POLISH JOURNAL OF MANAGEMENT STUDIES
Tabor J., Modrak J.

2015
Vol.12 No2

OCCUPATIONAL SAFETY MANAGEMENT IN SELECTED LOGISTICS SYSTEMS

Tabor J., Modrak J.*

Abstract: Actions being performed in logistic processes may be hazardous for employees' health and lives, especially due to the fact that most of them make use of all kinds of means of technical infrastructure. Our paper reviews accidents at work in some selected logistic systems in order to identify actions, deviations from the normal work flow and injury-causing events, as well as to determine reasons for accidents with special attention being paid to the ones that result from errors or shortages in the work safety management system. Our research results can be useful for managers to assess the way their work health and safety management systems operate, and to properly target preventive measures they should take.

Key words: logistics systems, occupational safety, accidents

Introduction

Means of technical infrastructure, and especially machinery and technical equipment, are one of the main sources of hazards that may result in accidents at work. According to Central Statistical Office data, actions related to all kinds of machines constitute as much as 40% of all actions that result in accidents. Improving the safety of work using machinery and technical equipment is one of the top priorities in the area of health and life protection in work processes, whereas systematic actions are important because any hazards in work processes, and so any risks related to them, keep undergoing systematic changes in terms of both quantity and quality.

Literature Review

Work health and safety (WHS) management can be highly varied depending on the company's size, sector, or its financial standing. In accordance with M.B. Weinstein's classification (1997), it is nowadays possible to distinguish between four main levels of development of work health and safety management actions – from actions targeted at avoiding penalties for not meeting regulations to those targeted at constantly improving all work health and safety processes. The first two levels correspond to the so-called reactive (traditional) approach to work health and safety management, whereas the third and the fourth level correspond to the systemic approach (Bottomley, 1999; Coehlo and Oliveira Matias, 2006). At the same time, management methods used in the area of work health and safety can be divided into traditional and innovative ones, whose distinguishing feature is direct

* **Joanna Tabor, PhD Eng.**, Czestochowa University of Technology, Faculty of Management, **Jan Modrak, MSc.,** Technical University of Kosice, Faculty of Manufacturing Technologies with a seat in Presov
✉ corresponding author: joanna.tabor@interia.pl

involvement of employees, which is perceived as the key component of any successful work health and safety management system (Mitchell, 1993; Gallagher, 1997). Furthermore, in case of targeted actions, it is possible to distinguish between three strategies in providing safe conditions of work: actions targeted at the employee (behavioural safety techniques), actions targeted at workstands (engineering hazard-limiting methods), and actions targeted at systems (safe systems) (Denton, 1982; Makin and Winder, 2008).

Work health and safety management can be performed based upon various guidelines and models. The most widely known is the work health and safety management system model: according to BS 8800 (BSI, 1996), according to HSE (HSE, 1997), according to International Labour Organisation ILO-OSH 2001 (Mori and Takebayashi, 2002), behavioural work health and safety management system model (Fleming and Lardner, 2002), work health and safety management system model using the problem-solving cycle on three levels of management (Hale, 2003), and the management system model according to OHSAS 18001, and its national equivalents (PN-N-18001:2004). Regardless of its components, the basic objective of each work health and safety management system is to minimise losses within the organisation, i.e. primarily effective prevention of accidents at work and occupational diseases, in particular through proper organisation of work processes (Tabor, 2013) and limiting risks related to employee errors (Olton and Głowacki, 2014). Proper work health and safety management constitutes a significant component for companies to build their competitive advantage (Górny, 2009), both in terms of their image and finance, as accidents at work translate into costs which have to be accounted for in operating costs of all kinds of systems, including logistic systems (Ślusarczyk, 2014). Logistic system constitutes a purposefully designed and interconnected set of subsystems including relations between them and their properties, which influence the flow of goods, and financial and information streams (Nowakowski, 2011). Logistic processes depend upon manufacturing strategies (Dima and Grabara, 2013) and commercial strategies (Grabara and Tanasescu, 2015) being in place within a company, while increasingly often the systemic approach predominates in managing these processes (Lis and Łapeta, 2009). It can be also said that the logistic system is used to maintain and supply the remaining systems, i.e. the process system, the control system, and the information system, so that the entire arrangement may work properly. Just as in case of all of these systems, the key measure of the way any logistic system is functioning is its efficiency (Ślusarczyk and Kot, 2014).

The sustainable development paradigm has been mirrored in the sustainable logistics concept (Grabara, 2013), while environmental responsibility has been mirrored in the reverse logistics concept (Szołtysek, 2009). Due to prospective further development of the transport and logistics services sector (Tomski et al., 2014), employment in the logistics sector is perceived to be very attractive (Sima

and Bălan, 2014), although it increasingly often adopts a flexible form (Karcz, 2014), with all its advantages and disadvantages.
In order to describe any logistic system, it is required to define and determine such its components as: the objective of its operation, its inputs and outputs, its transformation processes, its close and distant surroundings, its objects and infrastructure, and its human resources (Nowicka-Skowron, 2000). It can therefore be concluded that logistics is operated at the touchpoint between the following three areas: technology, information technology, and management. The area of management is the business infrastructure of processes, the area of information technology is information technology infrastructure of processes, whereas the area of technology is the technical infrastructure of transport, storage, handling, and packaging processes (Korzeń, 2003), i.e., most generally speaking, lifting, handling and storage machinery and equipment.

Research Methodology

The basic objective of our research work was to perform a quantitative analysis of accidents connected with lifting, handling and storage machinery and equipment from the standpoint of work safety management assessment in these logistic systems. Therefore, in the context of using these systems, we performed an analysis for the number of victims in accidents at work in terms of:
- actions being performed by a victim at the time of accident (A),
- events that constitute a deviation from the normal work flow (D), and
- events that cause injuries with victims (CM).

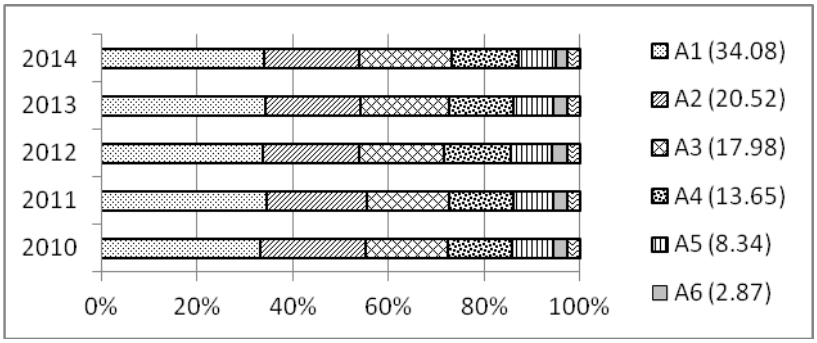
Our research works covered years 2010-2014. In performing them, we used statistical data as gathered and published by Central Statistical Office (*Accidents at work*, 2011-2015), based upon the Statistical Accident Chart. The way the Statistical Accident Chart's Z-KW form is designed makes it possible to indicate a single injury-causing event, a single event that constitutes a deviation from the normal work flow, and a single action being performed by a victim at the time of accident. Lifting, handling and storage machinery and equipment primarily comprise all kinds of conveyors, hoists, cranes, overhead travelling cranes, mobile transporting facilities, fork lift trucks, auxiliary transport devices, grasping devices, stationary and mobile storage and packaging systems, and all kinds of storage accessories. Our research results can be useful for managers to properly target their technical, organisational and behavioural preventive measures, especially in the form of training schemes and motivational systems, which motivate employees' attitudes towards hazards, and influence their appropriate perceptions of risky behaviours connected with using lifting, handling and storage machinery and equipment.

Results

Identification of Actions being performed during Accidents in the Analysed Logistic Systems

In the first part of our research work, we reviewed the number of victims of accidents at work connected with using lifting, handling and storage machinery and equipment, when such machinery and equipment was directly used by victims at the time of accident in connection with the action they performed.

The action performed by a victim at the time of accident is the action performed in the intended manner, directly prior to the accident. This type of action comprises: operating machines, works carried out using hand tools, driving means of transport / being driven on them, operating mobile machines and other equipment, manipulating objects, manual transport, moving around, etc. Figure 1 illustrates the share of numbers of victims of accidents at work depending on actions being performed while using lifting, handling and storage machinery and equipment.



Legend: A1- carrying by hand, A2- handling of objects, A3- driving / operating a means of transport or handling equipment, A4- movement, A5- operating machine, A6- working with hand-held tools, A7- other

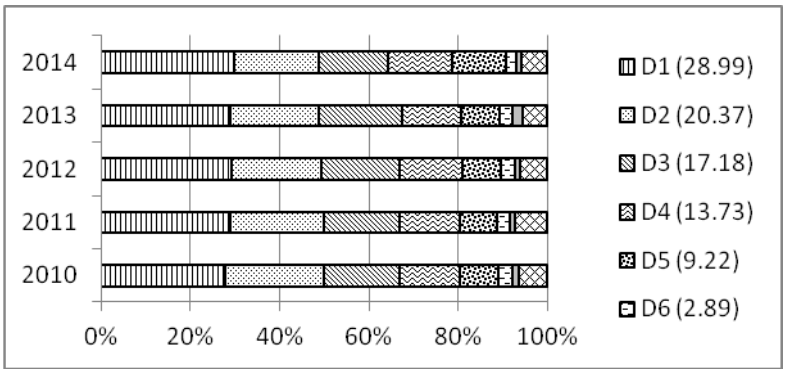
Figure 1. Actions being performed during accidents in the analysed logistic systems
(Author's elaboration based on GUS)

The research we have conducted suggests that over the years 2010-2014, as might have been expected, statistically speaking, the highest number of accidents connected with lifting, handling and storage machinery and equipment took place during manual transport (on the average A1=34.08% of all accidents) and while manipulating objects (on the average A2=20.52% of all accidents). In case of manual transport, an increase was observed, while in case of manipulating objects, a fall was observed in the share of this action over the analysed years.

Identification of deviations from the normal work flow during accidents in the analysed logistic systems

In the second part of our research work, we reviewed the number of victims of accidents at work connected with lifting, handling and storage machinery and equipment in case such machinery and equipment was directly connected with an

event that constituted a deviation from the normal work flow. Event that constitutes a deviation from the normal work flow is an event, which is non-conformant with the proper work flow, and which results in an accident. These events include: deviations related to electricity, explosion, fire, hazardous substance discharge, leak, or emission, damage, tearing, cracking, slipping off, falling, collapse of a material factor, loss of control over the machine, means of transport, load, tool or object being transported, slipping, stumbling, falling, body movements with and without physical effort, shock, fear, violence, etc. Figure 2 illustrates the share of numbers of victims of accidents at work over the years 2010-2014, depending on events that constitute a deviation from the normal work flow while using lifting, handling and storage machinery and equipment.



Legend: D1- loss of control of machine, means of transport or handling equipment, D2- breakage, bursting, splitting of material agent, D3- body movement with physical stress, D4- slipping, stumbling, fall of persons, D5- body movement without any physical stress, D6- presence, D7- other

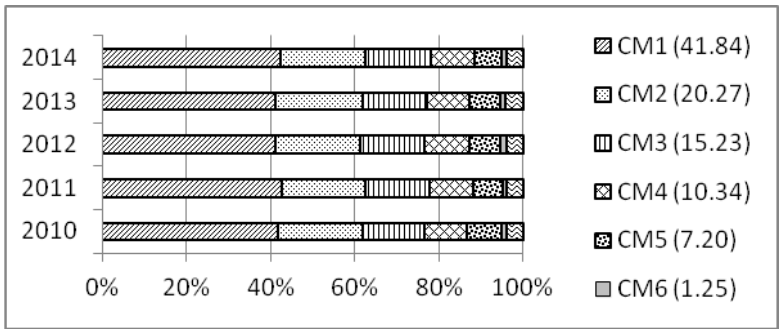
Figure 2. Deviations from the normal work flow during accidents in the analysed logistic systems *(Author's elaboration based on GUS)*

The research we have conducted suggests that over the years 2005-2010, statistically speaking, the highest number of accidents connected with using lifting, handling and storage machinery and equipment, were caused by such events, which were non-conformant with the proper work flow, as: loss of control over the machine, means of transport, transported load (on the average D1=28.99% of all accidents) and damage, tearing or rupture of a material factor (on the average D2=20.37% of all accidents). In case of loss of control, an increase was observed, while in case of damages, a fall was observed in the share of this deviation over the analysed years.

Identification of Injury-Causing Events during Accidents in the Verified Logistic Systems

In the third part of our research work, we reviewed the number of victims of accidents at work connected with using lifting, handling and storage machinery and equipment in case such machinery and equipment was a source of injury in connection with the determined injury-causing event.

An injury-causing event describes the way the victim sustained a (physical or psychological) injury caused by a material factor, in this case, by lifting, handling, or storage machinery and equipment. Such injury-causing events include: contact with electrical drive, temperature, hazardous substances or chemical preparations, sinking, burying, confinement, collision with / hitting against a stationary or moving object, contact with a sharp, uneven or rough object, entanglement, crushing, physical or psychological burden, displays of aggression, etc. Figure 3 illustrates the share of numbers of victims of accidents at work depending on injury-causing events while using lifting, handling and storage machinery and equipment.



Legend: CM1- struck by object in motion, CM2- impact with or against a stationary object, CM3- trapped, crushed, CM4- physical or mental stress, CM5- contact with sharp, pointed, rough coarse material agent, CM6- contact with electrical voltage, temperature, hazardous substances, CM7- other

Figure 3. Injury-causing events during accidents in the verified logistic systems
(Author's elaboration based on GUS)

The research we have conducted suggests that over the years 2010-2014, statistically speaking, the highest number of victims of accidents connected with lifting, handling and storage machinery and equipment, sustained injury as a result of getting hit by an object in motion (on the average CM=41.84% of all accidents), and collision with or hitting against a stationary object (on the average CM=20.27% of all accidents), and there were no significant changes in these shares over the analysed years.

Conclusion

The main objective of our research was to perform a quantitative analysis of accidents in some selected logistic systems in order to assess work safety management in these systems. The research we have conducted suggests that, statistically speaking, the highest number of accidents connected with lifting, handling and storage machinery and equipment:

– occurred while manually transporting or manipulating objects,

- were caused by such events as loss of control over the machine, means of transport or transported load, and damage, tearing or rupture of a material factor,
- resulted in the employee suffering an injury as a result of getting hit by an object in motion and collision with or hitting against a stationary object.

In order to determine the direction of work safety management actions in the analysed logistic systems, it is necessary to try to identify possible direct reasons for the most frequently occurring events that resulted in suffering an injury: a person getting hit by an object in motion, and collision with or hitting against a stationary object. Both in case of the former and the latter injury-related event, the most frequent direct reasons related to dangerous human behaviours could primarily comprise: operating equipment without authorizations required, inappropriate hazard warnings, operating equipment with inappropriate speed, failure to use safety precautions, or inappropriate use of equipment. On the other hand, reasons related to unsafe conditions of work could mainly include inappropriate protections or protective devices, and insufficient lighting. In case a person is hit by a moving object, it would be advisable to complement the reasons related to dangerous human behaviours with: using defective equipment, inappropriate offloading, inappropriate lifting, or maintenance of equipment during its operation (motion), whereas reasons related to unsafe conditions should be complemented with using an inappropriate warning system. At the same time, in case of collision with or hitting against a stationary object, it would be advisable to complement the reasons related to unsafe conditions of work with inappropriate protective equipment, damaged tools, equipment, materials, as well as with equipment overload or performing prohibited actions.

Identification of direct reasons will make it possible to identify indirect reasons and errors or shortages in the work safety management system when work involves lifting, handling and storage machinery and equipment, which, being subsystems themselves, constitute a significant component of the majority of logistic systems.

Because of the subject of analysis we have selected, our research works are rather general in nature. Due to the fact that they are strongly varied and specialised, it would be advisable to perform some more detailed research in both the objective and subjective scope. Proposals for relevant solutions must correspond to the specificity of the particular technical subsystem, and must result from verification of levels of work health and safety actions in the particular logistic company.

References

Accidents at work in 2010-2014, Statistical Information and Elaborations, Central Statistical Office, Warsaw, 2011-2015, [Available at: http://www.stat.gov.pl, Access on: 2015.10].

Bottomley B., 1999, *Occupational Health and Safety Management System: Strategic Issues Report,* National Occupational Health and Safety Commission, Canberra, Commonwealth of Australia.

BS 8800:1996: *Guide to occupational health and safety management systems*, British Standards Institution (BSI), London, 1996.

Coehlo D.A., Oliveira Matias J.C., 2006, *The Benefits of Occupational Health and Safety Standards,* Handbook of Standards and Guidelines in Ergonomics and Human Factors, Lawrence Erlbaum Associates, Inc. Publishers, Mahwah, New Jersey.

Denton D., 1982, *Safety Management: Improving Performance*, McGraw-Hill, New York.

Dima I.C., Grabara I., 2013, *Elements of Logistics Used in Industrial Operational Management*, [in:] Industrial Production Management in Flexible Systems, IGI Global, Hershey.

Fleming M., Lardner R., 2002, *Strategies to promote safe behaviour as part of a health and safety management system,* Contract Research Report 430, Health and Safety Executive, UK.

Gallagher C., 1997, *Health and Safety Management Systems: An Analysis of System Types and Effectiveness,* National Occupational Health and Safety Commission, Commonwealth of Australia.

Grabara J., 2013, *Sustainable Logistics Management*, Editura Universitatii "Lucian Blaga" din Sibiu.

Grabara J., Tanasescu D., 2015, *Interdependence Relation between Industrial Companies' Logistics and Commercial Strategies*, [in:] Advances in Logistics, Operations and Management Science (ALOMS), Systemic Approaches to Strategic Management: Examples from the Automotive Industry, Business Science Reference, Hershey PA.

Górny A., 2009, *Zarządzanie bezpieczeństwem pracy w budowaniu przewagi konkurencyjnej przedsiębiorstwa*, „Zeszyty Naukowe Uniwersytetu Szczecińskiego, Seria: Ekonomiczne Problemy Usług", 540(34).

Hale A.R., 2003, *Safety Management in Production,* "Human Factors in Manufacturing", 13(3).

HSE, 1997, *Successful health and safety management*, HSG65, (2nd edition), Health and Safety Executive.

Karcz J., 2014, *New Forms of Employment in the Logistics Industry*, "Polish Journal of Management Studies", 9.

Korzeń Z., 2003, *Logistyczne systemy transport bliskiego i magazynowania. T1. Infrastruktura, technika, informacja,* Wydawnictwo Instytut Logistyki i Magazynowania, Poznań.

Lis T., Łapeta J., 2009, *A system Approach to the Issue of Logistics Management in Commercial Enterprises*, "Advanced Logistics Systems", 3.

Makin A.M., Winder C., 2008, *A new conceptual framework to improve the application of occupational health and safety management systems,* "Safety Science", 46.

Mitchell M., 1993, *The TQM Safety System,* "Australian Safety News", May.

Mori K., Takebayashi T., 2002, *The Introduction of an Occupational Health. Management System for Solving Issues in Occupational Health Activities in Japan,* "Industrial Health", 40.

Nowakowski T., 2011, *Niezawodność systemów logistycznych,* Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław.

Nowicka-Skowron M., 2000, *Efektywność systemów logistycznych,* Polskie Wydawnictwo Logistyczne, Warszawa.

Olton I., Głowacki D., 2014, *The Risk Associated with Employees' Errors in Enterprises with Critical Infrastructure Defined in Executives Terms*, "Polish Journal of Management Studies", 10(2).
PN-N-18001: 2004 *Systemy zarządzania bezpieczeństwem i higieną pracy – Wytyczne.* Polski Komitet Normalizacyjny, Warszawa, 2004.
Sima E., Bălan G., 2014, Logistician's Career in the Twenty-First Century, "Polish Journal of Management Studies", 10(1).
Ślusarczyk B., 2014, *Logistics Costs Measuremant at Enterprise*, „Economic Annals - XXI", 11-12.
Ślusarczyk B., Kot S., 2014, *Transport Effectiveness in Distribution of Steel Products*, „Applied Mechanics and Materials", 718.
Szołtysek J., 2009, *Logistyka zwrotna. Reverse Logistics,* Instytut Logistyki i Magazynowania, Poznań.
Tabor J., 2013, *Occupational Safety Management in the light of Causes Analysis of Accidents*, "Polish Journal of Management Studies", 7.
Tomski P., Lis T., Bajdor P., 2014, *On Diversity Management. The Transportation and Logistics Sector Perspective,* "Logistyka", 4.
Weinstein M.B., 1997, *Total Quality Safety Management and Auditing,* CRS Press LLC, Boca Raton, Florida.
Makin A.M., Winder C., 2008, *A new conceptual framework to improve the application of occupational health and safety management systems,* "Safety Science", 46.

ZARZĄDZANIE BEZPIECZEŃSTWEM PRACY W WYBRANYCH SYSTEMACH LOGISTYCZNYCH

Streszczenie: Działania realizowane w procesach logistycznych mogą stanowić zagrożenie dla życia i zdrowia pracowników szczególnie, że w większości z nich wykorzystywane są różnego rodzaju środki infrastruktury technicznej. W artykule dokonano analizy wypadków przy pracy w wybranych systemach logistycznych w kierunku identyfikacji czynności, odchyleń od stanu normalnego oraz wydarzeń urazowych a także określenia przyczyn wypadków ze szczególnym uwzględnieniem tych, które wynikają z błędów lub braków w systemie zarządzania bezpieczeństwem pracy. Wyniki przeprowadzonych badań mogą być przydatne zarządzającym do oceny funkcjonowania systemu zarządzania bhp oraz właściwego ukierunkowania podejmowanych działań profilaktycznych.
Słowa kluczowe: systemy logistyczne, bezpieczeństwo pracy, wypadki

職業安全管理在選定的物流系統

抽象：在物流過程所執行的操作可能會危害員工的健康和生命，特別是由於這樣的事實，他們大多利用各種技術手段的基礎設施的。我們綜述了事故在一些選定的物流系統的工作，以確定行動，偏離了正常的工作流程，並損傷引起的事件，以及以確定原因的事故特別地注意那些導致錯誤或短缺的安全生產管理體系。我們的研究結果可能是有用的管理人員評估他們的工作場所健康和安全管理體系的運作方式，並正確目標的預防措施，他們應該採取。
關鍵詞：物流體系，職業安全，事故