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Injuries at work: a methodology for outlining and analyzing the "Seveso sector"

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The "Seveso" legislation aims at the prevention of major-accident hazards involving dangerous substances in industrial plants, based on well-defined thresholds and in this field most of the studies and publications focus on environmental or plant-engineering problems, while the aspects connected to workers are not always evident. Instead, this paper wants to focus on the workers and it wants to allow to find this hidden dimension by applying a specific methodology. Through the use and the processing of appropriate statistical data and information, contained in several databases, the main variables connected with the injuries occurred in "Seveso" field are analysed.
The developed methodology aims to carry out an analysis of injuries that occurred in this sector, which was properly articulated by the authors in four areas: production and distribution of metals, chemical industry, storage, depots and distribution, other activities.
Moreover, it allows to overcome difficulties caused by the transversality of the ATECO codes, i.e. the Italian classification for economic activities arising from the NACE nomenclature created by Eurostat: the dangerous substances indicated in the Seveso Directive, in fact, are present in several industrial processes that fall into different sectors of economic activities, and the most of them are not subject to the Seveso legislation.
In this paper the results of the analysis carried out for the period 2017-2020 will be presented.

Keywords: injuries at work, Seveso, statistical characterization of injuries

1. Introduction

In the context of European legislation, the Directives on Major Accident Hazard (the so called "Seveso" Directive) have historically been included in the environmental competences, while overlapping with social Regulations regarding workers' health and safety. According the criteria included in the Annex 6 of the Directive, major accidents have had important consequences for the workers within the establishment. The European data finds correspondence in the accidents that took place in Italy, where workers have paid a price in terms of deaths and permanent or temporary disabilities. Most of the studies and publications on the Seveso matter have been produced starting from the environmentalist approach; the present study, on the other hand, focuses on the workers, using the statistical data relating to the overlap between safety and industrial risk, obtained through the joint analysis of existing databases.
This approach allows defining the path for a quantitative evaluation of the composition of the workers' injuries in the Seveso sector.
It is not easy to understand the real dimension of Seveso sector, because of its "transversal" feature. In Italy, the application of the Seveso

Directive, in fact, involves a thousand industrial establishments and is guided only by the quantities of dangerous substances held within the individual establishment, not depending, therefore, on the company size or industrial typology. Following the Italian classification of productive activities (ATECO), it is far from easy to reconstruct a "Seveso sector". The only activities well identified in the ATECO classification which completely fall under the Seveso one, are the oil refining and the blending and bottling of LPG (ATECO codes: C19.20.1, C19.20.2). The dangerous substances indicated in the Seveso Directive are present in many industrial processes and, consequently, many sectors of the ATECO classification fall potentially in it. Moreover, the Seveso legislation applies to establishments intended as a unit well identified by physical limits, while the ATECO codes apply to Companies, which are organizational realities not necessarily linked to a single physical structure. In summary, since the available data are based on the ATECO classification it has always been difficult to extract specific data for the "Seveso sector ". On the other hand, talking about a "Seveso sector", albeit transversal to the ATECO classifications, makes perfect sense. Indeed, despite their diversity, the Seveso establishments share the same management system, the same identification models, quantitative risk analysis and assessment and are subjected to specific controls by Competence Authorities.

1.1 About Inail

Inail, Italian Institute for Insurance against Accidents at Work, is a public non-profit entity safeguarding workers against physical injuries and occupational diseases. The role of INAIL is to protect workers against physical and economic damages deriving from injuries and diseases caused by the working activity.

As part of the process of enhancing its information assets, Inail makes available to citizens a set of data: a heritage that can represent an interesting opportunity due to its historical-statistical value, but above all social and scientific.

Furthermore, Inail does research activity in the field of work accident prevention, safety at workplace, health in the living and working environment. The legislative decree n. 105 of 26 June 2015, transposing the Directive 2012/18/EU (Seveso III), has confirmed Inail as a Technical Body for applying the legislation. At national level, the Inail specific technical workers guarantee the fulfillment of the decree and support the institutional activity through a specific research one that also allows to provide methodological guidelines.

1.2 Seveso Directive

The "Seveso" Directive is related to the control of major injuries hazards involving dangerous substances that have serious consequence for health and are also the cause of huge economic losses.

According Seveso Directive, establishments are classified on the basis of the quantity of dangerous substances held; it is an obligation of Operators to implement prevention and protection measures to limit the consequences due to fires, explosions, and the release of dangerous substances.

All operators are required by law to implement a safety management system (SMS) as a necessary measure to prevent major injuries and to limit their consequences, regardless of the size and organization of the establishment and the establishment's classification. These measures must consider technical, organisational and management aspects which, if maintained, guarantee satisfactory levels of health and safety with a view to continuous improvement.

European Directive 2012/18/EU and the Italian decree transposing have confirmed the obligation to undertake an SMS, already introduced by previous legislation. It can be considered one of the main tools that the Operator can put in place for the management of the significant risks present in the plant.

From this point of view, the control system carried out by the Competent Authorities and Technical Bodies has reached satisfactory levels of effectiveness.

2 Aims

This paper does not regard environmental issues or technical aspects of Seveso sector, but a different approach of study has been applied that concerns the consequences related to health and safety of workers in terms of occurrence of injuries events in the Seveso's establishments.
The aim of the present activity is to understand the real hidden dimension of the sector, overcoming the difficulties induced by transversality respect to ATECO coding.
In particular, the paper wants to answer to the following questions:

- what is the number of injuries occurred;
- what are their main characteristics.

3 Methodology

The methodology integrates Inail information and data with the contents of external databases.
The identification of the establishments was the starting point for the delimitation of the Seveso sector. The only point of reference to know the updated data regarding the number and other information about establishments pursuant to Legislative Decree n. 105/2015 is the "Seveso Inventory" of the Italian Environment Ministry (MASE).
Information regarding the insured companies, injuries and occupational diseases was extracted from the Inail database.
The data extracted from Inail database referred to whole company: a company can be made up of several establishments not all of which are subject to the Seveso directive. The variables used to identify the establishment of our interest are tax ID, Vat number, municipality of the establishment and location of the injury.
The data was collected from 2017 to 2020. In the "Seveso Inventory" of the Italian Ministry of Ecological Transition, every year about 1000 establishments are included. Of these, 743 have reported at least one injury to Inail.
In other words, the number of establishments resulting in injury data base is lower than whole population because was summarized and described only the information concerning the industries who communicated at least n.1 injury to Inail, according to Italian legislation (the law 19/2017 requires the obligation to notify Inail the data relating to accidents involving an absence from work of at least one day, excluding that of the event).
An important aspect to be underlined is that all the national establishments subject to the Legislative Decree n. 105/2015 have been surveyed so, the number of establishments is not a sample, but the universe of the population. For these reasons the carried out descriptive statistics analysis provide information for the whole population.
Furthermore, only the workplace injuries were taken into consideration and not "in itinere" (i.e. an injury while in transit on the way to work/commuting).
Data concerning the reports of injuries made to Inail and related to technical and administrative activities conducted within the establishments were analysed considering typical institutional mode of action and according to specific variable, which describe the distribution of activities, and to specific aspects of injury occurrences, belonging to Institute's information assets.
The variables used for the study are:

- working professions
- degree of disability
- deviation and contact
- part of body
- nature of lesions

For some variables used in this paper are reported below the definitions:

- **Working professions**

The working professions are according to Italian Institute of Statistics' classification code CP2011.

- **Degree of disability**

In biological damage regime, it represents the rate "p" which measures the level of psychophysical integrity in consequences of an injury; the range of "p" is "1%-100%".
For this paper, the injuries are aggregated into two categories depending on the degree of disability recognised by Inail to which a third category must be added for fatal injuries:

- *first category* which contains the number of cases with absence of disability or "p" ranging between 1% and 5%
- *second category* which contains the number of cases with "p" ranging between 6% and 100%
- *third category* which contains fatal injuries cases

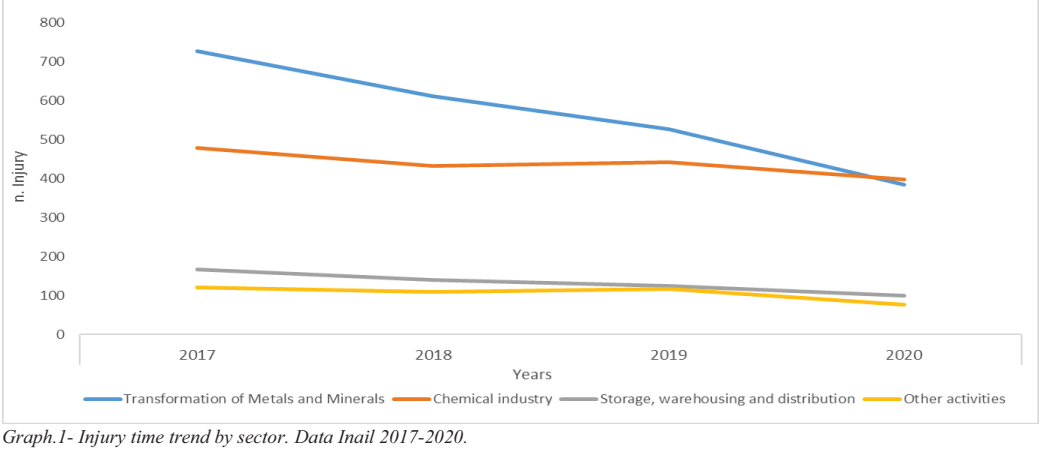
- **Deviation and Contact**

Inail collects the data based on the ESAW (European Statistics on Injuries at Work) methodology that allows collecting Union-wide comparable data on injuries at work. ESAW variables were used to describe the characteristics of the injury.
Deviation represents last event differing from the norm and leading to the accident. This is the description of the abnormal event, i.e., the deviation from normal working process. The 'Deviation' is the event that triggers the accident. Contact represents the contact that injured the victim. This describes how the victim was hurt (physical or mental trauma) by the 'Material Agent' that caused the injury. If there are several 'Contacts -Modes of Injury', the one causing the most serious injury must be recorded.

For an easier reading of the data, the establishments have been divided into four main activity groups based on the classification indicated in the "Seveso Inventory": transformation of metals and minerals, chemical industry, storage, warehousing and distribution, other activities.

4 Results

Between 2017 and 2020, n. 4949 injuries have been recorded: 45% in the transformation of metals and minerals sector, 35% in the chemical industry, 11% in storage, warehousing and distribution and 9% in other activities. The number of injuries, in the five-year period examined, is decreasing in all groups (*Graph.1*). Transformation of metals and mineral is the group with the greatest total decrease (47%); Chemical sector shows the smallest total decrease (16%).



Graph.1- Injury time trend by sector. Data Inail 2017-2020.

The Inail database contains data on injuries occurring to insured workers that are classified also by profession (*Table 1*).
As regards those we have examined, it should be noted that 36% of injuries occur in the category "Industrial establishment operators" which is defined in the database as "professions involving the management of automated industrial establishment or machinery that operate in the entire production process or in specific activities of extraction and treatment of minerals, transformation and processing of metals, glass, ceramics, wood

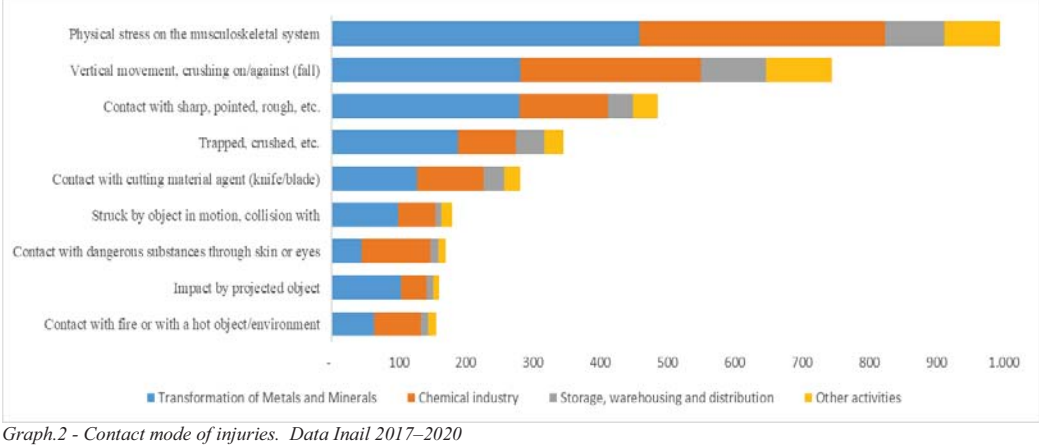
and paper and the production of chemical and petroleum derivatives “.

Table 1 – Injuries by Professions - Data Inail 2017-2020

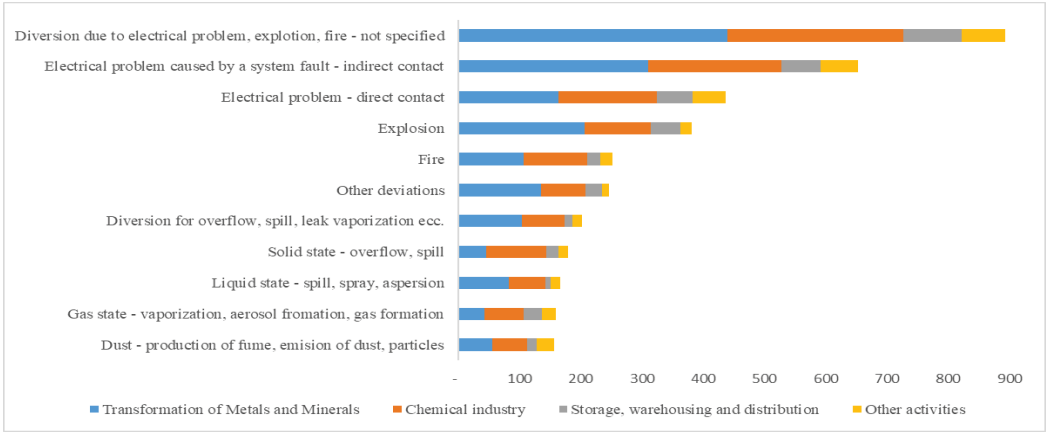
Working professions	Totale	%
Industrial plant operators	1.799	36%
Craftsmen, skilled metal workers,etc.	733	15%
Semi-skilled workers of stationary machinery for mass production and assembly workers	468	9%
Technical professions in the scientific, engineering and production fields	395	8%
Drivers of vehicles, mobile and lifting machinery	364	7%
Unqualified professions in trade and services	261	5%
Unskilled professions in manufacturing, mining and construction	234	5%
Artisans and skilled workers in precision mechanics, artistic craftsmanship, printing and similar	150	3%
Employees involved in administrative, accounting and financial management	119	2%
Technical professions in organization, administration and in financial and commercial activities	94	2%
Clerks in charge of secretarial functions and office machines	83	2%
Other working professions	249	5%
Totals	4.949	100%

Injuries analyzed by the *Degree of disability* indicate that 92.5% of total injuries fall into the first category, the 7.3% into the second category and the 0.2% into third category of fatal injuries. Then, the most of injuries is contained in the first category: 45% of them fall within the Transformation of metals and minerals activity group, 35% within Chemical industry, 11% within storage, warehousing and distribution and 9% within Other activities.

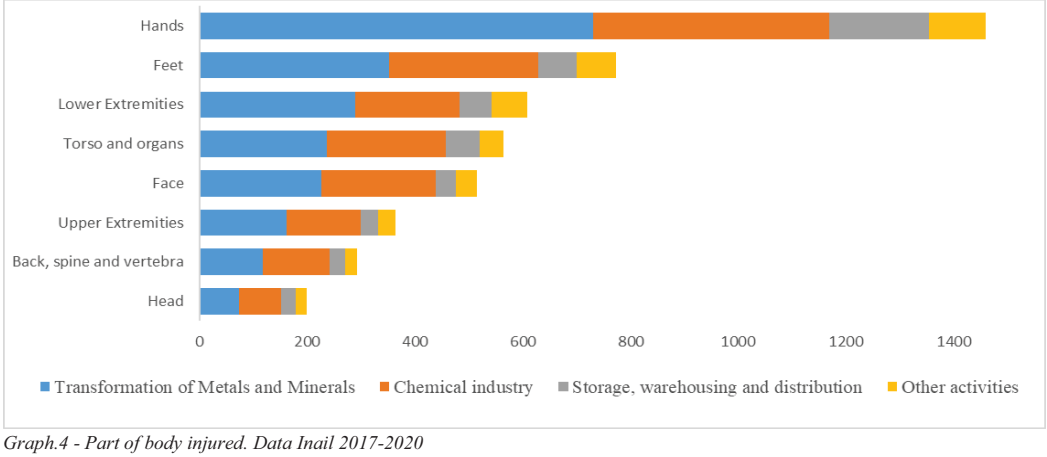
Regarding the variable Contac*t mode* (*Graph.2*) the "Physical stress on the musculoskeletal system" is the first pattern, with 22.7 % of the total cases. For *ESAW deviation* (*Graph.3*) more over the greatest one is the "Diversion due to electrical problem, explosion, fire" with 20,3%. For the "*Part of body injured*" (*Graph.4*), “Hands” (30,6%), “Feet” (16,2%), “Lower Extremities” (12,7%) and “Torso and Organs” (11,8%), with a total of 71,3%, are the parts of the body most involved by injuries. The 85,9% of the *Nature of lesion* (*Graph.5*), is represented by the following modalities: "contusion" (29,9%), "dislocation, sprain, strains" (23%), “wound” (18%) and “break, fracture” (15%).



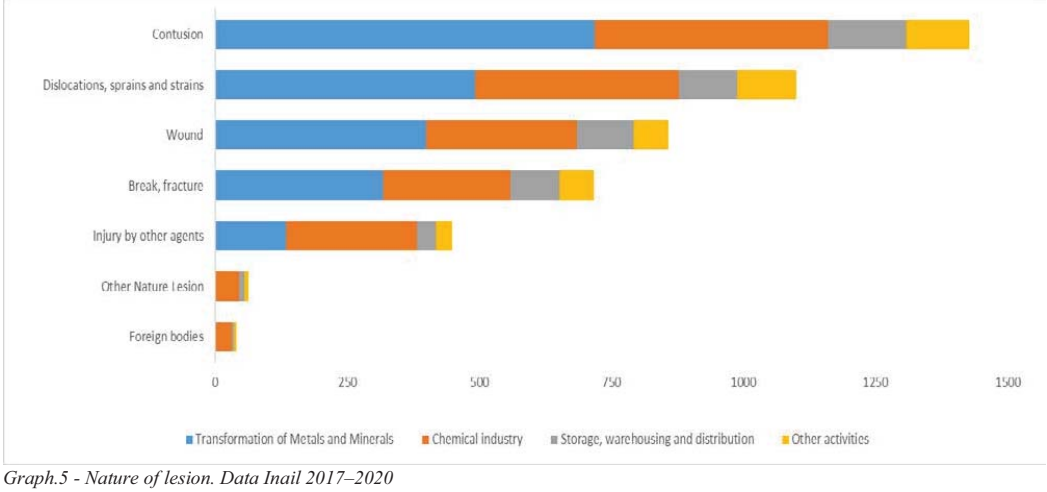
Graph.2 - Contact mode of injuries. Data Inail 2017–2020



Graph.3 - Deviation. Data Inail 2017-2020



Graph.4 - Part of body injured. Data Inail 2017-2020



Graph.5 - Nature of lesion. Data Inail 2017–2020

5 Conclusions

On the basis on the implementation of the Seveso III Directive in Italy, the study about injuries in this specific sector has been conducted. A methodology for a focused analysis has been studied and has been applied using a set of data deriving through the use and the processing of appropriate statistical data and information, contained in internal and external to Inail databases.

Data are related to five years (from 2017 to 2020) and the database represents the only national explanatory basis of the Seveso sector from which various information can be drawn. In fact, in addition to information presented in the present paper, the database contains other data such as, for example the regional distribution of injuries, injured gender and age. This analysis represents the starting for future comparisons to obtain trends and useful information to define effective guidelines, procedures and policies and improve safety and health of workers who carry out their activities in Seveso establishment with major accident hazard.

The results provide a photography of the Seveso sector from the point of view of the workers' injuries in the fields of work presented.

They show that, in the considered period, injuries' trend was stable in the storage sector and there was a decrease in Trasformation of metals and minerals sector and in the Chemical one. There is also a high number of injuries related to manual operations carried out in the company. Specifically, the carried out analyses highlight a sector where the fatal injuries and "p" ≥6 (degree of disability) have a low probability of occurrence.

Moreover, this aspect could be an element of further study through more particular analyses, for instance, related to specific processes or to maintenance, also in relation to the aging.

Analyzing these data is very interesting, especially from the Seveso perspective; for example, if the cause of an accident is imputable to human error, it is also necessary to take into account the performance shaping factors impacting the workers, such as training, ergonomics and human-machine interface and to determine how these factors are considered in the risk analysis.

It should also be pointed out that the database would be also useful to draw up prevention strategies and to plan specific areas of action for workers such as their education and training.

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