

Measuring the information society in Poland – dilemmas and a quantified image

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Abstract—This paper focuses on measurement of information society in Poland. The aim of this paper is twofold. The first objective is to present a coherent picture of measurement methods for information society. The second aim of the paper is to show measurement findings of information society in Poland. Firstly, the paper presents available methods of information society measurement and a core set of internationally agreed information society indicators. Secondly, the measurement of information society in Poland has been performed with the application of two methods – measuring the influence of ICT on GDP and measuring ICT Development Index. Finally, a discussion has been undertaken in order to establish a framework for development of information society quantitative measurement methods in Poland.

I. INTRODUCTION

INCREASING role of information, knowledge, information and communication technology (ICT) determines the complexity and variability of a social system and its sub-systems, and especially the economic one. Transitions of these systems have been reflected in many research concepts. According to the assumptions being put forward, the basic factors of socio-economic development are information and its derivative – knowledge.

The pioneering work in this field was undertaken by Bell who first used the term postindustrial society in Salzburg in 1959. By its means he denominated a society which transitioned from the stage of foods production to the stage of service society [1]. These studies were further developed by Bell in the direction of identifying the position of knowledge in social development [2]. The concepts of knowledge economy, knowledge industry, types of entities managing knowledge and types of knowledge were introduced to economic research by Machlup [3]. In parallel, e.g. at the beginning of 1960s the term information society came out in the Japanese social science [4]. At the end of the 1970s Drucker stressed the significance of transition to the so-called post-capitalist society, based on knowledge and knowledge economy [5]. He developed this idea in his further work by introducing the notion of knowledge economics [6]. On the basis of Bell's, Machlup's and Drucker's approaches Porat stemmed his research devoted to the information economy and information industry [7]. In the 1980s Toffler presented the idea of “the third wave” – post-industrial civilization where the basic resources are: information and ICT [8]. The informational manner of development of contemporary capitalist so-

cieties (network societies) based on ICT expansion, which creates the ground for a complete change of conditions and style of social life was studied by Castells [9], [10], [11]. Issues concerning information society and knowledge based society have become widely discussed in publications in Poland [12], [13], [14], [15], [16], [17], [18], [19], [20]. Economies and societies using information and knowledge, to extend unprecedented ever before, are denominated in various ways e.g. as based on knowledge, digital, post-industrial, new or information.

The researchers face many cognitive and empirical challenges referring to information society (IS). The cognitive challenges refer to terminology describing information society, identification of phenomena, processes and success factors of this society and also the methodology of information society measurement. The empirical challenges are mainly connected with building information society and its measurement. Research of this scope is conducted in the academic environment [20], [21], as well as among practitioners [22].

The measurement is an important issue in the debate about the information society and the role it plays in economic and social development [21], [20], [23], especially in transition and emerging economies. This paper focuses on measurement of information society in Poland. The aim of this paper is twofold. The first objective is to present a coherent picture of measurement methods for information society. The second aim of the paper is to show measurement findings of information society in Poland.

To achieve those aims, the paper takes the following structure. Firstly, the paper presents available methods of information society measurement and a core set of internationally agreed information society indicators. Secondly, the measurement of information society in Poland has been performed with the application of two methods – measuring the influence of ICT on GDP and measuring ICT Development Index. Finally, a discussion has been undertaken in order to establish a framework for development of information society quantitative measurement methods in Poland.

Hopefully, the achieved research findings can become useful in diagnosing information society, planning for information society undertakings as well as monitoring and evaluating the conducted undertakings.

II. RESEARCH METHODOLOGY

The primary objectives of the research required commencing work of theoretical and empirical characteristics. Various research methods were applied here. In order to present the methods of information society measurement, a critical analysis of foreign and Polish subject literature has been carried out as well as reports prepared by international organizations. The Internet statistical databases were explored at the 72 industry level for all non growth accounting variables, i.e. EU KLEMS [24]. Additionally, data from the International Telecommunication Union and European Statistical Office (Eurostat) were used for the measurement of the information society in Poland. The calculations, figures and tables were prepared in the Microsoft Excel program.

III. THEORETICAL BACKGROUND – INFORMATION SOCIETY AS MEASUREMENT SUBJECT

To date there has not been in operation a commonly accepted definition of information society [2], [8], [4], [25], [14], [26], [18]. Lack of consensus with regard to the definition of information society is undoubtedly a derivative of complexity of processes taking place in a social system, characteristics of information as a resource, and the dynamics of ICT changes. This brings specific consequences for the undertaken attempts for measuring phenomena within the frame of a category, which might be and is understood in various ways.

Nonetheless, despite the conceptual limitations there are attempts taken to describe the information society quantitatively. These ideas were presented in the following sources:

- scientific monographies and papers, i.a. Machlup [3], Porat [7], Timmer, Inklaar, O'Mahony, van Ark [27], Dziuba [28], Goliński [20], Oleński [29], Batorski [30], Żelazny [21];
- reports and studies prepared by international organizations, i.a. International Telecommunication Union – ITU [31], [32], Organisation for Economic Cooperation and Development – OECD [33], United Nations – UN [34], European Union – EU [35], [36], World Bank [37], World Information Technology and Services Alliance – WITSA [38];
- reports of commercial organizations, i.a. World Economic Forum – WEF [39], International Data Corporation – IDC [40], Economist Intelligence Unit – EIU [41]; and
- monographies of national and trans-national services of public statistics and authorities, i.a. Central Statistical Office – GUS [42], Statistical Office of the European Union – Eurostat [43], Office of Electronic Communication – UKE [44], Ministry of Administration and Digitization of Poland – MAC [45], [46].

Generally speaking there are two approaches to the quantitative description of information society. The first one comprises the preparation of the list of indicators characterizing information society. The other is connected with compiling the so-called composite indexes which are aggregate

measures. It should be stressed that the composite index is based on the previously chosen set of indicators. Some significant constraints can be pinpointed in both approaches. The arbitrariness of the choice of indicators, disorderliness of gathering source data, lack of standardization and time-space comparability, substantive errors in assigning indicators to specified information society dimensions and errors in constructing a given index – those are some of the significant drawbacks and constraints.

The above mentioned constraints gave rise to taking efforts on the international scale to institutionalize the methodology of information society quantification. Work in this field was commenced by OECD. In 1997 the OECD established the Working Party on Indicators for the Information Society, which main objective was development of index-based description of information society. One of its major achievements was identifying ICT sector. In 1998 an ICT sector definition was provided basing on the so-called International Standard Industry Classification (ISIC Rev. 3), according to which [33]:

- for manufacturing industries, (1) the products must be intended to fulfill the function of information processing and communication including transmission and display, and (2) the products must be use electronic processing to detect, measure and/or record physical phenomena or control a physical process; and
- for services industries, the products must be intended to enable the function of information processing and communication by electronic means.

Taking into account the above approach, the following were regarded as ICT industries: manufacture of office, accounting and computing machinery (3000), manufacture of insulated wire and cable (3130), manufacture of electronic valves and tubes and other electronic components (3210), manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy (3220), manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods (3230), manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, industrial process control equipment (3312 – 3313), wholesale of machinery, equipment and supplies (5150), renting of office machinery and equipment (including computers) (7123), telecommunications (6420) as well as computer and related activities (7200). The OECD's activity-based definition of ICT was slightly reviewed in 2002 (ISIC Rev. 3.1). The entry 5150 was replaced then by its components i.e.: wholesale of computers, computer peripheral equipment and software (5151), wholesale of electronic and telecommunications parts and equipment (5152).

One important feature of the ICT sector definition by OECD is that it breaks the traditional ISIC dichotomy between manufacturing and services activities. Activities producing or distributing ICT products can be found everywhere in the economy. Moreover, by identifying the key sectors whose main activity is producing or distributing ICT products, this definition constitutes a first order approxima-

tion of the "ICT producing sector". Hence, ICT producing sector means both ICT manufacturing industries (items: 3000, 3130, 3210, 3220, 3230, 3312, 3313) and ICT services industries (items: 5151, 5152, 7123, 6420, 7200) [33].

The following modifications of definitions of ICT sector resulted from the review of ISIC rev. 4 and ended in 2007. The presented above definition of ICT sector was narrowed in the part referring to manufacturing industries accounting only for activity and products which fulfill the function of information processing and communication including transmission and display [23], [47]. The present complete set of ICT sector is shown in [23].

An identical view of ICT sector can be found in the statistical classification of business activities in the European Union – Nomenclature statistique des Activités économiques dans la Communauté Européenne (NACE rev. 2), being in force from January 2008. To the ICT sector were included the following types of business activities: 261, 262, 263, 264, 268 (ICT manufacturing) and 465, 582, 61, 62, 631, 951 (ICT services) [48].

Another milestone in the development of information society statistics, after defining ICT sector, was the establishment of the Partnership on Measuring ICT for Development [49]. The participants of this forum became the following organizations and their agencies: ITU, OECD, Eurostat, United Nations Conference on Trade and Development (UNCTAD), UNESCO Institute for Statistics (UIS), World Bank, United Nations Department of Economic and Social Affairs (UNDESA), United Nations Economic Commission for Africa (ECA), United Nations Economic Commission for Latin America and the Caribbean (ECLAC), United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), United Nations Economic and Social Commission for Western Asia (ESCWA), and United Nations Environment Programme/Secretariat of the Basel Convention (UNEP/SBC). As a result of the activities taken up by the Partnership on Measuring ICT for Development, a core list of ICT indicators was developed. The core list of ICT indicators is composed of over 50 indicators in the following areas:

- ICT infrastructure and access (A – 10 indicators);
- ICT access and use by households and individuals (HH – 12 indicators);
- ICT access and use by enterprises (B – 12 indicators);
- ICT sector and trade in ICT goods (ICT – 4 indicators);
- ICT in education (ED – 8 indicators); and
- ICT in government (EG – 7 indicators).

The list, which is revised regularly (the last time in 2012), was identified to help guide countries in measuring the information society. The full list of basic ICT indicators is available in [50].

The above indicators endorsed by the UN Statistical Commission are recommended as a measurement standard of in-

formation society on the international scale. As it has already been indicated, this set is a subject to supplementation and modification in response to the dynamic processes occurring in the economic and social environment. Such a consensual composition of a common set of indicators by major international institutions should be evaluated positively. A divergent issue stays the scope of implementation of this proposal in the statistical practice of the states, especially developing ones.

Indicatory description of the information society can be found in works of many organizations, both the members of the Partnership on Measuring ICT for Development, e.g. Eurostat, ITU, OECD or World Bank, and those remaining outside (WEF, IDC, EIU). These organizations collect and publish statistical data monitoring information society in various dimensions. Hence their proposals of composite indexes are an important element of their activities. As Goliński [20] argues the increasing popularity of composite indexes is connected with, among the others:

- ease of their interpretation and creation of prices on their basis;
- media attractiveness of composite indexes in relation to the necessity of conducting complex analyses based on single indicators;
- ICT development expediting the acquisition of statistical data, their processing and presentation; and
- demand for attractive tools expediting the evaluation of new socio-economic challenges.

Currently the most popular composite indexes measuring the information society are – ICT Development Index (IDI) of the authorship of the International Telecommunication Union and Networked Readiness Index (NRI) of the authorship of the World Economic Forum.

Considering the significance of works undertaken by the world oldest international organization – ITU on research and measurement of IS, and its active membership in the Partnership on Measuring ICT for Development, the further analysis was conducted on IDI. ITU experience in works on information society measurement was taken into account in the methodology for compiling this indicator. The theoretical framework for this indicator was based on the three-stage model for information society development, i.e. readiness, intensity and impact [31], [23]. The first stage – readiness – reflects the level of networked infrastructure and access to ICT. The second stage – intensity – reflects the level of use of ICTs in the society. The third stage – impact – reflects the result of efficient and effective ICT use. Therefore, the construction of IDI is based on three sub-indexes – access sub-index, use sub-index and skills sub-index. Relevant statistical dependence is presented in Table I.

The IDI was computed applying the following steps – preparation of the complete data set, normalization of data, rescaling of data and weighting of indicators and sub-indices. The IDI is currently calculated for 155 countries.

IV. RESEARCH FINDINGS – MEASUREMENT OF INFORMATION SOCIETY IN POLAND

A. Share of ICT producing sector in GDP in Poland

Evaluating the share of ICT sector in GDP the most current available data were used from Eurostat referring to 2009 [52], and the database of EU KLEMS [24] referring to the period of 1995-2006.

The value added at factor cost in the ICT sector as percentage of total value added at factor cost of the selected EU countries in 2009 is presented in Figure 1. The value added at factor cost is defined as gross value added (at basic prices) minus other taxes less other subsidies on production.

The lowest share of ICT in GDP (3.15%) was found in Poland among the researched countries (Figure 2). In the group of the Central and East European countries the best result was achieved by Hungary (5.93%). An interesting fact is that in the majority of the countries there was a drop in the share of ICT in GDP in the period of 2000-2009. The increase was only noted in case of Hungary (from 5.91% in 2000 to 5.93% in 2009) and in Bulgaria – from 4.63% in 2000 to 5.36% in 2008. A significant decrease took place in Finland – from 10.16% to 5.31%.

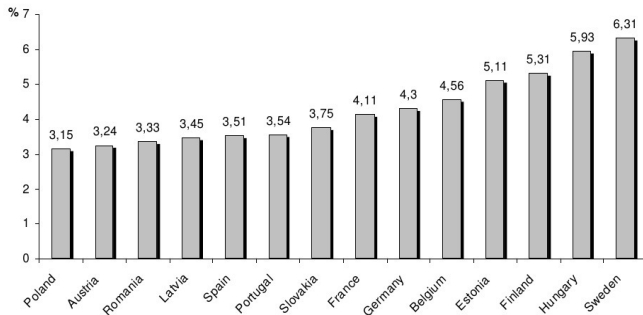


Fig. 1. Percentage of the ICT sector on GDP in selected EU countries with available data in 2009

Source: own study based on Eurostat data [48]

Accounting for the components of the ICT sector i.e. manufacturing industries and service industries, the major

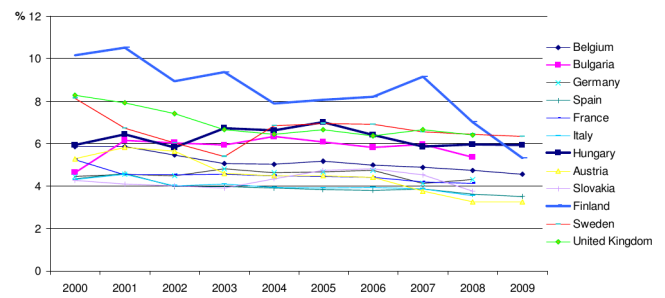


Fig. 2. Percentage of the ICT sector on GDP in selected EU countries with available data in 2000-2009

Source: own study based on Eurostat data [48]

role of business activities based on services needs to be emphasized in all countries. The only exception was Finland in the period of 2000-2007, when the share of ICT manufacturing industries in GDP was higher than the share of ICT service industries. In the Eurostat database there is a lack of data referring to the share of ICT manufacturing industries, as well as ICT service industries in Poland's GDP. In Poland the presented share of ICT sector in GDP at the level of 3.15% in Figure 1 took place in 2009 and was composed respectively of 0.35% manufacturing industries and 2.8% service industries. The share of net ICT sector revenues from sales in the total net sector revenues from sales was about 4.8% in 2009, 5.3% in 2010 and 5.1% in 2011 in Poland [42].

Manufacturing goods and providing ICT services directly influence the increase of the value added generated in the economy. The ICT influence on economic growth is calculated as a product of a nominal ICT producing sector share in GDP and a real output growth and provision of services by this sector. In order to estimate the ICT producing sector share in GDP one should: (1) select the period for an analysis, (2) on the basis of a chosen classification (in this paper ISIC Rev. 3) estimate the share of ICT producing sector in GDP, and (3) calculate the product of ICT producing sector share in GDP and the real growth rate of ICT producing sector. The result of using this algorithm is the value of ICT producing sector share in the GDP growth rate in percentage

TABLE I.
ICT DEVELOPMENT INDEX (IDI) – SUB-INDEXES, INDICATORS AND WEIGHTS

Sub-index	Weights (sub-indices)	Indicators	Weights (indicators)	Reference value
ICT access	40%	Fixed-telephone lines per 100 inhabitants	20%	60
		Mobile-cellular telephone subscriptions per 100 inhabitants	20%	180
		International Internet bandwidth (bit/s) per Internet user	20%	408*813
		Percentage of households with a computer	20%	100
		Percentage of households with Internet access	20%	100
ICT use	40%	Percentage of individuals using the Internet	30%	100
		Fixed (wired)-broadband Internet subscriptions per 100 inhabitants	30%	60
		Active mobile-broadband subscriptions per 100 inhabitants	30%	100
ICT skills	20%	Adult literacy rate	30%	100
		Secondary gross enrolment ratio	30%	100
		Tertiary gross enrolment ratio	30%	100

Source: [31].

points. A suitable data and original calculations in this respect are presented in Table II.

B. ICT Development Index in Poland

As it has been mentioned earlier, the ICT Development Index (IDI) is very often used in order to measure the information society. The values of ICT Development Index, sub-indexes and individual indicators for the years 2011 and 2010 are presented in Table III.

C. Discussion of research findings

The measurement of information society in Poland has been conducted by applying two diagnostics approaches. The influence of ICT sector on GDP has been measured and the composite index – IDI has been presented.

The performed calculations and statistical data analysis proved a small share of ICT sector in Poland's GDP. The average share of ICT producing sector in GDP in the period of 1995–2006 in Poland constituted only about 17% of the total GDP growth rate, i.e. 0.62% out of 3.7%. The percentage of ICT producing sector value added (ICT manufacturing industries and ICT services industries) in GDP in the period of 1995–2006 equaled in real value 4.17% average. The ICT services industries decidedly dominated over the ICT manufacturing industries – the annual average in the period of 1995–2006 was at 2.9% and 1.3%. In 2009 it was respectively 2.8% and 0.35% with the total share of 3.15%. It proves a relatively weaker position of Poland in producing ICT (like hardware) in comparison to other countries. At the same time, significant difficulties were identified in getting to current data allowing for making appropriate calculations and international comparisons. Generally speaking, the attempts to study the ICT sector in Poland (even though they embrace the business entities with workforce over 10 persons) by the Central Statistical Office should be evaluated positively [42]. The access to data with regard to the number of enterprises and employees of the ICT sector, the size and structure of net revenues from sales, labor efficiency, operating costs of ICT sector, profitability of sales or import and export of ICT goods are essential, all the same it should be complemented by the measurement of this sector influence channels over economic growth, also at the regional level.

Taking into account the IDI in 2011, Poland occupied the 31st position out of 155 studied countries. With the value of the IDI equals 6.19 it took the 21st position among the studied European countries, and 17th among the EU countries. The theoretical maximum value of the indicator can amount to 10. In comparison to 2010 the result improved by 0.1, however in the global ranking Poland fell by one position. It is the result of faster development of the countries close to Poland with regard to information society development. South Korea opens the ranking with the IDI value equals 8.56, on the second position is ranked Sweden (8.34), and the third Denmark (8.29). Assuming for the particular sub-indexes (the maximum possible result–10), Poland achieved the best result in the field of skills, next access and in order – use. According to this method, the level of IS development in Poland, taking into account the group of developed countries, is moderate.

V. CONCLUSIONS AND FUTURE WORKS

This research can be useful for researchers and practitioners who are interested in measuring information society. It suggests important issues for measuring information society. The replication of this study in emerging and developing countries will be useful to improve their knowledge related to information society, its measurement and its monitoring.

Both diagnostic approaches to the information society measurement have benefits and drawbacks. Manufacturing goods and providing ICT services directly increase the value added generated by an economy. However, the calculation of ICT service industries and ICT manufacturing industries share in GDP is mainly based on hardly accessible historical data on the international scale. Apart from that there is the necessity of accounting for the qualitative dynamic changes and using deflators allowing for these changes. Their use allows for calculating prices proportionate to the changes in ICT products and services quality. The ICT producing sectors identification by itself and on the regular basis accounting for changes in the methodology of calculations are the steps in the right direction, heading to diligent measurement of information society. They allow for conducting comprehensive estimates of the values of the sector in particular countries and conducting trans-national comparisons.

Despite the advantage of IDI over other proposed composite indexes (e.g. NRI) with respect to methodological correctness it cannot be used for the complex evaluation of information society in a given country. It is worth to notice that in the construction of IDI just few indicators from the core list of ICT indicators were used. The compatibility of some indicators to the description of IDI sub-index seems to be disputable, e.g. the percentage of households with a computer indicator to the ICT access characteristics, or the adult literacy rate indicator to the ICT skills. The weighting of selected sub-indexes for the IDI calculation also pose some doubts. Lower weighting for ICT skills is explained by the adoption of proxy indicators with regard to the absence of more targeted indicators, such as ICT literacy. Taking into account the methodology applied to the Principal Components Analysis (PCA) such an approach seems to be controversial [32].

The methodology of information society measurement showed in this research should be explored in greater depth. In the opinion of this paper authors', in works on the measurement of information society, the critical success factors for implementing information society in a given country or region should be accounted for. For every identified factor, an indicator or indicators should be pointed which will allow for its quantitative description. Surely, such an approach will provide for reflecting on current issues of information society implementation. Simultaneously, it may turn out to be helpful in modification of the existing methods of the information society measurement. Such research is conducted by the authors.

TABLE II.
CALCULATING OF ICT PRODUCING SECTOR IN GDP GROWTH IN POLAND IN 1995–2006

		POLAND											
		(gross value added in constant prices from 1995 in mln PLN)											
Code as per ISIC rev. 3	Business activity	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
30	Office, accounting and computing machinery	195	244	244	339	592	882	562	501	599	721	1 268	918
313	Insulated wire	441	547	569	644	673	751	747	739	1,018	1,088	1,157	1,726
321	Electronic valves and tubes	139	178	223	215	206	202	223	161	162	268	282	398
322	Telecommunication equipment	423	466	577	674	811	753	867	660	538	713	700	688
323	Radio and television receivers	572	594	719	827	956	874	1,088	985	1,127	1,325	1,247	1,754
331	Scientific instruments	889	1,179	1,372	1,582	2,041	1,851	1,755	1,522	1,555	1,804	2,066	2 341
64	Post and telecommunications	5,048	5,221	6,399	7,197	7,445	7,485	9,040	10,891	10,964	13,155	12,466	13,377
72	Computer and related activities	825	1,209	1,104	1,419	1,600	1,809	2,173	2,441	2,743	3,133	2,731	3,372
Σ ICT producing value added		8,531	9,637	11,207	12,896	14,324	14,607	16,455	17,899	18,706	22,207	21,918	24,574
Σ gross value added		297,702	314,547	334,663	350,346	364,925	378,448	382,113	387,138	400,580	418,880	432,043	457,294
nominal share of ICT producing sector in GDP (%)		2.87	3.06	3.35	3.68	3.93	3.86	4.31	4.62	4.67	5.30	5.07	5.37
GDP growth rate (w %)		–	5.66	6.40	4.69	4.16	3.71	0.97	1.31	3.47	4.57	3.14	5.84
average share of ICT producing sector in GDP (%)		4.17											
ICT producing sector annual growth rate (%) – Törnqvist index		14.80											
real GDP annual growth rate (%)		3.70											
average share of ICT producing sector in GDP growth (in percentage points)		0.62											

Source: own study based on EU KLEMS database [24]

TABLE III.
VALUES OF PARTICULAR IDI COMPONENTS FOR POLAND IN 2011 AND 2010

IDI /position in 2011	Sub-index	Sub-indexes /position in 2011	Indicators	2011	2010
6.19/31	ICT access	6.46/43	Fixed-telephone lines per 100 inhabitants	18.1	20
			Mobile-cellular telephone subscriptions per 100 inhabitants	128.5	122.7
			International Internet bandwidth (bit/s) per Internet user	40'244	37'729
			Percentage of households with a computer	73	69
			Percentage of households with Internet access	66.6	63.4
	ICT use	4.57/32	Percentage of individuals using the Internet	64.9	62.3
			Fixed (wired)-broadband Internet subscriptions per 100 inhabitants	14.4	13
			Active mobile-broadband subscriptions per 100 inhabitants	48.4	50
	ICT skills	8.89/17	Adult literacy rate	99.5	99.5
			Secondary gross enrolment ratio	97	97
Tertiary gross enrolment ratio			70.5	70.5	

Source: own study based on statistical data from [31]

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