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CONVERGENCE OF MOBILE TECHNOLOGIES IN CONTEMPORARY ORGANIZATIONS

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Mobile technologies have become an indispensable functional element of modern organizations. They provide continuous access to information, regardless of the user's location and time of connection. The dynamic development of mobile technologies results in gradual overcoming spatial barriers, increased productivity, and new business opportunities. Article identifies the impact of mobile technology on developments inside and outside the organization, presents the key features and benefits of mobile technologies, devices and applications. Paper presents the convergence of mobile technologies, converging solutions and their benefits. Document is enriched with analysis of case studies showing the practical application of this subject.

Keywords: mobile technologies, the convergence of mobile technology, e-economy

1. Introduction

Mobile technologies have become an indispensable functional element of contemporary organizations. The term 'mobile technologies' represents a class of devices operating independent of user's geographic location. Mobile devices offer the capability of sending, receiving and processing of data without the constraints of a wired connection to telecommunications networks. They provide continuous and largely uninterrupted access to information, regardless of the user's location and time of connection. Practical use of mobile technologies requires not only investment in contemporary mobile devices and applications, but also proper design of mobile infrastructure, providing users with remote access to company resources.

Rapid development of mobile technologies has the effect of gradually eliminating spatial constraints. It offers time-saving benefits and increases employee mobility, thus promoting cost-optimization and dispersion of business operations. The main goal of the study was to answer how the convergence of mobile technologies appears on the market, and to show the benefits for companies that are achievable through new mobile solutions. Literature research on the convergence of new technologies has led to the formulation of the following research problem: what are the benefits brought about convergence of mobile technologies and what are the real cases of this occurrence.

2. Internal organizational changes related to the use of mobile technologies

Mobile devices eliminate the spatial barriers of Internet access, typical in desktop systems, thus forming a good basis for development and propagation of communications systems closely related to virtual company model of small business units operating without physical contact with the 'base of operation'. Changes brought about by the introduction of mobile technologies in contemporary organization include the following [1]:

- organizational integration; facilitated contact between employees, independent of time and space constraints,
- leveling (decentralization) of organizational structures; direct contact with associates, customers and contractors largely eliminates the need for elaborate hierarchies and structures,
- global scope and global reach; direct access to remote places and locations,
- time as measure of performance; focus on speed of accessing information; data, information and knowledge can be generated almost instantaneously – from the viewpoint of organizations, it means that required information is up to date and that decisions based on such information are effective and relevant,
- flexibility, adaptability, susceptibility to change; reduction of distance and time facilitates prompt reaction and rapid adaptation to changes; effective contact between communicating parties (e.g. business partners),
- innovation, entrepreneurship; dynamic development of new technologies, conceptual evolution and continuous improvement of applications,
- quality of management; fast and direct contact facilitates and improves operations, both within the organization and outside its structure,
- focus on customer; fast and direct contact greatly reduces transaction time and purchase procedures,

- interactivity; since employees can access relevant information instantaneously, they can tackle operational problems as they arise,
- cost reduction; mobile devices allow for easy input, analysis and processing of data ‘in the field’, with results updated in real time and ready to be used both for operational purposes and long-term strategic goals.

The most notable benefit of mobile devices is their potential for increasing work effectiveness and productivity. Mobile employees, with the help of contemporary mobile devices, can access company data, information and knowledge just as easily as those working in company headquarters. Empirical research shows that employees with remote (wireless) access to information gain, on average, 8 to 12 hours of productive time per week [2].

The use of mobile devices offers a range of benefits for the organization, most notably [2]:

- reduction of document circulation times; tasks such as signing of documents, submission of motions and offers, reporting and effecting bank transfers can be done in (or close to) real time, without the usual constraint of direct physical contact or scheduled meeting between the parties,
- reduction of paperwork; laptops or handheld devices with wireless Internet connection offer easy access to electronic versions of trade documents, contracts and forms – they can be read, edited and printed from any location,
- facilitated communication; employees are well-informed – this helps them make appropriate business decisions,
- improved customer satisfaction; by responding promptly to their questions and needs, we can build better relations with customers.

Analysis of changes within organizations shows that increased information flow (brought about, among other things, by the advance of mobile technologies) and enhanced coordination have an effect of leveling of organizational structures, as well as make organizations more flexible and better informed.

3. External organizational changes brought about by mobile technologies

Managing customer relations is one of the more significant aspects of operation in companies active on customer-oriented markets. This aspect applies mainly to forms and means of communication with customers in such areas as sales, marketing and post-sale servicing, i.e. areas where mobile technologies are increasingly useful and prevalent. Communication can be initiated both by company and by individual customers. In the latter scenario, customers typically expect prompt reaction to their requests or problems. Mobile devices seem ideal for this purpose,

since they do not require constant office duty on the part of customer relations specialists.

The above argument, coupled with rapid development of mobile devices with wireless access to the Internet, makes companies more aware and inclined to utilize mobile technologies as the main platform of communication with potential customers. In this context, supplementing general information published on Internet mobile platforms with data and functionality specific to customer's present location seems of particular importance. An estimated 30% of search engine queries initiated from mobile devices (tablets, smartphones, etc.) are made with reference to local business services. Mobile users of search engines and other Internet applets often seek localized services (e.g. local retail outlets) using online maps, and an estimated 70% of them are ready to finalize the purchase [3].

Another important aspect of company communication in the area under study is the need to supplement company websites with mobile-specific functionality and format. Advertising and marketing campaigns also require careful redesign of company websites, to make them accessible and manageable from mobile devices. Organizations intent on promoting their services through mobile platforms should also be aware of technological requirements of the most popular models, with the most important determinant being the type of operating system used in mobile devices. At present, the most popular mobile devices in Poland are powered by Android (Google), followed by iOS devices (Apple) [4]. Mobile Internet users in Poland are estimated at 4.38 million, with smartphone devices constituting ca. 45% of total mobile phone sales in 2011 [5].

Mobile marketing offers vast potential of increasing target audience by providing new communication tools, such as geolocalization, augmented reality, QR codes, mobile advertising (banners) and methods for targeting mobile device users.

Geolocalization, one of the more popular and widely used services on Polish market, offers easy localization of company outlets and via digital maps, custom content based on user's geographic location and reporting of user's current location on social networking platforms. Within the last 10 months of 2011, the increase of user locations reported by geolocalization services was estimated at an overwhelming rate of 2744 percent [6]. This dynamic growth can be attributed to the increased use of smartphone devices and tablets among Polish consumers, as well as the popularity of social networking services.

Augmented reality is a contemporary system integrating real world data with digitally generated content, giving users new ways of interacting with their immediate surroundings. One of the most popular applets based on AR technology is Layar. AR technology is widely researched by many organization, with Google Glass being the most advanced project in this area. QR code technology, on the other hand, is based on alphanumerical, two-dimensional codes that may be

scanned by cameras built into mobile devices to offer users fast and easy access to relevant information resources (such as company website). At present, the use of QR codes on Polish sites is scarce.

Despite the fact that mobile technologies in Poland are still in the infancy stage, many organizations have already made their move towards changing their mode of economic operation. Companies are more and more aware of the growing popularity of mobile devices and are intent on utilizing their potential in their business strategies, as platforms for e-commerce and other e-business applications. The number of mobile users grows at a rapid rate. In the year 2010, the number of smartphone users in Poland was estimated at 13%, while reports for 2012 place it in the range of 25% [7]. Rapid development of mobile market has caused companies to increase their spending on mobile marketing solutions. Mobility and remote access to company market offer is the most important argument for continued development in this respect. Mobile solutions play an increasingly important role not only in mobile marketing application, but also in other areas of contemporary business.

4. Convergence of mobile technologies

Changes in the sector of information and communications technologies are often referred to as 'convergence of mobile technologies'. Convergence means the occurrence of similar traits in unrelated individuals (in this case – companies) existing in similar conditions [8]. Integration of computers and telecommunication devices based on wireless Internet access has created a new information architecture. Convergence of mobile technologies allows companies to increase their business effectiveness, reduce cost of operation, simplify customer servicing procedures, reduce the time of product and service delivery to customers, improve coordination with suppliers and contractors, and – in effect – improve their competitive advantage.

Converging solutions are primarily noticeable in [9]:

- internal communication systems, through integration of mobile telecommunication and remote IT services, communications platforms (SMS, MMS, WWW, IVR – *Interactive Voice Response*), remote access to company Internet resources, mobile business representatives, sales reporting and supervision systems, telemetry and monitoring,
- mobile services for business, such as: Business-To-Customer services based on the use of electronic and mobile technologies as support for direct transactions with individual customers in m-commerce, e-commerce, IT services, marketing and sales; Business-To-Business services as support for relations between business partners in such areas as order fulfillment, settling of accounts, payment services, mobile financial services,

- integrated telecommunications systems that combine different forms of communication, from cellular telephony and SMS to fixed telephony and data transmission for a range of applications, including company internal communication (for telecommunications cost optimization and integration of company communications systems), communication with customers (call centers, information services, loyalty programs) and effective communication with external services (police, fire service, medical services),
- mobile applications to service database connectivity, such as intranet, accounting and banking systems, and remote networking of sales teams (mobile devices can be used to transmit sales reports, check inventory, place orders, access company e-mail system) and mobile financial services (mobile banking units, verification of banking balance and payment collection, booking and ticket sales).

Convergence of technologies facilitates creation of mobile organizations, offering, on the one hand, independence from time and space constraints and, on the other hand, personalization of company operation [10]. The former allows for effective information exchange and making informed decisions without the need for physical contact between the parties, while the latter helps manage employee and contractor identification in highly dispersed organizations.

Mobility of organizations brings a range of benefits, such as [10]:

- integrated overview of business needs as a result of increased communication, both in internal and external dimension,
- improving company operational effectiveness despite large dispersion of its resources,
- simplification of complex procedures and task distribution within organization,
- facilitated outsourcing of services,
- improving flexibility of decision-making processes in management,
- reduction of market fluctuation risk through active communication with business partners,
- enforcing continued and strict safety policy in response to potential breach of company information resources.

It must be noted that implementation of mobile solutions can also involve full integration with traditional structures of an organization. Consequently, convergence of mobile technologies makes it increasingly more difficult to demarcate the impact of mobile solutions on changes both within and outside the organization. In other words, the division between company internal and external structures becomes more and more blurred.

5. Case studies

5.1. Arizona Beverage Company

Arizona Beverage Company, Ltd. (often labeled AriZona) offers a wide array of iced tea beverages and energy drinks to customers around the world. The company employs more than 400 employees, is owned and operated in the United States and continues to expand its product line and global presence. Arizona has implemented Mobile Device Management (MDM) solution for equipment owned by the corporation, and allowed 'bring your own device' (BYOD) programs for employee devices [11].

Most of the benefits from the implementation of mobile technologies has been noticed in the sales department. The total number of sales representatives is a team of nearly 200 people, and they previously needed to make a business trip to customers, process orders on paper on site, with this information go back to the office in order to finalize the contract, and then once again go out to new customers. The implementation of mobile solutions has enabled access to the online inventory system in real time by the secure virtual private network (VPN) connection, access to email and contacts with detailed customer information. This allows sales representatives to place orders directly on their mobile devices, particularly tablets. This innovation made their sales department a step ahead of the competition. All devices are password-protected and equipped with Active Directory, ActiveSync, Wi-Fi and VPN connections, so that an adequate level of security of transmitted data is provided.

Product catalogs for business meetings are now available anytime, anywhere, enabling the presentation of new and existing products and their promotions in form of a digital presentation. The company also saved a lot of paper, which helped with AriZona environmental initiatives.

5.2. Mobile Banking

In the period from July to September 2010 Accenture (multinational management consulting, technology services and outsourcing company) done research on understanding the economics of mobile banking by in-depth telephone interview with 10 bank executives [13]. Banks and executives agreed to participate on condition of the case studies being blinded, however study population consisted of, among others, a major Western bank with high mobile adoption, a European bank with a focus on technology innovation, a South Asia bank with an extensive history of mobile banking, and a European bank focuses on meeting the needs of a demanding customer base through excellence in delivery of mobile banking services [12].

Key factors related to the convergence of mobile technologies in electronic banking were – according to surveyed executives [12]:

- in the area of competitive advantage that drove original mobile banking business case:
 - a) making banking simple, convenience, and providing superior customer service,
 - b) enabling self-banking,
 - c) close integration into other bank channels and services,
 - d) common user experience across channels,
 - e) customer migration to lower cost channels,
 - f) low cost of deployment through leveraging shared services,
 - g) converting existing customers to mobile banking: customer time savings and experience,
 - h) acquiring new customers, increasing retention,
 - i) building the infrastructure to enable customer acquisition,
- in the current areas of competitive advantage that are driving evolution:
 - a) driving economics through value-added services,
 - b) increasing speed of transactions for greater customer ease,
 - c) increasing transparency and control of transactions on an account,
 - d) seeing tablets and touch computing as the next revolution,
 - e) increasing power of mobile devices and network bandwidth,
 - f) capturing unbanked (especially rural) population,
 - g) providing exclusive product offers via mobile device,
 - h) acquisition of new customer segments,
- in the current focus of activity to realize competitive advantage:
 - a) international remittances,
 - b) expansion of services to support on-device applications and next generation devices,
 - c) increasing the variety of transactions available on the electronic wallet,
 - d) developing alternative points of presence to supplement existing banking infrastructure,
 - e) expanding marketing and selling products exclusive to mobile,
 - f) expanding mobile marketing and cross-sell,
 - g) improving usability.

Furthermore, the research shows that [12]:

- mobile banking investments have very high return on investments (ROI) – into the multiple hundreds of percent,
- measurement enables stakeholdering, which avoids the risk of mobile being seen as cost-only or generating pressure to generate revenues from mobile banking fees,

- minimizing fees drive greater engagement from customers, which will be critical for future opportunity capture (e.g. cross-selling of both financial and non-financial products).

Study shows that in the context of the development of mobile technologies, banks – even though the difference of their geographical location – are developing their mobile strategies in a similar way in the face of mobile and technological revolution.

6. Conclusions

Integrated approach to mobility allows for effective implementation and management of mobile business, mobile organization, mobile sales and security, as well as mobile financing services. Mobile technologies have become an important instrument for support of business endeavors, both from the viewpoint of company management and that of individual employees, setting up new standards of work and communication. They also define changes in company procedures. For example, new communications platforms improve functionality of micropayments (dues can be collected instantaneously via mobile devices), enable dynamic ‘matching’ of buyer and seller, or help manage and localize transportation units (tracking vehicle movement, monitoring and optimizing energy and fuel consumption).

It must also be noted that security risks inherent in mobile applications, although marginal, are still a force to be reckoned with. Managing company operations through mobile technologies is a great challenge. Equipping employees with contemporary mobile devices and providing them with wireless connectivity to company resources and application is fairly straightforward, but enforcing best communication practices and safety measures without affecting the comfort of remote connectivity may present a problem, since lax safety poses the risk of losing effective control over company processes. Mobile management strategies have become an important element of organizational management, setting standards and limitations for mobile use. For example, health care organizations offer mobile access to reception procedures, but restrict the practice of remote counseling and medical consultation, although such services are technically viable.

Mobile organization management involves implementation of mobile applications, mobile networking, mobile content of management systems and mobile safety restrictions to replace traditional paperwork bureaucratic procedures and solutions. It must be noted, however, that mobile technologies can in no way replace the benefits of personal contact, mutual understanding, interpersonal relations or traditional forms of social support and conflict resolution. In addition, contemporary organizations – by placing great emphasis on wireless communications and

technological innovation, may sometimes be perceived as technically inconsistent and unpredictable.

Despite the above limitations, mobile technologies are progressively becoming part of an integrated system in contemporary organizations. Business entities gradually adapt to new conditions by offering mobile versions of their corporate websites, keeping careful track of activities on their mobile platforms, measuring results of those activities and reaching for contemporary, interactive methods of communication.

REFERENCES

- [1] Stroińska E. (2012) *Transformacja struktury organizacyjnej wywołana wdrożeniem technologii teleinformatycznych (ICT) do organizacji, Systemy Inteligencji biznesowej jako przedmiot badań ekonomicznych* [ed.] Olszak C.M, Ziemia E., Zeszyty Naukowe No. 113, UE, Katowice.
- [2] Porębska-Miąc T. (2008) *Wykorzystanie technologii mobilnych w zarządzaniu relacjami z klientem, Systemy Wspomagania Organizacji 2008, Informatyka ekonomiczna jako dziedzina nauki i dydaktyki* [ed.] Pańkowska M., Porębska-Miąc T., Sroka H., Prace Naukowe AE, Katowice.
- [3] Rejzrewicz R. (2012) *Marketing mobilny. Raport 2011/2012*, <http://www.marketdog.pl/wpfiles1/wp-content/uploads/2012/05/Marketing-mobilny-raport-2011-2012.pdf>, (accessed on 24.09.2013).
- [4] Dwornik B, Ratuszniak B., Rynkiewicz M., Królewski J., Wilk P, Wawryszczuk B. (2011) *Raport Marketing Mobilny*, Interaktywnie.com, Wrocław, <http://interaktywnie.com/biznes/artykuly/raporty-teraktywnie-com/raportinteraktywnie-com-marketing-mobilny-21220>, (accessed on 24.09.2013).
- [5] Media Planet (2012) *Mobile w liczbach*, Direct Business No. 1, November 2012, http://doc.mediaplanet.com/all_projects/11421.pdf, (accessed on 24.09.2013).
- [6] Dzieduszycka-Jędrach J. (2012) *Social Media 2012*, Internet Standard, Warszawa, <http://www.internetstandard.pl/news/379568/Internet.Standard.prezentuje.raport.Social.Media.2012.html>, (accessed on 24.09.2013).
- [7] Frydrychowicz, K. (2011) *Raport Internet 2k11*, Internet Standard, Warszawa,
- [8] <http://www.internetstandard.pl/whitepapers/1837/Internet.Standard.prezentuje.raport.Internet.2K11.html>, (accessed on 24.09.2013).
- [9] Słownik Języka Polskiego (2013), Wydawnictwo Naukowe PWN S.A., <http://sjp.pwn.pl/slownik/2564602/konwergencja>, (accessed on 24.09.2013).
- [10] Żak A. (2010) *Konwergencja technologii w firmie*, *Ekonomika i Organizacja Przedsiębiorstwa* No. 12, Warszawa.
- [11] Hetman J. (2009) *Mobilne przedsiębiorstwo z wykorzystaniem e-usług*, Polska Agencja Rozwoju Przedsiębiorczości (PARP), Warszawa.

- [12] AirWatch (2013) *AirWatch Makes Mobile Deployment Smooth for AriZona Beverage; SCL, Enhances Sales Process*, http://www.air-watch.com/downloads/resources/Air-Watch_Case_Study_Arizona_Beverage.pdf, (accessed on 24.09.2013).
- [13] Accenture, *Mobile Banking Case Studies*, http://www.accenture.com/SiteCollectionDocuments/PDF/Mobile_Banking_Case_Studies_10_29_2010.pdf, (accessed on 24.09.2013).

SOURCING OF IT SERVICES – INDUSTRY TRENDS

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This article is an attempt to sum up the trends in the sourcing of IT services during the last decade and to forecast how the industry will develop in the coming years. A substantial part of the article concerns the trend of offshoring IT services and the experiences of those companies that decided to move part or whole of their IT operations offshore. The author analyses the outcomes of this phenomenon and shows possible new trends in this field. The role of Poland on the global offshoring market is also mentioned in the article. A short description of cloud computing as an important new IT outsourcing technology is also provided.

Keywords: IT outsourcing, offshoring, multisourcing, cloud computing

1. Offshoring – a new trend at the beginning of the second millennium

There are several methods and models of sourcing IT services by enterprises. IT services can be partially or fully provided by the in-house IT department in which case we have the insourcing model or they can be partially or fully outsourced which means they are provided by an external company. In the last decade another factor has been taken into account by companies deciding where their IT services should be placed – geographical location. For various reasons some companies decided to offshore their IT functions from the country where the company has its headquarters (usually North America or Western Europe) to another company in a different country or even continent.

At the beginning of the millennium we could observe offshoring of IT services as a new trend in the industry. Moving such services from the onshore

premises of companies to offshore contractors was a direct implication of cost cutting tendencies perceived by many companies as a necessity, especially in the IT domain. Cost calculation for offshore services showed direct saving opportunities for North American and Western European corporations. The main points were usually the cost of labour which was much lower in the most popular offshore locations like Asia or Eastern Europe and, most probably, tax savings. For some companies offshoring operations resulted in a great success as far as their targets were concerned, for others it was rather a more difficult experience.

After a decade of observing how these trends developed, we can now sum up the outcomes of offshoring as well as the lessons learned by the different companies that decided to move away part or entire IT services. We can also try to answer the question if this trend will continue to grow or not and what will be the possible role of new IT technologies like cloud computing in the shaping of IT services in the future.

2. Lessons learned- problem areas

As offshoring was mainly meant to bring about considerable **IT cost savings**, let's look first at this aspect of the whole operation. The companies interested in moving their IT operations to different countries were mostly interested in cutting a substantial part of their labour cost. Market studies showed that the level of wages for IT specialists in Asian and Eastern European countries was considerably lower than, for example, in the US or Western Europe. As it appears the most successful offshoring users may not even have saved 30% of cost [1]. The cost of labour in the countries to which the IT services were moved was lower indeed, but there were other factors that required bigger investment. These factors included the onsite equipment and hardware, communication, security and travel to the remote locations.

As for the labour costs – when the first outsourcing deals were made there was a really huge gap between the wages in countries like India or the Philippines and the likes of the US. Nowadays the differences still persist, but they are constantly diminishing which makes this factor somewhat less attractive.

The second area which posed some problems for the offshoring users was the **quality of service** and its perception by their customers. Many customers used to the local service found it hard to communicate with the offshore staff and complained about the language level which understandably was not as great as that of the native speakers [2]. The quality of service problems also resulted from the fact that the outsourcing organizations suffered usually from the high turnover of workers. The majority of work outsourced being repetitive and usually below the qualifications of the hired staff – it attracted mostly young people just out of school who then went onto search for more ambitious jobs and thus left the company.

The movement of some core business functions like, for example, strategic development projects requiring highly collaborative work or business processes was also in many cases not a good idea, because the outsourcing companies were not able to deliver the same level of know-how as the in-house teams [1]. Additionally pay for good IT analysts and product developers in India and China has been rising by up to 30% a year because of their scarcity on that market so to achieve a similar level of proficiency in more advanced projects than just basic IT support functions, the outsourcers would have to pay more and more similar wages to those in Europe or America [3].

Another possible source of problems can be **the technological gap** between the current time and the moment when the outsourcing contract was signed. A study performed by the outsourcing consulting company Alsbridge on 250 senior IT managers from the Western European companies showed that more than 35% of them found the existing outsourcing models “a barrier to new technology adoption”. Another interesting claim by these managers was that they did not believe their suppliers were motivated enough to implement new technologies as, for example, cloud computing which could reduce their bottom lines [4]. That is because if the outsourcing company based its pricing for example on the effective number of servers – this company would probably not like to move to cloud services which could reduce the cost of service and at the same time their revenue. The possible result of this problem can be the shift from the long term contracts towards more flexible short term ones with more freedom of decision-making about the technologies for the outsourcing users. The implications of cloud computing technologies for outsourcing contracts will be presented further in the article.

All the problems described above result in the trend some market observers have already labelled as “the death of offshoring” [5]. Rightly so or not – we need to look at this phenomenon closer.

3. Offshoring services – coming back home?

According to a recent survey by HfS Research, a business and IT consultancy, more and more companies are finding that high quality IT work is more likely to be achieved under in-house control. This shift in perception is already taking place in the USA and is another outcome of this survey [5]. Some of the early adopters of the offshoring idea are bringing the work back to their companies as they discovered that looking after customers and developing new IT tools are more of the “core” parts of their business. The possible trend known as “reshoring” can increase the demand for local labour in the developed countries, especially concerning the high quality, educated workers. An example here can be the

General Electric multinational corporation, whose former CEO Jack Welch was one of the pioneers of the offshoring trend. The company is currently moving back a substantial part of its IT services to their new centre in Michigan, US and hiring some well skilled, highly trained IT engineers [6]. Taking into account its offshoring experiences, the company found that the IT department was losing too much technical expertise and that the offshore services provider was not responding quickly enough to changing technological needs [7].

As the Nobel prize winning economist Joseph Stiglitz argues – the result of several years of offshoring of IT services from the US to the developing countries is a drop in wages even for the well skilled workforce in the US. Countries like India and China are producing more engineers than America and, with the possibility of the remote work in the IT sector, they are now quite a strong competition for the local specialists [8].

Recent research by the Hackett Group shows that the close to 1.5 million IT jobs that existed in 2002 in North America and Europe will be eliminated by 2017. The factors that contribute to this phenomenon are, first of all, offshoring (concerning mostly the roles in maintenance and development of applications as well as infrastructure support), but also new technologies driving better productivity and the general low-growth business climate [9].

This is why there can be even some political reasons for bringing work back to the countries of origin. This is the case with Bank of America (BoA) who has signed some major contracts with the Indian subcontractors: Tata Consultancy Services Ltd and Infosys Ltd – India's top two software developers. BoA will bring some of its IT projects back to the US either to some service providers or to their own company. One of the reasons is the will to “ward off political backlash against jobs being outsourced to India” [10]. This decision shows that there will probably be other factors taken into account by the decision makers in the IT departments apart from the costing factor. As it appears, the general image of the company and its social responsibility for the community in the country of origin starts to play some role in the decision process. We will see if this trend persists in the coming years.

There are other examples of companies that have already shifted their work from their offshoring partners or at least have started to think about doing it. General Motors, having billion dollar contracts with Indian and other foreign providers, announced that close to 90% of its IT projects will be moved to their in-house staff in three to five years. Wal-Mart and JPMorganChase are also in the process of moving some portions of their IT operations back to the US. Therefore some increase of business for the onshore providers can be expected in the near future [11].

The trend might be reinforced by the perception in the level of professionalism and skills of US workers versus their offshore counterparts. According to another survey performed by HfS Research this perception is more favourable for US workers. 82% of the surveyed IT managers agreed that US specialists were strong in cultural and communication skills compared to only 33% expressing the same opinion about their offshore staff. “Taking initiative” was the American quality according to 77% of the respondents versus 40% who found the offshore workers mastering this virtue. Concerning the term “innovative”, the results were respectively 77% and 45% [12]. These are other examples of “soft” factors (other than cost or professional expertise in the offshore locations) apart from the political ones described above which start to play a role in the IT departments’ strategies of sourcing of their services.

It will be interesting to observe what kind of impact the “reshoring” trend (if it persists) will have on the local and offshore markets. As far as the labour cost is concerned it could cause an increase in relative wages for the highly specialised IT experts in the US and Western Europe and at the same time the higher cost of IT operations. The cost can be nevertheless balanced by the introduction of new IT services organization models and technologies which will be described later in the article.

4. IT outsourcing services in Poland

As one of the most popular offshoring locations in the world, Poland definitely deserves a mention in our analysis. Whereas the leaders in outsourcing services offshore still remain India and China, Poland takes a very good third place in the world and is the unquestionable leader in Europe as far as foreign investment in outsourced services is concerned. IT services are the second most common part of business outsourced by foreign companies to Poland after finance and accounting [13].

During the last year Poland overtook India as far as annual growth of new jobs in the outsourcing services sector is concerned. From 2008 this growth has represented 20% year on year and there are no signs of it slowing down in the coming years. Therefore Poland can remain an exception in the growing “reshoring” trend described above. The main attraction factors for foreign investors in Poland are the availability of a well educated workforce with very good level of foreign languages and, at the same time, comparatively lower wages, as well as a constantly developing infrastructure and office space accessibility. The outsourcing services sector in Poland already employs 110,000 people with the main three cities for the location of these services being Cracow, Warsaw and Wroclaw [14].

As far as workforce skills are concerned, the future of outsourcing centres in Poland looks rather bright especially in technological domains. The number of students at technical faculties is constantly growing and international rankings put Polish students ahead of America's in subjects like science and maths [15]. Many industry experts forecast that in the coming years there will be more advanced services moved to Poland requiring more technological knowledge which would be very beneficial for the country and IT specialists, as far as the general technological development is concerned. Currently the country takes second place in Europe concerning IT services after Russia and according to the Antal International representative Poland will be the leader in Europe even before 2015. There are an estimated 4,000 new jobs currently being created in the sector in preparation for the development of such services as research and development, shared services centres, nearshore and offshore [16].

Worth mentioning is the fact that more and more Polish companies specializing in IT services are present on the international market. Three of them - Asseco, Comarch and Ericpol – already have a strong position in the Eastern and Central European region. Asseco Group created an international holding structure grouping subsidiaries from several countries of the region and also from Western Europe and Scandinavia. The strategy of the company for the following years will be to achieve a high level of specialisation within the group and therefore there will be competency centres created which is a form of concentrated insourcing of IT services within the organization. This strategy follows the following scheme: expanding internationally - taking over the know-how concerning the local market – optimizing process and consolidating [26].

5. Industry perspectives

Taking into account all the business factors and trends what can we expect the global IT services sourcing strategies to look like in the coming years? Few trends are definitely worth observing:

- As far as offshoring of the services is concerned, according to CIO.com surveys on this matter, low cost locations will still remain important but local support for customers will be given more attention. With onshore costs becoming relatively competitive more and more companies may decide to create their IT support centres in the US or Western Europe [17]. This will especially concern the core IT functions and projects that should be performed by the in-house teams. The simple and repetitive tasks as well as the basic support will possibly remain the domain of the offshoring providers. The

general business environment and technological advancement will play an important role in decisions concerning the relocation of IT services.

The table below shows benchmarking of different countries as far as general IT industry competitiveness is concerned. The factors presented in this table can be taken into account by companies planning to relocate their IT activities back to their country of origin or elsewhere.

Table. IT industry competitiveness by country

		Overall	Business Environment	IT infrastructure	Human capital	R&D development	Legal environment	Support for IT industry
Rank	Category weight		10.0%	20.0%	20.0%	25.0%	10.0%	15.0%
1.	USA	80.5	95.3	76.5	74.1	74.3	92.0	87.2
2.	Finland	72.0	98.2	71.0	52.1	67.3	89.5	78.6
3.	Singapore	69.8	91.0	65.2	51.8	67.2	81.5	82.3
4.	Sweden	69.4	90.1	83.3	46.4	54.9	85.0	81.6
5.	UK	68.1	93.2	74.0	57.5	46.7	88.5	80.0
6.	Denmark	67.9	95.1	87.2	47.9	42.0	90.5	79.0
7.	Canada	67.6	88.3	76.9	53.4	47.6	79.5	85.4
=8.	Australia	67.5	92.3	82.4	60.4	32.7	92.5	82.1
=8.	Ireland	67.5	96.0	59.3	54.8	55.9	85.0	83.9
=9.	Netherlands	65.8	90.1	84.3	43.8	43.8	90.5	74.6
=9.	Israel	65.8	81.3	64.4	47.2	71.3	73.0	68.1
10.	Switzerland	65.4	88.3	89.9	40.7	41.3	88.5	75.0
...28.	Poland	44.6	76.5	42.8	42.6	18.1	70.0	55.9
...32.	India	41.6	61.8	5.8	52.8	42.9	53.5	51.0
...35.	China	39.8	54.5	18.1	60.4	25.6	59.5	42.2

Source: Benchmarking IT industry competitiveness 2011, BSA
<http://globalindex11.bsa.org/>

As we can see, the US remains a strong competitor in all the most important factors influencing the attractiveness of that particular country for IT investors. Taking into account only the human capital (availability of IT talents), the ranking of the countries is somewhat different but nevertheless interesting. The top 10 countries in this respect are: US, China, Australia, South Korea, UK, New Zealand, Ireland, Taiwan, Canada and India [18].

- For the outsourcing companies dealing with more business-oriented projects and more sophisticated problems and change management, the new service level agreements (SLA) should include more qualitative values related to the customer satisfaction and business outcomes of the operation. The managed services model will become more popular for services like data centre and data storage [19].
- The multisourcing model will be more popular among the outsourcing users. In this model, IT services of a company are contracted to a number of vendors and can also include some in-house elements of the IT organization.

The purpose of this solution is to maximize the effectiveness of IT operations by making sure that the different elements are sourced from the best possible providers. The possible benefits of the multisourcing model are better competition between the service providers resulting in better quality and innovation of the services delivered. Companies using this model are also often using a related model called service integration in which one outsourcing company is managing several IT providers working for one company. According to recent statistics, US corporations are already working with, on average, 13.5 IT service providers and the management of these represents quite a big challenge. Therefore the service integration model offers better coordination possibilities and also flexibility in terms of the contract [20].

- More flexible outsourcing contracts should enable IT organizations to adopt new technologies like cloud computing which in turn should help to reduce the cost of IT infrastructure and to further concentrate on the core functions of the company.
- The importance of virtual teams will grow. Members of the particular teams will not necessarily be placed in the company premises or in the outsourcer or offshorer office, but will work remotely from their home, hotel, etc. and will even be placed in different countries and collaborate using new technologies such as cloud computing. The virtual team providers based on a similar model as the elance.com website will develop as a new and more powerful form of outsourcing.

6. Cloud computing – a new and effective outsourcing technology?

Cloud computing technology has become more and more popular during the last three years and according to industry observers this trend will continue to rise. Experts claim that during 2013 the cloud will make up 27% of all new IT spending [5]. To characterize it briefly – it is a technology enabling the customer to pay for the use of a particular IT service, for example a server or a piece of software, without having to buy additional hardware or a licence. This means a so called virtualization of the IT infrastructure where the infrastructure itself is provided by a third party and a final customer has access to it via a special interface.

This new technology offers several benefits to the company using it. We can point out the most important ones:

- More flexible costing model – cost of IT services is based on consumption of these; the company does not only depend only on its own IT infrastructure investment which then can be used only partially. At a lower cost the company is able to get more advanced features that could be difficult to obtain

using the traditional model. It can also pay only for the features of the software that are needed for its business. That represents an important advantage for small to medium sized enterprises that cannot otherwise afford the advanced IT infrastructure.

- Lower maintenance requirements – cloud computing service providers take care of the infrastructure and software as part of their delivery contract.
- Easier scalability – for the growing business it is possible to expand the services used without substantial investment. It is also easier to adjust to seasonal shifts or other changes in the business [21].
- Mobility of workers – they can access the IT services wherever they are, also in the BYOD (bring your own device) model, the only requirement is access to the Internet [22].

As an example of a successful cloud deployment on a bigger scale we can mention the company Ricoh that developed a private cloud working with Indian IT service provider Infosys at the beginning of this year. As for now the benefits of the operation appear substantial. The company consolidated nine data centres into two, which cut the IT infrastructure costs by 30% by eliminating 1,000 servers. Worth mentioning is also the environmental impact because, thanks to the implementation of this cloud, the carbon dioxide emission was reduced by 16,800 tons [23].

On a less positive note there are some concerns expressed by potential cloud users concerning data security in this model. The latest revelations by former NSA worker Edward Snowden concerning the agency's electronic surveillance PRISM program have created a perception that US government has an unlimited access to the data stored on the servers of companies like Google and Microsoft. That in turn provoked some worries about data safety and according to a recent survey by the Cloud Security Alliance, a non-profit organization, 56% of respondents (different company officials) said that they would be hesitant to allow US firms to handle their data [24].

Nevertheless we can expect that when more mature standards concerning the data security are achieved, cloud computing will gain more importance as one of the models of IT services outsourcing. The yearly report *BSA Global Cloud Computing Scorecard* evaluating “the international policy landscape for cloud computing” in 24 countries stated in its 2013 issue that the conditions for implementing cloud computing solutions in most countries are improving. The top three countries ranked in this report regarding the security and privacy legislation as well as broadband penetration in the country and the general support for a digital economy were Japan, Australia and the US. Poland is ranked 12th in this report, a slip of one place from 2012 due to “the small increases in the privacy policy and infrastructure development” [25].

To sum up, we can say that cloud computing can be considered an important new way of outsourcing IT services. It enables the companies not only to outsource

the infrastructure, but whole processes of management and administration of the IT systems including hardware and software used by the company. It also represents substantial cost savings and gives the opportunity to the small to medium sized enterprises to tap into their potential without requiring significant financial investment.

7. Conclusions

Summing up the analysis provided in the article we can conclude that there are some important changes in the strategies of sourcing IT services for all types of companies. The trend of cost cutting as a business priority that we have observed during the last decade is fading and instead we can see a tendency that we can consider as a more mature approach to cost optimization but without compromise on customers' perception, quality, core business needs and technological development. Therefore the decisions concerning the sourcing of IT services are also taken with consideration to these factors. The sourcing of IT services in offshore locations will still remain an important part of the business, but after some lessons learned by the early adopters of this solution we can expect some considerable improvements to be introduced in the coming years. The outsourcing users have also spotted the importance of differentiating the core business functions and more "routine" tasks. Core IT functions will probably tend to be performed in-house or, if outsourced, they will not be placed in very remote locations like India or China but instead the notion of nearshoring will become more common. The second category, "routine" projects and basic IT support that not represent the core value for companies, will most likely remain outsourced or even offshored but most probably with stricter service level agreements, not only on a basic quantitative level, but also on a qualitative one as well. The importance of flexibility in adapting the new technologies will also change relationships between the outsourcing users and their providers mostly regarding the type of contracts signed. The companies will also embrace new development opportunities resulting from dynamic technological changes that we have already observed in the form of various cloud computing solutions.

REFERENCES

- [1] Overby S., *7 lessons of the Offshoring Pioneers*, www.cio.com April 19, 2013.
- [2] Baldwin H., *Outsourcing, Adieu: Companies retake the reins on IT services*, www.cio.com July 18, 2013.
- [3] *On the turn; India's outsourcing business*, The Economist, January 19, 2013.

- [4] Du Preez D., *Outsourcing contracts leave IT leaders feeling 'stuck in the past'*, www.cio.com July 3, 2013.
- [5] Crane J., *The death of outsourcing and other IT management trends*, www.forbes.com/sites/ciocentral/ December 28, 2012.
- [6] *Welcome home; Offshoring*, The Economist, January 19, 2013.
- [7] *Here, there and everywhere*, The Economist, January 19, 2013.
- [8] Stiglitz J. *Outsourced and out of work*, www.project-syndicate.org July 4, 2013.
- [9] Overby S. *Offshoring will kill 1,5 million IT jobs by 2017*, www.cio.com August 30, 2013.
- [10] Sen A. *Bank of America shifts some projects back to US from India*, www.livemint.com May 13, 2013.
- [11] Sen A. *US-based outsourcing firms gain favour*, www.livemint.com Jul 8, 2013.
- [12] Thibodeau P. *U.S. workers found to outperform offshore staffers*, Computerworld, August 1, 2013.
- [13] *Outsourcing święci triumfy w Polsce*, www.egospodarka.pl January 2, 2013.
- [14] *Polski sektor BPO liderem regionu*, www.egospodarka.pl August 16, 2013.
- [15] *Best and brightest; Education standards*, The Economist, August 17, 2013.
- [16] *Polska staje się liderem branży IT w Europie. Niebawem wyprzedzimy Rosję*, www.wirtualnemedial.pl May 24, 2013.
- [17] Overby S. *9 IT outsourcing trends to watch in 2013*, www.cio.com December 18, 2012.
- [18] *Benchmarking IT industry competitiveness 2011*, BSA, <http://globalindex11.bsa.org/>
- [19] Overby S. *7 more IT outsourcing lessons from Offshoring Pioneers*, www.cio.com April 22, 2013.
- [20] Overby S. *Is integration-as-a-service the IT model of the future?*, www.cio.com September 13, 2012.
- [21] Lydecker D. *Cloud services are poised for a breakout moment*, www.cdwsolutionsblog.com, May 30, 2013.
- [22] Zaka Z. *Chmura w biurach*, Wprost, July 28, 2013.
- [23] Overby S. *How a private cloud saves money and environment*, www.cio.com, January 18, 2013.
- [24] Corbin K. *US cloud firms suffer from NSA PRISM program*, www.cio.com, July 25, 2013.
- [25] *2013 BSA Global Cloud Computing Scorecard*, www.cloudscorecard.bsa.org
- [26] Radło M. *Offshoring i outsourcing. Implikacje dla gospodarki i przedsiębiorstw*, Oficyna Wydawnicza SGH, 2013.

POWER LAW AND SELF-SIMILARITY IN THE DISTRIBUTION OF NATIONAL INCOME

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Economic systems as complex systems are the source of many unconventional researches. The actual phenomena in complex systems have the non-scalability features and non-scalability does not exist without the power laws. This paper presents the occurrence of power series of rights and self-similarity in the distribution of national income in 2010, in terms of countries, the European Union and the Polish sub-regions. This means that one can study economic systems using tools of complex systems theory. This applies especially to the study of the mechanisms governing the system at the local level that generate global action.

Keywords: power-law distribution, non-scalability, self-similarity, a complex system

1. Introduction

The general theory of complex systems provides a perfect foundation for the study of rights underlying operations of such systems. Economic systems as complex systems are home to universal laws, among which the most important are exponential power laws.

The system comprises a circuit whose operation is highly complex, and its complexity does not result from the mathematical difficulties that occur when attempting to describe or modeling. Traditional methods of drawing conclusions on the basis of information, such as trend analysis, have limited the usefulness of

complex systems. It is a consequence of phenomena characterizing the operation of such a system. The most important features of complex systems include [4]:

- unusual sensitivity to initial conditions,
- multiplicity of unpredictable interactions that occur between the components,
- constant evaluation.

Complex systems are home to a number of characteristic phenomena such as non-scalability dependence on power law, self-organization. In this approach, an economic system is characterized by the interaction of distributed agents, the lack of a central control center, multi-level organization, continual adaptation and the lack of overall balance. There are also complex systems that are completely non-deterministic, predicting their future behavior based on data from the past is virtually impossible. In complex systems, there is also a constant self-organization [6].

Complex system is the Internet, which is often used to study various phenomena. Also, business interactions, financial accounting are examples of issues in which there are investigated the characteristics of complex systems.

Complex systems and the actual phenomena included in them are characteristic of non-scalability, and non-scalability does not exist without power laws. Interdisciplinary researches on the prevalence of power laws confirm the operation of laws of Pareto, Zipf, Gibrat in economic systems [5, 9, 10].

2. Power law

Today, technology development made it possible to collect and study the actual data on an advanced level. Exponential distributions and the related concept of non-scalability has become the subject of many studies, not only in technical sciences, but also in the natural and social sciences. The most commonly used examples of the occurrence of power laws is the dynamics of the financial markets, the distribution of wealth in society, citation rate in scientific articles, the number of entries on the website. Exponential laws in the context of complex systems are analyzed in the study of the GDP of countries in financial profits of companies of different industries, sizes of cities.

Distribution of wealth in society was studied in the late nineteenth century by Pareto, who analyzed incomes statistics in Italy, and he said that the distribution of the power series is described in the power law. This is a consequence non-scalable distribution of wealth. His discovery is invoked today in the course of GDP in international trade, as well as, in an analysis of social inequality. Today we know that the complex system is inextricably linked to the occurrence of power distributions.

Exponential probability distributions can be expressed as a formula [3, 4]:

$$P(x) = cx^{-\alpha}, \quad (1)$$

where x is a random variable discrete or continuous, α is a constant parameter of the distribution known as the exponent or scaling parameter, c is normalization constant.

In case of continuous random variable probability density is:

$$P(x) = \frac{\alpha - 1}{x_{\min}} \left(\frac{x}{x_{\min}} \right)^{-\alpha}, \quad (2)$$

where constant C was determined from the normalization condition

$$\int_{x_{\min}}^{\infty} P(x) dx = 1 \quad (3)$$

assuming that x_{\min} is the smallest value of the variable x , while $\alpha > 1$.

When the random variable is discrete, power-law probability distribution is:

$$P(x) = \frac{x^{-\alpha}}{\xi(\alpha, x_{\min})}, \quad (4)$$

where

$$\xi(\alpha, x_{\min}) = \sum_{n=0}^{\infty} (n + x_{\min})^{-\alpha} \quad (5)$$

for $\alpha > 1$, is a generalized zeta function, which satisfies the normalization condition.

$$\sum_{x=x_{\min}}^{\infty} P(x) = c \xi(\alpha, x_{\min}) = 1. \quad (6)$$

Due to the difficulty in calculations, the sums of power functions are approached by integral. Thus in most cases, random variables are treated as continuous.

The average value of a random variable X with power-law distribution is equal to the integral.

$$\langle x \rangle = \int_{x_{\min}}^{\infty} x P(x) dx \quad (7)$$

The expression is divergent for $\alpha \leq 2$ the function distributions have infinite expected value, which means that none of the experimentally determined average values will be true. Non-scalability of studied systems will be demonstrated by the lack of repeatability and large fluctuations in the results.

Also for $m \geq \alpha - 1$ any moments $\langle x^m \rangle$ of examined distributions are divergent.

Therefore, in real systems beside the small and medium-sized events, there will appear extreme events (international armed conflicts, people with incomes comparable to the revenue of whole societies, global financial crises).

For the power-law distribution the characteristic exponent can be determined using the formula:

$$\alpha = 1 + n \left[\sum_{i=1}^n \ln \frac{x_i}{x_{\min}} \right]^{-1} . \quad (8)$$

Where x_i for $i = 1, 2, \dots, n$ represent the values of observed events. Parameter x_{\min} means the smallest value of the variable x_i about which it may be said that examined distribution has a power-law character for all $x_i \geq x_{\min}$.

Power-law distribution can be found in the literature under the names of non-scalable distribution, Pareto distribution, Zipf distribution [5, 9, 10]. Scientific results from the traditions and theories from which they arise. Consequence of the power law is the Pareto rule, which says that in a free market economy 80% of goods is held approximately by 20% of the richest members of the population. It is universal, which means that market mechanisms and free competition are not conducive to the equitable distribution of wealth.

Equally, you can meet the application of Zipf law, which in the original version was related to the words occurrence in a natural language, and the frequency is inversely proportional to the ranking. Application of this law refers to the distribution of GDP, or the study of population in urban areas.

The economic systems are complex systems constantly undergoing self-organization, providing the basis for creating a free market and competition. The basic step is the knowledge of the mechanisms governing the system at the local level, because the self-organization takes place in the direction of local activities to global consequences [6]. Power law is one of the common signatures of a nonlinear dynamical process, chaotic process, which is at a point self-organized. With power laws it is possible to express self-similarity of the large and small, i.e. to unite different sizes and lengths. In fractal and, for example, there are many more small structures than large ones. Their respective numbers are represented by a power law distribution. A common power law for all sizes demonstrates the internal self-consistency of the fractal and its unity across all boundaries. The power law distributions result from a commonality of laws and process at all scales [7].

3. Power laws in income distribution

In studies of complex systems, in which there are power law distributions, there have been examples of economic issues. Of interest are the results of research on the Japanese economy, as compared to the Italian economy, where there were studied business incomes of various industries [8], as well as research on the sizes of cities [1, 2].

To present the occurrence of power-law distribution in the distribution of national income we used data including selected countries, the European Union and Polish sub-regions. Research was related to the degree of similarity of the phenomena occurring, regardless of the spatial dimension. Polish sub-regions were selected as territorial units NUTS 3 in territorial classification of the European Union.

Calculations and graphs were prepared using the Statistica. The variable [v] shows the share of GDP of countries in the world, the European Union and the Polish sub-regions involved in the country's GDP.

Databases have been obtained from the analysis of the International Monetary Fund (report of April 2011, for the year 2010). Data for the Polish sub-regions derived from information portal of GUS (The Polish Central Statistical Office) from the document "Gross Domestic Product of regions and sub-regions in 2000-2010". The country or sub-region with the highest income received position (rank) 1. To present power laws there have been used two graphs: a scatter diagram and graph in the double logarithmic scale, which allows discovering the nature of power law distribution. They show how the distribution of the fluctuations depends on the number of cases.

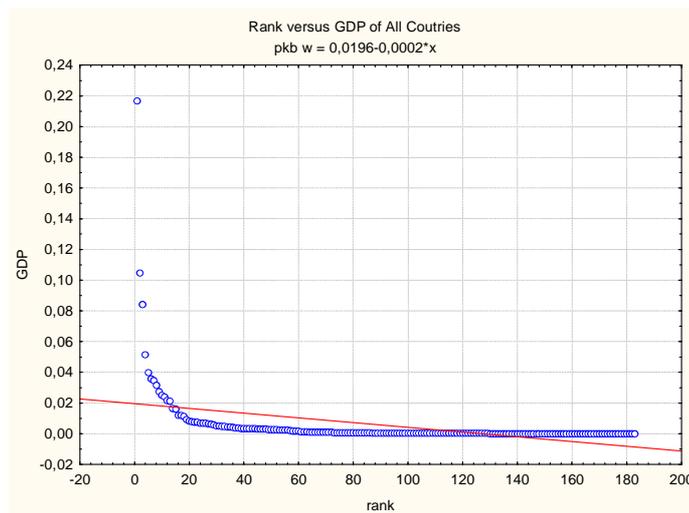


Figure 1. The share of 182 countries in the world in nominal GDP generated in 2010

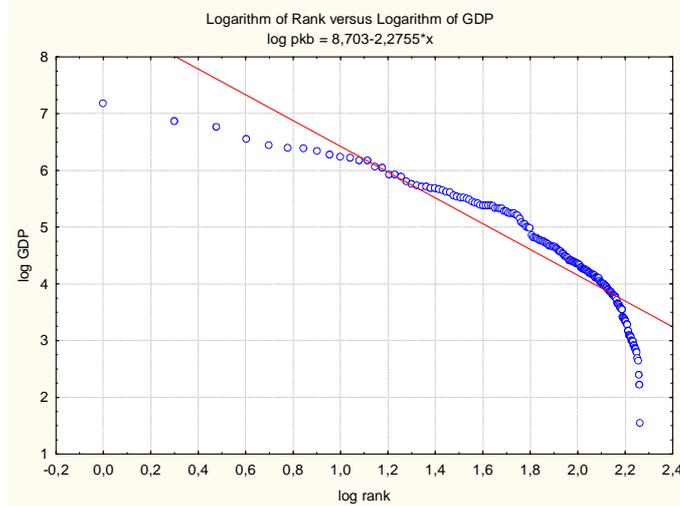


Figure 2. The share of 182 countries in the world in nominal GDP produced on a logarithmic scale in 2010

Table 1. Descriptive statistics regarding the participation of 182 countries in the world in nominal GDP generated in 2010

Descriptive statistics					
	N important	Mean	Minimum	Maximum	St. deviation
v	183	0,005468	0,000001	0,216683	0,019893

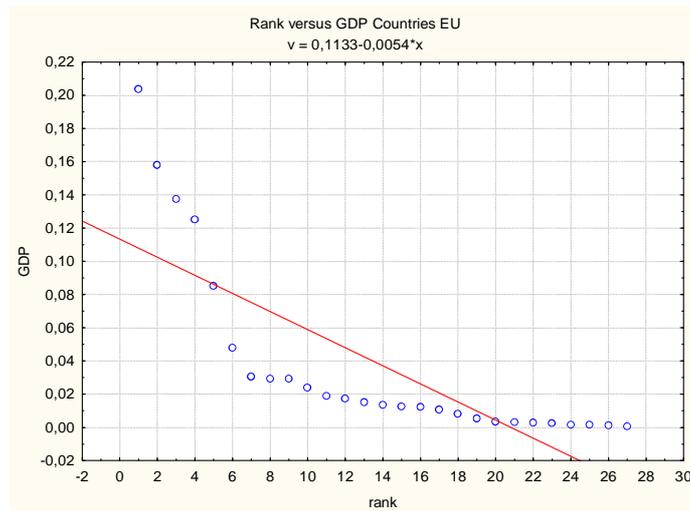


Figure 3. The share of the 27 countries of the European Union in nominal GDP in 2010

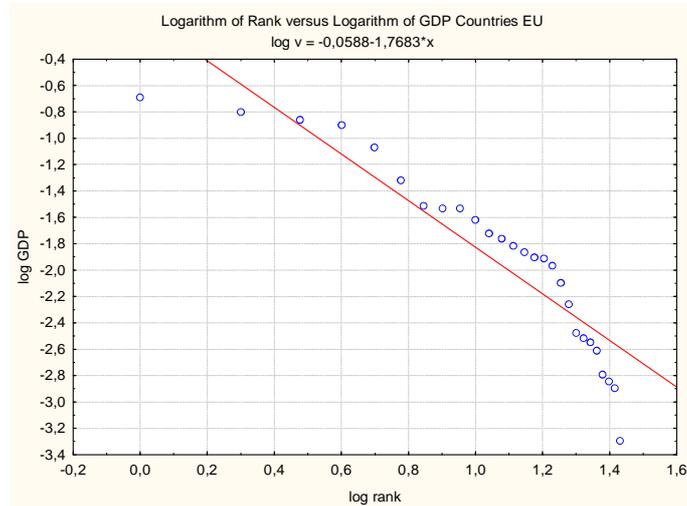


Figure 4. The share of EU-27 in nominal GDP shown on a logarithmic scale in 2010

Table 2. Descriptive statistics regarding the participation of 27 countries of the European Union in the resulting nominal GDP in 2010

Descriptive statistics					
	N important	Mean	Minimum	Maximum	St. deviation
v	27	0,037037	0,000506	0,203498	0,054853

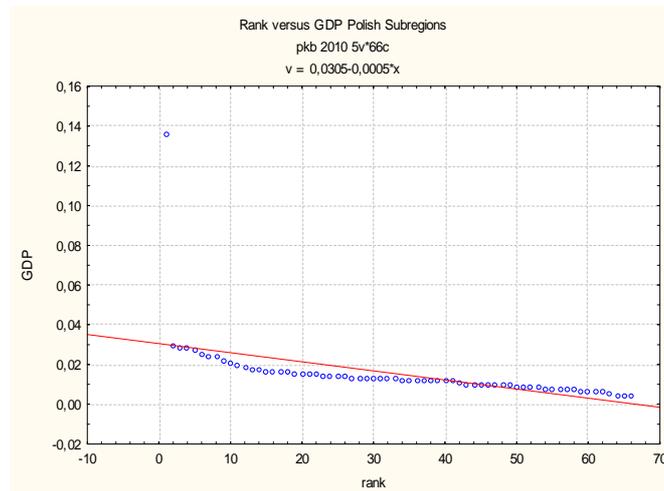


Figure 5. The share of 66 Polish sub-regions in nominal GDP in 2010

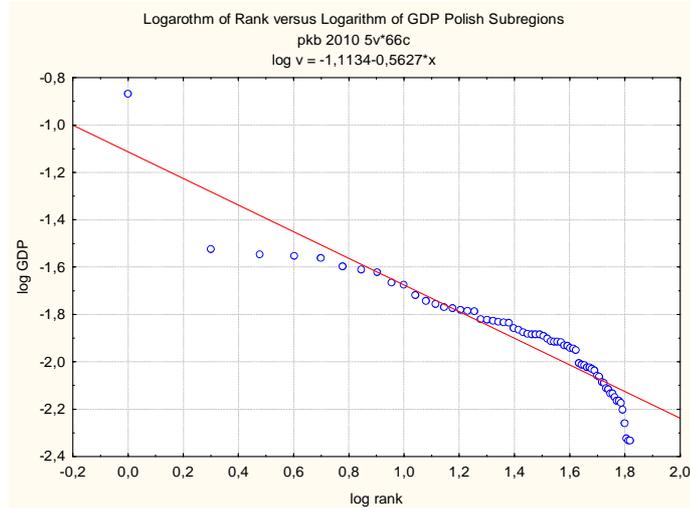


Figure 6. The share of 66 Polish sub-regions in nominal GDP on a logarithmic scale in 2010

Table 3. Descriptive statistics regarding the participation of 66 Polish sub-regions of the resulting nominal GDP in 2010

Descriptive statistics					
	N important	Mean	Minimum	Maximum	St. deviation
v	66	0,015152	0,004644	0,135372	0,016218

4. Summary

The charts that were used to visualize the given problem, suggest, due to the existing self-similarity, overlapping the power laws in the distribution of national income, and thus confirm the existence of these laws in economic systems. Non-scalability resulting from the graphs confirmed their presence at different levels of the studied phenomenon.

The values for the advanced, "rich" countries or sub-regions, in the logarithmic scale graphs normally form a line graph. For other cases, there is no such possibility. This shows that the existing inequalities in the distribution of national income at different levels cannot be avoided. It seems that on a global basis – as the most numerous, inequality will be exacerbated. It is a feature of the occurrence of power laws' distributions, where beside small and medium-sized cases, there must appear extreme events. Non-scalability is manifested by a lack of repeatability and large fluctuations in the results.

As a result, the rich countries of the world will grow faster than the others. What supports the hypothesis is also a significant share of the rich sub-EU countries in obtaining EU funds, and the development of large urban agglomerations. Interesting seem the programs aimed at reducing social inequalities that by means of the funding countries or 'poor' regions will compensate for the differences. However, a large part of funds obtained in such way anyway goes to the "rich" who are the owners of such new technologies and who thus will continue to increase their resources.

A very interesting phenomenon to be observed when examining economic systems, in the context of current power laws, are the results obtained for industries where there is a lack of competition, and even monopoly. These examples are characterized by the absence or low occurrence of power laws. This includes industries where there is poor competitiveness. An example is the energy, and in some countries, extractive industries controlled by the government.

REFERENCES

- [1] Axtell R., Flirida R. (2006) *Emergent cities: micro – foudations of Zipf's law*.
- [2] Axtell R. (2001) *Zipf Distribution of U.S. Firm Sizes*, Science 293, 1818-20.
- [3] Clauset A., Shalizi C.R., Newman M.E.J (2009) *Power – law Distributions in empirical Data*, SIAM Review 51(4) 661-713.
- [4] Fronczak A., Fronczak P. (2009) *Świat sieci złożonych, od fizyki do internetu*, Wydawnictwo Naukowe PWN, Warszawa.
- [5] Gibrat R. (1931) *Les Inegalites Economiques*, Sirey, Paris.
- [6] Grabowski F. (2013) *Nonextensive model of Self – Organizing Systems*, Cadmus Art.CPLX21438, 1-10.
- [7] Komulainen T. (2004) *Self-Similarity and Power Laws*, Helsinki University of Technology, Control Engineering Laboratory, Helsinki, Finland, Report 145/2004, 109-122, <http://neocybernetics.com/report145/Chapter10.pdf>
- [8] Okuyama K., Takayasu M., Takayasu H. (1999) *Zipf's law in income distribution of companies*, Physica A., 269, 125-131.
- [9] Pareto V. *a Le Cours d' Economie Politique*, Macmillan, London, pp. 1896-1897.
- [10] Zipf G.K. (1941) *National Unity and Disunity*, Bloomington, Indiana, Principia.

SOME REMARKS ON LOGISTICS INVESTMENTS AMONG POLISH FOOD PROCESSING AND AGRIBUSINESS COMPANIES

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Paper reports partial results of survey conducted to explore logistics processes among Polish food processing and agribusiness companies. Data gathered from survey conducted in 2009 and 2010 were used. Investigated companies were divided into four categories: (1) up to 9 employees, (2) 10-49 employees, (3) 50-249 employees and (4) 250 employees and more. Survey was carried out to quantify three research areas: (1) Logistic investments scale among agribusiness companies; (2) Knowledge of solutions for logistics; (3) Plans to acquire new logistic solutions and existing logistic base modernization.

To the best of our knowledge, this research is the first trial that focuses on logistics processes in the Polish agri-business enterprises. This study provided real data about the organization, management and logistics costs in the food processing companies in Poland, covering all agri-business sectors and companies of all sizes.

Keywords: Agribusiness, Poland, Food processing, Logistics investments

1. Introduction

Poland with its strong agricultural heritage is recognizable and leading producer of dairy, apples, potatoes, rye, rapeseed, hogs, and cattle in Europe. Nonetheless, agriculture sector is the least productive sector of the Polish economy, employing about 14% of the work force while contributing less than 4% to the gross domestic product (GDP) for 2010. Poland's agricultural sector remained

largely in private hands during the last decades before the transformation in 1989. Most former big state farms are now privately owned and represent the largest production enterprises. On the other hand, based on the Central Statistical Office data [3] there are about 1.25 million farmers who have other employment apart from the farm and produce food mostly for their own consumption. These farms are small, no larger than 10 hectares and are highly inefficient, mainly due to inefficient management practices [9]. There are about 326,000 farmers with plots over 20 hectares and only 25,000 with plots over 50 hectares. These last two categories of farmers produce about 90% of food which is then supplied to agribusiness sector for further processing. In Poland, food processing sector consists of about 30,000 of enterprises and most of them are micro companies (with less than 10 employees) and small companies (with less than 50 employees) called SME.

Referring to agribusiness we mean a generic term for the various businesses involved in food production. More specifically, Davis and Goldberg (1957) [4] defined agribusiness for the first time in 1957 as the system which integrates of all operations involved in the manufacture and distribution of farm supplies, production operations on the farm, and the storage, processing, and distribution of farm commodities and items made from them.

Undoubtedly, logistics issues are very important for agribusiness enterprises, mainly due to the fact that food products are very sensitive to the production and transportation conditions. As a result of inadequate production process, storage and transportation goods may lose their nutrition properties or even can get spoiled. Therefore, in agribusiness industry the logistic chain needs to be particularly well-defined in every aspect of its links including products, products delivery, food production and distribution [1]. This value chain concept assumes that any particular actions being part of the processes implemented by a company should lead to the creation of the value added for both customers and the company itself.

The paper reports partial results of the study on logistics investments and processes in Polish agricultural companies and it is a part of a broader research project on “Logistics processes and the functioning of food processing and agricultural companies in Poland”. In this research we focused mostly on investment issues and the main research questions were:

- (1) The level of ongoing investments among Polish agribusiness companies;
- (2) The knowledge of solutions for logistics;
- (3) The plans to purchase new solutions to support logistics in chosen areas.

The remainder of the article consists of literature overview and three sections. The second section presents the characteristics of the sample and experiment design. The third section presents the results of a survey among Polish agribusiness companies. Then, in the last section, we discussed the findings and summarized the research.

2. Literature review of similar problems

Logistics is an essential function in every organization. It is best viewed as a single, but it consists of series of linked activities. These range from procurement to initiate the flow of raw products into an organization, through to physical distribution to deliver final products to customers. Not only is logistics essential, but it is also expensive, so it is in the awkward position of being essential, expensive and spanning most of the organization's operations [13].

The way in which the logistics processes are organized affects costs, profits, relations with suppliers and customers, customer service, and indirectly every other aspect of company performance [13]. Therefore, it plays a significant role in the successes or failures of every organization. Undoubtedly, the role of logistics has changed and it became more important and responsible for the value-adding activities instead of cost-generating.

According to Haan et al. (2007)[6], based on the survey among Polish small and medium firms, the companies use different coordination mechanisms when they grow in size. Large firms apply more formal management techniques as well as more sophisticated information systems to deal with the increased business complexity. These results give empirical support to the conceptual growth models and provide the description of managerial environment for decision making in logistics. On the other hand, the authors discovered that logistics and supply chain management are not well developed in the majority of Polish SMEs since specialization of such functions is not too deep in these companies.

In the field of logistics the literature pays also some attention to the use of information systems and computers for logistics as the factors that create value indirectly. The problem is that SMEs lag seriously in the area of information technology which supports only their administrative tasks. However, Bridge and Peel (1999) [2] refer that use of computers will shift from operational tasks to decision making (financial modeling) in the area of logistics organization and supply chain management in SMEs.

In 2003, a survey among Polish SMEs was held by Kisperska-Moron [6] in which the coordination of the logistics function was analyzed. The results of this survey (based on 127 questionnaires) were used to analyze the managerial environment for logistics management. Those surveys showed that Polish manufacturers changed their attitudes towards customer service and its competitive advantage aspects. They were aware of growing customer requirements and adopted sets of standards to evaluate that service.

Taking into account the declared knowledge of the logistics concept a study by Dimitrov (2005) [5] among 64 manufacturing companies revealed that Bulgarian firms had the knowledge which was much higher than its implementation both in the organizational structures and in the applied managerial

practices. The investigated companies claimed also to have better knowledge of the supply chain management concept than logistics. We suppose that due to a similar level of economic development, the same economic transformation problems and location in Central and Eastern Europe these findings may also concern Polish companies.

The other research by Lehmusvaara and Huiskonen (1998) [10] held among process industry companies discovered the factors that can prevent companies from improving logistics operations. One of them was the lack of investments in control and physical systems including computer systems, equipment and working machines used in logistics. Even if the company had such systems it still did not solve the problem. The reasons were that the benefits of the systems were not realized by the users of the systems; the users were not able to operate with the systems; and finally the management did not require the employees to use these systems. Although this study was done more than 10 years ago, we expect that in case of Polish agribusiness companies these findings may be still valid.

3. Investments issues related to logistics

During the last few decades, logistics developed from a supporting function to an important set of activities that create a great value added to companies. In order to create a value added every business needs investments. Investments, understood generally as company's expenses to increase its income in the future, however, are expensive. Investments require engaging own or borrowed capital. Therefore, in today's market conditions the choice of cost-effective concept of investing in particular processes is not an easy problem for the company.

The level of ongoing investments

In the survey we asked about company's level of ongoing investments taking into account the consumption of fixed capital which reflects the decline in the value of the fixed assets of enterprises due to normal wear, obsolescence and normal rate of accidental damage. We had four categories: (1a) companies, in which the value of investments exceeds the value of fixed capital consumption; (2a) companies, in which the value of investments is equal to the value of fixed capital consumption; (3a) companies, in which the value of investments is lower than the value of fixed capital consumption; (4a) companies, in which investments are not undertaken. There were also 9.5% companies, which couldn't be assigned to any category, because they did not answer the question about the scale of investment processes. Distribution of non-response was similar in the companies according their size. As a result we could assign 19.1% of companies to the 1a category, 30.8% to the 2a category, 28.8% to the 3a category, 11.8% to the 4a category, please see Table 1 for details.

Table 1. Distribution of answers to the question about the level of the investment processes in companies

Investments scale	Count	Percent
(1a) investments exceed the value of fixed capital consumption	97	19.1
(2a) investments are equal to the value of fixed capital consumption	156	30.8
(3a) investments do not cover the value of fixed capital consumption	146	28.8
(4a) investments are not undertaken	60	11.8
Not filled in	48	9.5

At first, we were interested in the scale of investments by branch of the companies. This is because the survey was run in hard times as economics of many European countries faced slowdowns. Therefore, we were aware of the fact that crisis could directly or indirectly affects the position of a particular company or the entire branch. A crisis in one industry can have severe adverse effects on companies from completely different branches.

Table 2. Categorization of companies according to investments level and a branch

Branch	Investment	Count	Percent
Meat	low	57	49
Meat	high	59	51
Fruits and vegetables	low	12	36
Fruits and vegetables	high	21	64
Fats and oils	low	1	17
Fats and oils	high	5	83
Milk	low	5	21
Milk	high	19	79
Cereal and starch	low	20	54
Cereal and starch	high	17	46
Bakery	low	117	55
Bakery	high	95	45
Other grocery	low	19	42
Other grocery	high	26	58
Animal feed	low	9	69
Animal feed	high	4	31
Beverages	low	6	55
Beverages	high	5	45
Tobacco	low	1	100
Not filled in	-	9	100
Sum		507	

To analyze the companies' situation taking into account the investments we distinguished two groups of firms based on the scale of the investment processes. Companies that invested a lot, in which investments exceeded or were equal to the value of fixed capital consumption formed investment category "high". The other companies were assigned category "low", see Table 2 for details.

It turned out that the largest scale of investments took place in companies operating in fats and oils industry (83%), milk processing (79%), fruits and vegetables (64%) and other grocery (58%).

The next step was to analyze the relations between the size of a company and the investment scale. We used a surface chart with percentage shares calculated as the number of items that fall into the categories of companies according to their size (A-D) and answers assigned to a particular category (1a-4a) divided by the group count. The crossing of the categories presents percentage (as interval) of the companies which fall into the particular category.

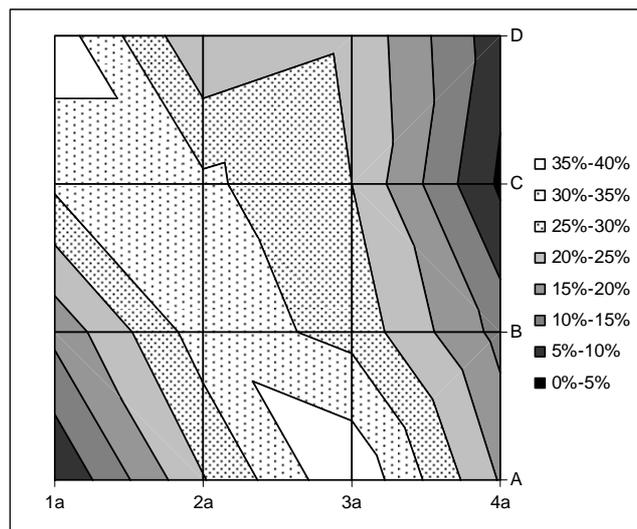


Figure 1. The percentage share of investments (1a – 4a) taking into account the size of the company (A – D)

From Fig. 1 we can learn that the size of company is accompanied by the level of investment processes. Among large enterprises (D) there are between 35% and 40% of them, in which investments exceed the value of fixed capital consumption, see upper left corner of the figure with interval from 35% to 40%. In case of micro companies (A) we can find that investments do not cover the value of fixed capital for about 35%-40% of them. At the same time, between 15% and 20% of these companies declare that investments are not undertaken at all. Finally, only between

5% and 10% of micro firms admitted that investments exceed the value of fixed capital consumption.

The knowledge of solutions for logistics

One of the conditions to obtain competitive superiority in a highly fragmented agribusiness market is to create a value added at every step of production process. Therefore, we believe that the logistics and supply chain management are the main components which are responsible for the excellence of whole company. It seems especially important for the food processing companies, which usually cooperate with many products providers and supplies its final products to many recipients. Nowadays, organization of logistics and supply chain management can be highly supported by wide range of IT systems (Thakur and Hurburgh, 2009). For instance, in small companies the use of information technology is limited to operational and administrative tasks while bigger companies use IT and available systems to support decision making and planning.

Introduction of information technology solutions to support logistics requires not only resources (money), but also a professional knowledge. Therefore, we asked companies in survey to choose their knowledge about logistic solutions offered by IT industry. There were four answers to choose: (1b) our knowledge is on sufficient level, (2b) our knowledge is usually sufficient (3b) sometimes we lack knowledge (4b) our knowledge is definitely too small. There were also 5.1% companies, which couldn't be assigned to any category, because they did not answer the question. Distribution of non-response was similar in the companies according their size. For details, please see Table 3.

Table 3. Distribution of answers to the question about the knowledge on solutions for logistics

The knowledge of solutions for logistics	Count	Percent
(1b) knowledge is on sufficient level	97	19.1
(2b) knowledge is usually sufficient	190	37.5
(3b) sometimes we lack knowledge	114	22.5
(4b) knowledge is definitely too small	80	15.8
Not filled in	26	5.1

To analyze the relations between the size of a company and the knowledge of solutions dedicated to logistics we used a surface chart with percentage shares calculated as the number of companies according to their size (A-D) and the number of answers assigned to a particular category (1b-4b) divided by the group count.

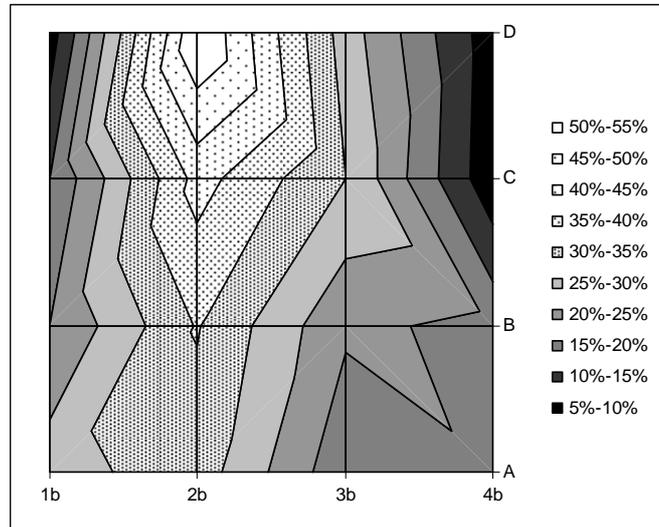


Figure 2. The percentage share of the knowledge of logistic solutions (1b – 4b) taking into account the size of the company (A – D).

In Figure 2 we can see that companies' evaluated their knowledge of logistic solutions as usually sufficient (category 2b). However, there is a relation between the company size and the percentage of answers in 2b category. Such progressive concentration of declaration round the 2b category, which grows up with the size of the company can be interpreted as a growth of declared level of knowledge of logistic solutions due to the growth of company size.

Plans regarding logistics

In the survey the respondents were also asked about their plans and intentions regarding the logistics in company. There were 10 categories to choose from (multiple choice): (1) Implementation of IT solutions; (2) Implementation of activity based costing system for logistics; (3) Investment in warehouses; (4) Investments in transportation means; (5) Outsourcing of warehouses; (6) Outsourcing of transport; (7) Investments in packaging equipment; (8) Centralization of logistics tasks by setting up the logistics department; (9) Participation in special courses, trainings and studies connected with logistics; (10) Other investments.

Not surprisingly, the results showed that the priority for the companies is to invest in transportation means (vehicles), regardless the company size. This finding is consistent with other research by LaLonde et al. (2007). They found, based on regular surveys that transportation is the most commonly included activity in logistics, and therefore it is the main factor that is subject to investment. In our

survey, we have found that more than a half of the companies (52.5%) are planning to invest in transportation means.

The other important issues for the companies are: investments in warehouses (26.4%), investments in packaging equipment (26.0%) and implementation of computer aided solutions and information technologies (20.5%). Noticeable is that with the size of the company the attitude to invest in particular area also is greater. For instance, only 1.6% of micro firms (A) declare investments in information technologies to support logistics. In case of small companies (B), 16.4% of them see the need to invest in information technologies. Continuing, 37% of medium firms (C) want to invest in IT solution, and finally, 48.3% of large companies (D) are interested in computer solutions.

We continued our analysis to find out how many different areas as a subject to invest were chosen by respondents. Fig. 3 presents the findings.

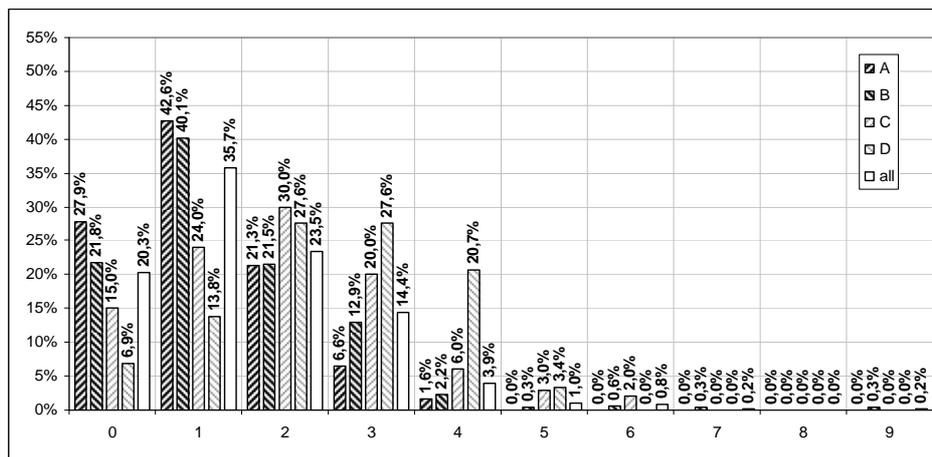


Figure 3. The percentage share of companies which declared plans and intentions to invest in logistics solutions in given areas (0 – 9). Where answer 0 means that the company is not willing to invest, 9 means that company plans to invest in nine different areas

Source: Authors' elaboration based on survey data

One-fifth of the companies (20.3%) declared having no plans or intentions regarding implementation of logistic solutions. These are micro and small companies that do not plan expenditures on logistics. Slightly more than one-third (35.7%) of the companies is going to invest in just one area. This is particularly true for micro and small companies in which 42% and 40.1% of them respectively, have chosen only one filed to invest.

Plans to implement solutions to support logistics in more than two areas appear more frequently among medium and large companies. In particular, 30% of

medium and 27.6% of large companies declare investments in two different fields. Taking into account investments in three areas of logistics we found that 20% of medium and 27.6% of large companies had such intentions. Finally, 20.7% of large enterprises considered to support four different aspects of logistics.

4. Conclusions

This paper has been aimed at presenting the state of Polish agribusiness companies concerning the investments related to logistics. The objective was to shed light on three issues: (1) The level of logistics investments among agribusiness companies; (2) The knowledge of the solutions for logistics; (3) The plans to acquire new solutions for logistics. Instead of proving specific research hypotheses' concerning the logistics issues we rather intended to present general picture of Polish agribusiness companies. Realization of the research objectives seems to be very important for a thorough diagnosis of logistics systems and to indicate possible directions of improvement on this field.

The major findings of our research in the area of logistics are as follows:

- 1) The results of investigations show that in agribusiness sector the scale of investments grow up together with the size of company. In case of large and middle companies there are majority of such firms, in which the scale of logistic investments is equal or exceed the value of fixed capital consumption.
- 2) Taking into account the branch of the companies we could find that some of them invest much more than others. It turned out that the biggest scale of investment processes (calculated as percentage of companies investing at least to cover the fixed capital consumption) took place in companies operating in fats and oils industry (83% of them invested), milk processing (79%), fruits and vegetables (64%) and other grocery (58%).
- 3) The declared knowledge of the logistics solutions is usually perceived as sufficient. In particular, there is a relation between the company size and the growing number of respondents indicating sufficient level of their knowledge.
- 4) When it comes to plans regarding the logistics a certain relation between the size of the company and the number of positive declarations was apparent. In eight out of ten categories of possible investments the percentage share of companies grew up together with the size of the company. Not surprisingly, the results showed also that the priority for the companies is to invest in transportation means (vehicles), regardless the company size. One-fourth of companies declared investments into warehouses as well as packaging equipment. One fifth of companies mentioned about the plans to implement computer solutions.

The overall results of the research suggest that most of the Polish agribusiness companies are aware of the fact that today's competitive market environment requires investment efforts. These efforts should lead to the creation of the value added for the customers and the company. Our studies indicate that the scale of investments, the knowledge of the solutions for logistics and finally the plans to acquire new solutions for logistics are the domain of large companies. This is due to the fact that many of small companies operate in a very traditional way [6], not attempting to create logistics solutions to reduce the costs and to help them operate more effectively. Our work confirmed also that logistics and supply chain management are not well developed in the majority of Polish agribusiness companies. This is not surprising for micro and small companies in which specialization of different functions (including logistics) is operated by one or two staff members.

REFERENCES

- [1] Blaik P., Matwiejczuk R. (2009) *Logistic processes and potentials in a value chain*. LogForum 5, 2, 2.
- [2] Bridge J., Peel M. (1999) *Research note: a study of computer usage and strategic planning in the SME sector*. International Small Business Journal 17, 82–87.
- [3] Central Statistical Office in Poland (2010) *The National Agricultural Census results, conducted in autumn 2010* (www.stat.gov.pl).
- [4] Davis J.H., Goldberg R.A. (1957) *A Concept of Agribusiness*. Division of Research. Graduate School of Business Administration, Harvard University Press, Boston, USA, MA.
- [5] Dimitrov P. (2005) *Logistics in Bulgarian manufacturing companies*. International Journal of Production Economics 93–94, 207–215.
- [6] Haan J., de Kisperska-Moron D., Placzek E. (2007) *Logistics management and firm size; a survey among Polish small and medium enterprises*. International Journal of Production Economics 108, 119–126.
- [7] Kisperska-Moron D. (2005) *Logistics customer service levels in Poland: Changes between 1993 and 2001*. International Journal of Production Economics 93–94, 121–128.
- [8] LaLonde B.J., Ginter J.L., Stock J.R. (2007) *The Ohio State University 2007 survey of career patterns in logistics*, www.cscmp.org.
- [9] Latruffe L., Balcombe K., Davidova S., Zawalinska K. (2005) *Technical and Scale efficiency of Crop and Livestock Farms in Poland. Does Specialisation Matter?* Agricultural Economics 32 (3), 281–296.

- [10] Lehmusvaara A., Huiskonen J. (1998) *What prevents companies from improving logistics operations: Some empirical findings*. International Journal of Production Economics 56-57, 389-396.
- [11] Mangina E., Vlachos I. (2005) *The changing role of information technology in food and beverage logistics management: beverage network optimization using intelligent agent technology*. Journal of Food Engineering 70, 403–420.
- [12] Thakur M., Hurburgh C. (2009) *Framework for implementing traceability system in the bulk grain supply chain*. Journal of Food Engineering 95, 617–626.
- [13] Waters D. (2008) *Supply Chain Management An Introduction to Logistics*. Palgrave Macmillan.

INFORMATION SECURITY MANAGEMENT SYSTEMS IN MARSHAL OFFICES IN POLAND

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The article presents results of a survey concerning Information Security Management Systems (ISMS), which was conducted in Marshal Offices between December 2012 and April 2013. Survey questionnaires were sent to all sixteen Marshal Offices in Poland. The aim of the research was identifying in which government offices information security management systems are implemented, according to which standards are developed and certified and gathering information about factors facilitate the implementation of the ISMS, problems encountered in the implementation of this system and documentation concerning information security.

Keywords: information security, information security management systems, information security policy

1. Introduction

Managing information safety and security [2], [4], [7], [9],[10], [11], [16] in all kinds of organizations is a big challenge for contemporary organizations and institutions.

Information Security Management System (ISMS) is defined in ISO/IEC 27000 standard as part of the overall management system, based on a business risk approach, to establish, implement, operate, monitor, review, maintain and improve information security (see: 2.23. in [5]). According to the standard scope, the stand-

ard 27k family is applicable to all types of organization (e.g. commercial enterprises, government agencies, non-profit organizations). In the field of research concerns the marshal offices [18].

Particularly interesting, from the point of view of research, a group of organizations that decide to implement the ISMS are public administration offices. First and foremost – as opposed to individual commercial organizations all are forced to various contacts with the administration, and so information security in offices corresponds directly to the security of citizens. Secondly, the government offices have a strictly defined scope of its tasks and competencies, so it is easy to conduct a comparative analysis on information security management in different offices, the role of the "specifics" so important in commercial organizations is minimum in offices [1], [8], [15]. Thirdly, finally – last but not least – offices, in accordance with the principles of the access to public information, are particularly convenient research material, and although the practice shows that the tendency to hide information is present among the workers of offices, however, the responsiveness of research organizational units of public administration is definitely higher than in the case of commercial organizations.

2. Aim of the research

The research had primarily cognitive objective, that was (apart from identifying in which government offices are implemented information security management systems, according to which standards are developed and certified) answer the following questions: the reasons why respondents did decide (or not) to implement and certification of ISMS, how long it took to implement the ISMS, identify problems encountered in the implementation of this system, whether they could count on the support of the state administration bodies, which factors facilitate the implementation of the ISMS, which the operations relating to the operation of the ISMS have the most problems, what documentation concerning information security has been implemented in these units, together with the brief overview of the application, whether the administrator of information security has been appointed, and how often safety reviews has been conducted.

The survey is a part of our investigations concerning selected aspects of cybersecurity in government organizations in Poland [12].

3. Method of the research

The research was conducted using a survey questionnaire. For all marshal offices a letter asking for help in the implementation of a scientific study by completing a questionnaire was sent. The content of the letter was posted a link to the ques-

tionnaire in electronic form, which is located on a server google.com. The annex to the letter with a questionnaire in Microsoft Word file was also sent. In the course of the research numerous telephone and e-mail contacts with officials was conducted.

Obtained 13 positive responses. The Office of the Marshal of Podlaskie Voivodeship sent written notice of the lack of interest to participate in the survey, two offices (The Office of the Marshal of Lower Silesia Voivodeship and the Office of the Marshal of Kuyavian-Pomeranian Voivodeship), despite numerous telephone and email communications from investigator, did not submit any response.

4. Results of the research

Among the 13 marshal offices, in nine the information security management system is implemented. In the four offices (The Office of the Marshal of Lublin Voivodeship, The Office of the Marshal of Łódź Voivodeship, The Office of the Marshal of Silesian Voivodeship, The Office of the Marshal of Świętokrzyskie Voivodeship), such a system does not work and in the past had not been attempts to implement it (see Figure 1).

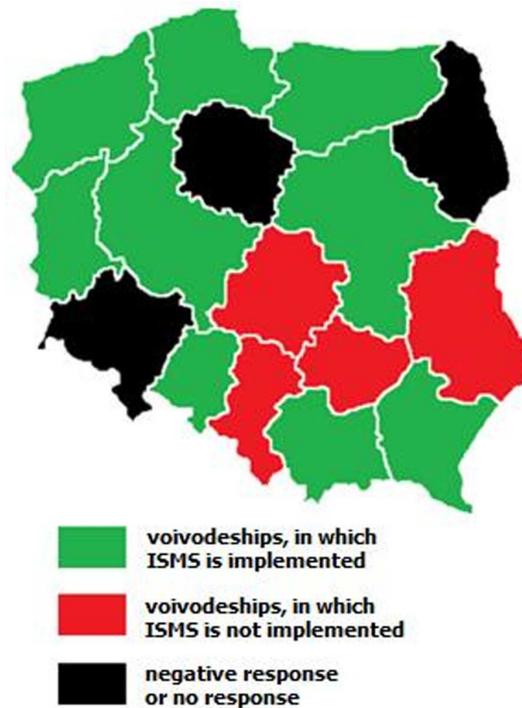


Figure 1. Information security management systems in Marshal Offices

The reasons, why the officials did not take such action, include: lack of funds, lack of time and lack of sufficient knowledge. The reason, why the Marshal Office of the Silesian Voivodeship, was not implemented ISMS is implementation of partial solutions in the field of safety management, which in the opinion of officials are now sufficient due to the nature of the Office.

Seven of the nine implemented Information Security Management Systems – were developed by the recommendations of the standards, including five offices were using PN-ISO/IEC 17799, and two offices ISO/IEC 27002. Detailed answers to the survey questions in this area are presented in Table 1.

Table 1. Development and certification of information security management systems

Voivodeship, in which is the Marshal Office	The system developed by the recommendations of the standards	The system developed by the recommendations of the standards	The system certified compliant with the standard
Lubusz Voivodeship	Yes	ISO/IEC 27002	PN-ISO/IEC 27001
Lesser Poland Voivodeship	Yes	ISO/IEC 27002	PN-ISO/IEC 27001
Masovian Voivodeship	Yes	PN-ISO/IEC 17799	PN-ISO/IEC 27001
Opole Voivodeship	Yes	PN-ISO/IEC 17799	-
Subcarpathian Voivodeship	No	-	-
Pomeranian Voivodeship	Yes	PN-ISO/IEC 17799	-
Warmian-Masurian Voivodeship	Yes	PN-ISO/IEC 17799	-
Greater Poland Voivodeship	No	-	-
West Pomeranian Voivodeship	Yes	PN-ISO/IEC 17799	-

Only in three offices decided to certify the information security management system according to PN-ISO/IEC 27001.

In offices where decided not to certify the ISMS, indicated the following reasons for not taking such action:

- certification does not affect the quality of the information security management (3 answers),
- it is a time-consuming project (2 answers),
- it is an expensive proposition (2 answers).

Respondents from all offices which certify the ISMS said they had decided on this because certification has an impact on the quality of information security management. Also examined the ISMS implementation time. Accordingly, the three offices have identified it as belonging to the range of 6-12 months, one – 12-18 months and four for more than two years.

For the success factors and problems with the implementation of the ISMS [1] respondents indicated respectively, as a source of problems: lack of use of formal methods of implementation of the system (4 answers), lack of substantive preparation workers (3 answers), too extensive documentation (3 answers), insufficient

financial resources (3 answers), lack of experience of the certification body (1 answer).

Only three offices of the nine implementing an Information Security Management System [3] were able to count on the support of the state administration bodies. The stages in which the aid was granted: the establishment information security management system (2 answers), implementation and operation of information security management system (1 answer), monitoring and review of information security management system (2 answers), maintaining and improving information security management system (1 answer), no aid (6 answers).

Only one of the officials showed what this aid consists of:

- The Internal Security Agency and the Inspector General for the Protection of Personal Data supports employees of public administration in the establishment of information security management systems,
- Training own officers and employees, participated in training sessions and conferences organized by other entities,
- Advice and current aid,
- Portals of programs in support the workers on security, guides, explanations, and above all, the database of current legislation and guidelines,
- Visits, audits, inspection, accreditation, certification, etc'.

In another question, the officials indicated which of these factors facilitate the implementation of Information Security Management System. Evaluation factors are shown in Figure 2.

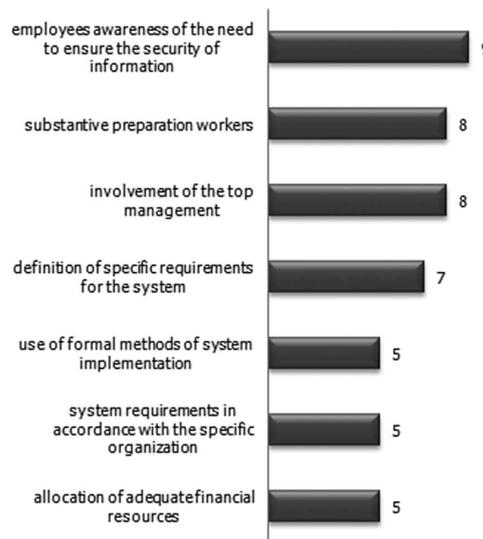


Figure 2. Evaluation of factors that facilitate the implementation of the ISMS

High rating factors: employees awareness of the need to ensure the security of information and involvement of the top management is was highlighted by the comments of an official: ‘The commitment and staff awareness of information security requirements is crucial for the proper functioning of the system. This is achieved by, among others, properly implement the planned course of internal and external training, internal controls, etc.

According to officials, the implementation of Information Security Management System has a positive effect on the unit, especially can increase the level the information security, raising the employees awareness of information security management, is necessary and beneficial. The three officials also indicated that it is an expensive venture (Figure 3).

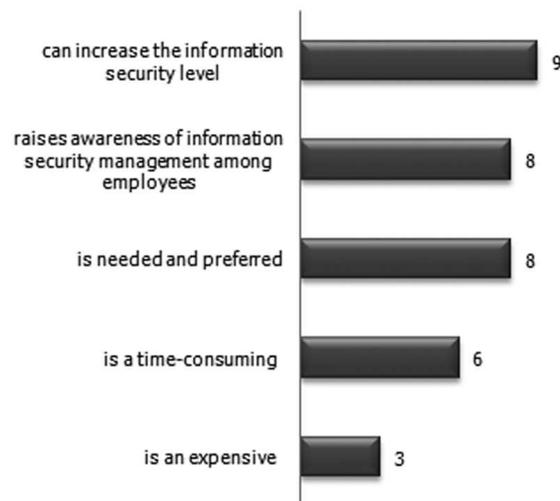


Figure 3. Opinion on the ISMS implementation

Respondents also indicated the steps on the operation of the Information Security Management System, which have the most problems. The results are shown in Figure 4.

One official also indicated a problem with ‘too frequent regulatory changes and changes in the organizational and staffing (though this is inevitable and should be taken them continuously into account)’. This comment, however, should be included under question concerning problems with the implementation of the system.

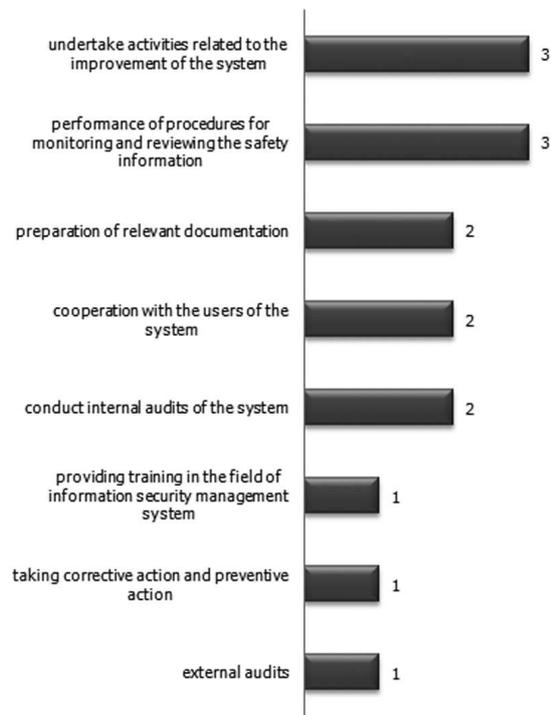


Figure 4. Actions on the operation of the ISMS, which officials have the most problems

Another survey questions focused on conducting documentation. Among the 13 surveyed offices, 12 have developed and implemented an information security policy that contains the policy of protection of personal data in accordance with the requirements of the Law on the Protection of Personal Data [18], [13], [17] and the one of the offices (The Marshal Office of Subcarpathian Voivodeship) has only a policy of protection of personal data in accordance with the requirements of the Law on the Protection of Personal Data [19]. Table 2 presents the characteristics of each document.

Also in each of the 13 units are conducted the security reviews. The frequency of these inspections is shown in Figure 5.

In all of the 13 offices the information security administrators were established and training for employees of the implemented information security policy / protection of personal data policy were conducted.

Table 2. Characteristics of information security documentation in Marshal Offices

Voivodeship, in which is the Marshal Office	Structure	Approximate number of pages	Last updated	Disclosure of document
Lublin Voivodeship	the main document with attachments	102	2012-07-03	Only some parts of the document
Lubusz Voivodeship	the main document with attachments	67	2011-08-16	Yes
Łódź Voivodeship	the main document with attachments	81	2012-06-14	Yes
Lesser Poland Voivodeship	the main document with attachments	50	2012-10-30	Only some parts of the document
Masovian Voivodeship	the main document with attachments	200	2011-12-28 currently being updated	Only some parts of the document
Opole Voivodeship	the main document with attachments	62	2011-06-30	Yes
Subcarpathian Voivodeship	the main document with attachments	43	2012-04-30	Yes
Pomeranian Voivodeship	the main document with attachments	140	2012-04-10	Yes
Silesian Voivodeship	the main document with attachments	110	2012-10	Only some parts of the document
Świętokrzyskie Voivodeship	the main document with attachments	126	currently being updated	Yes
Warmian-Masurian Voivodeship	the main document with attachments	68	2011-11-21	Only some parts of the document
Greater Poland Voivodeship	the main document with attachments	105	2009-08-05 currently being updated	Yes
West Pomeranian Voivodeship	the separate procedures and instructions	about 120	2013-02-22	Yes



Figure 5. Frequency of the security reviews

5. Conclusion

On the basis on the results of the research it can be concluded, that the issues related to information security are known for officers, especially in the field of personal data protection. All offices have examined the relevant documentation, in each unit the information security administrator was appointed, all units have adequate physical security of access to information and appropriate security systems. Therefore officials are performing tasks in field of personal data protection [14], [19].

In 9 offices, from 13 participating in the research, was implemented information security management systems. The main reasons for which other entities involved in the study did not implement such a system are: lack of funds, lack of sufficient knowledge and lack of time. The first two mentioned tend to be understood. Typically, any action aimed at improving a process at the office, are not made because of the limited budget, or lack of proper training. The last reason is due to poor organization of work and lack of willingness to take on new tasks by the officials.

Based on the responses obtained from the offices in which the information security management systems is implemented, key success factors have been identified to implement the ISMS. These include: employees awareness of the need to ensure the security of information, involvement of the top management, definition of specific requirements for the system, substantive preparation workers.

Therefore, in order to achieve the successful implementation of an ISMS it is necessary to continue raising awareness for employees of all levels of the organization and their respective substantive preparation. This can be achieved through the participation of officials in various training courses in the field of information security. In addition, the subject matter should be addressed in different conferences, involving representatives of the public administration.

Actions on the operation of the ISMS, which officers have the most problems are: taking actions related to the improvement of the system and conducting the procedures for monitoring and maintenance of information security. Only a few offices can count on the support of government units in undertaking activities related to the implementation of the ISMS. It is worth noting the answer to the question on the frequency of ISMS review, which acted as a control question in the survey. Review is an activity undertaken to determine the suitability, adequacy and effectiveness of the subject matter to achieve established objectives (see: 3.8.2.2. in [6]) (in this case: ISMS) and can be carried out every few months or in the event of need, but it is impossible to review ISMS which has dozens of pages documentation every week or even every day.

Officials also indicate problems they encountered during the implementation of ISMS. In addition to the questionnaire (lack of use of formal methods of imple-

mentation of the system, insufficient financial resources, too extensive documentation, lack of substantive preparation workers) also drew attention to the problems of the legal and organizational nature. The first is a result of frequent changes in rules on information security and inconsistencies of these provisions during the period of change. The second - the frequent organizational changes in personnel offices.

REFERENCES

- [1] Calder A.: *Nine Steps to Success: an ISO 27001 Implementation Overview*, IT Governance Publishing, UK, 2005, pp. 107-112.
- [2] Gillies A.: *Improving the quality of information security management systems with ISO27000*, TQM Journal, Volume 23, Issue 4, 2011, pp. 367-376.
- [3] Humphreys E., *Implementing the ISO/IEC 27001 Information Security Management System Standard*, Artech House, Norwood 2007, pp. 11-44.
- [4] Ilvonen I.: *Information security culture or information safety culture - What do words convey?*, 10th European Conference on Information Warfare and Security 2011, ECIW 2011, Tallinn 2011, pp. 148-154.
- [5] International Standard ISO/IEC 27000:2009 Information technology — Security techniques — Information security management systems — Overview and vocabulary. First edition, ISO 2009.
- [6] ISO Guide 73 Risk management — Vocabulary. First edition, ISO 2009.
- [7] Jašek R.: *The information security of enterprises and citizens' security context*, Komunikacie Volume 7, Issue 3, University of Zilina, Žilina 2005, pp. 45-48.
- [8] Kister Ł.: *Significance of information security in a company*, (w:) Riešenie krízových situácií v špecifickom prostredí, University of Zilina, Žilina 2009, pp. 329-334.
- [9] Korzeniowski L. F.: *Securitology - The concept of safety*, Komunikacie, Volume 7, Issue 3, University of Zilina, Žilina 2005, pp. 20-23.
- [10] Korzeniowski L. F.: *Informačná bezpečnosť podnikania*. Žilina: Multiprint, 2010
- [11] Korzeniowski L. F.: *Podstawy nauk o bezpieczeństwie*, Warszawa: Difin, 2012.
- [12] Lisiak-Felicka D., Szmit M.: *"Tango Down" – Some Comments to the Security of Cyberspace of Republic of Poland*, [in:] Biały W. Kaźmierczak J. (ed.), *Systems supporting production engineering*, pp. 133-145, PKJS, Gliwice 2012, ISBN: 978-83-62652-34-1.
- [13] Monarcha-Matlak A.: *Obowiązki administracji w komunikacji elektronicznej*, Wolters Kluwer Polska, 2008, pp. 239-268.
- [14] Regulation of April 29, 2004, by the Minister of Internal Affairs and Administration as regards personal data processing documentation and technical and organizational

conditions which should be fulfilled by devices and computer systems used for personal data processing (Journal of Laws of 2004 No. 100 item 1024).

- [15] Robinson N.: *IT excellence starts with governance*, Journal of Investment Compliance, Volume 6 Issue 3, 2005, pp. 45-49.
- [16] Stoll M., Breu R.: *Information security measurement roles and responsibilities*, 6th International Joint Conference on Computer, Information and Systems Sciences and Engineering, Lecture Notes in Electrical Engineering, Volume 151, 2013, pp. 11-23.
- [17] Suchorzewska A.: *Ochrona prawna systemów informatycznych wobec zagrożenia cyberterroryzmem*, Wolters Kluwer Polska, 2010, pp. 279-285.
- [18] Ustawa z dnia 5 czerwca 1998 r. o samorządzie województwa (Dz. U. z 2001 r., Nr 142, poz. 1590 z późn. zm.).
- [19] Ustawa z dnia 29 sierpnia 1997 r. o ochronie danych osobowych (Dz. U. z 1997 r., Nr 133, poz. 883, z późn. zm.).

**„PROJECT-FACTOR-DECISION”
DECISIVE FACTORS IN IT PROJECTS AND THEIR IMPACT
ON ITS SUCCESS**

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The aim of this article is to indicate the need for a deepening, systematizing and codifying of the theoretical and practical knowledge on IT project management, in the area of management decision-making processes. The scope of decisions made by managers is constantly on the increase. Project managers make decisions not only within the classic triangle of constraints, which consists of a schedule, a budget and the project scope, but also in reference to a number of other problems which occur during project execution. The observed need to identify and define all the factors which are present in projects results in the identification of a finite set of variables for decision-making and for the decisions themselves and, finally, in determining their mutual correlation.

Keywords: IT project management, decision-making processes, organization maturity

1. Introduction

Project management is one of the major challenges of the modern economy. Organizations which form the core of the economy dynamically change their structure and thus imply changes both in management processes and structures. One element of these changes is the development of modern, rapidly-changing (following market requirements) products, which is different from the current approach. As part of these changes, traditional organizational structures are replaced by dedicated project teams. With the growing significance of projects for

organizations, project management becomes an important issue as well. This issue is particularly visible in the IT industry, where complex (difficult to pre-define), and unique projects with a high development risk are often carried out by dispersed (difficult to manage) project teams [2].

Results of studies published by consulting companies show that more than half of IT projects fail due to budget or schedule overruns [1]. It has also been indicated that one of the main causes of project failures are the mistakes of project managers. These errors are the result of badly implemented project management processes, which in the case of IT projects amounts to bad decisions in such areas as mismatching IT project management methods to the specific nature of the projects, selecting team members, and building a relationship with the client in an IT project [8].

The authors' interest in the subject comes from the fact that the scope of decisions made by managers is constantly increasing. Project managers make decisions not only in the classic triangle of constraints, which consists of a schedule, a budget and the project scope (Figure 1).

During the implementation of projects, a number of other problems occur, including human resources issues connected with the construction (and later management) of project teams, decisions regarding communication with the client and the method of conducting business analyses, as well as decisions which stem from the changing nature so typical of IT projects (not only in reference to requirements but also conditions, e.g. technological, in which the project is run).

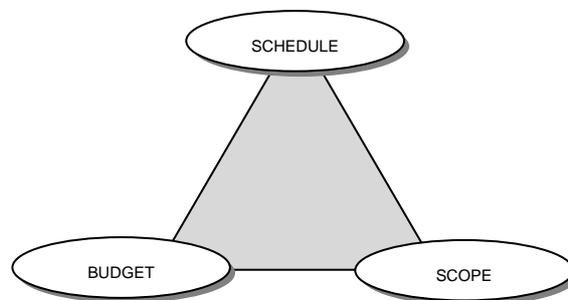


Figure 1. Triangle of boundary conditions in an IT project
Source: own study based on [1]

The need to identify and define all the factors present in projects would enable a more detailed description of the field of project management. It could also initiate the search for key factors to ensure the success of projects. Therefore, the authors' goal is to deepen, systematize and codify the theoretical and practical knowledge on IT project management in the area of management decision-making.

2. Successful decisions - success of an IT project

2.1. A new Triangle of Constraints in IT projects

As was mentioned before, the primary criterion for the success of an IT project is its completion within the conventional project constraints understood as project completion within the following framework [1]:

- a fixed schedule,
- an adopted budget,
- in the full established scope

This does not mean, however, that the decisions of managers refer to only these three areas. The classic triangle of constraints is created in consequence of previous actions and decisions made by the project manager. The project scope is generally determined on the basis of interviews with the client, the schedule is determined by the assessment of the resource potential of the company implementing the IT project (the supplier), the budget is usually the result of the assessed workload of the project team on the part of the supplier and client's financial capabilities. Hence, it can be concluded that before the project manager makes any decisions regarding the realization of the project in terms of the classic triangle of constraints, a number of prior decisions are made regarding the client or the team.

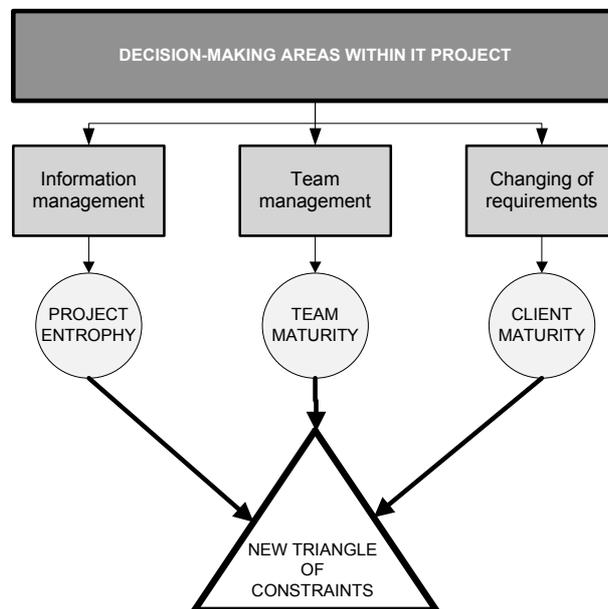


Figure 2. Decision-making areas as a new Triangle of Constraints in an IT project

In view of the best practices contained in project management methods (such as RUP or SCRUM) and the need to complement the classic triangle of constraints with an additional set of decision variables, the authors observed three project areas which must be analyzed before the project is initiated.

These areas could be described as a category of decision-making problems (hereinafter referred to as decision-making areas), which managers' decisions refer to. They include:

- the client and client maturity,
- the project team and project team maturity,
- the volatility and organization of the information necessary for project completion (project entropy).

The new Triangle of Constraints is shown in Figure 2.

2.2. Client Maturity - awareness of own needs

The first of these areas includes processes carried out with the participation of the client in IT projects. The client is usually (but not always) the main recipient of the product resulting from the IT project. The decomposition of project management methods (performed by the authors for creating an adaptive approach to project management) [5, 6] has allowed the extraction of those best management practices which apply only to project managers. A fragment of the decomposition of one of the project management methods, focusing on customer relationship management, is shown in Table 1.

Table 1. Decomposition of the RUP method for management decisions

BEST PRACTICE	JUSTIFICATION
Defining the products of labour as input/output to/from a job.	This allows the manager to communicate the client's expectations regarding the realization of a specific task to the team.
Defining precise project roles.	This allows the manager to organize the team for the specific actions. Contacts with the client are entrusted to a single person (Business Analyst).
The use of high-level models.	This allows the manager to present the product of an IT project in a way which is more understandable to the client.

Other project management methods also include recommendations related to the presence of the client. In many cases, it is even recommended to include the client in the manufacturing and management processes (*Scrum, XP Programming*), which implies certain decisions to be made by project managers. This perception of the project, where it is necessary to assess client maturity and to decide on the client's place in the project, requires a thorough knowledge of the client. The task of managers is therefore to make certain decisions in order to build a suitable relationship with the client and to establish a suitable place for the client within the project. Lack of knowledge about the specific nature of the client may lead to the wrong decisions regarding the project realization method. In the case when an immature client frequently changes the requirements, the project manager should make certain decisions in order to make the manufacturing processes more flexible, namely seek to use agile methods. Such decisions will, however, only be possible after a thorough analysis of all the factors involving a client which imply volatility. Hence the necessity suggested by the authors to form a complete set of factors under which managers make decisions that relate to both the client and further project work [7].

2.3. Supplier team maturity – proper progress of work

Another area of decision-making processes discussed widely in all project management methods are the team processes of the supplier organization. It is the supplier team, under the supervision of a project manager, that is responsible for the proper progress of work, for how and when certain work is carried out. Therefore, it seems reasonable that before the project is initiated the project manager should properly recognize the potential for the realization of the project by his team. This diagnosis should be done with regard to project competence, but also in terms of the competences for group work. Such an analysis allows the project manager to correctly allocate an appropriate role to each participant in the project.

The proper allocation of roles increases work efficiency. It should also be taken into account that decisions about the selection of project management methods or the selection of best practices have to depend on the state of the supplier team. In addition, the awareness of one's own maturity level helps to match best practices relating to team management. Thus, it seems necessary to define a set of possible parameters (factors) describing the team so that the manager could make correct decisions regarding the mechanisms of motivation and the allocation of tasks.

2.4. Project entropy – aiming at order

The third area of decision-making processes is associated with decisions of project managers in reference to the level of information in the carried out IT project, as well as those about the assessment of the complexity of the project, the volatility of requirements and the uncertainty of achieving the end product. In the case of most IT projects realized in the incremental way, requirements change over time, and the final product is not precisely defined, thus defining tasks and manufacturing processes is difficult. Insufficient knowledge about the state of the project implies that the uncertainty of managers hinders planning decisions (short and long-term). Project managers having an incomplete (inadequate) level of information in an IT project should adapt best practices to the current state of the project. It was decided, therefore, that information problems in projects will be measured according to their level of order, called project negentropy.

2.5. The problem of maturity in the context of scientific research

The groups of management problems presented in the previous chapter were identified during research conducted by the Department of Information Technology Management, operating at the Technical University of Gdansk since 2006. The team's previous research on management problems in IT projects has led to the improvement of activities associated with the selection and application of project management methods (such as RUP, SCRUM, PRINCE2, etc.) and to a systemic approach to project management, taking into account the above problem areas (on the basis of such concepts as CMMI or enterprise architecture).

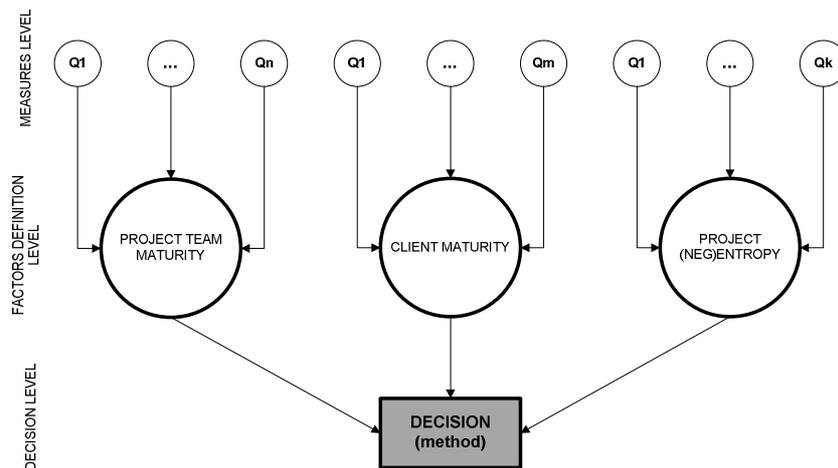


Figure 3. The direction of research on maturity in IT projects

The current state of research on a complete solution which would take the issue of maturity into account forces the refinement of some of its aspects. It is a natural step then to extract (decompose) the three main areas of decision-making (client, team, entropy) into single, defined and named factors implying key decisions in projects. The strength (weight) of each of the separate implications should also be determined.

3. Decision-making factors vs. Project decisions

3.1. The impact of decision-making factors on the catalogue of decisions

It should be noted that each of the described decision-making areas consists of a number of minor factors which directly or indirectly influence future project decisions. Hence, creating a complete (full) set of decision-making factors would allow for the structuring of knowledge in project decision-making.

Such a set can be created by the decomposition (causal analysis) of indicated decision-making problems to smaller (individual) factors.

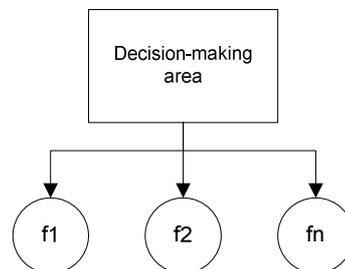


Figure 4. Decomposition of decision-making areas to a list of decision-making factors

Defining the decision-making factors and the correlation between them and the project decisions, as well as an investigation of the impact of these factors on the success of the project would primarily help to increase the awareness of the decision-making mechanisms occurring in the project and would allow project managers to extend their knowledge of project management [9].

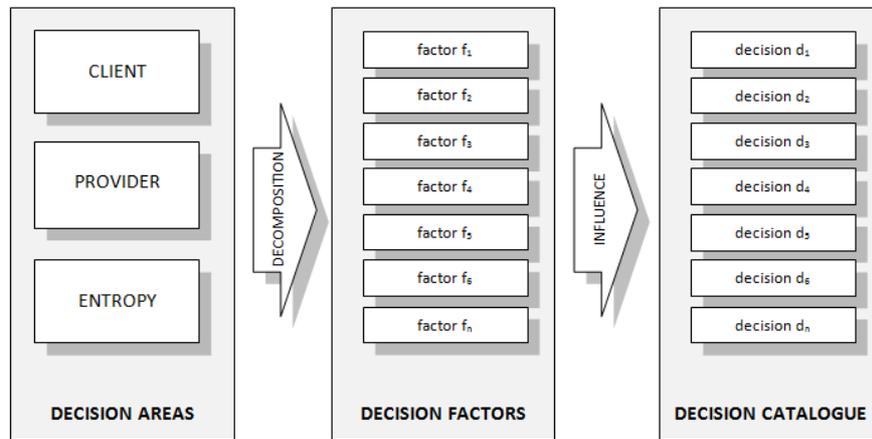


Figure 5. Relationship between decision-making areas, list of decision-making factors and their impact on the need to make certain project decisions

On the basis of the authors' experience, the following can be argued:

- There is a finite set of factors which are important from the point of view of the three previously-mentioned groups of decision-making problems (the maturity of the client and supplier and project entropy).
- Decision-making in projects depends to various degrees (correlation) on these factors.

At this stage it can be concluded that the results of this part of the study will constitute a two-dimensional matrix, which is shown in the table 2, as an example.

Table 2. Examples of correlations between decision-making factors and the identified project decisions

	f_1	f_2	f_n
d_1	0,4	0,01	0,03
d_2	0,1	0,9	0
d_3	0	0	0,4

Note: f_n – decision-making factor, d_n – project decision

The values in the above table have been introduced for demonstrative purposes, as at this stage there is still no research to estimate the strength of the relationship between decisions and project factors. Nonetheless, on the basis of the authors' own experience and previous research, examples of factors from various

categories can be presented (e.g., personal, technological, organizational) as well as project decisions to show how different they may be in terms of the force of mutual influence.

Examples of factors (f_n):

- Regarding the client and client maturity:
 - (total/partial) lack of experience in running projects with a particular client,
 - lack of (any/some) technical competence related (directly/indirectly) to the project field;
- Regarding the supplier and supplier maturity:
 - the arrival of a new team member (on the client side/inside the manufacturing team) (before/during/before the completion of) the project,
 - (sudden/increasing) conflict in the team (between two members/among many members) which (disorganizes/hinders/completely prevents) work;
- Regarding project negentropy:
 - change (broadening/reduction) of (key/less significant) requirements by the client,
 - equipment failure (workstation/server).

Examples of project decisions (d_n):

- To employ an additional member of the team (as an analyst/programmer/etc.),
- To (shorten/lengthen) work cycles,
- To realize (the recognition/purchase of) the CASE tools,
- To obtain (free/commercial) software to support the team in the processes of (application development/documentation generation/obtaining requirements / etc.),
- To add (using own resources/buying an external service) a new (necessary/useful) functionality to the existing software,
- To replace a team member (to hire a new person/to select from those available), who (temporarily/long-term/forever) ceased to be available (due to illness/dismissal/etc.),
- To change the methodology of the current project (for one less/more flexible).

4. Project managed with awareness

Every IT project has its own individual character. The experience gained by the authors, however, allows the conclusion that it is possible to specify the significant common parts which allow for generalization. On the basis of detailed knowledge, the plan is to obtain reasonable results for the average IT project.

The results of the proposed solution may be important for the development of project management issues in the following areas:

- The implementation of the proposed project, allowing the definition of all the decision-making factors, increases the awareness of project managers to suggest possible actions (activities) in the course of projects.
- The development of a catalogue of decisions will enable better planning/management of IT projects.
- Drawing the managers' attention to informal aspects (i.e., other than the formal arrangements concerning the budget, schedule, and scope), namely: client or project team maturity. Thus, new boundary conditions are created (a new triangle of constraints) in the framework of which the project manager functions (in particular, making decisions).
- Gaining the ability to diagnose the causes of failed projects and to analyze the success of projects completed in accordance with the objectives.
- Gaining the ability to predict the effects of activities undertaken by the project manager in the given project conditions.

The proposed approach to project management goes beyond the traditional perception of this area, as it indicates additional aspects beyond the focus on jobs, financial issues and schedule.

Despite the qualitative aspects of an IT project and those which are difficult to measure, the authors attempt the fully quantitative approach – with the aim to quantify (select and grant measures to) all the relevant factors in IT projects. These studies are intended to expand the environment of project decision-making by increasing the awareness of decision-making factors and the correlations between them. At this stage it is obviously difficult to speak of any measurable results of a possible implementation of the developed solution. Nonetheless, it could be concluded that using the results of this study may directly or indirectly lead to a reduction in project risk, thus reducing the costs of failed projects and may also constitute the basis for reinforcing IT project simulation environments.

REFERENCES

- [1] Philips J. (2007) *Zarządzanie projektami IT*, Helion, Gliwice, Poland.
- [2] Schwaber K. (2004) *Sprawne zarządzanie projektami metodą Scrum*, Microsoft.
- [3] Sommerville I. (2003) *Inżynieria oprogramowania*, Wydawnictwa Naukowo-Techniczne, Poland.
- [4] Chrapko M. (2012) *O zwinnym zarządzaniu projektami*, Helion, Gliwice, Poland.
- [5] Orłowski C., Kowalczyk Z. (2012) *Modelowanie procesów zarządzania technologiami informatycznymi*, PWNT, Gdańsk, Poland.
- [6] Orłowski C., Ziółkowski A. (2010) *Supporting Software Project Management Processes Using the Agent System*, Setchi R., Jordanov I., Howlett R., Jain L. [eds.]:

Knowledge-Based and Intelligent Information and Engineering Knowledge-Based and Intelligent Information and Engineering Systems, Springer-Verlag, Berlin Heidelberg, Germany.

- [7] Czarnecki A., Orłowski C., Ziółkowski A. (2010) *Validation of an Agent and Ontology-based Information Technology Assessment System*, Cybernetics and Systems, Vol. 41, Issue 1.
- [8] Henderson-Sellers B., Gorton I. (2002) *Agent-based Software Development Methodologies*. *International Conference on Object-Oriented Programming, Systems, Languages and Applications, OOPSLA*, Seattle, USA.
- [9] Murch R. (2001) *Project management. Best practices for IT Professionals*. Prentice Hall PTR, New York, USA.