

Ensuring Process Continuity of Multifaceted and Hybrid Supply Chains in Maritime Area

Joanna Pleszko

Maritime University of Szczecin, Poland

The supply chain formula based on strict close interdependence between all its elements causes the smallest disturbance in one of the links to menace the whole supply chain, which is why it is so important for the participants to identify the weakest links of the supply chain and indicating, through complex analysis, potential situations threatening the realization of the whole process; this is possible by respecting unified criteria of proceeding both on domestic and regional level, and on global scale. Safety management in the supply chain is a process aimed at determining areas menacing its proper functioning. An element of this process is undertaking suitable activities, using proper means to eliminate risk or minimise the consequences of its occurrence. Along with economic development increased risk can be observed, as well as qualitative changes in the character of appearing threats transposed from previous well recognizable, mainly fate kind of risks, to categories pertaining to the conditions of activities and process realization. What is important, in the case of hybrid supply network, the threat bound with conduct of activity exceeds the framework of a single enterprise. As a consequence, the appearance of risk in any link or stage of process realization significantly affects the whole supply chain.

The article presents guidelines aimed at ensuring the continuity of the functioning of certain processes, the assumed level by providing the resources and commitment of top management, the critical parameters identified and proposed solutions dealing with crisis situation.

It was noted that an appropriate response to this situation depends not only on the availability of information about the incident, but also awareness and competence of employees. Modern hybrid form characterized by high complexity of the organizational, structural and task require all participants in the supply chain of involvement in the process and creating a positive image. Effective management of multi-level logistic network can not be confined only to the traditional and well-known methods but requires uncommon merger holistic solution.

Keywords: business continuity, risk, incident, management system, supply chain, management strategies, process approach, hybrid structures, sea ports.

1. INTRODUCTION

The new concept of business management has been taking shape since the early eighties and is currently known as supply chain management.

It should be kept in mind, however, that the theoretic and methodological sources of the idea discussed were rooted in results of research concerning distribution channels, cooperation between production enterprises or integration systems, published at least twenty years earlier [16].

In the simplest possible form the supply chain is composed of two links: supplier and receiver.

Considering premises like cost reduction, competitiveness, intercontinental range, such simple structures have become insufficient. Supply chains have been extended by successive links of participants like “suppliers of suppliers” and “customers of customers” or companies rendering to participants financial, marketing, transport and storage services. The ambiguity of concepts and complexity of processes making up the supply chain structure have caused the creation of many

definitions taking into account various activity aspects.

2. MANAGEMENT OF SUPPLY CHAIN IN THE CONTEXT OF COMPLEX STRUCTURES

One of the first definitions of supply chain in logistic context was the statement that it is the planning, coordination and control of the flow of materials, parts and finished products from suppliers to receivers, embracing two separate flow streams (materials and information) [14].

Yet being process-oriented, the need of integrating all streams (financial, materials and information) and the optimisation of added values far exceeds the essence of logistic management and requires orientation on the fulfilment of final receiver's expectations. Considering the integration aspect it becomes essential to adduce the definition of supply chain management modified to "integrated management oriented towards processes of goods and information flow ranging from raw material sources to the final customer, aimed at creating values for the customer by increasing customer service quality and cost reduction"[2].

The transformation of business models expressed in classical management strategies resulted from the necessity of enterprises adapting to the requirements of dynamic market, the necessity of building up competitive advantage, maintaining close relations with customers, reasonable care for the suppliers' good, the implementation of innovative technological and IT solutions. The idea of supply chain management far exceeding the structures of one enterprise creating a network of mutual connections and relationship with suppliers, contracting parties and customers, is currently oriented towards a multi-level area of managing the logistic network, i.e.: a group of independent companies competing and cooperating in order to improve the efficiency and effectiveness of the flow of products and information accompanying it in accordance with customers' expectations.

In the aspect of multi-level management supply-chain orientation is characterised by:

- efficient information and documentation flow,
- subcontractors' mutual confidence (*co-makership* – partnership relations particularly in

the area of formulating strategic assumptions) and proper division of profits,

- minimisation of total costs by shortening the time of ordering, reliability of supplies and optimisation of reserves level, and also proper policy of returns,
- continuous improvement of internal and external processes.

In order to accurately forecast demand many theoretical models have been worked out, enabling the generation of predictions burdened with ever decreasing estimation error [3,6,7,10]. The analysis of various criteria, including the singling out of many determinants affecting the correct and competitive functioning of the supply chain has led to the formulation of strategies and making use of management methods which are a combination/synthesis of many solutions functioning in the market, creating innovative hybrid forms characterised by high methodological, structural and task complexity. A premise for their design and implementation is the conduct of economic analyses making use of mutually complementary quantitative and qualitative methods, genetic algorithms, connectionist networks, simulation and visualisation leading to the aggregation of optimal decision-making scenarios.

Due to their varied and expanded architecture, hybrid structures require a complex approach to the system's designing process. Assumptions concerning the modelling of structures and the interactions between particular elements are based on widely available methodologies supporting the process management.

The changes taking place in global economy, including corporative internationalism and technological progress have essentially changed the way of perceiving organisation and technological progress - compare Figure 1. The stress has been shifted from activities set on processing material streams and production of goods to information flow and security of the enterprise's functioning.

Not without significance are also factors considerably affecting the profitability of an activity, i.e.: the punctuality of supplies and their correct realisation (completeness, accuracy), trust in the supplies, created image or brand.

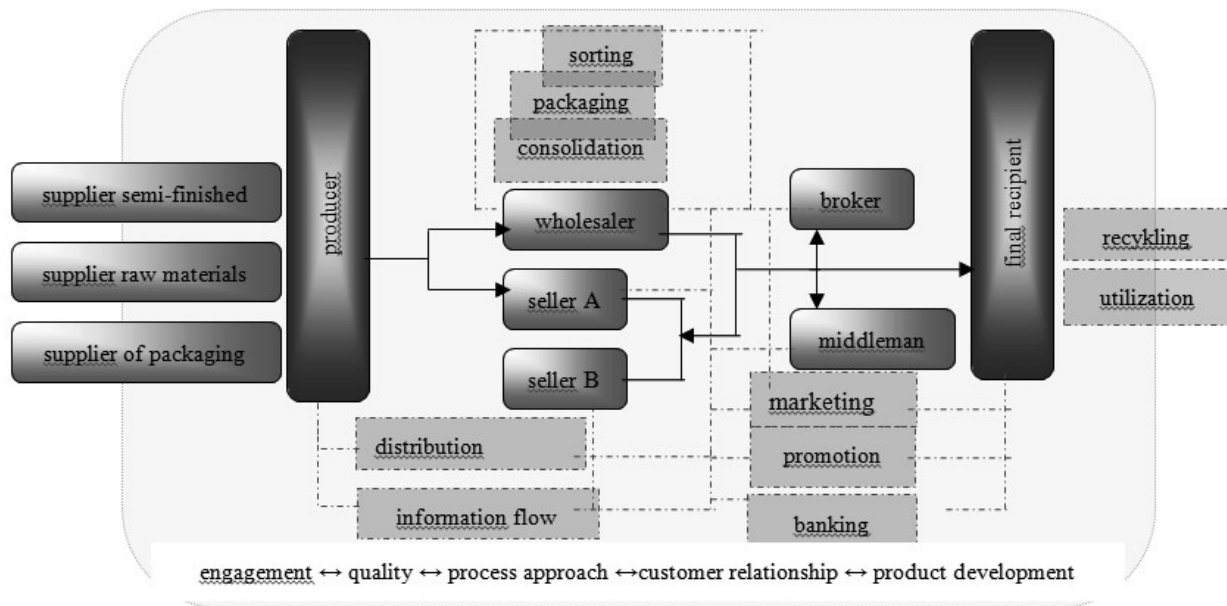


Fig. 1. Evolution of supply chains

Source: own study

3. DECISION-MAKING SUPPORTING SYSTEMS IN THE PROCESSES OF MANAGING CONTINUITY OF ACTION

The decision-making capacities of an enterprise depend on available information, and next on proper reaction to a situation, particularly in conditions of uncertainty. The proper functioning of an enterprise, and thereby the whole supply chain, is conditioned by a reliable and profound analysis preceding the formulation of a strategy. The reaching of satisfactory results is possible through proper determination of critical parameters, estimating consequences and building a reliability policy [1, 12].

Among the main areas of activity continuity management, there can be counted:

- analysis of the effect of a crisis event on business processes
- formulating and establishing a strategy for preserving action continuity
- preparing emergency plans for selected areas
- reacting to threat and undertaking corrective measures
- formulating and implementing an action continuity plan
- training employees and raising their awareness

- cooperating with public services and supervisory institutions

Activity continuity management in the supply chain is a process aimed at determining the areas threatening its proper functioning. An element in such a system is undertaking suitable actions, making use of proper means, in order to eliminate risk or minimise its consequences. Along with economic development there can be observed generic changes in the nature of occurring threats transposed from previous well recognised, mainly random kinds of risk (atmospheric phenomena, natural disasters, catastrophes) to categories attendant on conditions of activities and realisation of process (loss of data, system breakdowns, subcontractors' decisions, information theft, unqualified data modification). What is important in the case of a supply network, the threat attendant on conducting activity exceeds the framework of one enterprise. In consequence, the occurrence of threat in any link or stage of the process realisation significantly affects the whole supply chain. [13].

The identification and estimation of risk plays a key role in the scope of maintaining proper security level and constitutes the most difficult and labour-consuming preparation stage in the organisation. The quantification of risk is an

unusually difficult process, as it concerns potential events, whose estimation is carried out in virtual conditions, frequently using statistical methods with restricted access to reliable information, based on the estimator's subjective opinion. The estimation of potential threats includes a detailed analysis of existing controlling means in the scope of operational capacities of technical infrastructure and IT systems [4,5,8,9,11].

An analysis of the effect of a crisis event on business processes is aimed at characterising the event's results on the functioning of the enterprise. The analysis makes it possible to obtain two kinds of results: qualifying the effect of the event on the enterprise's further activity as critical/urgent or non-critical/less urgent. The former is the case when the phenomenon is inadmissible for the organisation or its subcontractors. Perceptions of the acceptability of disruption may be modified by the cost of establishing and maintaining appropriate business or technical recovery solutions.

Two maximant parameters have been differentiated for this group of factors:

1. admissible delay of recoverable data, *Recovery Point Objective*, determines the time interval for the lost data to be re-implemented for the process determined,
2. admissible time of restoring the state of activity realisation, *Recovery Time Objective*, determines the time and level of services for the process to be resumed after breakdown or disturbance, so as to avoid inadmissible effects caused by the break in activity continuity.

During analysis a classification is also made of the used solutions for determining real time of reproducing the resource's functioning. Admissible tolerance ranges are determined for the organisation for business functioning with the exclusion of the resources researched. The analysis is the basis for determining costs and a real plan for counteracting delays.

The analysis is based on the realisation of the following tasks:

- identifying particular organisational functions and responsible persons,
- determining criticality rules for particular components,

- making polls,
- determining the minimum time window for reproducing particular functions,
- specifying resources required for the reproduction of a given function,
- making the final report.

Emergency plans for selected activity areas make up documents determining resources, activities and tasks and the flow of information indispensable for management in order to eliminate or reduce disturbance effects down to acceptable level. Preparation of particular solutions makes it possible to avoid costly delays or to preclude total blocking of activity. The assumed procedure strategies should take into account the most pessimistic event results and unfavourable event scenarios – compare Figure 2. When characterising a subject three partial goals can be set, constituting a complementary planning whole, including: sectional analysis of functioning aspects, building solutions guaranteeing the required resistance level, attaining and maintaining flexibility of the staff's activity.

The basic objective of conducting systemic risk estimation is the optimal selection of security means by an iterative supervision process enabling repeatability and continuous improvement of the system in the scope of its effectiveness and application validity, as also taking account of the verifiability of monitoring methods and the assessment of their adaptation to the enterprise's specificity and economic conditions.

Assuring the enterprise's sustained activity is bound with a conscious decision of the top leadership about implementing a plan of counteracting any predictable delays. In the process of creating a plan of assuring functioning continuity it is indispensable for all organisation departments to cooperate, which is bound with the assignment of tasks to be realised in a crisis situation. The very project of building a functioning continuity plan provides accurate information on the organisation, which is next used by commercial and support departments, the administration, quality control department.

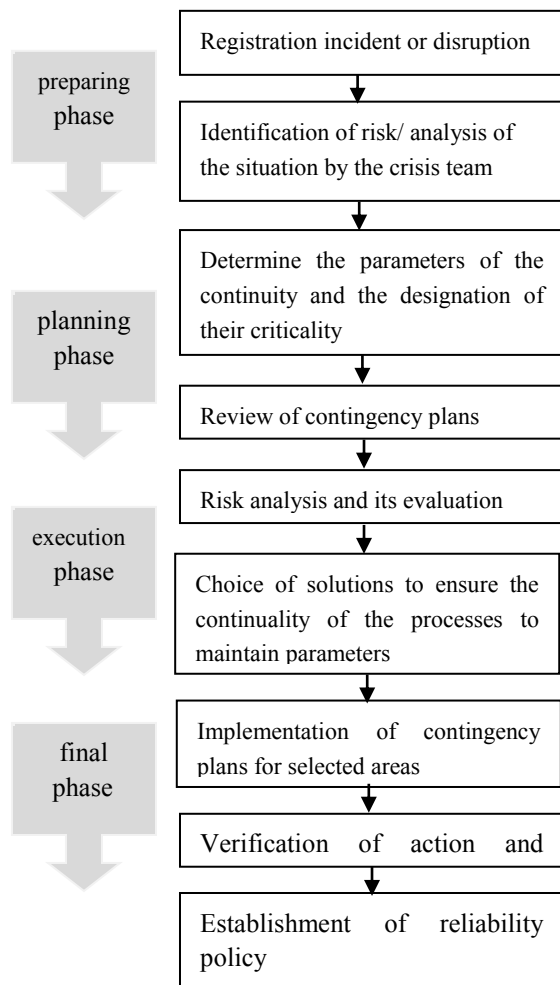


Fig. 2. Sample scenario for dealing with threats
Source: own study

The information mentioned here is the positive result of analyses previously conducted, like *Business Impact Analysis*, system security analyses etc. Essential information from analyses conducted has essential effect on the effectiveness of solutions implemented in the scope of technology, recommending a way minimising risk and it has a qualitative effect on managing the organisation.

The process of functioning continuity planning requires some flexibility in predicting potential events. The assuring of activity continuity is formed on a few levels:

The assumed strategy of organisation management, long-term activities, functions of business processes, analysis of process criticality and other factors involved in minimising risk.

An initial plan of functioning continuity, transitory projects, possible implementation

scenarios, emergency procedures, including reproduction procedures, types of reaction to incidental events, estimating other alternative activity variants, establishing persons coordinating activities, range of responsibilities for the staff.

Increasing the employees' awareness through training programmes, taking into account any changes in the standard model.

The most frequent process parameters supervised within the BCM framework are availability (of services, resources etc.) and punctuality (of task and process realisation etc.). The determination of minimal parameters in the range of process functioning permits the selection of proper mechanisms that are taken consideration of in activity continuity plans.

Each activity of business is potentially subject to sudden unexpected occurrences effecting breaks in the enterprise's functioning. Depending on size, branch or activity area, the key assumption for every enterprise is the preservation of continuity of activity, which becomes essential particularly on the case of unpredicted phenomena and situations. Caring for their correct functioning the firms focus not only on profit and competitive advantages, but also preserving the brand's reputation and the customers' confidence. An indispensable element in this area is the identification of disturbances in the functioning of some specific processes in the company, and consequently the possibility of eliminating their causes. The effects of neglect in the management of crisis situations may be destructive, even bringing about the company's fall and liquidation. To preclude this, mechanisms of preserving functioning continuity are made.

The share of enterprises in the global supply chain embraces multi-layer interconnections between particular links, and mutual interrelationships concern not only the flow of goods but also the accompanying banking, insurance and IT services; that is, the basic processes are supplemented with the flow of financial streams, the customers' personal data and wide documentation.

4. ENSURING FUNCTIONING CONTINUITY IN ENTERPRISES OF THE MARINE BRANCH

The target group researched in 2011 embraced marine enterprises in the area of forwarding, transport, marine expertise, services related to ships' technical supply and catering, seaports and crewing agencies. The research covered altogether 356 business entities from the West Pomerania and Pomeranian Provinces. Eventually data from 54 companies were acquired. The amount and quality of data obtained were considered to be sufficient, as after the analyses of 31 randomly selected questionnaires, each successive one did not bring in new solutions; the effect of content saturation was thus obtained.

The research aimed at indicating and characterising activity areas exposed to disturbances and identification of factors determining the company's risk degree of breaking its continuity of functioning. The triangulation method was used for data collection, which is a quantitative research technique based on direct questionnaire interview, verified and supplemented with qualitative technique, viz. Individual in-Depth Interview.

For the needs of the research an analysis of threats was made, dividing them into two basic groups, viz. internal and external threats. Among the first group there were counted: the human factor, infra- and suprastructure and IT network; among the second group: business environment embracing suppliers, service providers and contracting parties. Besides, the complexity of assessing the effects of particular factors was analysed in simple tetragonal system, estimating the direct and indirect effect of each factor on the acceptability or non-acceptability of the results of its occurrence, in the aspect of the unavailability time of the process and the financial and image effect – cf. Figure 3.

The questionnaire embraced 42 questions concerning *inter alia* systematic risk identification, documentation, monitoring the process of risk identification, indicating the level of acceptable risk, supervising indicated processes, reaction to risk, communication and management methods.

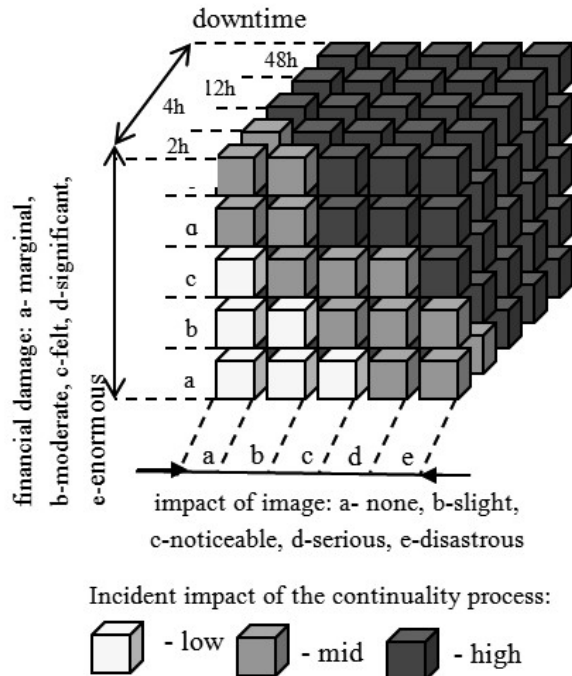


Figure 3. Risk identification in simple tetragonal structure.
 Source: own study

The analysis takes into account three main groups of business entities, viz. commercial ships, other sailing vessels and seaports constituting explicit transport chains and other enterprises participating indirectly in multi-layer logistic networks. The questionnaire research indicates that the subject of managing continuity of functioning is essential and important for the enterprises (98% of entities examined). The conclusion comes to mind that not all enterprises have an ordered and clear system of reacting in unpredicted situations (22% of external contracting parties). Yet the specificity of marine economy imposes through obligatory legal acts and branch regulations the implementation of additional security warranties not applied in other economic branches, in the form of codes, conventions or agreements. That is why in the entities analysed, particularly on vessels, the determined mechanisms of preserving functioning continuity oscillate between 81%- 98% - cf. Figure 4. The striving of Polish enterprises to minimise activity risk appears very favourable, particularly against the pessimistic research background of the American market, where 69% of enterprises do not have sufficient mechanisms of functioning continuity preservation [15].

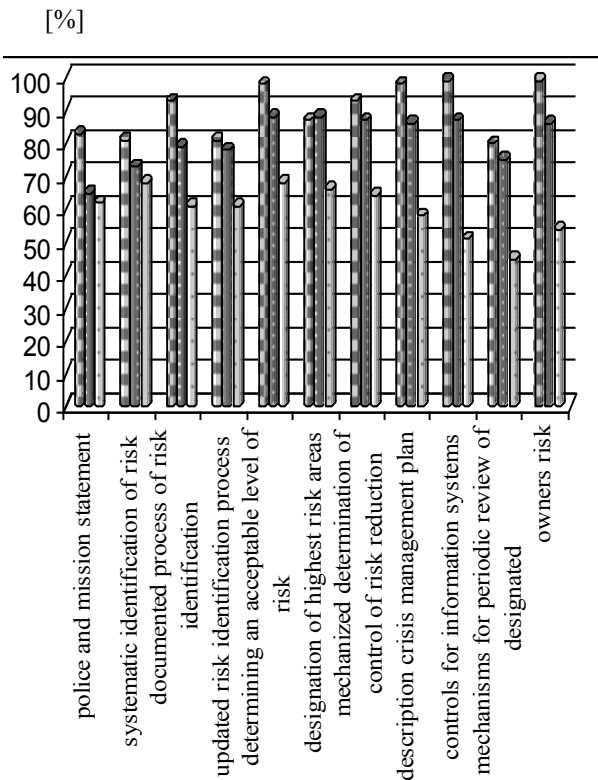


Figure 4. Mechanisms of preserving functioning continuity in the surveyed enterprises, adequately in: ships and others floating objects, seaports, contractors and external suppliers.

Source: own study

Risk threat can occur in a varied and multivariant way, therefore an accurate procedure cannot be described, but there should be determined threat areas and persons responsible for action coordination. In the case of marine transport chains there is much likelihood of risk on ferries and passenger ships and key port objects like anchorages, roads, piers, canals. The threat may be initiated for instance by encroachment or taking over control over an object on port ground or nearby, using a port object as place of contraband, electronic manipulation, sabotage. – cf. table 1.

A separate group with high danger coefficient is constituted by commercial vessels carrying hazardous goods (gas carriers, chemical cargo carriers, tankers), with respect to character of cargo carried.

Most spectacular and attractive for the media are seizures and takeovers of ships by terrorists;

yet due to the character of this threat and the unpredictability of scenarios this activity is unusually difficult to characterise and master, in spite of existing procedures, and at the same time socially highly sensitive.

Table 1., Security threat scenarios to maritime supply chain

| Example security threat scenarios | Potential threat situation | Recommended courses of action |
|-------------------------------------|--|--|
| control over the means of transport | damage or destruction of the ship, destroying other purpose outside with moving goods and means of transport, take hostages, extortion, calling the social and | granting the SOS signal, the crew members to provide security, protection of goods transported, seek the protection of the environment, notification shall set out supervisory and control |
| smuggling, contraband | import or export of illegal weapons, terrorist activities, people smuggling | adequate lighting board, implement modern warning systems |
| manipulation of information | unauthorized access to information or documentations, enforce political, media publicity | define strategies to survive, establish procedures for communicating |
| infringement of cargo | manipulation, theft for terrorist | increase insurance coverage |
| unlawful used of property | carry out actions aimed at facilitating terrorist activities using the means of transport as a weapon | change of route navigation, naval escort, identifications of port facilities |

Source: own study

Other threat may also concern: negative effect on natural environment in the case of marine disaster, explosion of dangerous cargo carried, storm damage, technical breakdowns, sinkings, cargo damage etc. As there are almost infinitely

many possible methods of carrying out an attack, some general threat scenarios are assumed in order to demonstrate the full scope of dangers in the port.

To sum up, it should be stressed that most threats in enterprises researched are due to employees' inattention and concern information protection (unauthorised access to information, transferring data to third parties, lack of access to IT system). Setting up proper procedures, security of IT system and supervision allow to eliminate weak spots.

The increased expectations in relation to port objects, not only as links in the land-sea transport chain, but first of all as effective and competitive business entities also procure the necessity of confirming reliability and security in realising goals and meeting the customers' demands.

5. CONCLUSIONS

An effective multi-level management of structures requires a systemic approach and interdisciplinary knowledge expressed by the application of various concluding methods and combining many differentiated pieces of knowledge, which requires a principal change in the traditional approach to business continuity through the application of holistic solutions. The unquestionable merits of the concept mentioned are increased probability of attaining success, guaranteeing the liquidity of business processes, minimising losses, possibility of recovering lost data, managing the enterprise's image, anticipating threats and promptly reacting to changing conditions.

The assuring of process functioning continuity on a particular assumed level is made possible by ensuring resources and the involvement of top leadership in a material dimension (expenses borne, financial losses) and a non-material dimension (reputation, image, customer's trust).

REFERENCES

- [1] BS 25999-2:2007 Business Continuity Management Part 2: Specification, London 2007.
- [2] Carbonara N., Giannoccaro I., Pontrandolfo P., *A theoretical model of study industrial districts as supply chains*. LERC, Cardiff 2000, p. 128.
- [3] Christopher M., *Logistyka i zarządzanie łańcuchem dostaw*, PCDL, Warszawa 2000, p.17.

- [4] Christopher M., Juttner U., *A Strategic Framework for Integrating Marketing and Supply Chain Strategie*", International Journal of Logistics Management, Vol. 21, No. 1, pp 104-126, 2010.
- [5] Christopher M., Peck H., Towill D., *A Taxonomy for Selecting Global Supply Chain Strategie*", International Journal of Logistics Management, Vol. 17, No. 3, pp. 277-287, 2006.
- [6] Ciesielski M., (red.), *Instrumenty zarządzania logistycznego*, PWE, Warszawa 2006.
- [7] Coyle J.J., Bardi E. J, Langley C. J., *Zarządzanie logistyczne*, PWE, Warszawa 2007, p.28.
- [8] Enarsson L., *What we really mean by supply chain management?*, CSCPM's Supply Chain, Q1/2009, s. 60-63.
- [9] Frazelle E., *Supply chain strategy: the logistics of supply chain management*, Business & Economics, 2002, p. 125-137.
- [10] Hadaś Ł., Cyplik P., *Hybrid production planning system in make-to-order company- case study*, Electronic Scientific Journal of Logistics, Vol. 6, Issue4, No 5, 2010, p.45-55.
- [11] Jabłoński W. J., Bartkiewicz W., *Systemy informatyczne zarządzania. Klasyfikacja i charakterystyka systemów*, Kujawsko-Pomorska High School Press, Bydgoszcz 2006.
- [12] Lambert D.M., *Supply chain management: processes, partnerships, performance*, Business & Economics, 2008, p.231-284.
- [13] Pleszko J., *Iterative Methodology of Safety Management in the Supply Chain*, Polish Journal of Commodity Science 1 (26) 2011, Radom 2011, p. 17-25.
- [14] Stevens G.C., *Integration of the Supply Chain*, International Journal of Physical Distribution & Logistics Management, 1989, vol.19, No 8.
- [15] Whitacre E.E., *Report of independent registered public accounting firm on internal control over financial reporting*, AT&T, Houston, 2004.
- [16] Witkowski J., *Zarządzanie łańcuchem dostaw. Koncepcje, procedury doświadczenia*, PWE, Warszawa 2003.

Joanna Pleszko
Maritime University of Szczecin, Poland
j.pleszko@am.szczecin.pl