

**Verma, Manish; Verter, Vedat**

**Railroad transportation of dangerous goods: population exposure to airborne toxins.** (English) [Zbl 1102.90308](#)  
[Comput. Oper. Res.](#) 34, No. 5, 1287-1303 (2007).

Summary: Hazardous materials are potentially harmful to people and environment due to their toxic ingredients. Although a significant portion of dangerous goods transportation is via railroads, prevailing studies on dangerous goods transport focus on highway shipments. We present an analytical framework that incorporates the differentiating features of trains, notably volume and nature of cargo, in the assessment of transport risk. We focus on hazardous materials that are airborne upon an accidental release into the environment. Each railcar is a potential source of release, and hence risk assessment of trains requires representation of multiple release sources in the model. We propose a risk approximation approach, which is not only effective but also robust with regards to the positioning of hazardous cargo in the train. We report on the use of the proposed approach for the assessment of population exposure associated with "Ultra-train" that passes through the city of Montreal everyday.

**MSC:**

90B06 Transportation, logistics and supply chain management  
91B30 Risk theory, insurance (MSC2010)

Cited in 8 Documents

**Keywords:**

Hazardous materials; railroad shipments; risk assessment; Gaussian plume model

**Full Text:** [DOI](#)

**References:**

- [1] United Nations Environment Programme. <http://www.uneptie.org/pc/apell/>
- [2] List, G.F.; Mirchandani, P.B.; Turnquist, M.A.; Zografos, K.G., Modeling and analysis for hazardous materials transportation: risk analysis, routing scheduling and facility location, *Transportation science*, 25, 2, 100-114, (1991)
- [3] Erkut, E.; Verter, V., Hazardous materials logistics, (), [chapter 20] · [Zbl 1041.90003](#)
- [4] Transport Canada Dangerous Goods Division: Newsletter, vol. 22 (2). Winter 2002-03.
- [5] Railway investigation report. Report Number R 99H0010. Transportation Safety Board of Canada (TSB); September 2002.
- [6] Swoveland, C., Risk analysis of regulatory options for the transport of dangerous commodities by rail, *Interfaces*, 17, 4, 90-107, (1987)
- [7] Saccomanno, F.F.; Shortreed, J.H.; Van Aerde, M.; Higgs, J., Comparison of risk measures for the transport of dangerous commodities by truck and rail, *Transportation research record*, 1245, 1-13, (1990)
- [8] Federal railroad administration office of safety analysis. <http://safetydata.fra.dot.gov/>
- [9] 2000 North American emergency response guidebook, prepared by transport Canada, US Department of transportation and the Secretariat of communications and transportation of Mexico. Downloadable from: <http://hazmat.dot.gov/gydebook.htm>
- [10] Batta, R.; Chiu, S.S., Optimal obnoxious paths on a network: transportation of hazardous materials, *Operations research*, 36, 1, 84-92, (1988)
- [11] ReVelle, C.; Cohon, J.; Shobrys, D., Simultaneous siting and routing in the disposal of hazardous wastes, *Transportation science*, 25, 2, 138-145, (1991)
- [12] National institute for occupational safety and health: NTIS Publication No. PB-94-195047. Accessible at <http://www.cdc.gov/niosh/idlh/i1.html>
- [13] Cordeau, J-F.; Toth, P.; Vigo, D., A survey of optimization models for train routing and scheduling, *Transportation science*, 32, 4, 380-404, (1998) · [Zbl 0987.90507](#)
- [14] Glickman, T.S.; Rosenfield, D.B., Risks of catastrophic derailments involving the release of hazardous materials, *Management science*, 30, 4, 503-511, (1984)
- [15] Glickman, T.S., Rerouting railroad shipments of hazardous materials to avoid populated areas, *Accident analysis and prevention*, 15, 5, 329-335, (1983)
- [16] Saccomanno, F.F.; Shortreed, J.H., Hazmat transport risks: societal and individual perspectives, *Journal of transportation engineering (ASCE)*, 119, 177-188, (1993)
- [17] Barkan, C.P.L.; Dick, C.T.; Anderson, R., Railroad derailment factors affecting hazardous materials transportation risk,

- Transportation research record, 1825, 64-74, (2003)
- [18] Conlon PCL. Rail transportation of hazardous materials in the United States. Rail International-English Edition. June 1999. p. 8-17.
- [19] Barkan CPL. Personal communication, February 2004.
- [20] Conlon PCL. Personal communication, February 2004.
- [21] Raj, P.K.; Pritchard, E.W., Hazardous materials transportation on US railroads, Transportation research record, 1707, 22-26, (2000)
- [22] Barkan, C.P.L.; Treichel, T.T.; Widell, G.W., Reducing hazardous materials releases from railroad tank car safety vents, Transportation research record, 1707, 27-34, (2000)
- [23] Glickman, T.S., Benchmark estimates of release accident rates in hazardous materials transportation by rail and truck, Transportation research record, 1193, 22-28, (1988)
- [24] Leeming, D.G.; Saccomanno, F.F., Use of quantified risk assessment in evaluating the risks of transporting chlorine by road and rail, Transportation research record, 1430, 27-35, (1994)
- [25] Kornhauser, A.L.; Pasternal, D.J.; Sontag, M.A., Comparing risks of transporting chemicals by highway and rail: a case study, Transportation research record, 1430, 36-40, (1994)
- [26] Hwang, S.T.; Brown, D.F.; O'Steen, J.K.; Policastro, A.J.; Dunn, W., Risk assessment for national transportation of selected hazardous materials, Transportation research record, 1763, 114-124, (2001)
- [27] Gifford, F.A., Atmospheric dispersion models for environmental pollution applications, (), [chapter 2]
- [28] US Environmental Protection Agency's: computer-aided management of emergency operations software with ALOHA. Complete kit accessible and downloadable at <http://response.restoration.noaa.gov/cameo/aloha.html>
- [29] Arya, S.P., Air pollution meteorology and dispersion, (1999), Oxford University Press Cambridge
- [30] US Environment Protection Agency. Technology transfer network support center for regulatory air models. <http://www.epa.gov/scram001>
- [31] Patel, M.H.; Horowitz, A.J., Optimal routing of hazardous materials considering risk of spill, Transportation research record, 28A, 2, 119-132, (1990)
- [32] Zhang, J.; Hodgson, J.; Erkut, E., Using GIS to assess the risks of hazardous materials transport in networks, European journal of operational research, 121, 316-329, (2000) · [Zbl 0951.91031](#)
- [33] Environment Software and Services. <http://www.ess.co.at/AIRWARE/gauss.html>
- [34] Environmental Protection Magazine. <http://www.environmental-center.com/>
- [35] Pasquill F, Smith FB. Atmospheric diffusion. 3rd ed. Chichester, UK: Ellis Horwood; 1983.
- [36] Sivakumar, R.A.; Batta, R., The variance constrained shortest path problem, Transportation science, 28, 4, 309-316, (1994) · [Zbl 0823.90130](#)
- [37] Gopalan, R.; Kolluri, K.S.; Batta, R.; Karwan, M.H., Modeling equity of risk in the transportation of hazardous materials, Operations research, 38, 6, 961-973, (1990) · [Zbl 0723.90017](#)
- [38] Erkut, E., Inequality measures for location problems, Location science, 1, 3, 199-217, (1993) · [Zbl 0923.90101](#)
- [39] Verter, V.; Kara, B., A GIS-based framework for hazardous materials transport risk assessment, Risk analysis, 21, 6, 1109-1120, (2001)
- [40] Dougherty K. Accident could have been much worse. The Gazette, A1, January 5, 2000.
- [41] Toxic Committee of the California Air Pollution Control Officers Association, Gasoline service station. Industry-wide Risk Assessment Guidelines, November 1997.
- [42] Brown DF, Policastro AJ, Dunn WE, Carhart RA, Lazaro MA, Freeman WA, Krumpoic M. Development of the table of initial isolation and protective action distances for the 2000 emergency response guidebook. Decision and Information Sciences Division, Argonne National Laboratory: ANL / DIS-00-1. October 2000.

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.