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Original
Occupational accident-precursors data collection and analysis according to Human Factors Analysis and Classification System (HFACS) taxonomy / Baldissone, G., Demichela, M., Comberti, L., Mure, S.. - In: DATA IN BRIEF. - ISSN 2352-3409. - ELETTRONICO. - 26:(2019), p. 104479. [10.1016/j.dib.2019.104479]

Availability:
This version is available at: 11583/2777472 since: 2020-01-07T15:41:50Z

Publisher:
Elsevier Inc.

Published
DOI:10.1016/j.dib.2019.104479

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http://dx.doi.org/10.1016/j.dib.2019.104479

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14 October 2026

Data in brief 26 (2019) 104479

Contents lists available at ScienceDirect

Data in brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Occupational accident-precursors data collection and analysis according to Human Factors Analysis and Classification System (HFACS) taxonomy

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ARTICLE INFO

Article history:
Received 24 July 2018
Received in revised form 5 August 2019
Accepted 27 August 2019
Available online 4 September 2019

Keywords:
Accident-precursors
Unsafe acts
Unsafe conditions
HFACS
Accident prevention

ABSTRACT

Data were collected in an automotive production plant during a campaign of observations performed by safety experts. A period of one week of observations was done during which safety experts monitored the working activity of an assembly line. All accident-precursors identified were reported in a format and immediately analysed and classified according to HFACS. Each collected element was classified in 3 categories as: unsafe acts (related to human behaviour), unsafe condition (related to the working condition and working organisation) and near miss (a situation that involved workers without physical consequence for them). Then each element was classified according to the four levels of HFACS: individual factor (violation or error), environmental factor, supervision and organisational factor. This step was supported by short interview with workers and/or supervisors involved to better identify the characterising factors of the event. This survey allowed the identification and classification of 100 accident-precursors that could be used in the company where they have been collected and, more in general, in manufacturing companies, to identify behaviours and areas of improvement for health and safety based on

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https://doi.org/10.1016/j.dib.2019.104479
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more recurrent factors that characterised the observed events, according to the methodology described in Baldissone et al. [1].

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Specifications Table

Subject	Manufacturing engineering
Specific subject area	Occupational Safety
Type of data	Table
How data were acquired	Observation campaign
Data format	Raw
Parameters for data collection	The data were collected and just classified according to the taxonomy during the manufacturing plant normal operational activity
Description of data collection	The data were collected within one campaign of observation over both the shift of the plant production. Health and Safety experts observed the work environment, identifying the causes of the collected events and classifying them according to the Human Factors Analysis and Classification System, after an interview of the people involved, where relevant.
Data source location	Town: Torino Country: Italy
Data accessibility	With the article
Related research article	Author's name: Baldissone G., Comberti L., Bosca S., Murè S., Title: The analysis and management of unsafe acts and unsafe conditions. Data collection and analysis. Journal: Safety science https://doi.org/10.1016/j.ssci.2018.10.006

Value of the Data

- The data presented here were collected with an observation campaign and analysed. Occupational accident-precursors collection are rare and this data set is useful since it reports a relevant number of events with information on the causes in four possible level of analysis: individual factor (violation or error), environmental factor, supervision and organisational factor. Data might contain valuable information useful to support the Health and Safety service (HSE).
- Authors developed a method to collect, analyse and classify accident-precursors in automotive plant. The shared data can be used by the HSE service of the manufacturing plants to identify critical area and to better design measures to safety improvement. Researchers in the field of HSE, since they gives indication on the causes of the accidents-precursors and the correlation among active, latent, supervision and organizational causes.
- The dataset can be used for the development, monitoring and verification of HSE policies and procedure in manufacturing companies. In fact Company can introduce corrective measures and repeats the campaign of observation. The comparison between the data shared and the subsequent campaign would give an evaluation of the measures effectiveness.
- As additional value, this dataset shows empirical evidence on the diffusion of the accidents-precursors in a manufacturing company and their more common types.

1. Data

The shared data were collected with a campaign of observation in a automotive assembly plant.

All observations were analysed with HFACS method and classified according to his taxonomy (Fig. 1). The criteria adopted to judge if any behaviour or condition observed could be considered as an occupational accident-precursors was related to an objective increase in term of risk for worker safety.

As an example if a worker did not wear a prescribed gloves during his assembly activity this could expose him to bigger risk of cuts. As a consequence this observation was classified as an Unsafe Act and analysed with HFACS method.

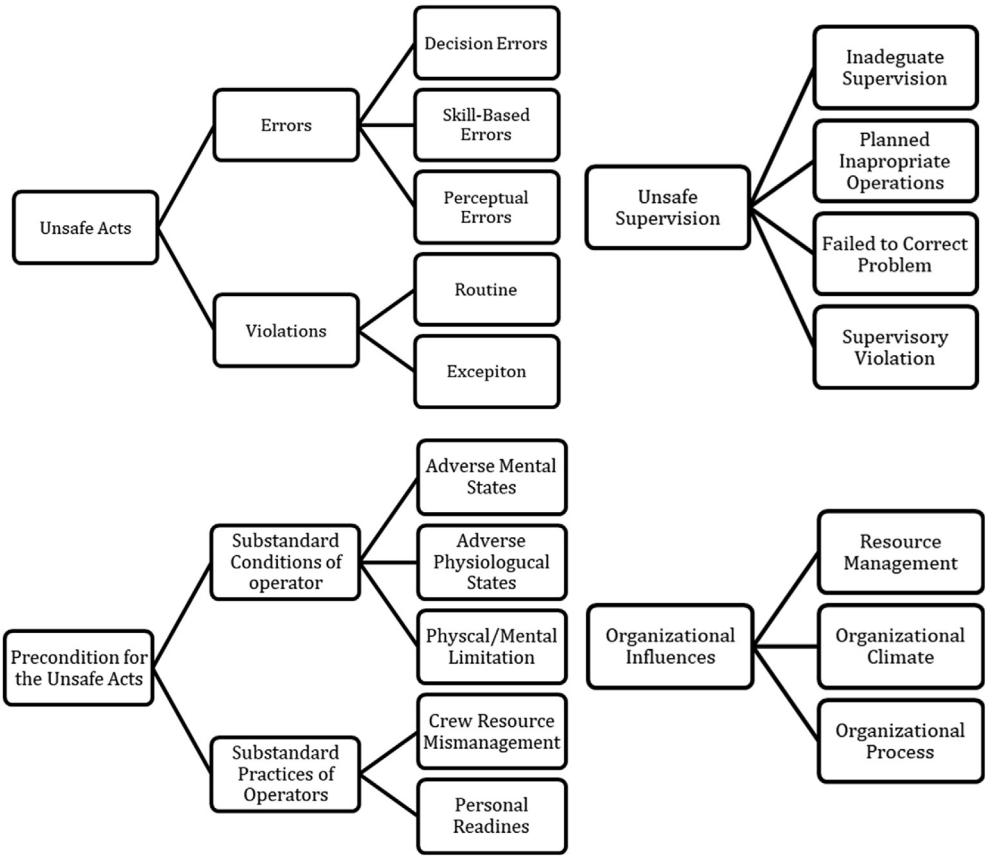

Fig. 1. The taxonomy used for the causes classification.

On the basis of this approach 100 observation of accidents-precursors were collected, analysed and categorized [2]. Table 1 resumes all data dived in category and sub-category (if present). The "Description" column provides for each category the reason why these observations represented an relevant increase of Risk. Last column of Table 1 reports the number of events for each category.

HFACS analysis and observation provided a lot of attributes related to each accident-precursors collected. Table 2 resumes the kind of information provided as supplementary data in an excel file.

The accidents precursors are initiators of sequences of events that can bring to an accident [3,4], without arriving to their consequences. As expressed in the "Swiss cheese" model [5] the accidents precursors show leakages in the barriers that should interrupt the sequence towards accidents. Under the accidents' precursor label the Unsafe Acts, the Unsafe Conditions and the Near Misses can be collected [6]. Accidents precursors were identified according to the definition initially given in Bird and Germain [7] and reported in the follows: an Unsafe Act is "*any behaviour or activity of a person that deviates from normal accepted safe procedures*", an Unsafe Condition is "*an hazard or the unsafe mechanical or physical environment*" and a Near Miss is "*any incident where an exchange of energy occurs but there is not contact, and which under slightly different circumstances could have resulted in injury, property damage or loss of process*".

Table 1
Accidents precursors.

Category	Sub-category	Description	Number of event
Non compliance with Working-cycle	Recover Advanced other	Workers performed a working activity out of the designed working station, out of the protective measures and adopting dangerous postures.	13
Lack in PPEE using	Generalized, Individual, Casual, Continues	Workers performed his own working activity without the PPE prescribed by the H&S service.	19
Defective PPE	–	The PPE used by the worker were find with failures able to compromise their protective efficacy.	1
Obstacles	Pedestrian crossing, Working-place	The presence of material in wrong position can hinder the regular activity and cause scrambles and fells	3
Passage obstruction	Chest, Carriage, Other	The presence of equipment and material in the middle of internal route strongly reduce the space for manoeuvre for fork-lifts and bulls. That can cause collision.	7
Carriage recharge out of the dedicated zone	–	Presence of electrical vehicle in charge out of the designed area with interference with other working activity.	1
Driving	Dangerous, Not use of safety belt, Gridlock	Any dangerous behaviour performed driving fork-lift and bulls inside the working area and causing possible prejudice to workers safety.	16
Unauthorized using of mobile phone during working activity	Production, Driving, Other	Using of personal mobile phone out of the break area and during the working activity. That causes an attention reduction and interference with working equipment.	6
Interference	Workers/means of transportation, Pedestrian cross and driveway	Workers and vehicles travelled wrong way causing interference and risk of collision to other workers/equipment.	2
Crossing out of pedestrian cross	–	Workers crossed the internal way out of the prescribed cross. That behaviour can cause impact with the huge number of fork-lift operating in the working area.	2
Dereliction	Carriage, Chest, Equipment, Other	The dereliction of any material out of the prescribed area can causes a negative interference with the working activity	17
Defiance of Fireproof system	–	Presence of non compliance of fire-proof system in the working space	1
Food and drink consumption out of dedicated areas	–	Food consumption inside the working area is not allowed because food can be contaminated by the chemical substances (oil, paint …) widely used in the working area.	4
Chest unblocked	–	Chest unblocked can move alone and impact to workers.	1
Unfit equipment	–	Identification of equipment not well fit with the working activity/space. That force workers in adopting dangerous postures	4
Improper signage	–	Not compliance with the risk assessment document and signal in the working area	3

2. Experimental design, materials, and methods

Collect and analyse data on the Accidents Precursors is difficult both for the hidden nature of the events and because the events don't have evident consequences. Accidents precursors are more numerous than the accidents [5].

The accidents precursors data collection is proposed in different industrial fields, as: process industry [8,9], construction field [10] and in manufacturing industry [11].

The data were collected in one week of observation in the assembly department of an automotive manufacturing company located near Turin, in the northwest of Italy. The observations were conducted during the normal work activity: the working activity was organized in 2 shifts (6–14 and 14–22).

The data was collected using adopting the form, with the following procedures:

Table 2
Attributes of accidents-precursors.

Column	Description
A	Id
B	Date
C	Time of the observation
D	Classification
E	Interview
F–I	Hierarchical level of the interviewed (operator, team leader, supervisor, chief)
J	Description of the event observed
K	Category of observation
L-O	Decisional errors
P–S	Skill-based errors
T	Perceptual errors
U–Y	Routine violations
Z-AD	Exceptional violation
AE-AK	Adverse mental states
AL-AO	Adverse physiological states
AP-AR	Crew resource management
AS-AV	Personal readiness
AW-BC	Physical environment
BD-BI	Technological environment
BJ-BM	Formation, information and training
BN-BQ	Monitoring, supervision
BR-BT	Hazard identification, Risk evaluation
BU-BW	Failed to correct behaviour
BX-CA	Failed to correct problems
CB-CD	Resource management
CE-CG	Procedure management
CH	Supervisory violation
CI-CL	Human resource management
CM-CO	Design/equipment
CP-CR	Organisational climate
CS-CU	Organisational process
CV	Observer notes

1. Observation of the events;
2. Identification of the type of event (Unsafe Act, Unsafe Condition and Near Miss);
3. Identification of the worker involved;
4. Investigation on the causes, with also the conduction of the interview of the worker and/or other figures involved;
5. Classification of the causes and recording of the data.

The accidents precursors data can be collected through two possible approach [12]. The bottom up approach, where the worker and the supervisor collect the data and the centralized approach, where the data are collected by the Health and Safety personnel or by external personnel. The advantage of the bottom up approach is that the workers well know the work environment and the work procedures [13] and they can immediately identify the incorrect situation. But, at the same time, this type of approach requires high levels of safety culture.

The advantages of the centralized approach are that observations are made by external personnel not involved in the work place dynamics and the observer has usually higher level of knowledge about safety and risk assessment. But, on the other hand, an external observer will never have a detailed knowledge on work environment or work procedures. The data here reported has been collected according to a centralized approach.

In both cases, during the data collection, it is important to investigate and classify the root causes of the accident's precursor observed. In this way the data collected can be used for preventive purpose.

Data was collected through a centralized approach; the observations were made by a couple of external experts in Health and Safety with the collaboration of the Health and Safety personnel of the company.

After the accident's precursor observation, the data collection team investigated on the root causes of the events. The investigation involved two steps: first a classification of the root causes made by the observer, according to the taxonomy included in the form; then, wherever possible and relevant, an immediate and short interview to the workers involved.

The interview was an “unstructured interactive interview”, where fluid conversation is conducted, with the worker explaining in detail the causes and the reason of the events according his/her perception. In this type of interview a confidential approach is used with a clear not judging style [14]. In case, during the interview, should appear that some causes are connected with the supervision or organizational factor, also the supervisor or the higher management were involved.

For the classification of the root causes of the accidents precursors the Human Factors Analysis and Classification System (HFACS) was used as reference. In its taxonomy, the causes are described as active failures, latent failures and latent conditions that can influence the accidents precursor occurrence and dynamic [15]. The causes are divided in Unsafe Act, Precondition of the Unsafe Act (Unsafe Condition), Unsafe Supervision and Organizational Influence [16,17]. The taxonomy structure used for the data collection and the roots causes classification is shown in Fig. 1.

The data are recorded in an Excel file and contains:

- The description of the event;
- Event classification: Unsafe Act, Unsafe Condition and Near Miss;
- The classification of the causes;
- Notes.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.104479.

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