



## WEAK SIGNALS IN LOGISTICS IN THE CONTEXT OF THE UNCERTAINTY PHENOMENON

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**ABSTRACT. Background:** High complexity and variability of the environment, the interconnected market, globalization, technological development, have a decisive influence on the essence of logistics management. In the author's opinion, an important qualitative research tool useful in 1) mitigating such areas of logistic uncertainty as: complexity, lack of communication, technology, and in particular lack of logistics vision and 2) minimizing information asymmetries between logistics triad actors is „weak signals” (by their identification and analysis). Weak signals are inaccurate early signs of upcoming events that allow to "recognize of unknowable" in confrontation with strong signals that are sufficiently visible and specific.

**Methods:** In the article were used the results of the method of analysis and logical construction as well as the method of analysis and criticism of the literature as the main research methods. On this basis was performed deductive reasoning.

**Results:** Scientific results is an attempt to answer the following research questions: 1) what is the relationship between weak signals and sources of uncertainty in the area of logistics?; 2) what are the sources of weak signals in the area of uncertain logistics development in relation to contextual search?; 3) which phenomena, minimizing information asymmetries between actors of the logistics triad can be treated as weak signals heralding strong signals, in extreme cases taking the form of wild cards?

**Conclusions:** The main problem in this article is focused on identification sources of weak signals as sources of uncertainty in relation to the development of selected areas of logistics. In the author's opinion, the selected research problem has not been taken up in the literature yet. Analyzes of weak signals are very important part of future management (e.g. foresight) and innovation research. In the author's opinion, logistics also belongs to the field where research of „seeds of changes” seems to be indispensable to avoid the effect of "surprise".

**Key words:** weak signals, uncertainty, future of logistics, novelty, sources.

### INTRODUCTION

Dynamism of changes in many dimensions (economic, political, social, environmental, technological) which today's organizations must face is unprecedented. Today's logistics system, based on physical network that extends all over the world, is extremely complex, interconnected and fast. Through a very large complexity (internal and external) is burdened by magnitude uncertainty and volatility [Müller, Oppolzer 2012].

Uncertainty about the future often eliminates any clear link between closer and long-term consequences [Müller, Oppolzer 2012]. In a relatively large array of methodological options in future studies, some approaches stress the need to be early on changes as a primary objective [Rossel 2011].

Complex networks of mutual relations in the world economy, unlike to positive connotation, can cause long lasting catastrophic disturbances [Bubner et al. 2014].

In the rapidly changing environment, the big threat is the lack of skills of management and anticipation of uncertain changes, which are often treated as accidental phenomena. Most systems used for anticipating change around the world recognise the uncertainties [Wilson 2013]. It is necessary to use scientific tools that can assist in the anticipation of phenomena preceding the occurrence of "accidental events" whose accidentality often results from not having the appropriate epistemological knowledge about them [Bishop, Hines 2012]. One such tool is qualitative analysis of "weak signals".

Weak signals are early, imprecise signs of inevitable important events [Bishop, Hines 2012]. According to M. Godet, a weak signal is a change factor difficult to recognize in the present but which will create a strong trend in the future [Ilmola Kuusi 2006].

In the opinion of P. Schwartz, in today's rapidly changing times a "new normality" is the uncertainty. One of the scientific ways of coping with this phenomenon is scenario planning [Müller, Oppolzer 2012]. According to author to these article one of most important scientific tools for constructing more reliable scenarios is the analysis of weak signals.

Every strong signal (in the form of a well-established trend, paradigm, tendency, etc.) always has its precursors in the form of weak signals that have their own characteristics and should be therefore detected enough early and interpreted adequately [Rossel 2011].

The environment (both external and internal) of an organization contains endless amounts of information, which is free and easy to access, but it is increasingly difficult to understand [Bishop, Hines 2012]. In this process, it may be helpful identification and analysis the aforementioned weak signals that should be considered as potential forerunners of changes of the "certain" future of the studied object. In this article analyzed object is logistics, as a complex, and therefore in many ways the uncertain, area of economic activities.

## **THE ROLE OF UNCERTAINTY PHENOMENON IN THE CONTEXT OF THE LOGISTICS DEVELOPMENT**

Uncertainty in logistic activity refers to a decision-making situation in which managers do not know for sure what decision to take because of undefined objectives. There is insufficient information on the internal environment (e.g. regarding the supply chain) and external (for example, the latest technological trends). It is not able to accurately predict (e.g. through the lack of effective control measures) the impact of possible actions on the behavior of individual logistic ecosystem participants. Uncertainty occurs when decision makers can not estimate the outcome of an event or the probability of its occurrence [Sanchez-Rodrigues et al. 2010].

Due to increasing volatility and uncertainty in increasingly unstable environment, the longevity of corporate strategies and competitive advantage is steadily decreasing. It is possible, for example, that in the future, the leading market position in the logistic industry will be achieved by companies from Asia and the Middle East, almost unknown today. That's why, western logistics companies should respond to greater strategic flexibility [Müller, Oppolzer 2012] using innovative solutions for this purpose.

Logistics operations are carried out in open systems. Uncertainty can be initiated from any one source and can potentially affect other members of the logistics triad (carrier, supplier, customer). If all triad members had access to full information, it would be possible to eliminate information asymmetries but perfect sharing of information is unlikely in practice [Sanchez-Rodrigues et al. 2008].

One of the most important areas of research in the field of logistics uncertainty is the supply chain and is important part – transport. Uncertain events can affect the ability of transport operations to satisfy customers [Sanchez-Rodrigues et al. 2010].

Sanchez Rodrigues, V., Stantchev, D., Potter, A., Naim, M., and Whiteing, A. developed the logistics uncertainty model

(based on logistics triad) [Sanchez-Rodrigues et al. 2008]. This model includes general five uncertainty sources that can have a negative effect on logistics (especially transport) operations [Sanchez-Rodrigues et al. 2010] (Tab. 1): (1) Supplier – any uncertainty originating from the point of despatch for the goods, which directly impacts upon transport performance; (2) Customer – any

uncertainty initiating from the receiver of products; (3) Carrier – any inefficiency originated by the carrier and directly affecting the delivery process; (4) Control systems – any issues originated by inadequate and fragmented ICT systems; (5) External uncertainty – any disturbance caused by external factors.

Table 1. Sources of uncertainty related to logistics uncertainty model

<b>Sources of uncertainty related to suppliers</b>	
<b>Area</b>	<b>Exemplary cause of uncertainty</b>
Supplier	Problems in supplier capacity
Supply chain management	Lack of communication in the ordering process
Marketing	Lack of integration between marketing and production
Manufacturing	Operational problems
Inventory and order management	Inventory and order management uncertainty
Transport, shipping and storage	Shipping uncertainty
<b>Sources of uncertainty related to the customer</b>	
<b>Area</b>	<b>Exemplary cause of uncertainty</b>
Supply chain management	Lack of integration of all strategic areas within supply chains
Ordering and inventory management	Wrong weekly forecast from customers
Unloading processes	Higher customer expectation, impacting on delivery frequency
Store and depot management	Costs and loss opportunities due to wrong innovation
<b>Sources of uncertainty from the carrier</b>	
<b>Area</b>	<b>Exemplary cause of uncertainty</b>
Transport fleet management	Single vehicle configuration
Transport process	Transport delays due to internal reasons, e.g. lack of driver
Transport network management	Demand for transport is not managed in a holistic way
Scheduling and routing	Lack of flexibility of transport shipment and scheduling
Cost and profitability	Low margins
<b>Sources of control systems uncertainty</b>	
<b>Area</b>	<b>Exemplary cause of uncertainty</b>
Information management	Inaccurate information of actual order status within the chain
ICT systems management	Forecast inaccuracy throughout the chain, demand amplification
Physical systems management	No synchronisation and poor visibility among adjacent processes
<b>External sources of uncertainty</b>	
<b>Area</b>	<b>Exemplary cause of uncertainty</b>
Transport macroeconomics	Variations in fuel prices
Market	Product and transport demand fluctuations
Road conditions	Traffic congestion
Uncertain impacts of future government policies	Future taxation levels affecting freight transport, policies
Severe or sudden external shocks	External events that disrupt the SC

Source: Sanchez-Rodrigues et al. 2008

Additionally, Sanchez-Rodrigues, V., Potter, A., and Naim, M. M. have found 15 clusters of sources of logistics uncertainty [Sanchez-Rodrigues et al. 2010]: 1) delays; 2) demand and information; 3) insufficient supply chain integration; 4) delivery constraints; 5) cost; 6) complexity; 7) lack of communication; 8) legislation; 9) inventory management issues; 10) global-sourcing;

11) technology; 12) returns; 13) rigid infrastructure; 14) lack of logistics vision; 15) inter-modal operations.

With respect to the first four sources (of 15), the following tools mitigating logistics uncertainty were proposed [Sanchez-Rodrigues et al. 2010]: strategic optimisation (such as network modelling software), operational

optimisation (for example, vehicle scheduling and routing software), quality management tools (like total quality management) and demand forecasting (demand and information issues were frequently dealt with through forecasting tools).

In the author's opinion, an important research tool extending the aforementioned group and affecting: A) mitigating such areas of logistic uncertainty as: 6) complexity, 7) lack of communication, 11) technology, and in particular 14) lack of logistics vision and B) minimizing information asymmetries between logistics triad actors may be identification and analysis of weak signals.

## **CHARACTERISTICS OF WEAK SIGNALS**

Weak signals are a form of information that deals with a potential change in the system under investigation and goes in an unknown direction. They are the first symptoms of important discontinuities, warning signs, or new possibilities [Heinonen et al. 2017, Hiltunen 2006]. Weak signals in the first contact may sound funny or awful, and may cause a lot of confusion because they always involve new ideas, innovations or ways of thinking [Heinonen et al. 2017].

The pioneer of the analysis of weak signals was at the turn of the 70s and 80s. H.I. Ansoff, although the validity of this concept was noticed until the beginning of the 21st century, mainly due to anticipatory research, especially foresight projects. Ansoff outlined an innovative view on the management of uncertainties. This author emphasized that strategic planning should be prepared in the context of turbulent landscape in which surprises and discontinuities are normality. All surprises and discontinuities are preceded by weak signals which are beyond what each one can know [Koivisto et al. 2016, Rossle 2011].

Weak signals taking on any form (verbal, written, graphic, multimedia, etc.) are characterized as something new, surprising, uncertain, irrational, unbelievable, difficult to trace, far from the moment when the events,

ideas are already mature and dominant [Hiltunen 2006].

According to the author of this article, the weak signal does not have to be "weak" per se, while it must be weak in some context. For example, the emergence of the Solidarity movement in the early 1980s in Poland was a very strong phenomenon, but as one of the heralds of changes in the former Eastern Bloc (the fall of the Berlin Wall or the breakup of the Soviet Union), from the perspective of the eighties should be treated as a weak signal.

The weak signal is an early announcement of change, which becomes stronger signal by combining with other signals [Hiltunen 2008b].

According to E. Hiltunen, weak signals are usually existing small and seemingly negligible events that can create strong trends in the future [Ilmola, Kuusi 2006].

E. Hiltunen also identified several aspects influencing the definition of weak signals, based on M. Moijanen's research. For the purposes of this article, the following were selected [Hiltunen 2008b]:

- A weak signal is a sign of changes and cause for a change in the future
- A weak signal does not exist without a receiver of it
- The interpretation of a same signal can be different from the point of view of the different receivers of the signal
- It is important who is the receiver or observer of the signal: experts, special groups etc. And who analyses and draws the conclusions

Weak signals can be the forerunner of unprecedented changes, for example in the form of wild cards [Magruk 2016], both sudden and gradual. Weak signals are better for gradual changes, although they are often ignored [Hiltunen 2006].

The concept of weak signals refers to qualitative and somehow surprising observations of the surrounding world which helps us to manage the patterns of chance [Kuosa 2011].

## **IDENTIFICATION OF WEAK SIGNALS FROM SELECTED SOURCES IN THE PROCESS OF UNCERTAIN DEVELOPMENT OF LOGISTICS**

Weak signals come from various sources – from somewhere and from someone. The process of their analysis (at the beginning rather slow and poor) begins with identifying past messages, visions of the future, and high uncertainty. According to B. S. Coffman, there are three general approaches to finding weak signals [Coffman 1997]:

1. Identification of their sources.
2. Verification that you can be an independent inventor.
3. Hybrid creation consisting of the first two approaches.

Identification of their sources corresponds to: a) the contextual search according to R. Ruttas-Küttim, in which one tries to find the situation for which a given signal appeared earlier and to search for the phenomena to which the signals indicated [Kuusi et al. 2016], and b) the scanning (environment) according to E. Hiltunen, for the maximum flow of information through the so-called surveillance filter (I. Ansoff concept) [Hiltunen 2006].

Verify that you can be an independent inventor is: a) interdependent with the process of creation of a context according to R. Ruttas-Küttim [Kuusi et al. 2016], and b) creative stimulation of the managers minds forcing openness to changes according to E. Hiltunen to broaden the mental and power filters (I. Ansoff concept) [Hiltunen 2006].

In this chapter, in the context of the uncertain development of logistics, attention will be focused on the first approach – identification of weak signals sources.

Traces of weak signals that provide information about important future events can be found in the present or past.

In the process of searching for and interpretation of weak signals can be very

helpful searching for various databases, group works, Delphi method (many people in different contexts can work out many more cases), traditional analytical methods, methods of planning and monitoring, quantitative research methods that can help answer questions about the importance and validity of each signals [Koivisto et al. 2016].

In addition to the above examples in the literature, several classifications of weak signals sources can be found. The most detailed studies in this field were conducted by E. Hiltunen [Hiltunen 2008a].

The first classification refers to Choo's model of information life-cycle of emerging issues [Hiltunen 2008a] based on previous studies by G. Molitor, A. Wygnant and O. Markley, P. Harris. In this classification there are 6 groups of weak signal sources:

1. Idea creation: artistic works, science fiction, fringe and alternative press, specialized journals, patent applications, doctoral dissertations.
2. Elite awareness: insider newsletters, research reports by analysts, banks, think tanks, trade journals, scientific, technical journals, popular intellectual magazines, business leader magazines.
3. Popular awareness: radio programs, TV programs, newspapers, popular general interest magazines, interest group publications, opinion polls, surveys, fiction and non-fiction works.
4. Government awareness: government sponsored reports, studies, government policy discussion papers, draft legislation, bills, public discussion forums, hearings.
5. Procedural routinization: government policies, regulations, institutional Staff or operating manuals, government fillings, incorporations in professionals practice, incorporation in education curriculum.
6. Record-keeping: legislative records, government or institutional archives, historical records of government filings, historical analysis studies.

The second classification refers to Choo's division of information into three categories [Hiltunen 2008a].

1. Human sources (internal sources and external sources): colleagues, scientist/researchers in universities or institutes, futurists, consultants in other area than futures, politicians, government officials, media people, artists, family/friends, "ordinary people" (e.g. observing them).
2. Textual sources (published sources and internal documents): educational and scientific books, academic and scientific journals, popular science and economic magazines and papers, periodicals, marginal/underground press, local newspapers, doctoral dissertations, patents, government and other public sector reports, annual reports of companies, reports of research institutes, proposals for laws, market research studies, television/radio, movies, art exhibitions, science fiction movies, books etc.
3. Online sources (on-line databases and cd-ROMs and Internet): Internet (companies' or organizations' web pages, homepages of individual people/consultants, electric databases, electric journals, blogs, discussion groups), email newsletters.

In additional analyzes by E Hiltunen [Hiltunen 2006], R. Eckhoff, M. Markus, M. Lassnig, S. Schön [Eckhoff et al. 2015], T. Kuos [Kuosa 2011] and R. Cachia, R. Compañó, O. Da Costa [Cachia et al. 2007] were identified the following sources: social media content; discussion forums; Wikis; mailing lists; methods for managing emerging patterns such as risk assessment and horizon scanning, megatrend management; anthropologists (as trend detectors) for observing people and their lifestyles, sophisticated systems for data gathering, analyzing and outlining the risks, global statistics, effective environmental scanning, focusing on extraordinary sources of information, like scanning the movements of minorities and activists of the society, artificial environments, such as Second Life, tag clouds.

Table 2 presents some original examples of weak signals based on the selected sources of their occurrence closely or indirectly related to the logistic sphere.

Table 2. Examples of weak signals in the logistics area based on selected sources

Sources of weak signal	Weak signal	Sources of uncertainty related to logistics	Potential strong signal / wild card / contribution to scenarios	Potential beneficiaries / context
human sources/ idea creation/ artistic works/graphics	Shipping and logistics mobility concept: hand holds a smart phone with icons splash. Vector file in layers for easy editing	Transport, shipping and storage uncertainty	Manage all logistical services from your smartphone	ICT companies, telecommunications industry, TSL industry
textual sources/elite awareness/annual reports of companies	Possibly unclear liability and uncertain quality standards within open business networks	Uncertain impacts of future government policies	Shareconomy Logistics – A new sharing culture leads to new logistics needs within the digitalized neighborhood	logistics providers, enterprises
online sources/research reports/ companies' or organizations' web pages	Cloud computing meets the challenges of complex, distributed, uncertain, volatile, and less-predictable logistics environments	ICT systems management	Paradigm of cloud-based services	logistics mall
textual sources/ scientist/researchers in universities or institutes	Lublin University of Technology and PGE Distribution are developing a new charging system for electric vehicles using chargers placed in street lanterns	Transport macroeconomics Supply chain management Cost and profitability	Electricity will be the primary car fuel in the future	TSL industry, Manufacturers of electric loaders
Popular awareness/ online sources	Shortage of personnel among Polish drivers	Transport network management	Autonomous vehicle management system	TSL industry, car industry, new professions

Source: own work based on Bubner et al. 2014

The analysis was enriched by 1) analysis of sources of uncertainty related to logistics; 2) identify a potential strong signal (which can be treated as a wild card or contribution to

scenario development); and 3) identify potential beneficiaries in a given research context.

## CONCLUSIVE REMARKS

In the case of such dynamically developing (and thus generating new areas of uncertainty) and complex (both exo and endogenous) [Grzybowska, Kovács, Lénárt 2013] areas as logistics, managers should seek the opportunity to read early signs of change, weak signals: trace information, coming from non-obvious sources and difficult but not impossible, to immediate interpretation. Such an approach makes it easier to anticipate the consequences of events and processes that today are barely signaled (e.g. informing you of the need to modify existing business indicators [Zimon and Zimon 2016], but may be transformed into future trends: technological, social, economic, environmental, cultural, including new time-space systems [Saritas, Proskuryakova 2017].

In relation to the first research question one should state that the most appropriate approach in the process of creating an economic future (including logistics) seems to be acceptance of the complexity and uncertainty of reality and readiness to handle the unpredictable, by grasping the weak signals ahead of time [De Toni et al. 2017].

Even small risks can have unpredictable impact on the supply chain in remote areas and can cause long-lasting disruption [Bubner et al. 2014]. In relation to traditional approaches – global uncertainty and growing volatility, especially in complex systems, require the use of unconventional management approaches that address inexplicable solutions based on exploration of periphery areas.

Dealing with uncertainty should be one of the main tasks of entities that take strategic decisions [Magruk 2017]. According to Funtowicz and Ravetz the three different categories of problemsolving strategies can be explained as follows: 1) we have the sort of problem where the “applied science” applies when the uncertainties and decision stakes are small; 2) we move into the “professional consultancy” domain when the uncertainties and the decision stakes are larger; 3) finally, we have “post normal science” when the uncertainties are very high, and are either of

the epistemological or the ethical kind [Aven 2013].

Regarding the second research question scope of knowledge in the present tense can be widened in the process of identifying weak signals by scanning multiple sources, presented in this article.

In order to influence the company strategy or its behavior, it is necessary to poll weak signals for practical use (meaning anything from a minor adaptation to a strategic move [Rossel 2011] and changes in the mental model of the organization [Cachia et al. 2007]

The answer to the third research question was formulated in tabular form (Table 2). In the author’s opinion, from the point of view of the logistics industry development, and taking into account trends in the area of modern energy and automotive development, the last 2 weak signals have a large potential to turn into strong signals. With proper management in the selected country, they have to be able to become wild cards, with the advantage of positive connotations, for the logistics industry and directly for the development of the entire economy.

The ability to recognize weak signals as trailers of future trends and events may be an opportunity for many organizations (including logistics). Weak signals early interpreted, giving companies time to adapt (often innovative) management decisions, allow to avoid unnecessary surprise effect [Eckhoff et al. 2015].

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## REFERENCES

- Aven T., 2013. On Funtowicz and Ravetz's Decision Stake-System Uncertainties Structure and Recently Developed Risk Perspectives, *Risk Analysis*, 33, 2, 270-280, <http://dx.doi.org/10.1111/j.1539-6924.2012.01857>.
- Bishop P.C., Hines A., 2012. Scanning. In *Teaching about the Future*, 176-193. Palgrave Macmillan UK.
- Bubner N., Bubner N., Helbig R., Jeske M., 2014. Logistics trend radar, Delivering insight today. Creating value tomorrow!, Pub. DHL Customer Solutions and Innovation, Troisdorf.
- Cachia R., Compañó R., Costa O. Da, 2007. Grasping the potential of online social networks for foresight, *Technological Forecasting and Social Change*, 74, 1179-1203. <http://dx.doi.org/10.1016/j.techfore.2007.05.006>.
- Coffman B. S., 1997, Weak Signal Research, Part IV: Evolution and Growth of the Weak Signal to Maturity, <http://www.mgtaylor.com/mgtaylor/jotm/winter97/wsrmatr.htm>.
- De Toni A. F., Siagri R., Battistella C., 2017. Corporate Foresight: Anticipating the Future. Routledge, Taylor & Francis Group, LCC CB158 .D437 2016/DCC 302.3/5-dc23, <https://lccn.loc.gov/2016023545>.
- Eckhoff R., Markus, M., Lassnig, M., Schön, S., 2015. No Outstanding Surprises when Using Social Media as Source for Weak Signals? In *Proceedings of the 9th international conference on digital society*, pp. 59-63.
- Grzybowska K., Kovács G., Lénárt, B., 2013. The Supply Chain in Cloud Computing-the Natural Future. In *KES-AMSTA*, 284-292, <http://dx.doi.org/10.3233/978-1-61499-254-7-284>.
- Heinonen S., Hiltunen E., 2012. Creative Foresight Space and the Futures Window: Using visual weak signals to enhance anticipation and innovation, *Futures*, 44, 3, 248-256. <http://dx.doi.org/10.1016/j.futures.2011.10.007>.
- Heinonen S., Karjalainen J., Ruotsalainen J., Steinmüller K., 2017. Surprise as the new normal-implications for energy security, *European Journal of Futures Research*, 5(1), 12, <http://dx.doi.org/10.1007/s40309-017-0117-5>.
- Hiltunen E., 2006. Was it a wild card or just our blindness to gradual change?, *Journal of Futures Studies*, 11, 2, 61-74.
- Hiltunen E., 2008a. Good sources of weak signals: a global study of where futurists look for weak signals, *Journal of Futures Studies*, 11, 4, 21-44.
- Hiltunen E., 2008b. The future sign and its three dimensions, *Futures*, 40, 3, 247-260. <http://dx.doi.org/10.1016/j.futures.2007.08.021>.
- Ilmola L., Kuusi O., 2006. Filters of weak signals hinder foresight: Monitoring weak signals efficiently in corporate decision-making, *Futures*, 38, 8, Oct. 2006, 908-924, <http://dx.doi.org/10.1016/j.futures.2005.12.019>.
- Koivisto R., Kulmala I., Gotcheva N., 2016. Weak signals and damage scenarios – Systematics to identify weak signals and their sources related to mass transport attacks, *Technological Forecasting and Social Change*, 104, 180-190, <http://dx.doi.org/10.1016/j.techfore.2015.12.010>.
- Kuusi O., Lauhakangas O., Ruttas-Küttim R., 2016. From metaphoric litany text to scenarios – How to use metaphors in futures studies, *Futures*, 84, 124-132. <http://dx.doi.org/10.1016/j.futures.2016.03.014>.
- Kuosa T., 2011. Different approaches of pattern management and strategic intelligence, *Technological Forecasting and Social Change*, 78, 3, 458-467. <http://dx.doi.org/10.1016/j.techfore.2010.06.004>.
- Magruk A., 2016. Wild Card as a Phenomenon Cushioning Uncertain Events-Example of Industry 4.0, *Logistics and Transport*, 31, 21-26.

- Magruk A., 2017. Concept of uncertainty in relation to the foresight research, *Engineering Management in Production and Services*, 9, 1, 46-55, <http://dx.doi.org/10.1515/emj-2017-0005>.
- Mendonca S., Pina e Cunha M., Kaivo-oja J., F. Ruff, 2004, Wild cards, weak signals and organisational improvisation, *Futures*, 36, 201-218. [http://dx.doi.org/10.1016/S0016-3287\(03\)00148-4](http://dx.doi.org/10.1016/S0016-3287(03)00148-4).
- Müller J. D., Oppolzer J., 2012. Delivering Tomorrow. Logistics 2050. A Scenario Study, Deutsche Post AG, Headquarters, Bonn.
- Rossel P., 2011. Beyond the obvious: Examining ways of consolidating early detection schemes, *Technological Forecasting and Social Change*, 78, 3, 375-385. <http://dx.doi.org/10.1016/j.techfore.2010.06.016>.
- Sanchez-Rodrigues V., Potter, A., and Naim, M. M., 2010. The impact of logistics uncertainty on sustainable transport operations, *International Journal of Physical Distribution and Logistics Management*, 40, 1/2, 61-83, <http://dx.doi.org/10.1108/09600031011018046>
- Saritas O., Proskuryakova L. N., 2017. Water resources—an analysis of trends, weak signals and wild cards with implications for Russia, *Foresight*, 19 2, 152-173, <http://dx.doi.org/10.1108/FS-07-2016-0033>.
- Wilson R., Skills anticipation – The future of work and education, 2013. *International Journal of Educational Research*, 61, 101-110, <http://dx.doi.org/10.1016/j.ijer.2013.03.013>
- Zimon G., Zimon D., 2016. Influence of logistics on profitability of commercial companies, *Carpathian Logistics Congress (CLC) Location: Jeseník, Czech Republic Date: NOV 04-06, 2015, CLC 2015: Carpathian Logistics Congress – Conference Proceedings*, 565-570.

## ŚLĄBE SYGNAŁY W LOGISTYCE W KONTEKŚCIE ZJAWISKA NIEPEWNOŚCI

**STRESZCZENIE. Wstęp:** Wysoka złożoność i zmienność otoczenia, komplikujący się rynek, globalizacja, rozwój technologiczny, w sposób zdecydowany wpływają na istotę zarządzania logistyką. W opinii autora niniejszego artykułu ważnym narzędziem badawczym wpływającym na 1) łagodzenie takich obszarów niepewności logistycznej jak: Complexity, Lack of communication, Technology, a w szczególności Lack of logistics vision oraz 2) minimalizacji information asymmetries pomiędzy aktorami triady logistycznej może być identyfikacja i analiza słabych sygnałów. Słabe sygnały są niedokładnymi wczesnymi zwiastunami nadchodzących wydarzeń, umożliwiającymi "rozpoznanie niepoznawalnego" w konfrontacji z silnymi sygnałami, które są wystarczająco widoczne i konkretne.

**Metody:** W opracowaniu wykorzystano wyniki metody analizy i konstrukcji logicznej oraz metody analizy i krytyki piśmiennictwa jako głównych metod badawczych. Na tej podstawie przeprowadzono wnioskowanie dedukcyjne.

**Wyniki:** Naukowym rezultatem w niniejszym artykule jest próba odpowiedzi na poniższe pytania badawcze: 1) jaka jest relacja słabych sygnałów do źródeł niepewności w obszarze logistyki?; 2) jakie są źródła słabych sygnałów w obszarze niepewnego rozwoju logistyki w relacji do przeszukiwania kontekstowego?; 3) które zjawiska, minimalizujące information asymmetries pomiędzy aktorami triady logistycznej można traktować jako słabe sygnały zwiastujące sygnały mocne, w skrajnym wypadku przyjmujące postać dzikich kart?

**Wnioski:** Główny problem poruszony w niniejszym artykule odnosi się do identyfikacji źródeł słabych sygnałów jako źródeł niepewności w relacji do rozwoju wybranych obszarów logistyki. W opinii autora wybrany problem badawczy nie był dotychczas podejmowany w literaturze przedmiotu. Analizy dotyczące słabych sygnałów są bardzo ważną częścią obecnych badań dot. przyszłości (np. foresight) oraz innowacji. W opinii autora, logistyka należy również do dziedziny, w której nieodzowne wydają się być badania umożliwiające unikanie efektu "zaskoczenia".

**Słowa kluczowe:** słabe sygnały, niepewność, przyszłość logistyki, nowość, źródła

## SCHWACHE SIGNALE IN DER LOGISTIK IM KONTEXT LOGISTISCHER UNSICHERHEIT

**ZUSAMMENFASSUNG. Einleitung:** Eine hohe Komplexität und Wandelbarkeit der Umwelt, der sich immer wieder komplizierende Markt, die Globalisierung und die technologische Entwicklung beeinflussen ausschlaggebend das Logistikmanagement. Nach Ansicht des Autors des vorliegenden Artikels können die Ermittlung und die Analyse von schwachen Signalen, die einen Einfluss auf die Linderung solcher Bereiche der logistischen Unsicherheit wie: Complexity, Lack of communication, Technology, und insbesondere Lack of logistics vision sowie auf die Minimalisierung von information asymmetries zwischen den Teilnehmern der logistischen Triada ausüben können, zu wichtigen Forschungstools werden. Die schwachen Signale sind ungenaue, frühe Vorzeichen von ankommenden Vorkommnissen, die eine „Erkennung von Unerkennbarem“ in Konfrontation mit starken Signalen, die genügend sichtbar und konkret sind, ermöglichen.

**Methoden:** In der vorliegenden Abhandlung wurden Ergebnisse von Methoden für die Analyse und eine logische Konstruktion sowie die Methoden der Analyse und der Kritik des betreffenden Schrifttums als hauptsächlich brauchbare Forschungsmethoden in Anspruch genommen.

**Ergebnisse:** Das wissenschaftliche Resultat des vorliegenden Artikels ist der Versuch einer Antwort auf die drei nachfolgenden Forschungsfragen: 1) wie ist das Verhältnis der schwachen Signale zu Quellen der Unsicherheit in der Logistik?; 2) wie sind die Quellen der schwachen Signale im Bereich der unsicheren Entwicklung im Verhältnis zu einer kontextuellen Nachsuche?; 3) welche Erscheinungen, die information asymmetries zwischen den Teilnehmern der logistischen Triada minimalisieren, können als die schwachen Signale, die die starken Signale ankündigen und im äußersten Fall eine Form wilder Karten annehmen, betrachtet werden?

**Fazit:** Das Hauptproblem, das im vorliegenden Beitrag angesprochen wurde, bezieht sich auf die Ermittlung der schwachen Signale als der Quellen der Unsicherheit im Verhältnis zur Entwicklung von ausgewählten Logistikbereichen. Nach Ansicht des Autors wurde das betreffende Forschungsproblem noch nicht in der Gegenstandsliteratur projiziert. Die die schwachen Signale anbetreffenden Analysen machen heutzutage einen wichtigen Teil gegenwärtiger, zukunftsorientierter Forschungen (z.B. foresight) und Innovationen aus. Der Autor vertritt dabei den Standpunkt, dass die Logistik zu einem Bereich gehört, in dem die Forschungen, die den Effekt einer „Überraschung“ vermeiden lassen, aus der modernen Logistikpraxis nicht mehr wegzudenken sind.

**Codewörter:** schwache Signale, Unsicherheit, Zukunft für die Logistik, Innovation, Quellen

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