and the WebIX value, is the demonstration of a possible use of the WebIX, and the connection between physical environment and digital presence.

Keywords: competitiveness, small and medium-sized business, web analysis

1 Introduction

The aim of our research was the automated examination of the online presence of Hungarian small and medium-sized businesses. Our motivation was fundamentally influenced by the fact that the use of infocommunication services is beneficial for the improvement of productivity, thus it can be identified as an important element of competitiveness [14]. Furthermore, the increasingly deeper information technological integration of businesses is expected to result in fundamental changes in competitiveness [10]. In our research, we applied the systemic approach, which was also used previously, in the examination of competitiveness (Systemic Competitiveness) [9].

The paradigm shift that occurred in web technologies[1] and their use generated a change regarding economy. It served as a transition from the earlier hit and link economy to “Like economy”. In the data-intensive approach of the “Like economy”, the flow of information is realised along the “friend” connections of the users, compared to the network of connections through conventional hyperlinks, created by designers. For the realization of this, the application of Web 2.0 technology is necessary [6].

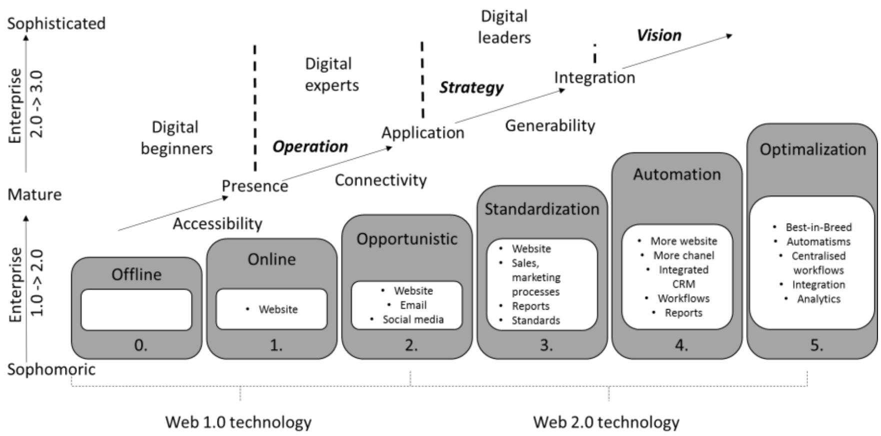

Figure 1.
The model of digital maturity

source: own edition based on [5] [11]

However, according to the results of the research carried out by Bell Research, the Hungarian small and medium-sized businesses (SMB) live in the “digital bronze age”. Although they are open to new trends (e.g. cloud-based services) in addition to the basic IT investments introduced in previous years, their expertise is limited concerning ICT developments outside their core activities. The companies that stepped beyond the establishment of basic IT infrastructure, created a company website in 41% of the cases, while only 30% of these companies have a Facebook profile as well [1]. In many cases the company websites remind the user of the web solutions of early years, although the world has progressed from the Web 1.0

1 Web 1.0 websites manage the movement between websites through the hyperlink defined by the designer of the page, while the Web 2.0 website is constructed along the connections resulting from the activities of users.

solutions ("Web-as-information-source") to the Web 2.0 solutions („Web-as-participation-platform") in the past years. The main difference between them can be identified in the management of information [12]. On the basis of this division, in Hungary the prevalence of Web 1.0-type solutions is characteristic. The majority of Hungarian businesses only falls into the first three categories of the stages of Digital Maturity presented in Figure 1.

For the purpose of our examination, we applied our model created with the systemic approach for the company database created by Szerb and colleagues for the HSMB research [13]. On the basis of the above, we carried out the examination of online presence (WebIX) through the technical analysis of company websites, which is a process that is performed in the previously created system, in an automated way.

1.1. The possibilities of analysing the websites

With the spreading of websites and the advancement of technology, the complexity of websites also increased. The websites can be analysed through a technological or content-based approach, but in both cases the identification, followed by the analysis of the websites requires significant human labour, which, however can be automated through IT support [3] [4] [15].

Surpassing the initial ability of storing static texts, the Web 1.0. sites appeared with dynamic contents, then they became capable of managing visual and interactive, multimedia objects. As a result, the loading time as the entry point of user experience has increased dramatically. Thus, early examinations basically focused on the measurement of performance, placing less importance of the study of content or design [2] [8].

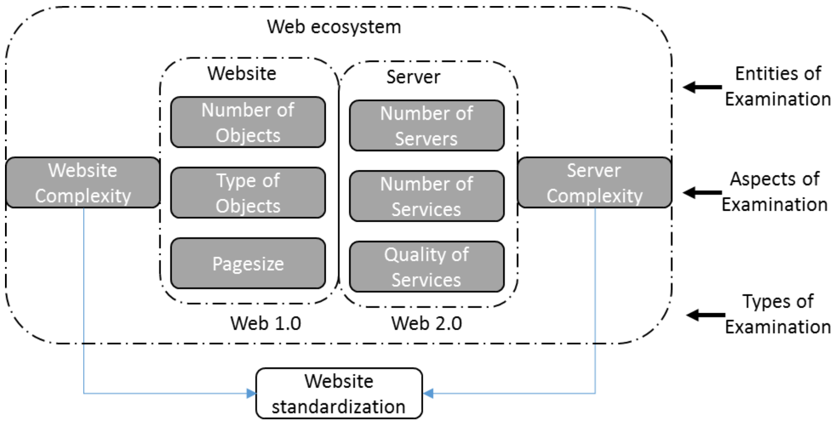

Figure 2.

The scheme of the model of Butkiewicz
source: own edition based on [2]

Several tools can be found on the Internet performing the examination of Web 1.0 websites. The following main examination categories can be created through the analysis of the operation thereof,[2] which are also complex in themselves: Performance, Mobile appearance, SEO (Search Engine Optimization), Security, User experience, and Compatibility. What poses a problem is that the tools assess the examined sites through their own scoring systems, and that they typically do not use weighting possibilities when applying the indicators within the main categories. The main problem of usage is the hiding of the examination method and technique of the indicator system consisting of the main categories.

Figure 2 shows the technology-based examination model created by Butkiewicz [2], whose uniqueness lies in its systemic approach. The model considers the subject of its examination, that is, the central website, to be part of a system, the “web-ecosystem”. This approach served as the basis of the conceptional model of our examination. In his model Butkiewicz places the emphasis on measurability, which he realizes by building on previous research – which focused on communication protocols and web flow – but also exceeding them, introducing a more complex system. He defines two different systems of criteria for the examination of complexity: server and content. In case of server type complexity, he analyses the network of *objects* embedded in the website, referring to external services and integrating the contents, functions available through those. In case of content complexity, besides the indicators of performance, he also means the examination of objects present on the website, responsible for appearance (CSS, scripts, images, etc.).

2 Conceptional model

We based the fundamental approach of the conceptual model created for our research on Butkiewicz’s model. We examined the websites as part of a system, and we created our examination criteria through using a reduced system of indicators, adjusted to the level of development of the Hungarian SMBs. The calculation of the indicators was carried out through the development of a unique software.

Figure 3 shows the conceptional model of WebIX created in a homomorphic way. By breaking down the two sub-indexes (*Web 1.0*, *Web 2.0*) in the model, four pillars can be created, three of which have been created with the Web 1.0 examination methods. These are Speed, Complexity and Appearance. The Web

[2] https://website.grader.com/; https://developers.google.com/speed/pagespeed/insights/; http://alexa.com https://varvy.com/pagespeed/; http://seositecheckup.com/tools/js-and-css-minification-test

2.0 type sub-index is only based on the Contact pillar. The pillars are created by consolidating further indicators.

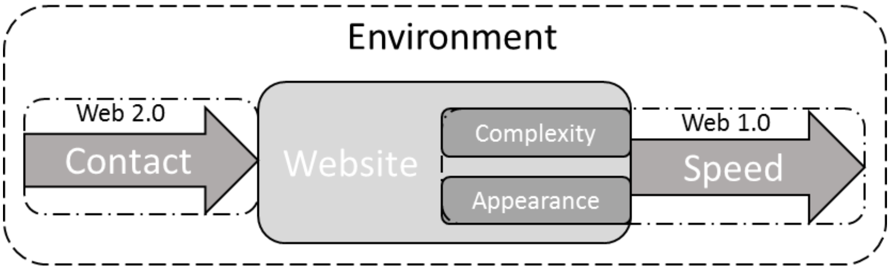

Figure 3
The conceptional model of WebIX

source: own edition

The indicators of the *Speed* pillar of the Web 1.0 sub-index characterize the output-type connection of the website with its environment: the Page Size value shows the size of the website in bytes, while the Load Time indicates the time necessary for loading in seconds.

The *Complexity* pillar of the Web 1.0 sub-index consists of six indicators, which were created through the examination of objects related to the internal structure, complexity of the website. The Inner Links indicator contains the number of links pointing from the website to the pages located within the boundaries of the given site, (relative links), while the Outer Link contains the number of links referring outside the boundaries of the site. The Images, Scripts, CSS, Forms indicators show the item number of image, script, style sheet and form objects on the website.

The *Appearance* pillar of the Web 1.0 consists of eight indicators, which are connected to the appearance of the website in the hit list of search engines, and with the client-side reading. The SSL indicator shows the use of the safe communication channel, the Page Redirects indicates the page redirection, the Cookie shows the use of cookies, the Browser Caching relates to caching, GAnalytics indicates the integration of an external analytical tool, the Page Title and the Meta Description indicate the appearance in the hit sets, while the Mobile Viewport application show reading on mobile devices, the use of responsive design.

The *Connection* pillar of the Web 2.0 sub-index consists of six indicators which describe the input-type relationship of the website with its environment. The Mail indicator shows the possibility of communication through email, while the Apple, GPlus, Facebook Twitter and Instagram indicators show the possibility of communication through the respective systems.

2.1. Calculation of WebIX

Figure 4 shows the process of calculating the WebIX. The first step is the automated identification of the websites of the companies listed in the HSMB database, where the input data are the name of the company and statistical number. As a result of the process, we receive the web address of the business. In the case of businesses which possess a web address, the values of the system of indicator numbers assembled in Chart 1 is defined for the calculation of WebIX, through downloading and analysing the index website.[3]

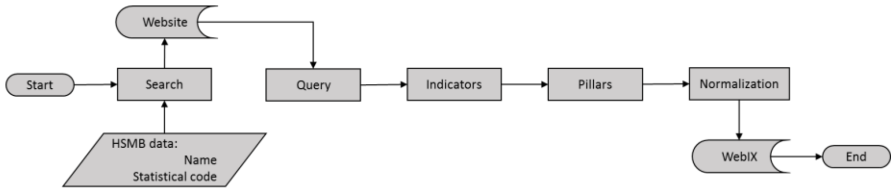

Figure 4.
Calculation process of WebIX

source: own edition

The calculation of pillars for each company is performed in accordance with the following:

$$P_{Sebesség} = \frac{Load\,Time}{Page\,Size} \quad (1)$$

$$P_{Összetettség} = Inner\ Link + Outer\ Link + Images + Scripts + CSS + Forms \quad (2)$$

$$P_{Megjelenés} = SSL + Page\ Redirect + Cookie + Browser\ Caching + GAnalytics + Page\ Title + Meta\ Description + Mobile\ Viewport \quad (3)$$

$$P_{Kapcsolat} = Mail + Apple + GPlus + Facebook + Twitter + Instagram \quad (4)$$

[3] The programmes necessary for the collection of websites and the calculation of WebIX were created in Python language.

Indicator (scale)	Pillar	Sub-index	Index
Page Size (byte)	Speed (Load Time / Page Size)	Web 1.0	WebIX
Load Time (second)			
Inner Links (pcs)	Complexity (SUM)		
Outer Links (pcs)			
Images (pcs)			
Scripts (pcs)			
CSS (pcs)			
Forms (pcs)			
SSL (0/1)	Appearance (SUM)		
Page Redirect (0/1)			
Cookie (0/1)			
Browser Caching (0/1)			
GAnalytics (0/1)			
Page Title (<65)			
Meta Description (<155)			
Mobile Viewport (0/1)			
Mail (0/1)	Connection (SUM)	Web 2.0	
Apple (0/1)			
GPlus (0/1)			
Facebook (0/1)			
Twitter (0/1)			
Instagram (0/1)			

Table 1.
The system of indexes for WebIX, source

own edition

We calculated the indicators and pillars in case of each company included in the HSMB database which has web address. After the calculation of the pillar values, the normalization thereof between the values 0-1 was performed (range transformation, 95% percentile). The calculation of sub-indexes and the WebIX value was carried out as follows, with normalized pillar values:

$$AI_{Web\ 1.0} = \frac{P_{Sebesség} + P_{Összetettség} + P_{Megjelenés}}{3} \quad (5)$$

$$AI_{Web\ 2.0} = P_{Kapcsolat} \quad (6)$$

$$WebIX = \frac{(AI_{Web\ 1.0} + AI_{Web\ 2.0})}{2} \quad (7)$$

3 Results

27% (226 businesses) of the sample of 849 SMBs listed in the HSMB database had a web address, out of which 12 websites were not available. The identification and loading of the website was successful in case of 25%, that is, 214 businesses of the complete sample.

Table 2 shows the distribution of indicators constituting the WebIX in case of the businesses included in the sample. It can be observed in the table that the businesses extremely undervalue the aspects of safety (SSL = 0%), and consider the SEO elements (Meta Description=89,72%, Page Title=87,85%), that is, good appearance in search engines important and pay attention to is. With regards to the usage of external services (GAnalytics = 15,89%) a significant possibility for improvement can be observed. The ignoration of Web 2.0 applications (Twitter = 6,54%, GPlus = 5,61%, Apple = 10,75%) outside the mainstream (Facebook = 25,33%). The support of alternative presentation devices (tablet, mobile) also holds significant room for improvement (Mobile=29,91%).

Indicators	Usage	
	Yes	No
Page Redirect	2,80%	97,20%
Cookie	21,03%	78,97%
Browser Caching	0,00%	100,00%
GAnalytics	15,89%	84,11%
Page Title	87,85%	12,15%
Apple	10,75%	89,25%
GPlus	5,61%	94,39%
Facebook	25,23%	74,77%
Twitter	6,54%	93,46%
Instagram	1,87%	98,13%
Meta Description	89,72%	10,28%
Mobile	29,91%	70,09%
SSl	0%	100%
CSS	79,43%	20,57%
Mail	31,78%	68,22%

Table 2.
The distribution of the values of WebIX indicators, n = 214

source: own calculation

Table 3 shows the distribution of our sample in the seven regions of the country, based on the NUTS2 territorial distribution. It can be seen that the main locations of the headquarters of businesses with web addresses are Central Hungary (1) and South Transdanubia (4). Northern Hungary (5), Central Transdanubia (2) and Western Transdanubia (3) have the lowest number of businesses with available web addresses, while the data concerning the Southern Great Plain (7) stands out among the other areas of that region. On the basis of the study of the average WebIX points with regard to the location of the business, it can be stated that businesses in Central Hungary have the best values, while those in South Transdanubia possess the lowest. However, on the basis of the calculation results of the Pearson-correlation (r= 0,052) of the WebIX value and the NUTS2 location of the businesses, no relation can be detected.

	NUTS2						
	1	**2**	**3**	**4**	**5**	**6**	**7**
p.c. of business	23,36%	8,41%	8,41%	28,04%	7,01%	10,28%	14,49%
WebIX average	0,35	0,20	0,28	0,32	0,28	0,31	0,28

Table 3.
The distribution of businesses involved in the study accoring to NUTS2 n = 214

source: own calculation

The calculation results of the Pearson-correlation between the pillar values of WebIX are shown in Table 4. On the basis of the correlation matrix, according to the Guilford categorization [7] the connection between Connection, Complexity and Appearance is of medium strength, significant relation, being $0,4 < |r| < 0,7$. This raises attention to the fact that those businesses, which have high values in the Complexity pillar, are also more open concerning the use of Web 2.0 applications, as the Connection pillar measure the application of Web 2.0 possibilities.

	Speed	**Complexity**	**Appearance**	**Connection**
Speed	1	-0,269	-0,142	-0,208
Complexity		1	0,373	0,461
Appearance			1	0,408
Connection				1

Table 4.
The Pearson-correlation maxtrix of WebIX pillar values n=214

source: own calculation

Conclusions

We created a systemic model with technological approach for the measurement of the digital presence of small and medium-sized businesses. We ran our model through the automated analysis of the index websites of businesses included in the HSMB database. The low proportion of available company websites indicates possibilities for the development of the digital presence of Hungarian SMBs. After the analysis of the correlation relation between the pillars constituted by the WebIX, the significant role of the Connection pillar and its components revealed the openness of businesses towards the Web 2.0 developments. No Pearson's correlation-based relationship can be identified between the NUTS2-level location of the businesses and the calculated WebIX values. Further possibilities for examination include the study of businesses in accordance with the given industry, and the deeper analysis of location at NUTS3 level.

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