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The added value of the new ESAW/Eurostat variables in accident analysis in the mining and quarrying industry

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ABSTRACT

Introduction: This paper presents a study on the causes and circumstances of occupational accidents in the Portuguese Mining and Quarrying (M&Q) activity sector. *Method:* To this effect, it uses national accident data (2001–2003), giving particular attention to the newly implemented harmonized ESAW/Eurostat variables. The study begins with a broad description of the M&Q sector and identifies its "typical accident." A series of accident pyramids are used to discriminate between causal patterns of fatal and non-fatal accidents. The causation mechanisms of the "typical accidents" (fatal and non-fatal) are established by examining the statistical dependency between pairs of modalities of two key variables: the Contact and the Deviation. *Results:* The results obtained by this method revealed certain details of the cause-effect mechanism that were unknown before, which also facilitate prioritizing preventive strategies. The study highlights the benefits of the new Eurostat variables for the production of accident statistics. *Impact on Industry:* The consistent adoption of harmonized classifications has a potentially positive impact on several communities: researchers will find it easier to compare their studies; the national authorities can plan more target-oriented preventive strategies; and the individual organizations may use this instrument to facilitate benchmarking of their performance indicators.

1. Introduction

This study typifies accidents at work occurring in the Mining and Quarrying (M&Q) activity sector in Portugal and is based on statistical data collected and compiled by the Office of Strategy & Planning (known by the acronym GEP in Portuguese), which is the governmental agency in charge of accident statistics under the Portuguese Ministry of Labour and Social Solidarity. Although the use of extensive accident data is a traditional approach, the methodology used here gives a novel and much more detailed picture of the situation, as it focuses on a set of new variables designed to elucidate the causes and circumstances of accidents.

The timing and the opportunity for such a study arises from the latest developments of the ESAW Project (European Statistics on Accidents at Work), which were launched by the Eurostat in 1990. The ESAW Project is a long-term project aimed at collecting harmonized data for the production of comparable statistics on accidents at work (EUROSTAT, 2001).

It is noteworthy that, despite the ESAW European's facet, this methodology is applicable worldwide because it is aligned with and is very similar to the international system adopted and recommended by the International Labour Organisation (ILO) (1998). A survey by Jacinto and Aspinwall (2004) summarizes and compares the most relevant aspects of the new developments of both ILO and ESAW.

The first two phases of the ESAW project produced a series of harmonized definitions and a group of 14 common variables, which were gradually adopted by the European Union Member States. These were pre-existing and "classical" variables already in place in most countries' official systems, although their classification schemes needed to be harmonized into a uniform format. Phase 3 of ESAW, by contrast, introduced eight "new" variables concerning the "causes and circumstances of accidents at work" (EUROSTAT, 2001) and marked the beginning of a new series of statistics. For this third phase, the reference year[1] of data was 2001, to be submitted to the Eurostat in 2003. In Portugal, the first results (2001 data) were published in the 2005 annual report (GEP/DGEEP, 2005). The current work analyzes the data covering the period 2001–2003.

The 14 "classical" variables typify the employers (economic activity and size of enterprise), the victims (age, sex, occupation, occupational status, and nationality), part of the circumstances (geographical location, date and time of accident), and finally, the consequences (type of injury, part of body injured, and days lost). On the other hand, the new 8 variables - implemented in 2001 - were designed to elicit

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[1] Reference year (for the data), defined as the year of notification of the accident.

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information on the accident itself (sequence of events) and the circumstances of its occurrence. These are named, respectively: working environment, working process, specific physical activity, material agent of specific physical activity, deviation, material agent of deviation, contact-mode of injury and, finally, the material agent of contact-mode of injury (EUROSTAT, 2001). Of these, each Member State had to select and implement a minimum of four variables in 2001. In Portugal these were: the working environment, the deviation, the contact, and the material agent of contact. Currently, two more variables are being implemented with accident data of 2005, which are: the specific physical activity and the material agent of deviation.

Given the aim of this study, it focuses essentially on the variables deviation, contact, and the material agent of contact. The inclusion of these new variables in the various national systems is potentially beneficial for designing prevention actions, since they allow a better understanding of causation pathways, namely by clarifying the type of accident (described by the contact), the material agent involved in it, and its immediate cause (described by the Deviation).

The activity under scrutiny is the M&Q sector, which in the Eurostat system corresponds to Section C of the variable Economic Activity of the Employer (EUROSTAT, 2001- code NACE, Rev.1). This work derives from a broader study made by the authors and is published in book format in Portuguese (Jacinto et al., 2007) covering all branches of activity. In this paper, however, the methodology has been improved and extended. It covers the triennium 2001–2003 and all the data were supplied first-hand to the authors directly by the competent authority (i.e., the Office of Strategy & Planning (GEP), which is, at national level, the agency responsible for collecting and coding all data on accidents at work).

This paper discusses the M&Q sector alone, which was chosen for two reasons: (a) this sector consistently shows higher incidence rates in Portugal; (b) in Portugal the M&Q is somewhat less studied than other problematic sectors, such as Construction or Fishing. The Portuguese Mining & Quarrying is not a large economic sector, as it only employs an average of 16,000 people, but this is systematically the activity where workers are more at risk of being exposed to accidents. In the period 2001–2003 the overall annual incidence rate was around 17,100 accidents/100,000 workers, whereas the fatal incidence rate is in the order of 60 deaths/100,000 workers. It should be noted, however, that the non-fatal rate is not directly comparable to the EU incidence rate, since the Portuguese national statistics of non-fatal accidents include the total number of accidents, with and without lost days, whereas the EU harmonized statistics only account for accidents leading to more than 3 days of absence from work (i.e., LTI, Lost Time Injuries >3 days). Despite the differences at a national level, the Portuguese agency (GEP) only sends harmonized data to the Eurostat for producing EU aggregated statistics.

The next section of this paper gives an overview of the accident literature in the extracting industry, while Section 3 explains the methodology used in this analysis of accident data. The results are presented and discussed in Section 4.

2. Literature background

Although the aim of this work is to show the potential of the new ESAW variables toward the design of prevention, the methodology used here is demonstrated in the Mining and Quarrying Sector, and the results presented only concern the Portuguese reality. Even so, a literature survey was carried out on other studies covering accidents in the same sector, essentially to ascertain what the focus of the analysis was and whether there were others already using the Eurostat classification schemes. The survey was not restricted to the EU countries because the variables under scrutiny and their classification schemes are also recommended by the latest resolution of the ILO (1998).

The safety literature shows that occupational accidents in the mineral extracting industry, especially in underground mines, have been a matter of concern over the years. Some authors put greater emphasis on risk and hazard analysis (e.g., Foster (UK), 1997; Düzgün & Einstein (Turkey), 2004; Komljenovic, Groves, & Kecojevic (US), 2008), while others concentrate on post-accident analysis as a means of identifying prevention strategies. A number of studies examine relevant differences in mining accident patterns and sometimes discuss the associated causation factors (e.g., Hull, Leigh, Driscoll, & Mandryk (Australia), 1996; Foster (UK), 1997; Sari, Duzgun, Karpuz, & Selcuk (Turkey), 2004; Ural & Demirkol (Turkey), 2008). Of these, some distinguish between "major mining hazards" and "occupational hazards" in mines (Foster (UK), 1997) and others use large amounts of statistical data, in the fashion of epidemiological studies, to characterize the mining working population, their accident rates or the seriousness of injuries (Hull et al. (Australia), 1996; Ural & Demirkol (Turkey), 2008).

Certain studies focus especially on technology as a determinant of occupational accidents in mining. Among these is the impact of technological development (Blank, Diderichsen, & Andersson (Sweden), 1996), showing that changes in technology are not sufficient in themselves to fully explain variations in accident frequency. Within the same line of research, (i.e., technology-related), certain publications (Sari et al. (Turkey), 2004; Kecojevic, Komljenovic, Groves, & Radomsky (US), 2007) give special attention to accidents attributable to equipment and to the level of mechanization or automation. Others discuss in detail very specific risks concerning roof falls in underground coal mines (Düzgün & Einstein (Turkey), 2004; Düzgün (Turkey), 2005; Palei & Das (India), in press).

In contrast to the above technical views, Paul and Maiti (India) (2007) turn their attention to behavioral-driven risks and discuss the role of behavioral factors on safety management in underground mines. As a result of their findings, these authors advocate that the design of safety programs, including safety training, should be more behaviorally motivated.

Another category of papers investigate the role and the impact of legislation and law enforcement on the rate of occupational accidents in the mining industry and in their prevention (e.g., Blank et al. (Sweden), 1996; Breuer, Hoffer, & Hummitzsch (Germany), 2002). Out of Europe, but still in the same line of research, is the work of Laurence (2005), who debates the changes in the Australian mining industry regulatory structure, from compliance-based to a risk-based approach. In his paper, he concludes that: (a) management and regulators should not continue to produce more and more rules and regulations to cover every aspect of mining; (b) detailed prescriptive regulations, detailed safe work procedures, and voluminous safety management plans will not "connect" with a miner; and (c) achieving more effective rules and regulations is not the only answer to a safer workplace. A related and more recent study is that of Poplin et al. (2007), which compares compliance-based and risk-based regulatory approaches between the United States and Australia to explain the rates of change in incident rate ratios (IRR) of LTIs among coal mines in the two countries.

Despite this variety of studies, all of which are devoted to occupational accidents in the mining industry, one finds it difficult to make cross-comparisons, or to derive conclusions from one to another, as the respective authors use a variety of classification schemes. Of the publications cited above, the study made by Ural and Demirkol (2008) is the one that already incorporates Eurostat /ESAW harmonized data. In spite of this, it uses the Eurostat data essentially for comparing incidence rates, but for describing the "type of accident," for instance, it does not adopt the harmonized classification of the variable "contact" – apparently, to be able to compare accidents across different countries: Turkey, United States, and New Zealand.

In many instances, such differences are not a problem since the object of the study is very specific; but in other cases it would be beneficial to have a common ground to facilitate comparison. This is where the ESAW methodology may be advantageous not only to researchers, but also to authorities and regulatory bodies.