

## **Safety and health management in logistics: literature review and future research**

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**Abstract:** The concept of occupational safety and health management is increasingly drawing the attention of researchers and practitioners. The concepts of occupational safety and health vulnerability and its managerial counterpart occupational safety and health management are still in their infancy. There are not many research articles that provide an overview of occupational safety and health in logistics. This paper assesses the impact of occupational safety and health measures in logistics. The existing literature on occupational safety and health management is reviewed. It analyses a body of literature on occupational safety and health issues. The authors examined various papers and have classified based on a suitable scheme. In addition, gaps that would provide hints for further research have been identified. Opportunities are identified for integration and cross-fertilization between research papers in disciplines such as logistics and occupational safety and health management and between the varieties of research methods used. This paper identifies future research directions. Specific research activities to meet these challenges are suggested in the paper. The paper ends with concluding remarks.

**Keywords:** Literature Review, Logistics, Occupational safety and health (OSH), Supply Chain Management (SCM)

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### **1. Introduction**

Market globalization and competition has forced many companies to revisit their operations strategy. In recent time, there has been increasing awareness of the risks of safety and health at workplace. Companies compete based on multiple competitive performance objectives such as quality, price, responsiveness, flexibility, and dependability. However, workplace safety issues have important implications for business opportunities to clients with a low risk tolerance.

Supply Chain Management (SCM) is a network of raw material extraction, production, distribution, and vendor, and it is one of the key strategies to increase organizational effectiveness. In logistics, standards are strategic instrumental to achieving efficiency gains by reducing waste. The logistics sector earns a rather substantial share of national income measured by gross domestic product (GDP) and is the one of the most important employers. In 2008, the transport and storage industry in Malaysia contributed 8.4% to the economy. The number of employed persons data show that the manufacturing sector employs 1.9576 million persons (17.6%), construction sector employs 1.0142 million persons (9.1%) and Transport, Storage and Communications sector employs 0.5337 million persons (5.1%) of the work force (DOS, 2009). According to International Labor Organization (ILO, 2003), an estimated 4% of gross domestic product (GDP) is lost with the costs of accidents and diseases through absenteeism, medical treatment, disabilities and survivor benefits. Social Security Organization (SOCISO) paid out RM1.354 billion in compensation for all industrial accidents and occupational diseases in 2009 (SOCISO, 2010). The impact of workplace safety issues on the economy is growing.

Enterprises in the logistics sector could incorporate concerns regarding safety and health into their operation activities. Enterprise's voluntary adoption of OHSAS 18001 Occupational Health and Safety Assessment Series brings establishment of Occupational Safety and Health Management System (OSHMS).

Policy which specifies the overall intent of the company maintains a safe and healthy work environment. OSH risk assessment needs to assess risks and quantified using risk matrices. OSH tool must also take into account planning in non-routine operations. OSH hazards have to be control following the hierarchy of risk control. The occupational safety and health management programs are designed to provide the means to deliver objectives by continuous improvement of OSH performance. Responsibilities of the program are specified. OSHMS ensures all personnel whose work may have OSH hazards to have appropriate training. Companies establish safety and health committees to for employee participation in decision-making. Work-related injuries, ill health, diseases and incidents are investigated to prevent recurrences. Safety inspection or audit is conducted to measure the safety performance. Emergency Response Plan (ERP) should be tested regularly for emergencies such as fire, spillage of oil or hazardous chemical substances.

Factories and Machinery Act (FMA) 1967 and subsidiary regulations were

enacted to protect workers working with machineries. The major policy concerning OSH was Occupational Safety and Health Act (OSHA) 1994 and subsidiary regulations that include a general duty for employers. Recently, the Code of Practice on Safety Health and Environment for Transportation Sector was published by the Department of Occupational Safety and Health (DOSH) in 2007 (DOSH, 2010).

SOCSO reported that there were 55,186 workplace accidents reported in 2009. Among these accidents, 20,810 cases happened during commuting to or from workplace, and 34,376 cases happened at the workplace (SOCSO, 2010). Data showed that road crashes are in upward trend being the common cause of work-related fatalities and injuries. By industrial sectors, manufacturing recorded the (31%) highest number of accident, followed by public services and social security (18%), commercial (17%), real estate, rental and business (8%), construction (7%), transportation (7%) and other sectors (12%) (SOCSO, 2010). The Industrial Accident Rate has been improved from 165/10,000 in 2001 to 55/10,000 in 2008. The Deputy Ministry of Human Resources was quoted in the Harian Metro that the Fatality Rate was 211 per 100,000 workers recorded in 2009 (Harian Metro, 26th May 2010).

## **2. Literature Review**

This section covers a review of previous literatures for this study. Dutta-Bergman (2005) reviewed the three central theories of health communication campaigns that represent the dominant cognitive approach, namely theory of reasoned action, health belief model, and the extended parallel process model. Noar and Zimmerman (2005) examined the understanding of health behaviour theory (HBT). They discussed the proliferation of HBT and why theory comparison is essential. Godin et al. (2008) reviewed the studies of healthcare professionals' intentions and behaviors based on social cognitive theories (SCT). They concluded that the TPB appears to be an appropriate theory to predict behaviour whereas other theories better capture the dynamic underlying intention.

## **3. Methodology**

Besides providing a review of literature on OSH in logistics with application of organizational psychology, this paper covers the following objectives:

- Organizing the publications in an orderly manner to enable easy and quick search;

- Classification of the literature;
- Highlighting gaps and providing suggestions for further research.

This paper identifies scholars and contributions in OSH and organizational psychology in logistics. The literature search included journals published in Elsevier, Emerald, Science Direct, Scopus, Taylor and Francis, and Transportation Research Information Services (TRIS). The number of publications listed and classified as journal papers, conference proceedings or periodicals. Dissertations, textbooks, unpublished working papers, and conference papers were also included.

This paper reviews the literature on OSH in logistics with application of psychology dating back to 1985, and puts it in a systematic framework. A literature survey was employed as the research methodology in the study to develop a framework. The literature was collected primary from journals in the areas of occupational safety and health management, logistics and organizational psychology. The attributes of the classification scheme considered essential to developing and managing OSH in logistics for comparisons are:

(a) OSH: applicable to logistics sector. Under this categorization, all literatures dealing with applications specific to the logistics sector are shown. This category forms a major aspect of the present paper.

(b) OSH: organizational psychology approaches. When the technique reaches a saturation stage in terms of its popularity, innovations start appearing in the literature. This category is considered to recognize paradigm shifts in its applications.

Articles reviewed inclusive those cited by Journal Citation Reports (JCR), Sciences Citation Index (SCI) or Social Science Citation Index (SSCI) were mainly published in the following journals:

- Health Education Research
- Journal of Safety Research
- Transportation Research. Part F: Traffic Psychology and Behavior
- Work: A Journal of Prevention, Assessment and Rehabilitation

## **4. Analysis of Result**

Thirty-three studies available on OSHMS in logistics are reviewed for their application and development based on the classification scheme.

### **4.1 Research of OSH in Logistics**

Researches related to the safety and health of in logistics is found in the Commonwealth countries especially Australia. These studies were reported by Haworth, Tingvall and Kowadlo (2000), Murray et al. (2003), Machin and De Souza (2004), Symmons and Haworth (2004), Wishart and Davey (2004), Rowland, Wishart and Davey (2005), Wills, Biggs and Watson (2005), Banks, Davey and Brownlow (2006), Davey, Freeman, and Wishart, (2006), Nwnam (2006), Newnam, Tay and Mason (2006), Rowland, Watson and Wishart (2006), Wills, Biggs and Watson (2006), Wishart, Davey and Freeman (2006), Banks (2008), Rowland et al. (2008) and Stuckey et al. (2010), majority of which originated from the Centre for Accident Research and Road Safety – Queensland (CARRS-Q), Queensland University of Technology. Baas (2003) studied on improving truck fleet safety in New Zealand through different approach of driver.

Clarke (1998) examined employees' reasons for failing to report incident by train drivers of the British Rail. Broughton et al. (2003) found that car drivers with high proportions of work-related mileage have a much greater risk of injury accidents. BOMEL Ltd (2004) found that tanker drivers carrying hazardous loads had most appreciation of rules or procedures. Clarke et al. (2005) grouped the accident-involved vehicles with 88% of the sample covered company cars, vans, lorries, buses, taxis and emergency vehicles. O'Dolan and Stradling (2006) found that drivers who have recently received a speeding ticket are more likely to have been involved in a road traffic accident and these accidents are more likely to have occurred during work time. Darby, Murray and Raeside (2009) reviewed the practical application of an online fleet driver assessment program.

Waters, Putz-Anderson and Baron (1998) reviewed manual material handling (MMH) assessment methods in grocery warehouses in USA. Arboledaa et al. (2003) suggested that the reduction in injuries was strongly impacted by the positive employee perceptions. Morrow and Crum (2004) found that safety practices have potential to offset fatigue-inducing factors associated with truck driving work in USA. Glazer, S., Laurel, A.R. and Kanan-Narasimhan (2005) presented a safety climate and safety culture framework the airline's safety culture in USA. Hamouda (2004) proposed a new comprehensive systematic approach to determine the best location of hazardous material (HazMat) teams utilising HazMat transport risk as a location criterion. Leroux, de Marcellis-Warin and Trépanier (2010) conducted survey of firms' practices of safety management of hazardous material transportation in Quebec, Canada. Lu and

Shang (2005) studied the safety climate in the Port of Kaohsiung, Taiwan. Kao, Stewart and Lee (2009) examined safety performance of airlines in Taiwan.

In Malaysia, there is rather limited literature on OSH in logistics. Aini et al. (2001) examined the emergency preparedness and response plans of the transportation companies, and they found that the common problems found in the companies were that they did not have a proper management system of safe management, had inadequate training of personnel, and the machinery was not provided with appropriate tools and equipment for emergency response during mishaps while the employees lacked general awareness and principal knowledge of emergency response. Rashid (2009) developed transportation risk analysis, Smart Advisory System, a decision supporting system, as a risk management technique that analyzed the risks and its uncertainty of accidents during the transportation of hazardous material.

## **4.2 Research of Belief-Attitude Theories in OSH**

On the other hand, there is a large volume of studies has been carried-out in health behaviour related to the psychology in prevention of the diseases comparing the suitability of various health theories and models especially among the healthcare professionals. From the thirty-five studies summarized, Janz and Becker (1984) reviewed studies in Health Belief Model (HBM) dimension. Perceived barriers proved to be the most powerful of the HBM dimensions across the various study designs and behaviors. While both were important overall, perceived susceptibility was found a stronger contributor to understanding Preventive-Health Behaviour (PHB) than Sick-Role Behaviors (SRB), while the reverse was found true for perceived benefits. Perceived severity was found the lowest overall significance ratios; however, while only weakly associated with PHB, this dimension was strongly related to SRB. Prentice-Dunn and Rogers (1986) compared the organization and research of the Health Belief Model (HBM) and Protection Motivation Theory (PMT).

DeJoy (1996) reviewed the applicability of theoretical models of health behavior to workplace self-protective behavior, the value-expectancy, environmental or contextual, and behavior change models. The author proposed a framework that highlighted the need to target interventions to each of the four stages with emphasis assigned to environmental or situational factors in enabling and reinforcing self-protective behavior. Wills, Watson and Biggs (2009) investigated the relative impact of safety climate within the TPB model, of which attitude was found the stronger predictor of future driving intentions.

## **5. Concluding Remarks and Implications for Future Studies**

There is a proliferation of literature on the topic of OSH in the last two decades. Among others, related components of OSH focused were employee assessment, safety behavior, safety climate, safety culture, risk assessment, safety training, safety practices, emergency preparedness, incident reporting, accident analysis and safety performance. In tandem with the frequent most common and cost effective choice of logistics usage, fleet transport safety has been given high attention. Research of the application of psychology such as those in the forms of HBM, PMT and TPB models have been gradually taken up. Recently, studies on workplace wellness have also been gaining popularity.

The present review of literature was carried out as a part of on-going research, and has identified certain issues which have not been satisfactorily addressed. These issues can be regarded as inadequacies and they offer scope for further exploration. Understanding the types of OSH risks and their probability of occurrence as well as the associated impacts is a starting point to develop effective OSHMS strategies. Suggestions for an agenda for future research directions are as follows:

(a) There is a lack of adequate research on the application and control of OSHMS. Though there have been researches on OSH in construction, there are a noticeably limited number of research papers on OSH in logistics. Application of psychology in OSH especially in the logistics should be enhanced. For instance, the Decomposed Theory of Planned Behavior (DTPB) could apply managerial and psychological perspective to resolve OSH issues. Suitable measures of performance and metrics should be developed as long as mass customization is a key performance objective in winning and keeping customers. With the rise of OSH issues demanded by the customers, enterprises have to adjust operations to prevent a loss of business.

(b) There is a need for further research on the implementation of OSHMS. Even though a number of models and frameworks are available for managing OSHMS, these models need to be modified in order to take into account the unique characteristics of the logistic sector. The possible research could be the design of a framework for collaborative OSHMS and possible schemes for collaborative between companies in a supply chain. Future research could be expanded to explore how collaborative OSHMS among companies in a supply chain could work. It could be interesting to explore differences and similarities in perceptions toward OSH risks inside an organization and across companies in a supply chain. More case studies in diversified economy sectors on OSHMS

the implementation should be carried out on the practices, and to identify the critical factors and potential barriers of success.

(c) Economic aspects of OSH. Costs associated of work related vehicle accidents usually are calculated in terms of vehicle damage. On the other hand, the costs of improved workplace safety follow two objectives. The first objective is to provide workplace safety which appears to be at attained at considerable investment costs whereas in the business context, there are the costs of compliance, which relate to innovations in the operations. The second objective is to shift expenses to the relatively safe logistics that caused little negative impacts in operations. The trade-off between safety performance and the cost of logistics needs further study that will allow the enterprises to estimate the return on investment (ROI) and to convince the top management for favorable decision. Deciding which control measures to choose among various possible alternatives such as elimination, substitution, engineering control, administrative control, and personal protective equipment could be a difficult decision making problem in a logistic enterprise.

Research on OSHMS that attempts to manage safety risk or to create a sustainable logistic sector is rather limited. It is necessary to understand the types of OSH risks, and then the appropriate risk reduction actions which vary with industry sectors. We have tried to classify systematically the available literature on OSHMS in logistics. We hope that this will facilitate a migration of knowledge and practice so that industry can start benefiting from OSHMS implementation. As the OSHMS research is growing rapidly, we see continual progress in building knowledge and insight. Hopefully, the research approaches suggested here could facilitate leveraging the lessons learned.

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