

Article

Topic Modeling of Occupational Accident Narratives in the Manufacturing Sector Using BERTopic: Sector-Specific Accident Pattern Analysis

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Abstract

Despite technological developments and increasing awareness in the field of occupational health and safety, occupational accidents remain one of the fundamental problems that continue to have significant economic and social consequences. Particularly in the manufacturing sector, the diversity of production processes, differences in the machinery and equipment used, and the complexity of working environments cause occupational accidents to exhibit risk patterns that are both shared across sectors and specific to individual sectors. In this context, this study conducted a topic modeling analysis using the BERTopic algorithm on 1,600,000 occupational accident narratives to identify sector-specific risk patterns and error types associated with 24 different economic activities within the manufacturing sector. To improve topic modeling performance, a multilingual SentenceBERT-based embedding model and a Turkish-specific tr-MTEB embedding model were compared, and the analysis was carried out using the model that provided higher representational capacity and better topic separation performance for the occupational accident narratives. The findings show that, although the sectors differ in terms of production structure, types of machinery and equipment used, material characteristics, and working environments, occupational accidents largely cluster around similar risk mechanisms. As a result, it was determined that the BERTopic method makes the sectoral risk patterns embedded in occupational accident narratives more visible and provides an analytical basis for developing sector-specific prevention strategies in occupational safety practices.

Keywords: BERTopic; manufacturing; occupational accident; topic modeling

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1. Introduction

The manufacturing sector encompasses a broad range of activities, including the production of goods from raw materials, assembly line operations, metal product manufacturing, and the installation, operation, maintenance, and use of heavy machinery and equipment. As one of the largest employment sectors and one characterized by highly hazardous working environments, manufacturing is exposed to diverse hazards and risks arising from technological advancements, evolving machinery and equipment, and changes in organizational practices. Occupational accidents not only pose significant risks to workers' health and safety but also directly affect production continuity, operational efficiency, and economic sustainability. Therefore, analyzing occupational accidents occurring in the manufacturing sector is of critical importance. In manufacturing work environments,

occupational accidents resulting from unsafe conditions and unsafe acts associated with intensive machinery use, physically demanding tasks, shift work, and production pressure are also influenced by various organizational and strategic-level factors [1,2]. These factors include inadequate safety protocols, ineffective management practices, operational failures, and machinery malfunctions. To prevent occupational accidents, administrative and regulatory measures, employee training, collective protective measures, the development of a strong safety culture, ergonomic designs, and appropriate workplace layouts should be implemented. Therefore, preventing occupational accidents in the manufacturing sector should be regarded as a fundamental priority from both humanitarian and organizational perspectives.

Accordingly, this study aims to support the prevention of occupational accidents, protect the physical and psychological well-being of workers, and facilitate organizational-level preventive measures by conducting a sector-specific error analysis of occupational accident narratives from 24 different economic activities within the manufacturing sector. Furthermore, the study seeks to identify hidden patterns and determine sector-specific risks.

Literature Review

Although artificial intelligence algorithms are actively used in the analysis of occupational accidents, most studies are conducted using structured data. In contrast, occupational accident narratives included in accident reports, which are mostly defined as unstructured data, provide valuable information for evaluating the factors that lead to accidents, such as environmental conditions, human errors, and organizational influences, through the contextual details they contain. However, these factors cannot be fully captured through structured data. In this context, Bondy et al. (2005) conducted a study showing that occupational accident narratives can be used systematically. In their study, they analyzed accident descriptions to identify the factors affecting occupational accidents in the construction sector [3]. This study demonstrated that occupational accident narratives can be actively used to generate additional information about the incident. However, it was not until 2016 that natural language processing (NLP) began to emerge as a distinct methodological approach in the occupational accident literature. Tixier et al. (2016) showed that an NLP system could rapidly and automatically screen unstructured injury reports with an accuracy of over 95% [4]. Since 2017, natural language processing and text mining algorithms have been used more actively on occupational accident narratives in safety reports for tasks such as causal classification, risk model extraction, topic modeling, and semantic representation. In parallel with this, a literature review was conducted on the use of topic modeling algorithms in occupational accident analysis. Sarkar (2020) created a hybrid dataset by analyzing accident reports and inspection reports from a steel plant in order to predict injury severity. Topic modeling was used to analyze the unstructured datasets, while six different algorithms, namely support vector machine, artificial neural network, Naive Bayes, k-nearest neighbors, regression tree, and random forest, were used for prediction. As a result of the study, it was concluded that including proactive data in the analysis, in addition to using only reactive data, improved the prediction of injury severity [5]. Suh (2021) aimed to extract cross-sectoral accident process patterns by using text mining and LDA on the narrative text fields of OSHA accident reports. As a result of the case study, five sectoral accident process patterns were identified: scale-intensive, facility-intensive, supplier-dominant, market-dominant, and service-dominant patterns [6]. Ahadh et al. (2021) proposed an automated, semi-supervised, and domain-independent approach for the analysis of accident reports. Using the proposed method, they applied semi-supervised keyword extraction and topic modeling and analyzed the reports according to user-defined topic headings. As a result of the study, they found the classification accuracy of the

proposed method to be 80% [7]. Rose et al. (2022) applied structural topic modeling to accident and incident reports published by the Aviation Safety Reporting System (ASRS) and the National Transportation Safety Board (NTSB). As a result of the study, the findings of the STM analysis were presented, and the correlations between pairs of topic labels were examined. Based on the findings, they concluded that STM was effective in identifying topics within technical datasets [8]. Miyamoto et al. (2022) used natural language processing tools, K-Means clustering, and t-distributed Stochastic Neighbor Embedding (t-SNE) for dimensionality reduction in order to extract patterns of operational inefficiency, categorize narratives, and visualize the results. Based on the analysis, they identified 7 main clusters and a total of 23 sub-clusters [9]. Bao et al. (2023) used a domain knowledge-based topic model to reveal hidden topics and trends from historical air traffic control incident reports. As a result of the study, 20 topics were identified, and their changes over time were examined. The findings showed that the causes of ATC incidents shifted over time from external technical factors to more human-related factors. In other words, rather than radar or equipment problems, human- and operation-oriented factors such as instruction communication and airspace handover became more prominent. In addition, these causes were found to vary according to ATC region and flight phase [10]. Xing et al. (2024) proposed a new framework combining text mining and network analysis to improve aviation safety by extracting meaningful structures from accident reports in free-text format. The proposed framework consists of four stages: transforming texts into numerical form using TF-IDF, identifying accident-related topics with STM, examining the relationships between risk factors through a word co-occurrence network, and quantitatively analyzing root causes. In the application conducted on NTSB accident reports, it was observed that STM separated topics in greater detail and distinguished similar incidents more effectively compared with traditional LDA [11]. Nanyonga et al. (2025) compared pLSA and BERTopic topic modeling methods to extract meaningful information from free-text narratives in aviation safety incident reports. The evaluation was carried out both quantitatively, using topic coherence scores, and qualitatively, in terms of topic relevance. The study showed that pLSA provides a robust probabilistic framework, whereas BERTopic, which uses transformer-based embeddings and HDBSCAN clustering, produces more detailed, context-sensitive, and meaningful topic groups. On the other hand, they noted that BERTopic requires higher computational cost and more complex parameter tuning processes [12]. Cao et al. (2026) examined 22,623 accident reports obtained from OSHA between 2004 and 2023 using topic modeling in order to better understand and prevent accidents on construction sites. As a result of the study, they found that BERTopic outperformed the traditional LDA model in terms of topic coherence and topic diversity. Through contextual embeddings, BERTopic was able to reveal detailed risk scenarios, occupation–accident relationships, and temporal trends that could previously have been overlooked more effectively [13]. As a result of the literature review, it was observed that topic modeling-based studies conducted on occupational accidents are largely based on LDA and similar traditional methods. However, since these methods rely on word co-occurrence structures, they can capture contextual meaning only to a limited extent, especially in short and heterogeneous narratives. In contrast, BERTopic combines transformer-based sentence/text embeddings, dimensionality reduction, and clustering steps, enabling narratives with similar contexts to be grouped under the same theme and thereby making latent patterns that classical methods may overlook more visible. In addition, topic modeling applications in the manufacturing sector are generally limited to a single sector, and no study was identified that determines sector-specific risks across the manufacturing sector, which includes a wide range of economic activities. Therefore, in this study, topic modeling was conducted using the BERTopic algorithm on occupational accident narratives that are independent of each other, not

in a standard format, and contain sector-specific risks, with the aim of identifying risks specific to economic activities in the manufacturing sector, revealing latent patterns, and supporting the development of a reporting system intended to improve occupational safety culture accordingly.

2. Materials and Methods

2.1. Data

The study dataset includes occupational accident reports that occurred in the manufacturing sector between 2012 and 2023 and was obtained from the Social Security Institution of the Republic of Türkiye (SGK). The accident reports were submitted to the SGK system in Turkish by the person reporting the accident and describe the cause of the accident and how it occurred. Since the occupational accident narratives were entered by authorized workplace representatives, the reports contain information presented in different formats. The economic activity codes of the 24 different economic activities within the manufacturing sector, as defined by the Social Security Institution (SGK), the names of the economic activities, and the number of accident reports obtained after data preprocessing are presented in Table 1.

Table 1. Classification of Economic Activities in the Manufacturing Sector and Number of Records.

Sector Code	Economic Activities	Data Count
10	Manufacture of Food Products	186,461
11	Manufacture of Beverages	5109
12	Manufacture of Tobacco Products	1205
13	Manufacture of Textiles	180,292
14	Manufacture of Wearing Apparel	53,143
15	Manufacture of Leather and Related Products	8299
16	Manufacture of Wood and of Products of Wood and Cork, Except Furniture; Manufacture of Articles of Straw and Plaiting Materials	33,400
17	Manufacture of Paper and Paper Products	31,969
18	Printing and Reproduction of Recorded Media	8156
19	Manufacture of Coke and Refined Petroleum Products	1778
20	Manufacture of Chemicals and Chemical Products	35,391
21	Manufacture of Basic Pharmaceutical Products and Pharmaceutical Preparations	8932
22	Manufacture of Rubber and Plastic Products	116,212
23	Manufacture of Other Non-Metallic Mineral Products	126,894
24	Manufacture of Basic Metals	155,432
25	Manufacture of Fabricated Metal Products (Except Machinery and Equipment)	220,012
26	Manufacture of Computer, Electronic and Optical Products	14,638
27	Manufacture of Electrical Equipment	85,306
28	Manufacture of Machinery and Equipment n.e.c.	102,623
29	Manufacture of Motor Vehicles, Trailers and Semi-Trailers	123,554
30	Manufacture of Other Transport Equipment	63,922
31	Manufacture of Furniture	59,868
32	Other Manufacturing	11,401
33	Repair and Installation of Machinery and Equipment	47,856

2.2. BERTopic

Topic modeling, developed within the context of natural language processing, is a set of methods used to identify latent thematic structures and semantic patterns embedded within textual data [14,15]. BERTopic is a topic modeling approach that combines transformer-based contextual embeddings, dimensionality reduction, and density-based clustering techniques [16]. Compared to traditional models, BERTopic is more effective at capturing semantic and contextual relationships within data [17,18]. Furthermore, it does

not require preprocessing in accordance with the embedded design [18]. The BERTopic method operates in several stages [16]. First, each text document is transformed into dense vector representations using transformer-based sentence embeddings. These embeddings preserve the semantic content of the texts and enable similar documents to be positioned close to one another. In the second stage, the high-dimensional embedding space is reduced to a lower-dimensional space using the UMAP method. This process facilitates clustering while largely preserving the structure of the data. In the third stage, the documents are clustered using the HDBSCAN algorithm. HDBSCAN can identify clusters with different densities and can also detect outlier documents separately. In the final stage, representative key terms are extracted for each cluster using c-TF-IDF, and thus each cluster is interpreted as a topic.

2.3. Research Framework

Within the scope of the study, embedding models were compared to identify the most appropriate embedding model for the Turkish language, and the BERTopic method was employed to model the topics within the unstructured and domain-specific expressions contained in the accident reports. In the first stage of the analysis, preprocessing steps were applied to the dataset obtained from the SGK. In this context, records from 2012 to 2023 that contained incorrectly entered date information or inconsistencies with the study scope were removed from the dataset. Subsequently, the ages of insured individuals were evaluated together with their employment start and end dates, and records identified as logically inconsistent were excluded. In the textual preprocessing stage, all texts were standardized, case normalization was applied, and punctuation marks were removed. In addition, domain-specific formulaic expressions that did not provide information about the accident occurrence process, such as “referred to the hospital,” “first aid was administered,” and “placed under treatment,” were removed from the text. After the preprocessing stage was completed, the BERTopic modeling process was conducted. Since the data used in the study were in Turkish, two embedding approaches were evaluated: tr-MTEB (trmteb/turkish-embedding-model-fine-tuned) [19], which is known to perform well in Turkish text representations, and a Sentence-BERT-based model (sentence-transformers/paraphrase-multilingual-MiniLM-L12-v2). To ensure that the comparison reflected only differences arising from the embedding models, the other core components of BERTopic were run with identical parameters for both models. In addition, a common maximum sequence length was used to reduce potential comparison bias arising from differences in the maximum sequence lengths of the models.

Embedding vectors were computed once for each sector and embedding model and subsequently reused across different BERTopic runs. The precomputed embeddings were provided to the BERTopic model; UMAP was used for dimensionality reduction, HDBSCAN for clustering, c-TF-IDF for generating topic representations, and Maximal Marginal Relevance for diversifying topic words. In the comparison of Model A and Model B, the UMAP and HDBSCAN parameters were held constant, and both unigrams and bigrams were used for topic word extraction. The modeling process was repeated using five different random seeds, and the results were evaluated in terms of the number of topics, outlier ratio, topic diversity, c_v coherence, c_{npmi} coherence, largest topic ratio, normalized topic entropy, embedding time, and stability metrics. Clustering stability was measured using the Adjusted Rand Index restricted to common inliers (ARI-CI), whereas topic-word stability was assessed using a penalized Jaccard-based index [20–25]. The experimental design was conducted across nine sectors representing three different corpus sizes. The small-sized dataset included Sectors 11, 18, and 21; the medium-sized dataset included Sectors 16, 33, and 31; and the large-sized dataset included Sectors 29, 24, and 13. A total of

90 BERTopic runs were performed using two embedding models and five seeds for each sector. Thus, the models were compared in terms of topic quality, document coverage, topic balance, computational cost, and stability across seeds.

After the modeling process, the topics obtained on a sectoral basis and the associated keywords were manually examined. In this context, an additional error analysis was conducted for each sector, and the interpretability of the model outputs was evaluated by considering the sectoral context. The workflow of the BERTopic algorithm used in the study is presented in Figure 1.

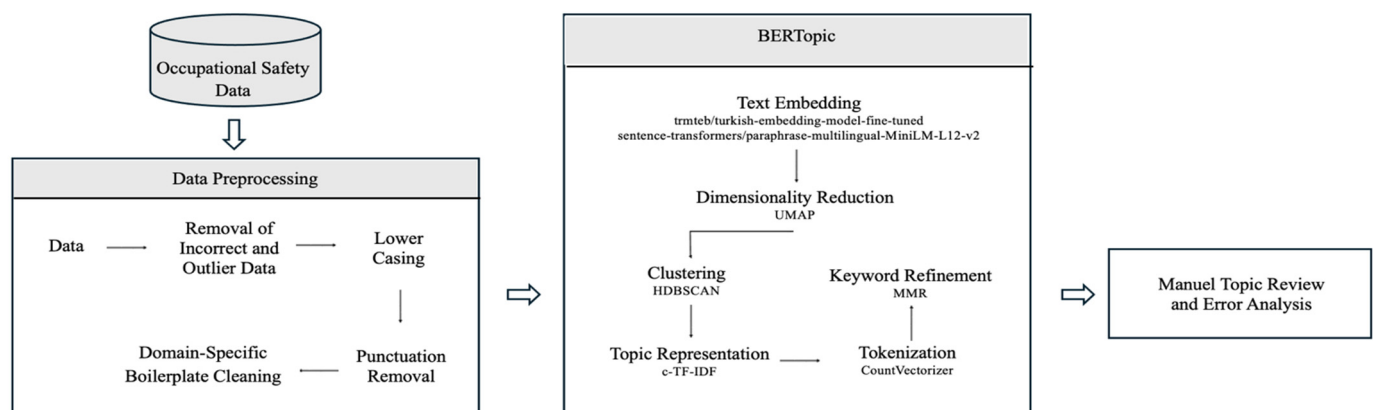


Figure 1. Flowchart of the BERTopic Algorithm.

For the developed model, two different BERTopic configurations, namely Model A (SBERT) and Model B (trMTEB) were compared in line with the hyperparameters presented in Table 2. In Model A and Model B, the performance of the embedding models was compared. In Model C, based on the embedding model found to be successful, general texts specific to occupational accident records were cleaned, CountVectorizer stop-word filtering was applied, and UMAP and HDBSCAN parameters were dynamically adjusted to reduce model instability arising from differences in dataset sizes. The n-gram range was expanded from (1,2) to (1,3) to better capture multi-word expressions frequently observed in occupational accident narratives and to improve the interpretability of topic keywords. Due to the diverse nature of workplace accident narratives, dynamic parameters have been manually selected to specify the maximum number of topics based on the number of documents in each sector. Smaller parameter values were used for sectors with fewer accident narratives to preserve small but meaningful clusters, whereas larger values were used for sectors with more narratives to reduce excessive topic fragmentation.

The embedding models were compared across nine sectors representing three different corpus-size groups. For each sector, the SBERT and trMTEB models were run with five different random seeds under the same BERTopic configuration, and the results are reported in Table 3 as mean $\pm$ standard deviation. Single-run metrics (number of topics, outlier ratio, topic diversity, c_v coherence, $c_{n\text{pmi}}$ coherence, largest topic ratio, normalized topic entropy, and embedding time) were computed separately for each of the five seed runs and reported as mean $\pm$ standard deviation across the five runs. Pairwise stability metrics (ARI-CI, common-inlier ratio, and topic-word stability) were computed for each of the ten unique seed pairs and reported as mean $\pm$ standard deviation across these pairs. The evaluation metrics included embedding time, which represents the time required by the model to transform the texts into embedding vectors; number of topics, which reports the average number of non-outlier topics identified across the five seed runs; outlier ratio, which represents the proportion of documents classified as outliers by the topic model; Topic Diversity@10, which represents the proportion of unique words among the top 10

keywords across all topics; c_v coherence, which evaluates the semantic coherence of the top-ranked topic keywords within the corpus; c_{npmi} coherence, which measures normalized coherence based on word co-occurrence relationships; largest topic ratio, which indicates the proportion of inlier (non-outlier) documents assigned to the single most populated topic within a given run; normalized topic entropy, which indicates how evenly documents are distributed across non-outlier topics, with values approaching 1 when topic sizes are perfectly balanced; ARI-CI, which measures, for each pair of seed runs, the agreement between cluster assignments computed only on documents classified as non-outliers in both runs of that pair; common-inlier ratio, which indicates, for each pair of seed runs, the proportion of the corpus classified as a common inlier in both runs, i.e., the subset of documents over which ARI-CI is computed; and topic-word stability, which measures, for each pair of seed runs, the extent to which the top 10 topic keywords are preserved via a penalized Jaccard-based index [20–25].

Table 2. Hyperparameters Used in the Compared and Developed Models.

	Model A (SBERT)/Model B (trMTEB)	Model C (O-SBERT)
Batch Size	128	Dynamic: 64/128/256
Vectorizer	ngram_range = (1,2), min_df = 1	ngram_range = (1,3), min_df = dynamic: 1/2/5/10/20/30, max_df = 0.70, max_features = 50,000
UMAP	n_neighbors = 15, n_components = 5, min_dist = 0.0, metric = cosine, random_state = 42,52,62,72,82	n_neighbors = dynamic: 15/30/40/50/75/100, n_components = 5, min_dist = 0.0, metric = cosine, random_state = RANDOM_STATE, low_memory = True
HDBSCAN	min_cluster_size = 20, min_samples = 10, metric = Euclidean, cluster_selection_method = eom	min_cluster_size = dynamic: 12/30/50/100/200/300, min_samples = dynamic: 2/5/8/10/20/30, metric = Euclidean, cluster_selection_method = eom, prediction_data = True, core_dist_n_jobs = -1
Representation Model	MMR, diversity = 0.3	MMR, diversity = 0.3

When the results presented in Table 3 are evaluated at the sectoral level, the performance of the SBERT and trMTEB models appears to vary depending on corpus size and the sector-specific narrative structure. In Sector 11, which belongs to the small-sized corpus group, although the trMTEB model produced higher Topic Diversity@10, c_v , and c_{npmi} values, it generated only 3.6 topics, resulting in the largest topic ratio of 97.3%, and produced a considerably low normalized entropy value. This indicates that trMTEB was unable to provide sufficient topic separation in this sector and concentrated the majority of inlier documents within a single dominant topic. In contrast, SBERT generated a larger number of topics and provided a more balanced topic distribution. In Sector 18, SBERT produced a higher number of topics, a lower outlier ratio, and a higher normalized entropy value. These results indicate that SBERT grouped the documents into more detailed and balanced topic structures in this sector. In contrast, trMTEB provided an advantage in terms of lexical diversity and topic-word stability, with higher Topic Diversity@10, c_{npmi} , and topic-word stability values. Similarly, in Sector 21, while trMTEB produced higher coherence and diversity values, SBERT yielded stronger results in terms of document coverage and topic balance, with a lower outlier ratio, a lower largest topic ratio, higher normalized entropy, and a higher ARI-CI value.

Table 3. Comparison of the Models based on Corpus Size.

Small-Size Corpus						
Sector 11		Sector 18		Sector 21		
Metric	SBERT	trMTEB	SBERT	trMTEB	SBERT	trMTEB
Documents	5109	5109	8156	8156	8932	8932
Embedding Time (s)	5.40	15.11	7.36	20.45	8.10	22.81
Topic Number	33.4 ± 2.3	3.6 ± 0.5	65.6 ± 5.2	48.6 ± 1.1	82.6 ± 4.6	66.8 ± 8.4
Outliers (%)	28.4 ± 2.4	0.8 ± 0.3	36.0 ± 3.6	37.5 ± 1.4	34.2 ± 1.2	38.1 ± 4.6
Topic Diversity@10	0.857 ± 0.009	0.995 ± 0.011	0.813 ± 0.014	0.886 ± 0.003	0.839 ± 0.016	0.880 ± 0.018
c_v	0.452 ± 0.012	0.650 ± 0.059	0.420 ± 0.010	0.406 ± 0.009	0.468 ± 0.009	0.528 ± 0.015
$c_{n\text{pmi}}$	−0.184 ± 0.009	−0.037 ± 0.010	−0.153 ± 0.010	−0.107 ± 0.012	−0.099 ± 0.012	−0.033 ± 0.013
Largest Topic (%)	18.6 ± 0.6	97.3 ± 0.2	15.5 ± 1.7	23.3 ± 0.5	6.6 ± 1.1	11.4 ± 4.5
Normalized Entropy	0.853 ± 0.008	0.114 ± 0.002	0.859 ± 0.036	0.820 ± 0.021	0.923 ± 0.011	0.900 ± 0.025
ARI-CI	0.938 ± 0.030	0.963 ± 0.017	0.832 ± 0.066	0.942 ± 0.030	0.898 ± 0.046	0.861 ± 0.077
Common-inlier ratio (%)	65.6 ± 1.5	99.0 ± 0.3	56.6 ± 2.0	56.8 ± 0.9	59.4 ± 1.1	54.5 ± 3.5
Topic-word Stability	0.627 ± 0.037	0.626 ± 0.161	0.505 ± 0.037	0.527 ± 0.027	0.557 ± 0.031	0.546 ± 0.066
Medium-Size Corpus						
Sector 16		Sector 33		Sector 31		
Metric	SBERT	trMTEB	SBERT	trMTEB	SBERT	trMTEB
Documents	33,400	33,400	47,856	47,856	59,868	59,868
Embedding Time (s)	27.37	76.77	37.17	108.50	43.80	128.25
Topic Number	141.0 ± 3.3	130.4 ± 3.6	224.8 ± 19.5	212.0 ± 7.6	247.4 ± 14.3	231.4 ± 7.7
Outliers (%)	37.1 ± 1.4	37.9 ± 1.0	40.1 ± 3.3	43.5 ± 1.7	38.0 ± 3.0	36.8 ± 1.0
Topic Diversity@10	0.803 ± 0.002	0.900 ± 0.011	0.804 ± 0.006	0.828 ± 0.008	0.813 ± 0.010	0.815 ± 0.004
c_v	0.375 ± 0.012	0.386 ± 0.008	0.389 ± 0.004	0.424 ± 0.008	0.395 ± 0.006	0.443 ± 0.007
$c_{n\text{pmi}}$	−0.098 ± 0.007	−0.063 ± 0.006	−0.068 ± 0.005	−0.005 ± 0.003	−0.061 ± 0.003	−0.001 ± 0.006
Largest Topic (%)	11.2 ± 0.4	20.4 ± 0.2	6.9 ± 2.8	7.8 ± 3.1	8.2 ± 0.2	6.7 ± 0.2
Normalized Entropy	0.817 ± 0.003	0.786 ± 0.005	0.870 ± 0.022	0.855 ± 0.020	0.803 ± 0.017	0.836 ± 0.011
ARI-CI	0.972 ± 0.007	0.971 ± 0.012	0.865 ± 0.073	0.878 ± 0.058	0.936 ± 0.016	0.924 ± 0.022
Common-inlier ratio (%)	57.5 ± 1.1	55.8 ± 0.6	52.2 ± 1.2	48.4 ± 0.7	55.1 ± 1.6	54.9 ± 0.9
Topic-word Stability	0.536 ± 0.025	0.515 ± 0.027	0.479 ± 0.041	0.519 ± 0.016	0.495 ± 0.021	0.564 ± 0.017
Large-Size Corpus						
Sector 29		Sector 24		Sector 13		
Metric	SBERT	trMTEB	SBERT	trMTEB	SBERT	trMTEB
Documents	123,554	123,554	155,432	155,432	180,292	180,292
Embedding Time (s)	95.34	291.03	115.06	342.78	138.07	410.22
Topic Number	484.2 ± 21.1	453.2 ± 9.7	670.4 ± 18.4	637.6 ± 24.4	747.6 ± 23.0	765.4 ± 10.8
Outliers (%)	45.3 ± 1.3	46.3 ± 1.3	45.1 ± 1.5	51.2 ± 1.5	42.9 ± 2.5	51.2 ± 0.8
Topic Diversity@10	0.821 ± 0.009	0.837 ± 0.009	0.757 ± 0.003	0.793 ± 0.003	0.714 ± 0.007	0.733 ± 0.003
c_v	0.421 ± 0.008	0.432 ± 0.005	0.412 ± 0.003	0.405 ± 0.004	0.476 ± 0.005	0.476 ± 0.003
$c_{n\text{pmi}}$	−0.026 ± 0.003	0.023 ± 0.004	−0.037 ± 0.005	0.003 ± 0.006	0.013 ± 0.003	0.054 ± 0.004
Largest Topic (%)	4.2 ± 2.0	5.7 ± 0.8	6.6 ± 0.2	6.4 ± 1.7	6.0 ± 0.5	3.3 ± 0.1
Normalized Entropy	0.844 ± 0.008	0.831 ± 0.005	0.845 ± 0.007	0.844 ± 0.015	0.815 ± 0.018	0.861 ± 0.005
ARI-CI	0.930 ± 0.020	0.911 ± 0.026	0.971 ± 0.008	0.919 ± 0.037	0.935 ± 0.023	0.961 ± 0.014
Common-inlier ratio (%)	47.0 ± 0.9	45.6 ± 0.9	48.1 ± 0.8	40.7 ± 1.0	49.1 ± 1.7	41.4 ± 0.8
Topic-word Stability	0.489 ± 0.020	0.522 ± 0.011	0.509 ± 0.014	0.482 ± 0.011	0.526 ± 0.015	0.555 ± 0.009

In Sector 16, which belongs to the medium-sized corpus group, trMTEB produced higher Topic Diversity@10 and coherence values. However, SBERT generated a larger number of topics, a lower outlier ratio, a lower largest topic ratio, and higher normalized entropy. Therefore, SBERT was found to produce more balanced and comprehensive topic structures in this sector. In Sector 33, the results were more balanced between the two models. While trMTEB showed an advantage in terms of coherence and topic-word stability, SBERT provided broader document coverage, with a lower outlier ratio and a higher common-inlier ratio. In Sector 31, trMTEB showed an overall advantage over SBERT, with a lower outlier ratio, higher coherence, higher normalized entropy, and higher topic-word stability. In Sector 29, which belongs to the large-sized corpus group, trMTEB produced higher Topic Diversity@10, coherence, and topic-word stability values. In contrast, SBERT provided more balanced results in terms of document coverage and clustering stability, with a lower outlier ratio, a lower largest topic ratio, higher normalized entropy, higher

ARI-CI, and a higher common-inlier ratio. In Sector 24, the advantage of SBERT was more pronounced. Compared with trMTEB, SBERT produced a lower outlier ratio, higher ARI-CI, a higher common-inlier ratio, and higher topic-word stability. This indicates that SBERT generated more stable topic structures across a broader set of documents in this sector. In Sector 13, trMTEB generated a higher number of topics, higher normalized entropy, higher ARI-CI, and higher topic-word stability. However, the substantially higher outlier ratio of trMTEB compared with SBERT indicates that the model left a larger proportion of documents unassigned to any topic. Therefore, although trMTEB demonstrated stronger performance in terms of topic structure in Sector 13, SBERT was more advantageous in terms of document coverage.

Overall, the trMTEB model showed an advantage in topic quality metrics such as Topic Diversity@10, c_v , and $c_{n\text{pmi}}$ across several sectors. However, in some sectors, higher coherence and diversity values did not necessarily indicate better topic separation. As observed particularly in Sector 11, a very low number of topics combined with a very high largest topic ratio indicates that the model was unable to sufficiently differentiate the documents into distinct topics. In contrast, SBERT provided shorter embedding times, lower outlier ratios, more balanced topic distributions, and broader document coverage across most sectors. Therefore, for the final modeling stage, the SBERT-based approach was selected by jointly considering computational efficiency, document coverage, topic balance, and overall interpretability.

3. Results

Within the scope of the study, BERTopic analysis was applied to occupational accident narratives in order to evaluate accidents occurring in 24 different economic activities within the manufacturing sector at the sectoral level and to identify implicit and latent types of occupational accidents. In line with the results obtained, occupational accident topic clusters, keywords, document densities, and thematic contents were evaluated.

3.1. General Information on Accident Analysis in the Manufacturing Sector

A general evaluation was first conducted on the obtained data in relation to the general activity performed, the specific activity, the event causing the injury, and the material agent causing the injury. Within the general activity performed, the most frequently reported category was production, manufacturing, processing, and storage, with 1,354,183 records. Within the specific activity category, the most frequently reported activities were machine operation, with 329,936 records, and working with hand tools, with 273,507 records. Among the events causing injury, the most common event was identified as contact with a sharp, pointed, hard, or rough material or tool, with 369,884 records. Among the material agents causing injury, as shown in Figure 2, the most frequently reported category was material, object, product, machine component, debris, or dust, unspecified. When evaluated on a sectoral basis, Sector 10, Manufacture of Food Products, stood out as the sector with the highest number of occupational accidents in the following categories: other material agents not listed in this classification or no information; transfer, transport, and storage systems, unspecified; chemical, explosive, radioactive, and biological substances, unspecified; buildings, structures, and surfaces at ground level, whether indoor or outdoor, fixed or mobile, temporary or permanent, unspecified; buildings, structures, and surfaces above ground level, whether indoor or outdoor, unspecified; office equipment, personal equipment, sports equipment, weapons, and household goods, unspecified; other vehicles, unspecified; and motors, energy transmission, and storage systems, unspecified. Similarly, Sector 13, Manufacture of Textiles, was the sector with the highest number of occupational accidents in the categories of fixed machinery and equipment, unspecified; non-powered

hand tools, unspecified; and powered hand-held or manually guided tools, unspecified. Sector 23, Manufacture of Other Non-Metallic Mineral Products, had the highest number of occupational accident records in the categories of land vehicles, unspecified, and bulk waste, unspecified. Sector 24, Manufacture of Basic Metals, had the highest number of accident records in the categories of material supply and distribution systems, pipelines, unspecified, and buildings, structures, and surfaces below ground level, whether indoor or outdoor, unspecified. Sector 25, Manufacture of Fabricated Metal Products (Except Machinery and Equipment), was identified as the sector with the highest number of occupational accidents in the categories of material, object, product, machine component, debris, or dust, unspecified; powered hand-held or manually guided tools, unspecified; hand tools with power supply, unspecified; and physical phenomena and natural elements, unspecified. Sector 27, Manufacture of Electrical Equipment, had the highest number of occupational accident records in the category of living organisms and humans, unspecified. Consequently, Sector 10 had the highest number of occupational accident records in 9 different categories, Sector 25 in 4 different categories, and Sector 13 in 3 different categories. Therefore, these sectors can be considered among the highest-risk economic activities in terms of the material agents causing injury.

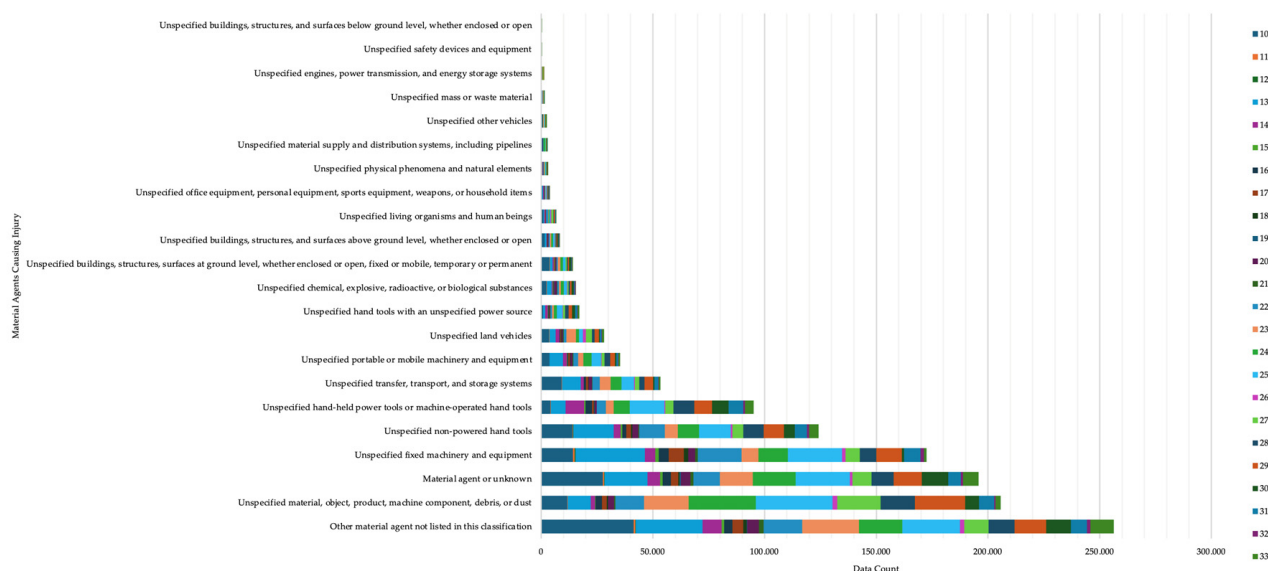


Figure 2. Distribution of Material Agents Causing Injury by Sector.

As shown in Table 4, the overall BERTopic results indicate clear differences across sectors in terms of the number of documents, number of topics, and outlier ratios. The diversity of textual content and the sector-specific structure of the accident narratives played an important role in determining the number of topics. In most sectors, outlier ratios ranged from 13% to 45%, suggesting that a considerable proportion of occupational accident narratives could not be clearly assigned to a specific theme. This may be attributed to several factors, including the very short length of some accident narratives, the use of non-standard expressions, the description of similar incidents in different ways, and the presence of various sub-activities within the same sector. These findings also indicate that occupational accident narratives are thematically heterogeneous. On the other hand, topic diversity values ranging from 0.38 to 0.95, excluding Sector 22, indicate considerable variation across sectors and show that the extracted topics are generally distinguishable from one another. In some sectors, lower topic diversity values point to topic repetition and thematic similarity. When the mean and median topic sizes are considered together, most sectors appear to be concentrated around a few dominant topics, while smaller but still

meaningful sub-topics are also present. In some sectors, the high shares of the top five topics despite high topic diversity indicate that the topics are semantically differentiated, although a substantial portion of the documents is concentrated in a limited number of dominant topics. Similarly, the difference between the mean and median topic sizes suggests the dominance of a few large topics, alongside the presence of smaller sub-themes. Overall, the results show that occupational accident patterns across sectors include both common risk areas and structures that vary depending on sector-specific conditions.

Table 4. Sectoral Overview of BERTopic Analysis Results.

Sector	Documents	Topics	Outlier Ratio (%)	Topic Diversity	Avg. Topic Size	Median Topic Size	Max. Topic Size	Top 5 Topic Ratio (%)
10	186,452	64	34.94	0.5813	1895.52	1121.5	13,639	37.78
11	5109	18	28.07	0.85	204.17	107.5	805	66.59
12	1205	22	13.11	0.9273	47.59	24	267	64.47
13	180,292	63	34.44	0.5317	1876.08	828	10,719	32.02
14	53,143	40	30.73	0.4714	920.25	480.5	6164	45.97
15	8299	23	30.85	0.8217	249.52	163	1851	59.45
16	33,400	34	40.48	0.7882	584.74	412	2664	41.85
17	31,969	33	45.27	0.7697	530.21	325	2538	48.15
18	8156	25	35.8	0.844	209.44	114	946	53.3
19	1778	44	25.14	0.9523	30.25	22	187	34.26
20	20,273	48	42.72	0.7063	422.35	228.5	3487	43.27
21	8932	32	41.11	0.8125	164.38	110	482	37.74
22	116,212	43	40.3	0.1651	1613.4	799	8245	39.7
23	126,894	69	32.79	0.8652	1236.1	392	14,142	48.22
24	155,432	59	40.48	0.5339	1567.95	871	9771	38.14
25	220,012	65	35.37	0.6477	2187.54	1287	20,611	38
26	14,638	56	38.39	0.7607	161.04	106	1015	29.78
27	85,306	59	41.47	0.578	846.29	537	5141	32.42
28	102,623	67	38.18	0.8866	946.84	412	7086	37.77
29	123,554	47	39.8	0.3851	1582.57	1009	10,849	41.58
30	63,921	45	34.1	0.5467	936.09	399	6415	46.95
31	59,868	39	36.1	0.5846	980.87	653	5132	40
32	11,401	33	33.16	0.8333	230.91	110	2832	60.76
33	47,856	57	38.4	0.7702	517.21	347	3287	34.6

3.2. Detailed Analysis of Economic Activities

Based on the keywords, representative accident narratives, intertopic distance map, and heat map obtained from the BERTopic analysis, 24 different economic activities within the manufacturing sector were evaluated, and a sectoral error analysis was conducted. The tables for all sectors are provided in Appendix A.

3.2.1. Manufacture of Food Products

As a result of the analysis conducted for the Manufacture of Food Products economic activity, the dataset was found to be semantically clustered under a total of 63 topics. The high number of topics indicates that the data structure is highly heterogeneous, as different branches of economic activity, work processes, and accident scenarios coexist within the sector. In the model outputs, the outlier rate was calculated as 34.94%. This rate can be considered an expected result, given that, among 186,452 occupational accident records, many narratives were short, contextually limited, highly diverse, or could not be grouped under a clearly defined theme. According to the intertopic distance map and heatmap shown in Figures 3 and 4, although several dominant topics were present, some clusters were not clearly separated from each other. This pattern indicates that a substantial proportion of the topics were semantically distant from one another, while some topics were close or similar. Examination of the topic distribution shows that, in addition to the

dominant risk areas commonly observed in the sector, more niche but still meaningful risk factors specific to certain production processes also emerged. When the topic distribution ratios were examined, the share of the top five topics was determined as 37.78%. This suggests that occupational accidents in the food manufacturing sector cannot be explained solely by general industrial risks, and that sector-specific operational conditions also shape accident patterns.

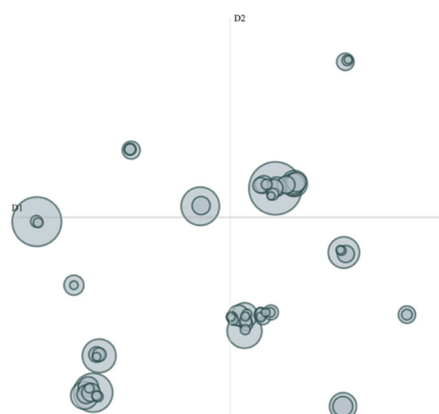


Figure 3. Intertopic Distance Map for the Manufacture of Food Products Economic Activity.

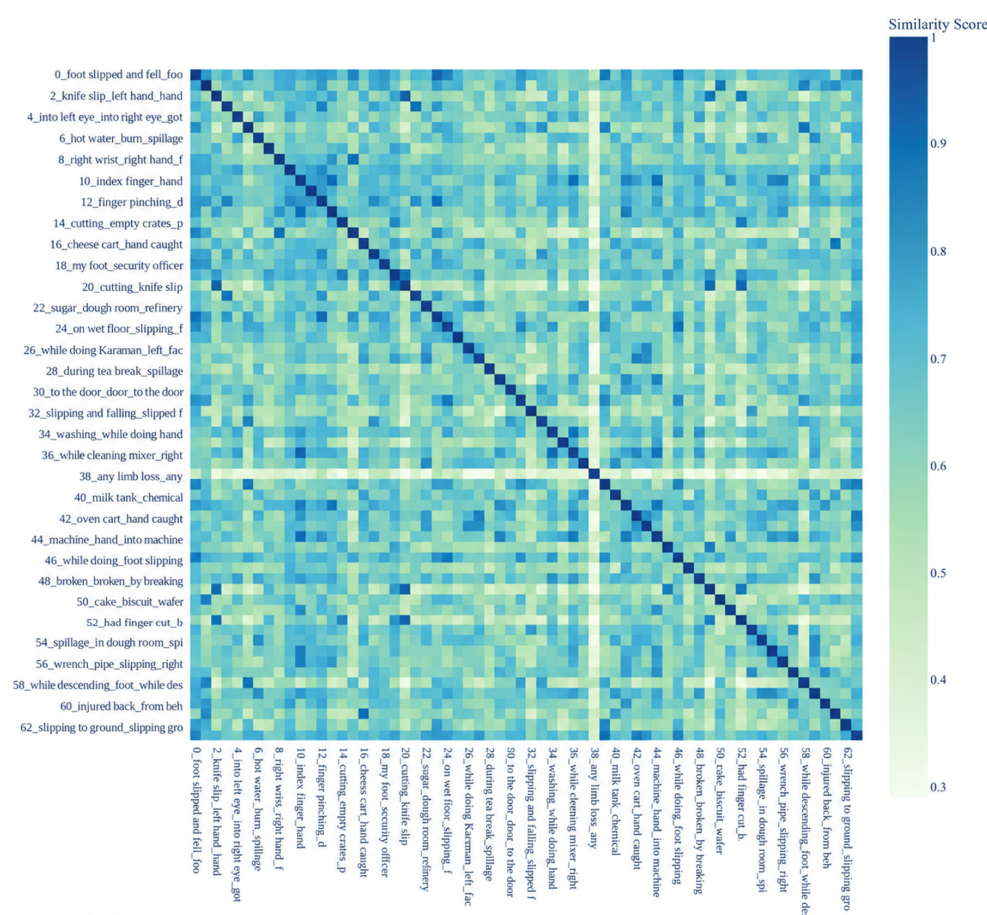


Figure 4. Heatmap for the Manufacture of Food Products Economic Activity.

According to the BERTopic analysis, six main themes related to the types of occupational accidents occurring in the manufacture of food products, along with their corresponding sub-themes, were identified. Due to the nature of the data structure, although many occupational accident narratives were action-based, the most general topics were included

in the analysis based on the most frequently used words. In this context, the most common type of occupational accident was identified as slip-, fall-, and impact-related accidents. When the keywords and representative accident narratives were examined, wet floors were found to be one of the most important causes of this accident type. Falls caused by slipping while descending stairs, as well as ankle sprains resulting from such falls, were frequently observed. Head impacts occurring while passing under a conveyor belt or production line also emerged as a prominent accident scenario within the impact-related accident type.

The second most common type of occupational accident was identified as injuries caused by cutting tools. In the food sector, where cutting tools are used extensively, a large number of cutting tool injuries occur due to both knives and machines. Among machine-related cutting tool injuries, cheese machines and bread slicing machines were particularly prominent. Exposure-related accidents, which ranked third, were also among the most common occupational accidents in the food sector. In these accidents, it is noteworthy that not only industrial chemicals used in the production process but also chemicals used in cleaning processes caused a considerable number of occupational accidents. In addition, exposure to hot water was among the most frequently occurring accident types. Fourth, entrapment and crushing-related accidents were identified. Entrapment of body parts in the machines used in production, and the resulting crushing accidents, occurred frequently. Material handling and packaging processes are of considerable importance in the food sector. Many occupational accidents also occur due to the material handling equipment used in these processes. In particular, occupational accidents resulting in crushing injuries occur during forklift use and material loading/unloading operations. Finally, electrical accidents were among the most common occupational accident types. Occupational accidents frequently occur during interventions carried out while work processes are continuing, particularly due to failure to switch off the electrical current. The topic classification conducted for the Manufacture of Food Products economic activity is presented in Table 5.

3.2.2. Manufacturing of Textiles

As a result of the analyses conducted for the Manufacture of Textiles, 63 clusters were identified. The outlier rate was determined as 34.44%, and the topic diversity score was 0.5317. The share of the top five clusters was calculated as 32.02%. As a result of the analysis, four main themes and their corresponding sub-themes were identified. The most common type of occupational accident in textile manufacturing was found to be entrapment and crushing-related accidents. Accidents caused by falling fabric rolls were frequently observed during the cutting and storage of fabric rolls. In addition, accidents involving carpet carts and yarn bobbin carts also occurred frequently. The second most common accident type was identified as accidents caused by cutting and piercing tools. In the textile sector, where cutting and piercing tools are frequently used due to the nature of the work, accidents such as cuts to the hand and fingers during fabric cutting; needle punctures to the hand and fingers during sewing; and cuts to the hand, fingers, and palm caused by hooks in yarn machines were frequently observed. The third most common accident type was slip-, fall-, and impact-related accidents. Impact-related accidents were frequently observed during work with bobbin carts. In addition, slip-and-fall accidents also occurred frequently due to ladders and work-at-height equipment used during material storage. Finally, exposure-related accidents were also among the common occupational accidents. In the textile sector, exposure accidents resulting from eye contact with chemicals such as peroxide, caustic substances, and dyes, as well as exposure to hot water causing burns to the hands and arms, were frequently observed. The topic classification conducted for the Manufacture of Textiles economic activity is presented in Table 6.

Table 5. Topic Classification for the Manufacture of Food Products Economic Activity.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Slip, Fall, and Collision-Related Errors	Slip- and Fall-Related	["slipped and fell", "his/her foot slipped", "sprained his/her ankle", "fell as a result of slipping", "fall due to foot slipping", "slipped and fell", "foot slipping", "while descending, his/her foot", "right foot slipping", "while descending, his/her foot"]	["the employee slipped while descending the stairs and fell to the ground", "the employee sprained the right ankle as a result of slipping while descending the stairs", "as a result of spraining the ankle while descending the stairs"]
	Collision-Related	["on his/her head", "of his/her head", "hit his/her head", "his/her head", "fell onto his/her head", "falling onto his/her head", "hit his/her head", "hitting the iron/metal", "was injured", "was slightly injured"]	["the employee named XXX XXX hit his/her head on the conveyor belt while passing under the belt in the biscuit section, resulting in a cut and bleeding on the right side of the head", "while passing under Line 5, the employee hit his/her head; a 1 cm laceration occurred on the head, and after the bleeding was controlled, the employee", "while passing under the conveyor belt, the employee hit his/her head, resulting in an approximately 3–4 cm disruption of tissue integrity on the right side of the head"]
Cutting Tool-Related Errors	Knife-Related	["knife", "slipping toward the left hand", "cut his/her hand", "cut on his/her finger", "cut on hand/finger", "cut his/her finger", "cut his/her index finger", "slipped from his/her hand toward the left", "slipped from his/her hand", "had his/her finger cut"]	["cut his/her finger with the knife he/she was using", "while working in the butcher section, the knife in his/her right hand slipped, causing a cut on the front part of the left arm", "punctured his/her finger with a knife in the production area"]
	Machine-Related	["cheese", "to/into the cart", "cut his/her hand", "became trapped", "trapped his/her hand", "middle finger", "getting caught", "in the manufacturing section", "cut", "left-hand ring finger"]	["while closing cheese in the machine, the machine threw the tin, resulting in an open cut on the upper lip", "while taking cheese from the cheese tin, the sharp edge of the tin cut the little finger of the hand, causing injury", "sprained his/her wrist while cutting cheese in the cheese-cutting machine"]
Exposure-Related Errors	Chemical-Related	["into the left eye", "into the right eye", "entry/splashing", "of the eye", "burning sensation", "into the eye", "right eye", "bone", "while cleaning", "water"]	["chemical splashed into the employee's right eye in the crate-washing room area", "chemical entered the employee's right eye while working in the crate-washing room", "chemical entered the employee's right eye while brushing during corridor cleaning"]
	Hot Liquid-Related	["hot water", "burning", "spillage", "splashing", "of the hose", "bursting", "cooking", "oven", "chemical", "refinery"]	["during the boiling of brine prepared for use in production, the tank discharge valve was left open, causing hot water to come into contact with the employee's feet and face and resulting in burns", "while taking water from the hot water boiler, the employee accidentally spilled water on both feet, resulting in burns to the feet", "burn injury caused by hot water during work"]

Table 5. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Entrapment/ Crushing-Related Errors	Entrapment-Related	["of the index finger", "trapped his/her hand", "trapping his/her finger", "entrapment of his/her finger", "while working, right hand", "hand finger", "of the hand finger", "his/her hand into the machine", "of the index finger of the hand", "while working on the machine"]	["while cutting dough in the dough-cutting machine, the employee attempted to remove dough stuck in the dough roller by hand without switching off the machine, resulting in the right hand being caught in the machine and two fingers being crushed", "while working on the weighing machine, the employee's right index finger became trapped, resulting in the amputation of the right index finger", "in the wafer manufacturing workshop, the employee's right index finger became trapped between the tray and the machine"]
	Crushing-Related	["empty crate", "tipped over", "empty crates", "from the crates", "fell in the production area", "fell onto his/her head", "tripped and fell", "to the pallet truck", "of the product", "struck in the production area"]	["while the employee was removing an intermediate crate, the full crates overturned onto him/her as a result of the crates slipping", "while the employee was unloading full crates, crates from the empty-crate pallet fell onto his/her leg", "while the employee was unloading full crates, crates from the empty-crate pallet fell onto his/her leg"]
Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "operator", "in reverse", "struck his/her foot", "load", "onto his/her left foot", "did not see", "of the vehicle", "to the ankle", "electric"]	["while adjusting the position of the forklift's front lifting forks, the fork came loose and struck the employee's leg", "when the jack fell on the forklift, the employee became trapped between the wheel and the fender", "injury occurred when palletized jars overturned onto the forklift during unloading with the forklift"]
Electrical-Related Errors	Electrical-Related	["electrical", "malfunction", "explosion", "motor", "due to the malfunction", "to switch off", "that it struck", "to the button", "assembly/installation", "the machine"]	["the employee was exposed to electric current as a result of intervening in the machine without cutting off the electrical power", "exposure to electric current while replacing a light bulb for illumination", "the employee was exposed to electric current during work"]

Table 6. Topic Classification for the Manufacture of Textiles Economic Activity.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Entrapment/ Crushing-Related Errors	Material Fall-Related	["onto the fabric", "fabrics", "of the roll", "textile", "in the stenter machine", "from the machine", "the machine", "from the machine", "in the machine", "was trapped between"]	["while cutting a roll of fabric in the knitting section, the roll fell onto the employee's right foot", "while arranging the fabric rolls from the floor onto the shelves, the employee dropped a roll onto him/her", "while lifting a roll of fabric from the floor, the employee lost his/her balance and fell to the ground; subsequently, due to pain in the lower back, the employee was taken to the nearest"]

Table 6. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Entrapment/ Crushing-Related Errors	Crushing-Related	["of the cart", "while pulling the cart", "the cart", "to the cart", "from the cart", "over his/her foot", "of the vehicle", "left foot", "due to carelessness while pulling", "was trapped between"]	["while pulling a yarn bobbin cart in the Open-End section, the cart wheel ran over the employee's right toe, resulting in an occupational accident", "while pulling the carpet cart, the end of the adjacent cart struck the employee's left leg, resulting in a work-related injury", "while loading material onto the machine, the cart moved, causing the employee's finger to be crushed under the cart wheel"]
	Entrapment-Related	["index finger", "his/her index finger", "index finger of the hand", "middle finger", "of the index finger", "while working on the machine", "finger of the hand", "to the middle finger", "finger was trapped", "middle finger of the hand"]	["while working on the brush-fitting machine, the employee's right index finger became trapped", "while attempting to correct a fault on Epoca Machine No. 22 in the curtain production section, the tip of the employee's right index finger became trapped between the needle housing and the cord housing", "while handling a yarn break on the yarn machine, the employee's right index finger became trapped between the rollers"]
Cutting Tool-Related Errors	Knife-Related	["cut his/her finger", "cut his/her hand", "cutting his/her finger", "slipping onto the left hand", "cut", "his/her thumb", "cleaning", "cut on his/her finger", "cutting his/her hand", "palm of the hand"]	["while cutting fabric with a knife, the employee cut his/her left index finger", "while cutting bread, the employee named XXX XXX, who works as an assistant cook at the workplace, cut his/her left index finger when the knife slipped; work was stopped immediately and the employee was transported to the hospital by a company vehicle", "while attempting to cut yarn entangled around the extruder bobbin shaft with a utility knife, the employee accidentally slipped the knife and cut the fifth finger of the right hand"]
	Needle-Related	["was injured", "to the accident", "while working on the machine", "left-hand finger", "to the finger of the hand", "cutting his/her finger", "to the thumb", "to the middle finger", "accident", "hand finger"]	["while attempting to thread the take-up lever of the sewing machine, the employee accidentally pressed the pedal due to momentary inattention, causing the take-up lever to strike the left thumb and resulting in injury", "while working on the sewing machine, the employee was injured when the needle punctured the left index finger due to momentary inattention", "while working on the sewing machine, the employee was injured when the needle punctured the left index finger due to momentary inattention"]
	Hook-Related	["cut his/her hand", "while cleaning, left", "palm of the hand", "to clean", "cut his/her finger", "slipping onto the left hand", "to cut", "cleaning", "the item being cleaned", "while cleaning"]	["while changing the tip of the hook used to clean yarn waste from the yarn machine, the employee named XXX XXX was injured when the sharp end of the hook struck the second finger of the right hand", "while cleaning yarn waste, the hook slipped from the employee's hand, resulting in a deep cut", "while attempting to cut yarn wrapped around the bobbin, the employee lost control of the hook in his/her hand and struck his/her arm, resulting in injury"]

Table 6. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Slip, Fall, and Collision-Related Errors	Collision-Related	["recklessly and carelessly", "while pulling", "trapping his/her hand", "trapping his/her finger", "over his/her foot", "of the cart", "striking his/her foot", "striking the iron part", "of the roll", "falling onto his/her foot"]	["while working, the employee fell after colliding with a bobbin cart as a result of acting carelessly and without due caution", "while the bobbin cart was being pulled, the employee was injured as a result of acting carelessly and without due caution", "while loading fabric onto the machine, the employee struck his/her head as a result of acting carelessly and without due caution"]
	Fall-Related	["while descending, his/her foot", "while descending", "foot slipping", "foot slipping and falling", "foot slipped", "slipping and falling", "slipping to the ground", "while descending downward", "slipped and fell", "slipping and falling"]	["while standing on a three-step ladder to retrieve material, the employee fell, resulting in a fracture of the foot", "after losing balance, the employee struck his/her hand forcefully against the stair railing, resulting in an injury to the right hand", "the employee fell after the ladder placed on the floor slipped"]
Exposure-Related Errors	Chemical-Related	["to the left eye", "to the right eye", "caustic", "of the eye", "protective", "oil", "while cleaning", "breaking and", "was injured", "automation"]	["the peroxide tank was accidentally left open, causing peroxide to overflow and splash into the employee's left eye", "an occupational accident occurred when caustic chemical splashed into the employee's left eye", "while mixing reactive dye, the dye splashed into the employee's left eye"]
	Hot Water and Steam-Related	["hot", "burn", "splashing", "washing", "bursting", "in the dyehouse section", "to the right arm", "oil", "caused", "in the factory"]	["while checking the hot water valve of the dyeing machine, hot water vapor came into contact with the employee's right hand, resulting in a burn", "while attempting to remove fabric from the operating machine, the employee's body came into contact with a hot part of the machine, resulting in a minor burn", "due to the employee's inattention, hot water from the machine spilled onto the back of the left hand, resulting in a first-degree burn"]

3.2.3. Manufacture of Chemicals and Chemical Products

As a result of the analyses conducted for the Manufacture of Chemicals and Chemical Products economic activity, 48 clusters were identified. The outlier rate was determined as 42.72%, and the topic diversity score was 0.7063. The share of the top five clusters was calculated as 43.27%. As a result of the analysis, five main themes and their corresponding sub-themes were identified. The most common type of occupational accident in this economic activity was entrapment and crushing-related accidents. Under this theme, machine-related finger entrapment accidents were particularly prominent. Occupational accidents resulting in entrapment, tissue damage, bleeding, and restricted movement, especially in the hands and index fingers, occurred in situations such as closing the conveyor cover, attempting to remove a jammed label from a labeling machine, and the activation of a production machine during cleaning. The second most common type of occupational accident was identified as exposure-related accidents. Under this theme, chemical-related, hot liquid-related, and foreign body-related accidents were prominent. In chemical-related accidents, splashes of chemical substances, particularly to the eye and facial regions, were notable during operations such as filling, production, washing, and raw material transfer.

In hot liquid-related accidents, occupational accidents resulting in burns occurred due to exposure to hot water or steam during operations involving hot water boilers, pumps, tanks, tankers, pressurized lines, and steam-related processes. In addition, foreign body-related accidents were observed during operations such as turning, maintenance, and metal part removal, where metal chips, burrs, or metal fragments came into contact with the eyes, face, or fingers. The third most common type of occupational accident was slip-, fall-, and impact-related accidents. Within this scope, fall accidents caused by slipping while descending or ascending stairs were particularly prominent. During stair use, workers fell due to lack of attention, loss of balance, or unsuitable floor conditions, resulting in injuries to the feet, legs, or different parts of the body. The fourth most common type of occupational accident was identified as accidents caused by cutting tools. Under this theme, accidents caused by utility knives were particularly notable. Hand and finger cuts occurred when utility knives slipped during operations such as cutting belts, opening packaged raw material bags, and similar tasks. This indicates that, in the manufacture of chemical products, not only production machines but also auxiliary hand tools constitute an important source of accidents. Finally, accidents related to material handling equipment were among the common occupational accident types. Under this theme, forklift- and pallet truck-related accidents were prominent. In forklift-related accidents, situations such as reversing maneuvers, the operator failing to notice a worker, pedestrian–forklift interaction and contact with forklift forks were notable. As a result of these accidents, injuries occurred particularly to the feet, head, and different parts of the body. In pallet truck-related accidents, the foot was frequently caught between the pallet truck and a platform, wheel, or another piece of equipment during the use of electric pallet trucks. The topic classification conducted for the Manufacture of Chemicals and Chemical Products economic activity is presented in Table 7.

Table 7. Topic Classification for the Manufacture of Chemicals and Chemical Products Economic Activity.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Entrapment/ Crushing-Related Errors	Entrapment-Related	["of the finger", "finger", "to his/her finger", "in the machine", "of the machine", "index finger", "his/her index finger", "on his/her finger", "right index finger", "the finger"]	["while working on Machine No. TK 15, the root of the left index fingernail became trapped between the cover and the machine while closing the conveyor cover, resulting in tissue damage, bleeding, and restricted movement", "while attempting to remove a label trapped between the two belts of the labeling machine, the employee's left index finger became trapped", "while cleaning the TLZ unit of the production machine, the machine started operating and trapped the employee's left index finger"]
	Chemical-Related	["to the eye", "eye", "to the right eye", "to the left eye", "splashed into the eye", "to the face", "chemical substance", "paint", "washing", "came into the eye"]	["the employee was injured when raw material splashed into both eyes during filling", "chemical splashed into the employee's eye in the production area", "the accident occurred when the employee rubbed his/her eye with his/her hand, resulting in contamination of the eye"]
Exposure-Related Errors	Hot Liquid-Related	["hot water", "pump", "steam", "tanker", "burn occurred", "tank", "pump", "of the line", "of the pump", "pressurized"]	["while removing the hose from the hot water boiler, hot water splashed onto the employee's arm due to wear on the boiler's shut-off valve", "hot water came out while the employee was opening the valve", "while emptying the hot water trays, hot water splashed onto the employee's abdominal area"]
	Foreign Body-Related	["metal", "to the head", "steel", "between iron materials", "metal part", "to his/her finger", "to the part", "of the machine", "index finger", "on his/her finger"]	["while machining a metal part on the lathe, metal shavings cut the employee's right index finger, resulting in an occupational accident", "while coworkers were removing a metal part using a hammer and punch, a metal fragment struck the area below the employee's right eye", "while coworkers were removing a metal part using a hammer and punch, a metal fragment struck the area below the employee's right eye"]

Table 7. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Slip, Fall, and Collision-Related Errors	Slip and Fall-Related	["stairs", "of the stairs/ladder", "slipping of the foot", "while descending, his/her foot", "fall", "while descending, his/her foot", "slipping while descending", "while descending", "foot slipping", "foot slipped"]	["the employee slipped and fell while descending the stairs due to inattention", "the employee fell down the stairs after his/her foot slipped", "while ascending the stairs, the employee's foot slipped and he/she fell down the stairs"]
	Utility Knife-Related	["knife", "blade/knife", "to the knife", "to cut", "cut his/her hand", "finger", "on his/her finger", "slipping onto the left", "his/her thumb", "of the finger"]	["while cutting a belt with a utility knife, the knife slipped and cut the employee's hand", "the employee sustained an occupational accident after cutting his/her hand with a utility knife", "the accident occurred when the utility knife accidentally slipped while opening a packaged raw material bag"]
Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "maneuver", "with the forklift", "reversing", "striking his/her foot", "of the operator", "shipment", "forklift", "of the left foot"]	["while the forklift was operating, the employee was talking with the forklift operator when the forklift moved and crushed the employee's right foot", "the forklift driver did not notice the employee in the area, and while reversing, the employee also failed to notice that the forklift was moving backward; as a result of both employees' inattention, the forklift wheel ran over the employee's right foot", "while sweeping sand from the floor, the employee failed to notice the forklift fork and struck his/her head against it"]
	Pallet Truck-Related	["his/her foot", "electric pallet truck", "with the pallet truck", "his/her left foot", "left foot", "being trapped between", "right foot", "his/her right foot", "ankle", "of the left foot"]	["while pulling the electric pallet truck used daily, the employee inadvertently pulled it in the opposite direction and trapped his/her foot between the platform and the pallet truck", "while pulling the electric pallet truck, the employee trapped his/her foot", "while pulling raw material with the pallet truck, the operator's foot became caught, preventing him/her from stopping the pallet truck, and the front steering wheel of the pallet truck trapped the employee's foot"]

3.2.4. Manufacture of Rubber and Plastic Products

As a result of the analyses conducted for the Manufacture of Rubber and Plastic Products economic activity, 43 clusters were identified. The outlier rate was determined as 40.3%, and the topic diversity score was 0.1651. The share of the top five clusters was calculated as 39.7%. As a result of the analysis, four main themes and their corresponding sub-themes were identified. The most common type of occupational accident in this economic activity was accidents caused by cutting tools. Under this theme, utility knife-related and machine-related accidents were prominent. In particular, occupational accidents resulting in cuts to the hands and fingers were frequently observed when utility knives or machine blades slipped during stretch film cutting, removal of burrs from plastic parts, and product retrieval. In addition, hand and finger injuries occurred as a result of attempts to remove jammed products while the machine was operating, interventions in the machine, or the accidental activation of the machine. The second most common type of occupational accident was exposure-related accidents. Under this theme, foreign body-related accidents, hot surface- and material-related accidents, and accidents related to fire, smoke, and asphyxiating gases were prominent. In particular, burrs or metal fragments entering the eyes during grinding, cutting, and maintenance operations were among the frequently reported occupational accidents. In addition, accidents resulting in burns to the hands, arms, and legs occurred as a result of contact with injection molding machines, hot machine components, and hot materials. Moreover, exposure to smoke and asphyxiating gases caused by solvent-containing waste or fires occurring in the printing section also constituted an important risk. The third most common type of occupational accident was identified as slip-, fall-, and impact-related accidents. Within this scope, material-related and fall-related

accidents were particularly prominent. Occupational accidents occurred when materials such as iron, pallets, and similar items fell onto workers during handling or unloading, when workers tripped over materials and fell, or when workers lost their balance and struck different parts of their bodies. In addition, accidents resulting from slipping, tripping, and falling were frequently observed during operations such as machine cleaning, mold clamping, and retrieving empty pallets. Finally, accidents related to material handling equipment were among the common occupational accident types. Under this theme, forklift-related accidents were particularly prominent. Injuries to the arms, shoulders, chest, legs, and feet occurred as a result of pallets overturning during forklift movements, workers being hit by forklifts, or workers entering forklift routes. The topic classification conducted for the Manufacture of Rubber and Plastic Products economic activity is presented in Table 8.

3.2.5. Manufacture of Other Non-Metallic Mineral Products

As a result of the analyses conducted for the Manufacture of Other Non-Metallic Mineral Products economic activity, 69 clusters were identified. The outlier rate was determined as 32.79%, and the topic diversity score was 0.8652. The share of the top five clusters was calculated as 48.22%. As a result of the analysis, five main themes and their corresponding sub-themes were identified. According to the analysis results, the most common type of occupational accident was slip-, fall-, and impact-related accidents. Under this theme, concrete-related, impact-related, and material-related accidents were prominent. In particular, occupational accidents resulting in falls, impacts, and entrapment were observed during concrete pouring, the folding or collection of concrete pumps, and operations carried out around truck mixers. In addition, injuries caused by materials falling onto the feet frequently occurred while feeding stones and similar heavy materials into machines or removing them from machines. The second most common type of occupational accident was identified as accidents caused by cutting tools. Under this theme, glass-related, broken tile-related, and utility knife-related cuts were prominent. Hand and finger cuts occurred when glass broke or shattered during glass handling. Similarly, cutting accidents, particularly involving the index fingers, were frequently observed while removing broken tiles from the conveyor belt or production line. In addition, occupational accidents resulting in cuts to the hands, fingers, and legs occurred during the use of utility knives. The third most common type of occupational accident was exposure-related accidents. Within this scope, exposures related to hot surfaces and materials, foreign body-related accidents, and exposure to chemicals such as epoxy were prominent. In particular, accidents resulting in burns occurred due to contact with furnaces, rotary kilns, hot ceramics, and hot water. In addition, burrs or dust entering the eyes during grinding and cleaning operations were among the frequently reported occupational accidents. During epoxy application, material retrieval from epoxy taps, or filling operations from epoxy drums, accidents resulting in chemical splashes, particularly to the eye region, were observed. The fourth most common type of occupational accident was accidents related to material handling equipment. Under this theme, forklift-related accidents were particularly prominent. Various occupational accidents occurred when forklifts struck stones, overturned, or hit workers while moving in reverse. This finding indicates that visibility, reversing maneuvers, and internal traffic organization are important risk factors during the use of material handling equipment. Finally, entrapment and crushing-related accidents were among the common occupational accident types. Under this theme, the entrapment of the hand between the stone and the machine, particularly while feeding stones into machines or removing them from machines, was prominent. In addition, injuries to the hands, wrists, or face occurred when wrenches slipped during maintenance, adjustment, or tightening operations. This indicates that both

material–machine interaction in the production process and maintenance and adjustment operations are among the important sources of accidents. The topic classification conducted for the Other Non-metallic Mineral Products economic activity is presented in Table 9.

Table 8. Topic Classification for the Manufacture of Rubber and Plastic Products Economic Activity.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Cutting Tool-Related Errors	Utility Knife-Related	["cut on his/her finger", "of the thumb", "carelessness, left", "thumb of the hand", "finger of the hand", "his/her little finger", "was slightly injured", "was injured slightly", "the finger", "slipping from his/her hand, right"]	["while cutting stretch film with a utility knife, the knife slipped, resulting in a cut on the employee's left middle finger", "while removing burrs from a plastic part, the utility knife slipped, resulting in a cut on the employee's left index finger", "while removing the product from the Bodinoz machine, the employee's hand came into contact with the blade, resulting in a cut on the index finger"]
	Machine-Related	["the machine", "was trapped between", "while performing assembly", "dropped", "due to carelessness", "while trying to remove", "while making the adjustment", "thumb of the hand", "was trapped between", "his/her little finger"]	["the employee named XXX XXX sustained a cut on the hand after reaching his/her right hand into the jammed capron-producing machine without switching the machine off", "while working in the production area, the employee accidentally activated the machine, resulting in the amputation of the fingertip", "while the machine was operating, the employee violated safety procedures by attempting to remove the product trapped in the combs beneath the jaw without stopping the machine, resulting in the employee's hand becoming trapped between the belts"]
Exposure-Related Errors	Foreign Body-Related	["was performed", "around 00:00", "drill", "while performing assembly", "due to carelessness", "2020", "of the operator", "slipping from his/her hand", "slightly", "worker"]	["while operating the crater machine, a burr entered the employee's eye despite wearing safety glasses", "while grinding during machine maintenance, a metal burr entered the employee's right eye despite wearing safety glasses", "while cutting the plastic-coated iron profile section, a burr entered the employee's eye from the side despite wearing safety glasses"]
	Hot Surface/Material-Related	["slightly", "on the upper part", "to production", "the machine", "his/her right arm", "2020", "worker", "of the operator", "while trying to remove", "leg"]	["while removing material from the machine, the employee dropped it onto his/her arm, resulting in a minor burn", "while removing a tray from the oven in the cafeteria, food spilled onto the employee's right arm, resulting in a minor burn", "while working on Injection Machine No. E 08, the employee manually intervened with a hot machine component that should not have been touched, resulting in minor burns to the palm and fingers of the left hand"]
	Fire/Smoke and Asphyxiant Gas-Related	["printing house", "vehicle", "around 00:00", "materials", "slightly", "was performed", "seeing", "worker", "slight injury caused by impact", "wall"]	["while attempting to extinguish a fire caused by solvent in a metal drum igniting due to extremely hot weather in the waste area containing packaging waste and solvent-contaminated cloths, the employee was affected by smoke", "during a fire in the printing section, the employee attempted to enter the area to help after believing that a coworker had fainted and become trapped; upon entering, the employee was unaware of the presence of colorless carbon dioxide gas and was exposed to the asphyxiating gas while attempting to intervene, resulting in poisoning and a risk of suffocation and loss of consciousness", "while attempting to extinguish a fire caused by solvent in a metal drum igniting due to extremely hot weather in the waste area containing packaging waste and solvent-contaminated cloths, the employee was affected by smoke"]

Table 8. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Slip, Fall, and Collision-Related Errors	Material-Related	["was trapped between", "of the right foot", "middle finger of the hand", "his/her little finger", "was injured slightly", "slipping onto the right hand", "slipping from his/her hand, right", "was slightly injured", "right foot", "finger of the hand"]	["after placing the first rope over the head and while placing the second rope, the rope slipped from the employee's hand; while attempting to retrieve it, the employee's hand became trapped between the 10-finger mandrel and the autoclave cart tray, resulting in a first-degree burn, swelling, and pain", "while pulling the mandrel on the floor in order to secure it, the tip of the employee's right ring finger became trapped between the mandrel and the support, resulting in an abrasion, bruising, and pain", "while opening the head of the Budinöz machine with a clamp for cleaning, the tip of the employee's left ring finger became trapped between the clamp arm and the Budinöz head, resulting in bleeding and pain"]
	Fall-Related	["of the right foot", "dropped", "while performing assembly", "cut on his/her finger", "slipping onto the right hand", "while trying to remove", "his/her right arm", "of the index finger", "carelessness, left", "middle finger of the hand"]	["while the forklift operator was passing by the employee, the pallets on the forklift overturned and struck the employee's right arm and chest", "while walking from the dough stock area near the M3–M4 workstation to Hall 3 to collect a garbage bag, the employee entered the forklift and pedestrian route near the copper wire winding machine without noticing a forklift approaching with an empty rack; when the employee stepped onto the route, the forklift was unable to stop, and the small dough cord-fabric rack on the forklift slipped from the forks and struck the employee's right shoulder", "while collecting a pallet in front of the factory building, the employee lost balance and fell, causing the left foot to become trapped under the tire of a passing forklift"]
	Forklift-Related	["of the right foot", "of the operator", "right foot", "vehicle", "leg", "was trapped between", "unloading", "by collision", "movement", "his/her leg"]	["while the forklift operator was passing by the employee, the pallets on the forklift overturned and struck the employee's right arm and chest", "while walking from the dough stock area near the M3–M4 workstation to Hall 3 to collect a garbage bag, the employee entered the forklift and pedestrian route near the copper wire winding machine without noticing a forklift approaching with an empty rack; when the employee stepped onto the route, the forklift was unable to stop, and the small dough cord-fabric rack on the forklift slipped from the forks and struck the employee's right shoulder", "while collecting a pallet in front of the factory building, the employee lost balance and fell, causing the left foot to become trapped under the tire of a passing forklift"]

Table 9. Topic Classification for the Manufacture of Other Non-metallic Mineral Products Economic Activity.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Slip, Fall, and Collision-Related Errors	Concrete-Related	["of the vehicle", "truck", "concrete pouring", "construction", "of the pump", "of the concrete pump", "of the truck", "transmixer", "of his/her foot", "cart"]	["while discharging concrete from the concrete truck being operated, the employee's hand became trapped in the concrete chute, resulting in injury", "after completion of the concrete pouring for the new building, the employee was in a blind spot while the concrete pump was being retracted, causing the concrete pump to lightly strike the employee", "while pouring concrete with the concrete pump, the employee slipped on the stairs near the pump hopper and fell"]

Table 9. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Slip, Fall, and Collision-Related Errors	Collision-Related	["his/her head", "to his/her head", "hitting his/her head", "on his/her head", "hitting his/her head against iron", "striking his/her head", "struck his/her head", "on the head", "hitting his/her head while passing", "falling onto his/her head"]	["the employee struck his/her head while cleaning the boiler", "while turning his/her head to start the machine, the employee struck his/her head against the machine", "while removing a stone from the vacuum unit, the employee bent over excessively and struck his/her head against the corner of the machine while standing back up"]
	Material-Related	["while feeding stone into the machine", "while feeding, the stone", "while feeding stone, the stone", "stone from the machine", "while taking stone from the machine", "stone from the machine", "falling onto his/her foot", "stone breaking", "stone onto his/her foot", "while taking stone from the machine"]	["while feeding a stone into the splitting machine, the stone broke and fell onto the employee's left foot", "while feeding a stone into the polishing machine, a stone fell onto the employee's right foot", "while feeding a stone into the polishing machine, the stone fell onto the employee's foot"]
Cutting Tool-Related Errors	Glass-Related	["of the glass", "of the glasses", "glass handling", "breakage of glass", "breakage", "occurred, glass", "while carrying glass", "while taking glass", "glass fragment", "occurred, glass"]	["while carrying glass, the glass broke in the employee's hand, resulting in a cut on the finger", "an occupational accident occurred when the glass cut both of the employee's arms while being carried", "an occupational accident occurred when the glass shattered during transportation"]
	Broken Tile-Related	["finger", "finger", "of the finger", "to his/her finger", "right index finger", "was injured", "finger of the hand", "the finger", "while taking the tile", "index finger"]	["while picking up a tile, the employee cut his/her left index finger", "while picking up a broken tile coming from the laboratory, the employee cut his/her right index finger", "while removing a broken tile from the conveyor belt, the employee cut his/her left index finger"]
	Utility Knife-Related	["knife", "utility knife", "of the knife", "the knife", "of the utility knife", "the knife", "knife onto the left", "to the knife", "with a knife", "slipping of the knife"]	["while cutting foam placed in crates with a utility knife, the knife struck the employee's leg, resulting in a cut", "while cutting an empty acid bucket with a utility knife, the employee cut his/her right index finger", "a minor cut caused by a utility knife"]
Exposure-Related Errors	Hot Surface/Material-Related	["coal", "from the furnace", "at the furnace exit", "fire", "rotary kiln", "burn occurred", "in the furnace", "occurred, furnace", "in the furnaces section", "hot water"]	["as a result of a furnace blowback from the flame-pipe inspection cover, the employee sustained first-degree burns to the neck and arms", "while intervening in a buildup of ceramic material inside the furnace, hot ceramic came into contact with the inner side of the employee's right arm, resulting in a burn", "the employee sustained a burn after touching a hot part of the ceramic furnace pipe with his/her hand"]
	Foreign Body-Related	["to the eye", "to the left eye", "burr into the eye", "in the eye", "burr entry", "burr entering the eye", "dust into the eye", "while performing, into the eye", "burr entered the eye", "the eye"]	["while cleaning with a grinding machine, a burr entered the employee's eye", "a burr entered the employee's left eye", "the employee went to the hospital after a burr entered his/her eye"]
	Chemical-Related (Epoxy)	["epoxy", "to the eye", "epoxy", "splashing into the eye", "in the epoxy section", "chemical into the eye", "in the epoxy line", "splashed into the eye", "splashing into the left eye", "occurred, epoxy"]	["while applying epoxy to the stone, epoxy splashed into the employee's right eye due to inattention", "while taking epoxy from the epoxy tap, epoxy splashed into the employee's right eye due to inattention", "while filling epoxy from the epoxy drum, the employee trapped his/her hand"]

Table 9. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "forklift operator", "from the forklift", "with the forklift", "of the forklift operator", "foot", "while getting off the forklift", "occurred, forklift", "forklift down"]	["while reversing with the forklift, the forklift struck a stone and overturned", "the employee was injured as a result of being struck by a forklift", "while working, the employee was struck by a forklift"]
	Entrapment-Related	["while taking stone", "while feeding stone", "stone into the machine", "trapped between", "stone into the machine", "between stones", "his/her hand while working", "while feeding stone into the machine", "stone from the machine", "while taking stone from the machine"]	["while attempting to feed a stone into the machine inside the factory, the employee trapped his/her hand between the stone and the machine", "while attempting to feed a stone into the machine inside the factory, the employee trapped his/her hand between the stone and the machine", "while attempting to feed a stone into the machine, the employee trapped his/her hand between the stone and the machine"]
Entrapment/Crushing-Related Errors	Material-Related (Wrench)	["slipping of the wrench", "with the wrench", "while tightening, the wrench", "the wrench from his/her hand", "pipe wrench", "of the pipe wrench", "the wrench in his/her hand", "slipping of the wrench from his/her hand", "while tightening, wrench", "slipping of the wrench onto the right"]	["while working beneath the press, the wrench slipped from the employee's hand and struck his/her nose, resulting in injury", "while tightening a nut with a wrench to adjust the machine, the wrench slipped and the employee injured his/her wrist", "at Cement 4, the wrench slipped, causing the employee's right hand to become trapped between the wrench and the component"]

3.2.6. Manufacture of Basic Metals

As a result of the analyses conducted for the Manufacture of Basic Metals economic activity, 59 clusters were identified. The outlier rate was determined as 40.48%, and the topic diversity score was 0.5339. The share of the top five clusters was calculated as 38.14%. As a result of the analysis, five main themes and their corresponding sub-themes were identified. The most common type of occupational accident in this economic activity was entrapment and crushing-related accidents. Under this theme, hand and finger entrapment accidents were particularly prominent. Occupational accidents occurred when fingers became caught between two materials, wedges, or parts during the boxing of cast parts, material arrangement, and marking operations. The second most common type of occupational accident was exposure-related accidents. Under this theme, foreign body-related accidents, hot surface- and material-related accidents, molten metal-related accidents, and metal dust-related accidents were prominent. In particular, burrs or foreign bodies entering the eyes were frequently observed during grinding, air blowing, and part processing operations. In addition, occupational accidents resulting in burns occurred due to hot barrels, hot molds, ladle overflows, and hot metal splashes. Splashes of molten metal from the casting furnace or during casting operations caused injuries particularly to the ears, arms, and different parts of the body. Moreover, contact of metal dust with the ear or facial region during sandblasting and similar operations was also among the notable accidents under this theme. The third most common type of occupational accident was slip-, fall-, and impact-related accidents. Within this scope, material-related and impact-related accidents were particularly prominent. Injuries occurred especially in the feet and ankles as a result of iron, steel billets, and packaged metal materials falling or slipping. In addition, situations such as steel ropes becoming detached from crane hooks, striking workers' hands or feet, and ropes breaking during production and injuring personnel were prominent in this accident type. The fourth most common type of occupational accident was identified as accidents related to material handling equipment. During the transport of products or pallets using electric pallet trucks, foot and ankle entrapment injuries occurred

when workers failed to notice the pallet behind them, when the pallet truck did not stop, or when workers became caught between the pallet truck and a crate, pallet, or another piece of equipment. Finally, accidents caused by cutting tools were among the common occupational accident types. Under this theme, sheet metal-related, equipment-related, and glass-related cuts were prominent. Cuts occurred in the hands, fingers, and elbow region due to slipping sheet metal, sharp edges of sheet metal parts, and burrs on chrome plates. In addition, cuts and injuries occurred around the legs and knees as a result of losing control of equipment such as grinding machines and angle grinders. The topic classification conducted for the Manufacture of Basic Metals economic activity is presented in Table 10.

Table 10. Topic Classification for the Manufacture of Basic Metals Economic Activity.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Entrapment/Crushing-Related Errors	Entrapment-Related	["finger of the hand", "to the finger of the hand", "index finger of the hand", "to the index finger of the hand", "left-hand finger", "finger was trapped", "to the left-hand finger", "to the thumb of the hand", "entrapment of the finger", "thumb of the hand"]	["while crating a cast component, the employee's right index finger became trapped between two parts", "while arranging materials, the employee's left thumb became trapped between the block and the material", "while marking the component, the employee's left thumb became trapped against the part"]
	Foreign Body-Related	["entered", "while grinding", "splashed", "redness", "angle grinder", "motor", "according to the statement", "according to his/her own statement", "according to his/her own statement", "according to the person's own statement"]	["while working, a grinding burr entered the employee's eye due to inattention", "while blowing compressed air onto the component, a burr entered the employee's right eye", "while grinding a component, a foreign object entered the employee's right eye"]
Exposure-Related Errors	Hot Surface/Material-Related	["burn", "oxygen", "cooling", "right and left", "aluminum", "injection", "on his/her foot", "while cutting", "of the hose", "left palm"]	["a burn occurred on the upper part of the employee's right foot as a result of the machine leaking molten material from the mold", "the employee sustained a burn on the back due to exposure to slag splashed as a result of the ladle overflowing", "while the employee named XXX XXX was carrying a hot drum, it came into contact with the left arm of the employee named XXX XXX, resulting in a burn"]
	Molten Metal-Related	["splashed", "to the furnace", "furnace", "of the furnace", "in the foundry", "occurred, casting", "charge", "spilled", "casting", "in the production area"]	["molten metal splashed from the casting furnace and struck the employee's right ear", "molten metal splashed onto the employee while pouring the casting", "while pouring the casting, molten metal splashed onto the employee's arm"]
	Material-Related	["ear", "neck", "burn", "while cutting", "from the machine", "oxygen", "the back side", "was injured by impact", "flying off", "occurrence of a cut"]	["an occupational accident occurred when metal dust entered the employee's ear while sandblasting", "while the roll was passing through the blade, a folded burr struck the employee's ear area", "when the curtain iron fell to the ground, a piece struck the employee's earlobe and head"]

Table 10. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Slip, Fall, and Collision-Related Errors	Material-Related	["onto the left foot", "falling onto the foot", "left foot", "on the foot", "to the left ankle", "striking the foot", "the foot", "to the right ankle", "of the ankle", "in the ankle"]	["the employee sprained his/her ankle while descending the stairs", "the employee sprained the left ankle while descending the stairs", "while descending the stairs, the employee's left foot slipped, resulting in a sprained ankle"]
	Collision-Related	["rope", "trauma", "soft tissue", "to the index finger", "finger of the hand", "falling onto the left hand", "on the finger of the hand", "while breaking", "cut on his/her finger", "to the little finger of the hand"]	["when the crane was lifted with the steel rope attached to the crane hook, the rope came free from the hook and struck the employee's left index finger", "while working, the steel rope struck the employee's hand", "during production, the rope section attached to the steel cable separated and fell onto the employee's feet"]
Material Handling Vehicle-Related Errors	Pallet Truck-Related	["foot slipping", "motor", "onto the left foot", "sprained his/her foot", "falling onto the foot", "while descending, his/her foot", "on the foot", "fell onto his/her foot", "of the ankle", "foot slipped"]	["while transporting products with an electric pallet truck, the employee failed to notice the pallets behind him/her, causing the right ankle to become trapped", "while taking the electric pallet truck to the charging area, the pallet truck failed to stop, causing the employee's left ankle to become trapped between the crate and the pallet truck", "after leaving the pallet being transported with an electric pallet truck in the quality-control hall and reversing, the employee trapped his/her right foot between the electric pallet truck and a pallet lying on the floor behind it"]
Cutting Tool-Related Errors	Sheet Metal-Related	["sheet metal", "cut his/her finger", "material", "occurrence of a cut", "cutting his/her finger", "was cut", "stitches", "while working on the machine", "occurrence of an incision", "his/her little finger"]	["due to the employee's inattention, the sheet metal slipped and the employee's hand became trapped between two sheets", "while dismantling a casting mold at the workplace, the employee lost balance and a piece of sheet metal cut the right elbow area", "while cutting a chrome sheet-metal plate, a burr on the plate cut the employee's finger"]
	Equipment-Related	["while grinding", "motor", "angle grinder", "occurrence of an incision", "while cutting", "cutting his/her finger", "coming off, left", "cut on his/her finger", "occurrence of a cut", "slipped from his/her hand"]	["the employee stepped on the grinding machine after placing it under his/her foot, resulting in an approximately 2 cm cut", "after losing control of the grinding machine, the grinding wheel came into contact with the employee's leg, resulting in injury", "while grinding runner material in the OPH area, the employee slipped and struck the grinding machine; the machine struck approximately 10 cm above the knee, resulting in an injury in that area"]

Table 10. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Cutting Tool-Related Errors	Glass-Related	["was cut", "waste", "cut his/her finger", "press", "in the machine", "by breaking", "while making the adjustment", "occurrence of a cut", "broken", "dropped"]	["the employee was injured when a glass window fell onto him/her while sitting", "while placing glass into the machine for processing, the employee struck his/her hand against the edge of the glass, resulting in a cut", "a 5-L glass Erlenmeyer flask was filled with water for washing; while the employee was gripping it firmly to lift it, the upper part broke and cut his/her hand"]

3.2.7. Manufacture of Machinery and Equipment Not Elsewhere Classified (n.e.c.)

As a result of the analyses conducted for the Manufacture of Machinery and Equipment Not Elsewhere Classified economic activity, 67 clusters were identified. The outlier rate was determined as 38.18%, and the topic diversity score was 0.8866. The share of the top five clusters was calculated as 37.77%. As a result of the analysis, five main themes and their corresponding sub-themes were identified. According to the analysis results, the most common type of occupational accident was exposure-related accidents. Under this theme, foreign body-related, hot surface- and material-related, and chemical-related accidents were prominent. In particular, burrs or foreign bodies entering the eyes were frequently observed during grinding, angle grinding, and similar operations. In addition, occupational accidents resulting in burns occurred due to hot water, hot enamel, hot flanges, oxygen, fire, explosions, and contact with hot materials. In chemical-related accidents, contact of chemical liquids with the eyes, arms, and different parts of the body was notable during product washing, cleaning, solvent use, and chemical transfer operations. The second most common type of occupational accident was slip-, fall-, and impact-related accidents. Under this theme, material-related accidents were particularly prominent. Injuries such as strains, sprains, and superficial wounds occurred especially in the feet and ankles as a result of crates, iron, metal, and similar materials falling. In addition, ankle sprains caused by tripping and loss of balance were also frequently observed. Although this topic was not included in the classification, elevator falls during elevator assembly and shipment processes, as well as elevator components such as rails being ejected and striking workers, were also among the notable accident causes. The third most common type of occupational accident was identified as entrapment and crushing-related accidents. Under this theme, entrapment and crushing incidents related to machines, metal materials, pipes, and hand tools were prominent. Finger entrapment between templates or materials during the positioning of metal plates, materials falling onto the hand, and impacts to the hands or fingers during hammer use were frequently observed in this accident type. In addition, occupational accidents occurred during pipe-related operations when pipes fell or when hands and fingers became caught between the machine and the pipe. Although not included in the classification, accidents caused by pressing the wrong pedal on machines such as CNC lathes, as well as accidents resulting from incorrect commands given to robotic welding systems, were also notable. In operations performed with magnetic drills, occupational accidents occurred when parts fell onto the hand or when the part did not adhere sufficiently to the surface due to liquids such as oil. The fourth most common type of occupational accident was cutting tool-related accidents. Under this theme, sheet metal-related, angle grinder-related, and pneumatic gun-related accidents were prominent. Cuts and injuries occurred in the hands, arms, or feet due to the sharp edges of sheet metal materials, sheet

metal cutting, and the handling of sheet metal parts. In angle grinder-related accidents, hand and finger cuts occurred when the grinding disk slipped or was ejected, or when workers operated the equipment after removing protective devices. In pneumatic gun-related accidents, incidents such as the pneumatic tightening gun falling onto the hand, chemical or adhesive contact during cleaning with an air gun, and nails penetrating the finger during nailing operations were observed. Although not separately included in the classification, accidents such as cuts and punctures during the use of pneumatic nail guns and solvent exposure during equipment cleaning also occurred. Finally, accidents related to material handling equipment were among the common occupational accident types. Under this theme, forklift- and transport cart-related accidents were prominent. In forklift-related accidents, injuries occurred when forklifts struck workers, when forklift wheels ran over workers' feet, or due to pedestrian–forklift interaction during maneuvering. In transport cart-related accidents, incidents such as ankle sprains during pushing or pulling transport carts, overturning of transport carts, and fingers becoming caught between two transport carts were observed. The topic classification conducted for the Manufacture of Machinery and Equipment Not Elsewhere Classified (n.e.c.) economic activity is presented in Table 11.

Table 11. Topic Classification for the Manufacture of Machinery and Equipment Not Elsewhere Classified (n.e.c.) Economic Activity.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Exposure-Related Errors	Foreign Body-Related	["burr into the eye", "burr entering the eye", "to the left eye", "burr entered the eye", "while performing, into the eye", "in the eye", "burr into the eye while performing", "burr into the right eye", "burr into the eye while grinding", "the eye"]	["a burr entered the employee's eye", "a burr entered the employee's eye", "a burr struck the employee's eye"]
	Hot Surface/ Material-Related	["burn occurred", "fire", "oxygen", "burning", "burns", "burning", "hot water", "occurrence of a burn", "burning", "explosion"]	["while taking hot water from the water dispenser, hot water spilled onto the employee's hand, resulting in a burn", "the employee struck his/her left arm against hot enamel, resulting in a burn", "while holding a hot flange in the foundry workshop, the employee sustained a second-degree burn on the palm"]
	Chemical-Related	["washing", "cleaning", "solvent", "dishwashing", "while washing", "in the kitchen", "cleaning agent", "liquid", "of the machine", "of the bottle"]	["while washing products at the workplace, chemical liquid entered the employee's eye, resulting in injury", "an occupational accident occurred when the employee trapped his/her hand in the washing machine", "while pouring chemical into the washing machine, the chemical spilled onto the employee's arm, resulting in injury"]
Slip, Fall, and Collision-Related Errors	Material-Related	["of his/her foot", "to his/her foot", "slipping of the foot", "falling onto his/her foot", "the ankle", "the foot", "sprained his/her foot", "onto the right foot", "on his/her foot", "onto the left foot"]	["a crate fell onto the employee's left foot", "the employee sprained the left ankle as a result of tripping", "the employee sprained the right ankle as a result of tripping"]

Table 11. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Entrapment/Crushing-Related Errors	Entrapment-Related	["to his/her finger", "trapping", "of the finger", "metal", "of the material", "accident", "machine", "falling occurred", "carelessness", "of the injured worker"]	["while positioning a metal sheet, the employee trapped his/her left index finger against the template, resulting in an occupational accident", "the employee sustained an occupational accident when material fell onto his/her hand", "the accident occurred when the employee struck the left thumb with a hammer while tack-welding the shaft"]
	Crushing-Related	["of the material", "hammer to his/her hand", "the material", "striking his/her hand", "to the material", "material fall", "falling onto the foot", "struck his/her hand", "falling onto his/her hand", "material to his/her hand"]	["the employee sustained tissue injury after striking his/her hand with a hammer", "the injury occurred when the employee struck his/her hand with a hammer", "the employee struck his/her hand with a hammer"]
Cutting Tool-Related Errors	Sheet Metal-Related	["sheet metal", "of the sheet metal", "sheet metals", "metal sheet", "of the sheet metals", "sheet metal material", "cutting", "iron sheet", "sheet metal cutting", "of the finger"]	["the employee cut his/her arm on sheet metal at the workplace", "while removing the plastic covering from a sheet-metal component, the employee cut his/her hand on the sheet metal", "a sheet-metal component fell onto the employee's foot"]
	Angle Grinder-Related	["angle grinder disc", "of the angle grinder disc", "angle grinder machine", "angle grinding", "while using the angle grinder", "angle grinder", "of the angle grinder", "the angle grinder disc", "of the angle grinder machine", "while cutting with the angle grinder"]	["while grinding, the employee sustained a cut on the hand from the grinding wheel", "while cleaning the surface of a metal sheet plate with an angle grinder, the grinding wheel slipped and injured the employee's finger; the employee named XXX XXX had removed the protective equipment from the angle grinder and operated it without the guard, resulting in the occupational accident", "while removing burrs with an angle grinder, the grinding wheel was ejected"]
	Pneumatic Gun-Related	["gun", "air gun", "of the gun", "of the gun", "pneumatic gun", "with the gun", "nail gun", "with the air gun", "the gun", "the air gun"]	["a pneumatic fastening gun fell onto the employee's right hand", "while cleaning plastic debris from products with a pneumatic air gun, the hose of the gun was punctured; after applying adhesive to the damaged area, the employee pressed the trigger before the adhesive had dried, causing the adhesive to enter the right eye and resulting in a minor injury", "while driving nails into crates with a pneumatic nail gun, the gun slipped from the employee's hand, causing a nail to penetrate the left finger"]

Table 11. Cont.

Main Topic Classification	Sub-Topic Classification	Keywords	Representative Documents
Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "with the forklift", "forklift operator", "forklift material", "from the forklift", "maneuver", "manlift", "left foot", "wheel"]	["the employee named XXX XXX approached the forklift and showed the location of the material; believing that the employee had moved away, the forklift operator turned the forklift to the left, causing the left wheel of the forklift to run over the employee's foot and resulting in an occupational accident", "a forklift struck the employee's right foot", "the employee was struck by a forklift"]
	Transport Cart-Related	["transport cart", "to the transport cart", "while pulling the cart", "of the transport cart", "between carts", "of the vehicle", "hand cart", "while carrying", "material handling", "with the cart"]	["while pushing a material transport cart at the workplace, the employee sprained his/her ankle and was injured after colliding with the cart", "while transporting a glass cart with a pallet truck, the employee lost balance and attempted to hold the overturning transport cart; the cart fell onto the front part of the employee's foot, resulting in injury", "while pulling a transport cart, the employee's finger became trapped between the cart being pulled and the adjacent transport cart"]

3.3. Sectoral Pattern Analysis

As a result of the clustering performed on the occupational accident narratives, 24 sectors were examined in detail, and seven main cluster categories were identified as shown in Table 12: Exposure-Related Errors, Cutting Tool-Related Errors, Entrapment/Crushing-Related Errors, Material Handling Vehicle-Related Errors, Slip, Fall, and Collision-Related Errors, Electrical-Related Errors, and Machine and Equipment-Related Errors. The analysis of the 24 sectors in terms of the main accident categories showed that Exposure-Related Errors were present in all sectors (24/24; 100%). This finding indicates that exposure-related accidents represent the most prevalent main risk category across the sectors examined. Cutting Tool-Related Errors were identified in 23 sectors (95.8%), while Entrapment/Crushing-Related Errors were identified in 21 sectors (87.5%). Thus, accidents related to cutting tools and entrapment/crushing were also highly prevalent across the sectors. Material Handling Vehicle-Related Errors and Slip, Fall, and Collision-Related Errors were each identified in 18 sectors (75%). This result indicates that accidents involving material handling vehicles and incidents involving slips, falls, and collisions constitute common risk areas in approximately three-quarters of the sectors. In contrast, Electrical-Related Errors were identified in only three sectors (12.5%), while Machine and Equipment-Related Errors were identified as an independent main category in only one sector (4.2%).

Table 12. Main Topic Classification.

Main Topic Classification	Count
Exposure-Related Errors	24
Cutting Tool-Related Errors	23
Entrapment/Crushing-Related Errors	21
Material handling Vehicle-Related Errors	18
Slip, Fall, and Collision-Related Errors	18
Electrical-Related Errors	3
Machine and Equipment-Related Errors	1

When the accident sub-topics were normalized based on semantic similarity and accident mechanisms, Entrapment-Related and Knife/Blade-Related accidents were found to be the most prevalent risks across sectors. Both accident families were identified in 19 of the 24 sectors (79.2%). This finding indicates that entrapment of hands and fingers in machinery or equipment and injuries involving knives and similar cutting tools represent common risk mechanisms across a large proportion of the sectors examined. Chemical Exposure-Related and Foreign Body-Related accidents were each identified in 15 sectors (62.5%). Thus, exposure to chemical substances and the entry of metal chips, metal particles, or other foreign bodies, particularly into the eyes, constitute common risk areas in approximately two-thirds of the sectors. Forklift-Related accidents were identified in 14 sectors (58.3%), while Slip/Fall-Related accidents were identified in 13 sectors (54.2%), indicating that vehicle traffic and slip/fall incidents are also among the prevalent risks across sectors. Risks with a moderate level of prevalence included Machine/Equipment-Related (50%), Collision/Impact-Related (45.8%), Hot Liquid/Water/Steam-Related (41.7%), Material Impact/Fall-Related (37.5%), and Hot Surface/Material-Related (37.5%) accidents. Although these categories were not common to all sectors, they represent recurring risk mechanisms across a considerable number of sectors. In contrast, lower-frequency categories such as Sheet Metal-Related, Grinding/Abrasive Tool-Related, Electrical-Related, and Glass-Related accidents can be considered more sector-specific risks, as they are more closely associated with manufacturing processes or equipment. The sub-topic classification is presented in Table 13.

In the similarity analysis conducted across sectors at the main topic and sub-topic levels, the findings at the main topic level showed that the sectors were largely grouped under common main classifications. This can be attributed to the fact that the defined main topics represent broad hazard and risk categories commonly encountered in manufacturing sectors, making them observable across a substantial proportion of the sectors. At the sub-topic level, the differences among sectors become more pronounced. According to the analysis results, similarities in terms of sub-topics were observed between Manufacture of Paper and Paper Products (Sector 17) and Printing and Reproduction of Recorded Media (Sector 18); Manufacture of Chemicals and Chemical Products (Sector 20) and Printing and Reproduction of Recorded Media (Sector 18); Manufacture of Basic Pharmaceutical Products and Pharmaceutical Preparations (Sector 21) and Manufacture of Chemicals and Chemical Products (Sector 20); Other Manufacturing (Sector 32) and Manufacture of Chemicals and Chemical Products (Sector 20); and Manufacture of Motor Vehicles, Trailers and Semi-Trailers (Sector 29) and Manufacture of Computer, Electronic and Optical Products (Sector 26).

Table 13. Sub-Topic Classification.

Sub-Topic Classification	Count
Entrapment-Related	19
Knife/Blade-Related	19
Chemical Exposure-Related	15
Foreign Body-Related	15
Forklift-Related	14
Slip/Fall-Related	13
Machine/Equipment-Related	12
Collision/Impact-Related	11
Hot Liquid/Water/Steam-Related	10
Material Impact/Fall-Related	9
Hot Surface/Material-Related	9
Pallet Truck-Related	8
Sheet Metal-Related	7
Grinding/Abrasive Tool-Related	6
Glass-Related	4
Crushing-Related	3
Electrical-Related	3
Fire/Gas/Explosion-Related	3
Needle-Related	2
Pneumatic Gun/Nail Gun-Related	2
Saw-Related	2
Screwdriver-Related	2

The accident profiles of Sectors 17 and 18 show substantial similarities around paper-based production processes, contact with machinery, cutting tool use, exposure, and material handling activities. In both sectors, entrapment/crushing accidents occur during interventions involving material jammed in paper-processing or printing machinery. In Sector 17, paper machines and jammed paper are prominent, whereas in Sector 18, printing machines, ink, printing areas, and accidents associated with jammed paper are more evident. Cutting tool-related accidents also represent a common risk area in both sectors. In Sector 17, hand and finger cuts caused by machine blades and utility knives are observed, while in Sector 18, injuries associated with utility knives and the cutting of paper and plastic are more prominent. In terms of exposure, both sectors include foreign body or chemical contact affecting the eye and facial regions. Sector 17 includes exposure associated with chemicals, paint, water, and heat, whereas Sector 18 is characterized by solvent exposure, glass fragments, and splash incidents affecting the eyes. Overall, occupational accidents in Sectors 17 and 18 are concentrated around common risk mechanisms associated with paper processing, printing and machine operations, cutting activities, chemical and foreign body exposure, and material handling vehicles such as forklifts and pallet trucks.

Sector 20 shows similarities with Sectors 18, 21, and 32 particularly in the themes of exposure, entrapment/crushing, cutting tool use, and material handling vehicles. In Sector 20, chemical splashes, hot water/steam, pressurized lines, tanks, and pump-related exposures are prominent, whereas Sector 21 includes accidents associated with hot water, washing operations, chemical splashes, tanks, pressure, and gases. Therefore, the strongest similarity between Sectors 20 and 21 is based on chemical and thermal exposure risks.

The similarity between Sectors 20 and 32 is more evident in chemical/foreign body exposure, contact with machinery, and cutting tool-related injuries. In both sectors, chemical or foreign body splashes to the eyes, contact with hot liquids or hot materials, machine-related finger entrapments, and hand/finger cuts caused by utility knives are observed as

common accident mechanisms. This indicates that activities such as assembly, washing, cleaning, and machine intervention generate similar risks in both sectors.

The similarity between Sectors 20 and 18 is primarily associated with machine intervention, cutting tool use, and material handling vehicles. In Sector 18, accidents involving printing machines, jammed paper, utility knives, solvents, forklifts, and pallet trucks are prominent, whereas Sector 20 includes machine-related finger entrapments, utility-knife cuts, chemical splashes, and forklift/pallet truck accidents. Overall, the common accident profile of Sector 20 with these three sectors is concentrated around chemical and hot-liquid exposure, machine-related entrapment, cutting tool injuries, and foot and body injuries associated with forklift and pallet truck use.

The accident profiles of Sectors 26 and 29 are similar particularly in terms of machine-related entrapment, cutting tool injuries, foreign body/hot surface exposure, slip/fall/collision incidents, and forklift/pallet truck use. In both sectors, finger entrapments, hand/finger contact during machine operation, and injuries associated with moving equipment constitute common risk mechanisms. In exposure-related accidents, foreign bodies entering the eye, splashes, and contact with hot surfaces or hot materials are prominent in both sectors. Sector 26 includes exposure associated with chemicals, plastics, glass, and hot materials, whereas Sector 29 is characterized by oils, hydraulic systems, explosions/splashes, and contact with hot materials. This indicates that similar exposure risks arise in both sectors during production, cleaning, maintenance, and machine intervention activities. Similarities are also evident in cutting tool-related accidents. In Sector 26, utility-knife- and sheet-metal-related cuts are prominent, whereas in Sector 29, hand and finger cuts associated with utility knives, grinders, sheet metal, and machinery are common. In addition, both sectors include accidents involving falling materials, physical contact, ankle injuries, and foot crushing or collision incidents associated with forklifts and pallet trucks. Overall, occupational accidents in Sectors 26 and 29 converge around contact with machinery, hand/finger entrapment, work with sharp surfaces, thermal/chemical/foreign body exposure, and internal material handling vehicles. Therefore, although the production technologies used in the two sectors differ, they exhibit similar risk patterns based on human-machine-material interaction.

In contrast, Manufacture of Coke and Refined Petroleum Products (Sector 19) was found to show no clear similarity at the sub-topic level with any of the 10 sectors included in the comparison. This can be attributed to the process safety risks specific to Sector 19. While occupational accidents in the other sectors are mainly concentrated around cutting tool use, contact with machinery, slips and falls, material handling, and manual operations, Sector 19 is characterized by flammable and explosive substances, corrosive chemicals, pressurized lines, tanks, pumps, compressors, and process equipment. Similarly, no common sub-topic was identified between Manufacture of Beverages (Sector 11) and Manufacture of Wearing Apparel (Sector 14). These findings indicate that, although there is a high degree of commonality among sectors at the main-topic level, sector-specific risk and hazard profiles become more clearly differentiated at the sub-topic level, which provides a more detailed classification.

4. Conclusions

In this study, topic modeling was performed using the BERTopic algorithm. First, the effectiveness of the SBERT and trMTEB embedding models in Turkish was compared, and it was concluded that the SBERT embedding model had a more effective clustering capability for occupational accident narratives. Subsequently, topic modeling was conducted on a sectoral basis for occupational accident narratives from 24 different economic activities within the manufacturing sector in order to identify latent patterns and perform sector-

specific accident error analysis. As a result of the BERTopic analysis, it was observed that occupational accidents across the 24 manufacturing sectors examined were concentrated around certain main themes. Although the production structure of the sectors, the types of machinery and equipment used, material characteristics, and working environments differed, occupational accidents were largely found to arise from similar risk mechanisms. In this context, slip-, fall-, and impact-related accidents, cutting tool-related accidents, exposure-related accidents, entrapment and crushing-related accidents, and accidents related to material handling equipment emerged as the main accident types commonly observed across many sectors. In the analyzed sectors, slip-, fall-, and impact-related accidents were found to be particularly associated with floor conditions, falling materials, lack of attention during worker movement, stair use, and disorder in the work area. In food and beverage manufacturing, wet floors were prominent risk areas for this accident type. In the chemical, pharmaceutical, and metal sectors, stairs, platforms, and passage areas stood out, while in ship- and shipyard-related activities, stairs inside ships, decks, and confined work areas were prominent. In addition, foot and ankle injuries frequently occurred in many sectors when crates, iron, metal parts, pallets, pipes, and similar materials fell onto workers' feet. Cutting tool-related accidents were also identified as a widespread accident type across the 24 sectors. In many sectors, including food, beverage, textile, leather, paper, plastic, metal, furniture, and ship manufacturing, tools such as utility knives, knives, saws, angle grinders, grinding machines, sheet metal, glass, broken tiles, needles, drills, and similar cutting or piercing tools frequently caused occupational accidents. These accidents mostly resulted in cuts, punctures, or disruption of tissue integrity in the hands, fingers, palms, and, in some cases, the arms. In particular, operations such as deburring, opening packages, cutting materials, fabric cutting, sheet metal processing, glass handling, and machine blade replacement emerged as critical activities for this accident type. Exposure-related accidents constituted one of the most common shared themes, although they varied across sectors. Factors such as chemical splashes, contact with hot water and steam, contact with hot surfaces or hot materials, foreign bodies entering the eyes, metal burrs, dust, paint, solvents, epoxy, caustic substances, acids, gases, smoke, and welding arc radiation were among the main causes of exposure-related accidents. While chemical exposure became more pronounced in sectors such as the manufacture of chemicals and chemical products, manufacture of basic pharmaceutical products, and manufacture of coke and refined petroleum products, eye injuries and burns were more prominent in sectors related to metals, machinery, automotive, ships, and furniture due to grinding, welding, cutting, and contact with hot parts. This indicates that the use of personal protective equipment, chemical safety procedures, and control measures for hot surfaces are critically important in many sectors. Entrapment and crushing-related accidents were concentrated particularly in work processes requiring direct contact with machinery, equipment, and materials. Press machines, packaging machines, conveyors, winding machines, molds, pipes, pistons, pneumatic systems, autoclave carts, profile packaging processes, and CNC machines were frequently highlighted as sources of this accident type. Workers' close contact with moving equipment while attempting to remove jammed products, intervening in machines, performing maintenance or adjustment, or positioning materials constitutes an important risk for hand and finger entrapment. This finding indicates that machine guards, energy isolation and lockout practices, and safe intervention procedures are common needs across sectors. Accidents related to material handling equipment also represented a recurring and important risk area in many sectors. During handling operations performed with forklifts, pallet trucks, electric pallet trucks, stacking carts, hand carts, transport carts, autoclave carts, and similar equipment, accidents such as impact, crushing, running over the foot, load overturning, impacts during reversing maneuvers, and entrapment

between vehicles occurred. Particularly in areas where forklifts and pallet trucks are used, pedestrian–vehicle interaction, reversing maneuvers, limited visibility, internal traffic organization, and load stability were identified as important risk factors. Overall, across all 24 sectors, occupational accidents were found to result not only from individual worker errors but also from production process design, machinery and equipment safety, workplace layout, material handling methods, floor conditions, maintenance and repair activities, and deficiencies in the use of personal protective equipment. Therefore, in addition to sector-specific measures, systematic measures targeting common risk areas across sectors should be developed to reduce occupational accidents. In particular, the implementation of comprehensive occupational safety policies on machine safety, cutting tool use, chemical and thermal exposure management, forklift and pallet truck traffic, stair and floor safety, work involving hot surfaces, and eye protection is of critical importance.

In conclusion, the BERTopic analysis revealed that occupational accidents across the 24 manufacturing sectors recur around certain patterns. Although sectoral differences change the types of accident sources, a large proportion of occupational accidents occur at points where human–machine–material interaction is intensive. Therefore, preventive activities should not be limited to post-accident corrective approaches; rather, they should be addressed through a proactive risk management approach that covers all stages, from the design of production processes and maintenance and repair procedures to employee training and the use of personal protective equipment.

5. Limitations

The accident narratives used in this study were entered as free-text descriptions by different individuals and were not based on a standardized reporting format. In addition, the narratives largely focused on the consequences of accidents and the resulting physical injuries rather than providing detailed information on the underlying causes of the accidents. Therefore, variations in terminology, spelling errors, differences in the level of detail, and the limited causal information provided in the narratives may have affected the consistency of the classification and analysis.

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Appendix A

Table A1. Classification of Sector-Based Topics.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 10	Slip, Fall, and Collision-Related Errors	Slip- and Fall-Related	["slipped and fell", "his/her foot slipped", "sprained his/her ankle", "fell as a result of slipping", "fall due to foot slipping", "slipped and fell", "foot slipping", "while descending, his/her foot", "right foot slipping", "while descending, his/her foot"]
		Collision-Related	["on his/her head", "of his/her head", "hit his/her head", "his/her head", "fell onto his/her head", "falling onto his/her head", "hit his/her head", "hitting the iron/metal", "was injured", "was slightly injured"]
	Cutting Tool-Related Errors	Knife-Related	["knife", "slipping toward the left hand", "cut his/her hand", "cut on his/her finger", "cut on hand/finger", "cut his/her finger", "cut his/her index finger", "slipped from his/her hand toward the left", "slipped from his/her hand", "had his/her finger cut"]
		Machine-Related	["cheese", "to/into the cart", "cut his/her hand", "became trapped", "trapped his/her hand", "middle finger", "getting caught", "in the manufacturing section", "cut", "left-hand ring finger"]
	Exposure-Related Errors	Chemical-Related	["into the left eye", "into the right eye", "entry/splashing", "of the eye", "burning sensation", "into the eye", "right eye", "bone", "while cleaning", "water"]
		Hot Liquid-Related	["hot water", "burning", "spillage", "splashing", "of the hose", "bursting", "cooking", "oven", "chemical", "refinery"]
	Entrapment/Crushing-Related Errors	Entrapment-Related	["of the index finger", "trapped his/her hand", "trapping his/her finger", "entrapment of his/her finger", "while working, right hand", "hand finger", "of the hand finger", "his/her hand into the machine", "of the index finger of the hand", "while working on the machine"]
		Crushing-Related	["empty crate", "tipped over", "empty crates", "from the crates", "fell in the production area", "fell onto his/her head", "tripped and fell", "to the pallet truck", "of the product", "struck in the production area"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "operator", "in reverse", "struck his/her foot", "load", "onto his/her left foot", "did not see", "of the vehicle", "to the ankle", "electric"]
	Electrical-Related Errors	Electrical-Related	["electrical", "malfunction", "explosion", "motor", "due to the malfunction", "to switch off", "that it struck", "to the button", "assembly/installation", "the machine"]
Sector 11	Cutting Tool-Related Errors	Box Cutter-Related	["finger", "to the machine", "in the machine", "finger", "to his/her finger", "the finger", "the machine", "to the machine", "index finger", "the machine"]
		Utility Knife-Related	["knife", "utility knife", "cut", "to the knife", "to cut", "cut his/her finger", "cut his/her hand", "shrink", "stitches", "a cut occurred"]
		Glass-Related	["bottle", "the bottle", "bottling", "bottles", "of the bottles", "water", "breakage", "glass fragment", "filling worker", "broken"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 11	Slip, Fall, and Collision-Related Errors	Slip and Fall-Related	["slipping of the foot", "fall", "foot slipping", "foot slipped", "slipping and falling", "foot slipping and falling", "while descending", "falling on the left", "falling to the ground", "foot slipping and falling"]
		Collision-Related	["head", "his/her head", "to his/her head", "hitting his/her head", "of the belt", "head", "of the conveyor", "by hitting", "filling worker", "to the machine"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "maneuver", "reversing", "shipment", "vehicle", "over his/her foot", "of the operator", "loading", "waste"]
		Pallet Truck-Related	["water", "spring water", "slipping of the foot", "while unloading", "wet", "from the vehicle", "fall", "losing balance", "falling to the ground", "of the floor"]
	Exposure-Related Errors	Industrial Chemical-Related	["chemical", "to the eye", "eye", "to the left eye", "protective", "to the face", "while cleaning", "to the right eye", "mechanical", "came into the eye"]
		Hot Water and Steam-Related	["hot", "hot water", "tea", "burning", "sugar", "water", "burn occurred", "pressurized", "was spilled", "washing"]
Sector 12	Entrapment/Crushing-Related Errors	Pallet-Related	["pallets", "of the pallets", "pallet making", "to the pallet", "pallet line", "between pallets", "in the palletizing machine", "from the pallet", "to the pallets", "on the pallet"]
	Exposure-Related Errors	Spraying/Fumigation-Related	["tobacco", "cigarette", "tobacco carton", "occurred", "the incident occurred", "the incident took place", "tobacco cartons", "filled with tobacco", "tobacco box", "the incident occurred involving tobacco"]
	Entrapment/Crushing-Related Errors	Entrapment-Related	["machine", "his/her finger", "finger", "in the machine", "to the machine", "finger", "of the machine", "of the machine", "in the machine", "right index finger"]
	Material Handling Vehicle-Related Errors	Hand Cart-Related	["hand cart", "of the cart", "of the hand cart", "to the hand cart", "the incident occurred", "with the hand cart", "cart with a box/carton", "hand cart with a box/carton", "to the ankle", "falling incident"]
		Pallet Truck-Related	["foot", "left foot", "electric", "of his/her foot", "ankle", "left ankle", "while pulling, his/her right foot", "electric pallet truck", "with the electric pallet truck", "his/her foot between the pallet"]
	Cutting Tool-Related Errors	Knife-Related	["knife", "his/her knife", "cutting knife", "of the knife", "final cutting knife", "utility knife", "the knife", "to the knife", "of the knives", "of the utility knife"]
Sector 13	Entrapment/Crushing-Related Errors	Material Fall-Related	["onto the fabric", "fabrics", "of the roll", "textile", "in the stenter machine", "from the machine", "the machine", "from the machine", "in the machine", "was trapped between"]
		Crushing-Related	["of the cart", "while pulling the cart", "the cart", "to the cart", "from the cart", "over his/her foot", "of the vehicle", "left foot", "due to carelessness while pulling", "was trapped between"]
		Entrapment-Related	["index finger", "his/her index finger", "index finger of the hand", "middle finger", "of the index finger", "while working on the machine", "finger of the hand", "to the middle finger", "finger was trapped", "middle finger of the hand"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 13	Cutting Tool-Related Errors	Knife-Related	["cut his/her finger", "cut his/her hand", "cutting his/her finger", "slipping onto the left hand", "cut", "his/her thumb", "cleaning", "cut on his/her finger", "cutting his/her hand", "palm of the hand"]
		Needle-Related	["was injured", "to the accident", "while working on the machine", "left-hand finger", "to the finger of the hand", "cutting his/her finger", "to the thumb", "to the middle finger", "accident", "hand finger"]
		Hook-Related	["cut his/her hand", "while cleaning, left", "palm of the hand", "to clean", "cut his/her finger", "slipping onto the left hand", "to cut", "cleaning", "the item being cleaned", "while cleaning"]
	Slip, Fall, and Collision-Related Errors	Collision-Related	["recklessly and carelessly", "while pulling", "trapping his/her hand", "trapping his/her finger", "over his/her foot", "of the cart", "striking his/her foot", "striking the iron part", "of the roll", "falling onto his/her foot"]
		Fall-Related	["while descending, his/her foot", "while descending", "foot slipping", "foot slipping and falling", "foot slipped", "slipping and falling", "slipping to the ground", "while descending downward", "slipped and fell", "slipping and falling"]
	Exposure-Related Errors	Chemical-Related	["to the left eye", "to the right eye", "caustic", "of the eye", "protective", "oil", "while cleaning", "breaking and", "was injured", "automation"]
		Hot Water and Steam-Related	["hot", "burn", "splashing", "washing", "bursting", "in the dyehouse section", "to the right arm", "oil", "caused", "in the factory"]
	Cutting Tool-Related Errors	Needle-Related	["textile", "in the machine", "in the machine", "of the machine", "machine", "while working on the machine", "while working on the machine", "to the machine", "to the left-hand finger", "steel"]
		Scissors-Related	["needle punctured", "to the middle finger", "carelessness, left", "left index finger", "left index", "ring finger", "to the thumb", "while performing, left", "the finger", "of the index finger"]
		Machine-Related	["cutting", "in the machine", "of the machine", "in the machine", "left index finger", "of the index finger", "finger of the hand", "left-hand finger", "thumb of the hand", "the finger"]
Sector 14	Entrapment/Crushing-Related Errors	Entrapment-Related	["in the machine", "in the machine", "the machine", "while working on the machine", "to the machine", "while working on the machine", "of the machine", "of the machine", "trapped his/her finger", "left index finger"]
	Exposure-Related Errors	Foreign Body-Related	["to the eye", "broken", "by breaking", "in the machine", "in the machine", "its cover", "cleaning", "metal", "of the machine", "while working on the machine"]
		Hot Liquid and Steam-Related	["hot", "while ironing", "printing", "in the production area", "to the face", "electricity", "in the cafeteria", "part", "of the leg", "of the right arm"]
	Electrical-Related Errors	Electrical-Related	["electricity", "while changing", "the machine", "while ironing", "metal", "struck", "of the cover", "in the machine", "of the table", "of the machine"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 15	Entrapment/Crushing-Related Errors	Entrapment-Related	["of the finger", "of the machine", "in the machine", "finger", "to the machine", "to his/her finger", "the finger", "index finger", "the machine", "while working on the machine"]
	Cutting Tool-Related Errors	Knife-Related	["the knife", "a cut occurred", "the leather", "cutting", "cutting his/her hand", "cutting his/her finger", "slipping onto the left", "his/her thumb", "cut his/her finger", "of the finger"]
		Machine-Related	["stitches", "in the sewing machine", "in the machine", "of the machine", "of the finger", "needle into his/her finger", "accidentally", "while sewing", "puncturing his/her finger", "of the middle finger"]
	Exposure-Related Errors	Chemical-Related	["to the eye", "chemical", "to the left eye", "eye", "to the right eye", "paint", "to the face", "splashing into the eye", "the eye", "in the eye"]
		Hot Water-Related	["hot", "burning", "last pulling operation", "burn occurred", "burning", "fingers", "in the machine", "oil", "chemical", "of the machine"]
	Machine and Equipment-Related Errors	Sanding-Related	["shoe sole", "the shoe", "manufacturing", "shoe sole", "capsule", "of the finger", "in the machine", "shoe production", "of the machine", "machine"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "electric", "right foot", "ran over his/her foot", "ran over", "of the truck", "over his/her foot", "by trapping between", "falling onto his/her foot"]
	Slip, Fall, and Collision-Related Errors	Slip-Related	["slipping of the foot", "falling onto the foot", "the foot", "onto the left foot", "on the foot", "the ankle", "in the ankle", "foot slipping", "while descending, the foot", "tripping of the foot"]
		Fall-Related	["wood", "motor", "to the saw", "to the machine", "the item cut", "to the machine", "while working on the machine", "in the machine", "in the cutting machine", "while performing the task"]
		Collision-Related	["carelessness while working", "of the wooden piece", "coming out of the machine", "in the cutting machine", "while cutting a piece", "carelessness while working on the machine", "cutting operation", "while cutting", "while cutting material", "while working on the machine"]
Sector 16	Entrapment/Crushing-Related Errors	Entrapment-Related	["to the machine", "while working on the machine", "in the machine", "trapped his/her hand", "while working on the machine", "his/her finger into the machine", "trapped his/her finger", "his/her hand into the machine", "his/her hand into the machine", "the machine"]
	Cutting Tool-Related Errors	Knife/Saw-Related	["knife", "knife", "haker", "while working on the machine", "cut his/her finger", "of his/her right hand", "index finger of the hand", "index finger", "thumb", "occurrence of a cut"]
		Machine-Related	["carpenter", "manufacturing", "in the workshop", "to the saw", "to his/her finger", "to the machine", "while cutting", "right index finger", "of the wood", "making"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 16	Cutting Tool-Related Errors	Pneumatic Nail Gun-Related	["gun", "to his/her finger", "nail into his/her finger", "while nailing", "to the thumb", "while performing nailing", "to the index finger", "nail into the thumb", "while assembling pallets with nails", "accidentally"]
	Exposure-Related Errors	Chemical-Related	["to the eye", "to the right eye", "to the left eye", "dust into the eye", "in the eye", "eye", "striking the eye", "the eye", "the eye", "to my eye"]
		Hot Water and Steam-Related	["hot", "burn", "oil", "steam", "hydraulic", "fuel", "of the hose", "pressure", "on the face", "bursting"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "shipment", "foot", "right foot", "on the foot", "of the right foot", "of the left foot", "ankle", "in the maintenance workshop"]
Sector 17	Entrapment/Crushing-Related Errors	Entrapment-Related	["paper", "jammed paper", "papers", "to the machine", "paper machine", "occurred, paper", "breakage", "ring", "in the paper machine", "waste"]
	Cutting Tool-Related Errors	Machine-Related	["knife", "cut his/her finger", "cutting", "a cut occurred", "his/her thumb", "cut on his/her finger", "cut his/her hand", "index finger of the hand", "thumb of the hand", "to his/her finger"]
		Box Cutter-Related	["to his/her finger", "hand finger", "the finger", "slipping onto the left hand", "right index finger", "left-hand finger", "to the index finger", "left index", "index finger", "index finger"]
	Exposure-Related Errors	Foreign Body-Related	["to the right eye", "chemical", "eye", "paint", "to the eye", "burning", "to the face", "protective", "struck his/her eye", "water"]
		Hot Water and Steam-Related	["burn", "hot", "burn occurred", "burning", "bursting", "malfunction", "chemical", "electricity", "occurred, paper", "from the machine"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "reversing", "shipment", "maneuver", "struck his/her foot", "of the left foot", "on the foot", "to the right foot", "of the injured worker"]
Sector 18	Material Handling Vehicle-Related Errors	Pallet Truck-Related	["sprained his/her foot", "slipping of the foot", "foot slipped", "foot was sprained", "while doing, his/her foot", "the ankle", "fell onto his/her foot", "slipped and fell", "while attempting, his/her foot", "of the left foot"]
		Entrapment-Related	["in the printing machine", "ink", "printing machine", "jammed paper", "in the printing machine", "of the printing machine", "of the machine", "printing section", "to the printing machine", "to the printing machine"]
	Cutting Tool-Related Errors	Utility Knife-Related	["knife", "knife", "cutting", "cut his/her finger", "paper", "plastic", "occurrence of a cut", "while cleaning", "his/her thumb", "of the machine"]
	Material Handling Vehicle-Related Errors	Pallet Truck-Related	["of his/her foot", "foot", "to his/her foot", "his/her foot", "left foot", "slipping of the foot", "the foot", "to the pallet truck", "left foot", "of the right foot"]
		Forklift-Related	["forklift", "of the forklift", "foot", "electric", "right foot", "stock area", "employee", "over his/her foot", "maneuver", "shipment"]
	Exposure-Related Errors	Foreign Body-Related	["to the eye", "to the left eye", "eye", "glass fragment", "burning", "splashed into the eye", "solvent", "the eye", "superficial", "by breaking"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 19	Exposure-Related Errors	Flammable/Explosive Substance-Related	["steam", "yağ", "yangın", "buhar", "pompa", "sıcak su", "hattın", "yanık oluşmuştur", "bacak", "ıbc tanka"]
		Corrosive Chemical Substance-Related (Caustic)	["degree burn", "burning", "first-degree burn", "occurrence of a burn", "burns", "burns occurred", "inner wrist", "degree burn occurred", "fire", "burn dressing"]
		Corrosive Chemical Substance-Related (Sulfuric Acid)	["eye", "polymer", "to the eye", "eye and neck", "front of the eye and neck", "increase of sulfuric acid", "sprinkler tests present", "chemical into the eye while performing", "into the eye while performing", "increase in gas pressure"]
	Slip, Fall, and Collision-Related Errors	Working at Height-Related	["stairs", "of the ladder/stairs", "while descending the stairs", "on the last step", "stairs", "while ascending", "on the last step of the stairs", "downward", "slipped and fell", "while descending, his/her foot"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "shipment", "forklift", "forklift operator", "transportation", "forklift operator", "did not see", "to operate, of the forklift", "running over his/her foot"]
	Entrapment/Crushing-Related Errors	Machine and Equipment-Related	["of the compressor", "compressor", "compressor", "mechanical", "was trapped between", "piston", "apparatus holding the part", "pump spare rotor", "pump spare", "of the impeller, his/her finger"]
	Entrapment/Crushing-Related Errors	Entrapment-Related	["of the finger", "finger", "to his/her finger", "in the machine", "of the machine", "index finger", "his/her index finger", "on his/her finger", "right index finger", "the finger"]
	Exposure-Related Errors	Chemical-Related	["to the eye", "eye", "to the right eye", "to the left eye", "splashed into the eye", "to the face", "chemical substance", "paint", "washing", "came into the eye"]
		Hot Liquid-Related	["hot water", "pump", "steam", "tanker", "burn occurred", "tank", "pump", "of the line", "of the pump", "pressurized"]
		Foreign Body-Related	["metal", "to the head", "steel", "between iron materials", "metal part", "to his/her finger", "to the part", "of the machine", "index finger", "on his/her finger"]
Sector 20	Slip, Fall, and Collision-Related Errors	Slip and Fall-Related	["stairs", "of the stairs/ladder", "slipping of the foot", "while descending, his/her foot", "fall", "while descending, his/her foot", "slipping while descending", "while descending", "foot slipping", "foot slipped"]
	Cutting Tool-Related Errors	Utility Knife-Related	["knife", "blade/knife", "to the knife", "to cut", "cut his/her hand", "finger", "on his/her finger", "slipping onto the left", "his/her thumb", "of the finger"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "maneuver", "with the forklift", "reversing", "striking his/her foot", "of the operator", "shipment", "forklift", "of the left foot"]
		Pallet Truck-Related	["his/her foot", "electric pallet truck", "with the pallet truck", "his/her left foot", "left foot", "being trapped between", "right foot", "his/her right foot", "ankle", "of the left foot"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 21	Exposure-Related Errors	Hot Liquid-Related	["hot water", "washing", "chemical", "burning", "water", "in the washing room", "waste", "gas", "of the tank", "pressure"]
		Chemical-Related	["to the eye", "eye", "to the left eye", "to the right eye", "the eye", "chemical", "splashing into the eye", "splashed into the eye", "experienced splashing", "the eye"]
	Slip, Fall, and Collision-Related Errors	Slip and Fall-Related	["of his/her foot", "slipping of the foot", "on his/her foot", "left foot", "sprained his/her foot", "fell to the ground", "foot slipped", "foot slipping", "slipping of the foot to the ground", "ankle"]
			["wet", "slipping of the foot", "foot slipping", "fell", "to the sink", "slipped and fell", "foot slipped", "fell to the ground", "foot slipping and falling", "slipped and fell"]
	Entrapment/Crushing-Related Errors	Entrapment-Related	["of the finger", "in the machine", "to his/her finger", "finger", "index finger", "trapped his/her finger", "index finger of the hand", "the finger", "his/her index finger", "entrapment of the hand"]
	Material Handling Vehicle-Related Errors	Autoclave-Related	["the cart", "while pulling the cart", "cart", "of the cart", "to the cart", "trapped between", "while pulling, left hand", "trapped his/her finger", "from the cart", "his/her ring finger"]
		Pallet Truck-Related	["electric pallet truck", "his/her foot", "foot", "between the pallet truck", "foot", "entrapment of the foot", "ankle", "right ankle", "the foot", "battery-powered pallet truck"]
	Cutting Tool-Related Errors	Glass-Related	["optical", "breakage", "pipette", "glass fragment", "broken", "broken", "broken glass", "glass shard", "in the laboratory", "cut on his/her finger"]
		Utility Knife-Related	["knife", "utility knife", "of the finger", "plastic", "was injured", "the item cut", "in the machine", "cut his/her finger", "causing cutting", "while working on the machine"]
	Sector 22	Cutting Tool-Related Errors	Utility Knife-Related
Machine-Related			["the machine", "was trapped between", "while performing assembly", "dropped", "due to carelessness", "while trying to remove", "while making the adjustment", "thumb of the hand", "was trapped between", "his/her little finger"]
Exposure-Related Errors		Foreign Body-Related	["was performed", "around 00:00", "drill", "while performing assembly", "due to carelessness", "2020", "of the operator", "slipping from his/her hand", "slightly", "worker"]
		Hot Surface/Material-Related	["slightly", "on the upper part", "to production", "the machine", "his/her right arm", "2020", "worker", "of the operator", "while trying to remove", "leg"]
		Fire/Smoke and Asphyxiant Gas-Related	["printing house", "vehicle", "around 00:00", "materials", "slightly", "was performed", "seeing", "worker", "slight injury caused by impact", "wall"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 22	Slip, Fall, and Collision-Related Errors	Material-Related	["was trapped between", "of the right foot", "middle finger of the hand", "his/her little finger", "was injured slightly", "slipping onto the right hand", "slipping from his/her hand, right", "was slightly injured", "right foot", "finger of the hand"]
		Fall-Related	["of the right foot", "dropped", "while performing assembly", "cut on his/her finger", "slipping onto the right hand", "while trying to remove", "his/her right arm", "of the index finger", "carelessness, left", "middle finger of the hand"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["of the right foot", "of the operator", "right foot", "vehicle", "leg", "was trapped between", "unloading", "by collision", "movement", "his/her leg"]
Sector 23	Slip, Fall, and Collision-Related Errors	Concrete-Related	["of the vehicle", "truck", "concrete pouring", "construction", "of the pump", "of the concrete pump", "of the truck", "transmixer", "of his/her foot", "cart"]
		Collision-Related	["his/her head", "to his/her head", "hitting his/her head", "on his/her head", "hitting his/her head against iron", "striking his/her head", "struck his/her head", "on the head", "hitting his/her head while passing", "falling onto his/her head"]
		Material-Related	["while feeding stone into the machine", "while feeding, the stone", "while feeding stone, the stone", "stone from the machine", "while taking stone from the machine", "stone from the machine", "falling onto his/her foot", "stone breaking", "stone onto his/her foot", "while taking stone from the machine"]
	Cutting Tool-Related Errors	Glass-Related	["of the glass", "of the glasses", "glass handling", "breakage of glass", "breakage", "occurred, glass", "while carrying glass", "while taking glass", "glass fragment", "occurred, glass"]
		Broken Tile-Related	["finger", "finger", "of the finger", "to his/her finger", "right index finger", "was injured", "finger of the hand", "the finger", "while taking the tile", "index finger"]
	Exposure-Related Errors	Utility Knife-Related	["knife", "utility knife", "of the knife", "the knife", "of the utility knife", "the knife", "knife onto the left", "to the knife", "with a knife", "slipping of the knife"]
		Hot Surface/Material-Related	["coal", "from the furnace", "at the furnace exit", "fire", "rotary kiln", "burn occurred", "in the furnace", "occurred, furnace", "in the furnaces section", "hot water"]
		Foreign Body-Related	["to the eye", "to the left eye", "burr into the eye", "in the eye", "burr entry", "burr entering the eye", "dust into the eye", "while performing, into the eye", "burr entered the eye", "the eye"]
		Chemical-Related (Epoxy)	["epoxy", "to the eye", "epoxy", "splashing into the eye", "in the epoxy section", "chemical into the eye", "in the epoxy line", "splashed into the eye", "splashing into the left eye", "occurred, epoxy"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "forklift operator", "from the forklift", "with the forklift", "of the forklift operator", "foot", "while getting off the forklift", "occurred, forklift", "forklift down"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 23	Entrapment/Crushing-Related Errors	Entrapment-Related	["while taking stone", "while feeding stone", "stone into the machine", "trapped between", "stone into the machine", "between stones", "his/her hand while working", "while feeding stone into the machine", "stone from the machine", "while taking stone from the machine"]
		Material-Related (Wrench)	["slipping of the wrench", "with the wrench", "while tightening, the wrench", "the wrench from his/her hand", "pipe wrench", "of the pipe wrench", "the wrench in his/her hand", "slipping of the wrench from his/her hand", "while tightening, wrench", "slipping of the wrench onto the right"]
Sector 24	Entrapment/Crushing-Related Errors	Entrapment-Related	["finger of the hand", "to the finger of the hand", "index finger of the hand", "to the index finger of the hand", "left-hand finger", "finger was trapped", "to the left-hand finger", "to the thumb of the hand", "entrapment of the finger", "thumb of the hand"]
	Exposure-Related Errors	Foreign Body-Related	["entered", "while grinding", "splashed", "redness", "angle grinder", "motor", "according to the statement", "according to his/her own statement", "according to his/her own statement", "according to the person's own statement"]
		Hot Surface/Material-Related	["burn", "oxygen", "cooling", "right and left", "aluminum", "injection", "on his/her foot", "while cutting", "of the hose", "left palm"]
		Molten Metal-Related	["splashed", "to the furnace", "furnace", "of the furnace", "in the foundry", "occurred, casting", "charge", "spilled", "casting", "in the production area"]
		Material-Related	["ear", "neck", "burn", "while cutting", "from the machine", "oxygen", "the back side", "was injured by impact", "flying off", "occurrence of a cut"]
	Slip, Fall, and Collision-Related Errors	Material-Related	["onto the left foot", "falling onto the foot", "left foot", "on the foot", "to the left ankle", "striking the foot", "the foot", "to the right ankle", "of the ankle", "in the ankle"]
		Collision-Related	["rope", "trauma", "soft tissue", "to the index finger", "finger of the hand", "falling onto the left hand", "on the finger of the hand", "while breaking", "cut on his/her finger", "to the little finger of the hand"]
	Material Handling Vehicle-Related Errors	Pallet Truck-Related	["foot slipping", "motor", "onto the left foot", "sprained his/her foot", "falling onto the foot", "while descending, his/her foot", "on the foot", "fell onto his/her foot", "of the ankle", "foot slipped"]
	Cutting Tool-Related Errors	Sheet Metal-Related	["sheet metal", "cut his/her finger", "material", "occurrence of a cut", "cutting his/her finger", "was cut", "stitches", "while working on the machine", "occurrence of an incision", "his/her little finger"]
		Equipment-Related	["while grinding", "motor", "angle grinder", "occurrence of an incision", "while cutting", "cutting his/her finger", "coming off, left", "cut on his/her finger", "occurrence of a cut", "slipped from his/her hand"]
		Glass-Related	["was cut", "waste", "cut his/her finger", "press", "in the machine", "by breaking", "while making the adjustment", "occurrence of a cut", "broken", "dropped"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 25	Exposure-Related Errors	Foreign Body-Related	["gözüne çapak", "sol gözüne", "sağ gözüne", "çapak kaçması", "taşlama yaparken", "kaçtı", "yabancı cisim", "spiral", "sol göze", "sağ göze"]
		Gas-Related	["burn", "injection", "gas", "cylinder", "explosion", "furnace", "chemical", "of the factory", "oil", "spilled"]
	Entrapment/Crushing-Related Errors	Entrapment-Related	["to the accident", "in the production department", "entrapment of the finger", "with injury", "striking his/her finger", "in the machine", "striking his/her hand", "falling occurred", "while working in the department", "right ring finger"]
	Slip, Fall, and Collision-Related Errors	Material-Related	["falling onto his/her foot", "onto the right foot", "of the left foot", "on his/her foot", "piece falling", "falling of the foot", "the foot", "fell onto his/her foot", "to the ankle", "onto his/her foot"]
		Collision-Related	["of the head", "striking his/her head", "struck his/her head", "head", "in the room", "in the paint shop department", "was injured by impact", "trauma", "trauma occurred", "striking the material"]
		Fall-Related	["from height", "building", "construction", "construction site", "of the panel", "m", "to the line", "while performing the task", "concrete", "breaking"]
	Cutting Tool-Related Errors	Sheet Metal-Related	["sheet metal", "to the press machine", "while working in the department", "working in the department", "in the press machine", "while performing cutting", "impact causing a cut", "cut his/her finger", "impact causing an incision", "from the machine"]
		Metal Part-Related	["metal part", "of the metal part", "the metal part", "metal material", "existing metal", "of the part, left", "between parts", "causing a cut", "right-hand finger", "left-hand finger"]
		Knife-Related	["cut his/her finger", "incision on his/her finger", "cut his/her hand", "cut his/her index finger", "an incision occurred on his/her finger", "cut his/her finger", "incision on the index finger", "to cut", "cutting of the finger", "while cutting material"]
		Angle Grinder-Related	["angle grinder", "while grinding", "motor", "while performing cutting", "burr entering the eye", "the machine", "while cutting material", "the broken-off part", "leg", "cutting operation"]
Sector 26	Entrapment/Crushing-Related Errors	Entrapment-Related	["finger", "finger", "of the finger", "in the machine", "entrapment", "of the machine", "his/her index finger", "index finger", "to his/her finger", "right index finger"]
	Exposure-Related Errors	Foreign Body-Related	["to the eye", "burr into the eye", "to the left eye", "in the eye", "imprudence/carelessness", "entry", "foreign object into the eye", "foreign body into the eye", "foreign body", "of the glass"]
		Hot Surface/Material-Related	["burn occurred", "heat", "imprudence/carelessness", "carelessness", "plastic", "imprudence/carelessness, right", "splashing", "carelessness, right", "explosion", "while working"]
		Chemical-Related	["chemical", "of the materials", "burning", "in the incident", "cleaning", "factory", "process", "in the workshop", "in the production department", "wrong"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 26	Slip, Fall, and Collision-Related Errors	Slip and Fall-Related	["foot", "of his/her foot", "in the ankle", "experienced through contact", "external physical contact", "physical contact occurred", "falling, right", "experienced with sprain", "left foot", "during the incident, his/her foot"]
		Collision-Related	["experienced with an incision", "impact to the right hand", "incision occurring on the finger", "finger of the hand", "of the finger of the hand", "on the right-hand finger", "physical contact occurred", "external physical contact", "physical contact", "experienced through contact"]
		Material-Related	["iron material", "dropping onto his/her foot", "material fall", "superficial carelessness", "superficial injury as a result of falling", "superficial carelessness as a result", "as a result of material fall", "superficial strain due to carelessness", "as a result of dropping material", "due to superficial carelessness"]
	Cutting Tool-Related Errors	Utility Knife-Related	["knife", "utility knife", "of the knife", "cut his/her hand", "plastic", "cut his/her finger", "while cleaning", "our employee", "cutting", "cut on his/her finger"]
		Sheet Metal-Related	["digital factory", "experienced, digital", "experienced, digital factory", "digital factory high-end", "factory high-end", "factory high", "high-end metal", "factory", "experienced with an incision", "factory metal"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "named forklift", "the injured worker", "Still", "operator", "of the forklift operator", "numbered Still brand", "maneuver", "no."]]
		Pallet Truck-Related	["pallet truck", "battery-powered", "battery-powered pallet truck", "physical contact", "physical contact occurred", "experienced through contact", "numbered battery-powered", "material cart", "of the cart", "experienced, shipment"]
	Exposure-Related Errors	Foreign Body-Related	["to the left eye", "to the right eye", "entry", "eye", "striking the eye", "struck the eye", "burning", "right eye", "left eye", "paint"]
		Hot Surface/Material-Related	["burning", "gas", "explosion", "paint", "oil", "plastic injection", "heater", "cleaning", "of the machine", "aluminum"]
	Entrapment/Crushing-Related Errors	Entrapment-Related	["of the machine", "right ring finger", "ring finger", "while working on the machine", "his/her ring finger", "index finger", "the finger", "while working on the machine", "of the index finger", "his/her index finger"]
Sector 27	Cutting Tool-Related Errors	Utility Knife-Related	["cut his/her finger", "cutting", "his/her thumb", "slipping onto the left hand", "thumb of the hand", "cutting his/her finger", "cut his/her hand", "his/her index finger", "a cut occurred", "while cleaning"]
		Sheet Metal-Related	["sheet metal", "a cut occurred", "with an incision occurring", "of the sheet metal", "minor cut", "experienced with an incision", "in the workplace infirmary", "mechanical manufacturing", "striking the left", "cutting"]
		Steel Rope-Related	["steel", "to the piece", "in the workplace", "ring", "in the workshop", "index finger of the hand", "to the thumb", "ring finger of the hand", "right index finger", "the item cut"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 27	Cutting Tool-Related Errors	Angle Grinder-Related	["grinding", "angle grinder", "motor", "a cut occurred", "explosion", "cutting", "index finger", "of the machine", "control", "left index"]
		Saw-Related	["aluminum", "cutting", "with a hammer", "left index finger", "index finger", "box", "existing metal", "to the index finger", "of the index finger", "of the index finger of the hand"]
		Screwdriver-Related	["screwdriver", "while tightening", "in the workplace infirmary", "slipping onto the left hand", "into the palm of the hand", "left index", "slipped from his/her hand", "injured", "slipped, left", "worker"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "maneuver", "physical contact occurred", "external physical contact", "physical contact", "external physical", "of the left foot", "of the right foot", "experienced with crushing"]
	Electrical-Related Errors	Electrical-Related	["energy", "test", "cable", "connection", "quality", "transformer", "electrical", "while connecting", "fuse", "faulty"]
Sector 28	Exposure-Related Errors	Foreign Body-Related	["burr into the eye", "burr entering the eye", "to the left eye", "burr entered the eye", "while performing, into the eye", "in the eye", "burr into the eye while performing", "burr into the right eye", "burr into the eye while grinding", "the eye"]
		Hot Surface/Material-Related	["burn occurred", "fire", "oxygen", "burning", "burns", "burning", "hot water", "occurrence of a burn", "burning", "explosion"]
		Chemical-Related	["washing", "cleaning", "solvent", "dishwashing", "while washing", "in the kitchen", "cleaning agent", "liquid", "of the machine", "of the bottle"]
	Slip, Fall, and Collision-Related Errors	Material-Related	["of his/her foot", "to his/her foot", "slipping of the foot", "falling onto his/her foot", "the ankle", "the foot", "sprained his/her foot", "onto the right foot", "on his/her foot", "onto the left foot"]
	Entrapment/Crushing-Related Errors	Entrapment-Related	["to his/her finger", "trapping", "of the finger", "metal", "of the material", "accident", "machine", "falling occurred", "carelessness", "of the injured worker"]
		Crushing-Related	["of the material", "hammer to his/her hand", "the material", "striking his/her hand", "to the material", "material fall", "falling onto the foot", "struck his/her hand", "falling onto his/her hand", "material to his/her hand"]
	Cutting Tool-Related Errors	Sheet Metal-Related	["sheet metal", "of the sheet metal", "sheet metals", "metal sheet", "of the sheet metals", "sheet metal material", "cutting", "iron sheet", "sheet metal cutting", "of the finger"]
		Angle Grinder-Related	["angle grinder disc", "of the angle grinder disc", "angle grinder machine", "angle grinding", "while using the angle grinder", "angle grinder", "of the angle grinder", "the angle grinder disc", "of the angle grinder machine", "while cutting with the angle grinder"]
		Pneumatic Gun-Related	["gun", "air gun", "of the gun", "of the gun", "pneumatic gun", "with the gun", "nail gun", "with the air gun", "the gun", "the air gun"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 28	Material Handling Vehicle-Related Errors	Forklift-Related	["forklift", "of the forklift", "with the forklift", "forklift operator", "forklift material", "from the forklift", "maneuver", "manlift", "left foot", "wheel"]
		Transport Cart-Related	["transport cart", "to the transport cart", "while pulling the cart", "of the transport cart", "between carts", "of the vehicle", "hand cart", "while carrying", "material handling", "with the cart"]
	Slip, Fall, and Collision-Related Errors	Slip and Fall-Related	["ankle", "of the left foot", "ankle", "of the right foot", "onto the left foot", "to the ankle", "right foot", "fell onto his/her foot", "falling onto the left", "fell to the ground"]
		Collision-Related	["cutting his/her finger", "entrapment of the hand", "trapping his/her hand", "while working on the machine", "while performing, left hand", "to the middle finger", "to the right-hand finger", "from his/her finger", "of the little finger", "while working, left hand"]
		Foreign Body-Related	["to the right eye", "splashing", "angle grinder", "went", "bursting", "oil", "while performing the operation", "while cleaning", "while working on the bench", "while performing cleaning"]
Sector 29	Exposure-Related Errors	Hot Surface/Material-Related	["burn", "oil", "bursting", "hydraulic", "cold", "on his/her fingers", "in the palm of the hand", "on the right arm", "from the machine", "of the product"]
		Chemical-Related	["splashing", "performed in the infirmary", "leakage", "strained his/her back", "dismantling operation", "falling onto the left", "while performing the operation", "suspended", "to the ankle", "fell onto his/her foot"]
	Material Handling Vehicle-Related Errors	Forklift-Related	["of the right foot", "of the left foot", "right foot", "ankle", "onto the left foot", "to the ankle", "fell to the ground", "ankle", "causing injury", "operator's right"]
		Utility Knife-Related	["cut his/her hand", "cutting his/her finger", "incision on his/her finger", "of the thumb", "slipping from his/her hand onto the left", "from his/her finger", "of the index finger of the hand", "was cut", "of the middle finger of the hand", "to the left wrist"]
	Cutting Tool-Related Errors	Angle Grinder-Related	["bursting", "the machine", "while performing, left hand", "incision on his/her finger", "cut his/her hand", "left-hand finger", "slipping from his/her hand onto the left", "splashing", "occurrence of an incision", "of the index finger of the hand"]
		Sheet Metal-Related	["in the press machine", "cutting his/her finger", "was cut", "cut his/her hand", "in the palm of the hand", "of the right foot", "slipping from his/her hand onto the left", "from his/her finger", "middle finger of the hand", "operator's right"]
		Machine-Related	["while working on the machine", "finger was trapped", "while working on the machine", "while working, right hand", "of the index finger of the hand", "while working, left hand", "thumb of the hand", "while performing, left hand", "the finger of the hand", "of the thumb"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 30	Slip, Fall, and Collision-Related Errors	Slip and Fall-Related	["ship", "on the ship", "ship", "slipping of the foot", "by falling", "in the engine room", "fall", "left foot", "losing balance", "by losing balance"]
		Collision-Related	["motor", "grinding wheel", "angle grinder", "motor", "while grinding", "machine", "while performing grinding", "grinding operation", "of the machine", "cut on his/her finger"]
		Equipment-Related	["of the finger", "finger", "the finger", "on his/her finger", "finger of the hand", "to the index finger", "index finger", "to the thumb", "his/her index finger", "thumb"]
	Cutting Tool-Related Errors	Utility Knife-Related	["his/her thumb", "on his/her finger", "cut his/her hand", "slipping onto the left", "plastic", "of the finger", "left-hand finger", "finger of the hand", "stitches", "slipping from his/her hand"]
		Sheet Metal-Related	["sheet metal", "steel", "finger", "of the finger", "carelessness", "while performing cutting", "of the material", "of the hand", "while performing assembly", "thumb"]
	Exposure-Related Errors	Hot Surface/Material-Related	["burn", "hot", "fire", "burning", "chemical", "gas", "explosion", "splashing", "welding operation", "being performed"]
		Foreign Body-Related	["burr into the eye", "on the ship", "burr entered", "to the left eye", "to the right eye", "to my eye", "burr entry", "while performing grinding work", "the eye", "burr into the eye"]
		Welding Arc-Related	["the eye", "eye", "foreign body", "in the production area", "while the operation was being performed", "to the right eye", "left eye", "to the left eye", "right eye", "burr entering the eye"]
	Entrapment/Crushing-Related Errors	Entrapment-Related	["pipe assembly", "pump", "tank", "while performing assembly", "hydraulic", "in the engine room", "being trapped between", "was trapped between", "finger of the hand", "while performing the operation"]
	Sector 31	Slip, Fall, and Collision-Related Errors	Material-Related
Collision-Related			["to the saw", "while cutting a piece", "in the workshop", "while performing cutting", "machine", "in the machine", "slipping of the piece", "processing", "while working on the machine", "while cutting material"]
Cutting Tool-Related Errors		Equipment-Related	["cut his/her finger", "slipping onto the left hand", "his/her index finger", "cut on his/her finger", "the item cut", "cutting his/her finger", "his/her thumb", "cleaning", "while working on the machine", "while cutting a piece"]
		Saw-Related	["in the machine", "while working on the machine", "while working on the machine", "machine", "electricity", "while cutting a piece", "of the index finger", "the machine", "the machine", "the machine"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 31	Cutting Tool-Related Errors	Drill-Related	["from his/her finger", "the wrist", "injuring", "middle finger", "of the middle finger", "carelessness, left hand", "his/her middle finger", "to the thumb of the hand", "to the middle finger", "of the middle finger of the hand"]
	Exposure-Related Errors	Chemical-Related	["to the eye", "paint", "grinding", "protective", "to the face", "went", "angle grinder", "while cleaning", "cleaning", "to clean"]
		Hot Surface/Material-Related	["hot", "sawdust", "outside", "bursting", "electricity", "splashing", "came out", "of the factory", "paint", "vehicle"]
	Material Handling Vehicle-Related Errors	Material Handling Vehicle-Related	["to the cart", "of the cart", "of the vehicle", "right foot", "conveyor", "his/her foot", "right foot", "of the right foot", "to his/her foot", "of the left foot"]
	Entrapment/Crushing-Related Errors	Entrapment-Related	["momentary distraction", "while working on the machine", "to the saw", "while working on the machine", "his/her index finger", "his/her index finger", "of the fingers", "cutting of the finger", "of the index finger", "while cutting"]
Sector 32	Entrapment/Crushing-Related Errors	Entrapment-Related	["of the finger", "to the machine", "finger", "in the machine", "to his/her finger", "to his/her foot", "in the machine", "on his/her finger", "of the machine", "the finger"]
	Cutting Tool-Related Errors	Utility Knife-Related	["knife", "blade/knife", "utility knife", "of the product", "of the knife", "plastic", "cut his/her hand", "coming out of the machine", "cutting", "while removing burrs"]
		Machine-Related	["the fabric", "to my finger", "was applied", "stitches were applied", "I went", "on my finger", "struck", "stitches", "I struck", "while working on the machine"]
	Exposure-Related Errors	Foreign Body-Related	["to the eye", "to the right eye", "to the left eye", "burr into the eye", "in the eye", "goggles", "while working at the assembly station", "adhesive", "burr entry", "metal"]
		Hot Liquid-Related	["fire", "chemical", "hot water", "plastic", "burn occurred", "explosion", "while washing", "electricity", "waste", "glass/cup"]
		Chemical-Related	["continued working", "to the left eye", "while performing assembly", "felt well", "continued working because he/she felt well", "continued working because he/she felt well", "while working at the station", "while working at the assembly station", "continued working after application", "continued working after application"]
	Slip, Fall, and Collision-Related Errors	Slip and Fall-Related	["stairs", "while descending the stairs", "of the stairs/ladder", "while descending, his/her foot", "fall", "slipping of the foot", "while descending, his/her foot", "by falling", "foot slipping", "while descending"]

Table A1. Cont.

Sector	Main Topic Classification	Sub-Topic Classification	Keywords
Sector 33	Exposure-Related Errors	Foreign Body-Related	["burr into the eye", "burr entered", "burr entering the eye", "burr entered the eye", "in the eye", "to the left eye", "while performing, into the eye", "burr into the eye while performing", "the eye", "entered"]
		Chemical-Related	["paint", "thinner", "splashing", "to the eye", "of the gun", "chemical", "while cleaning", "pump", "accidentally", "technician"]
	Slip, Fall, and Collision-Related Errors	Material-Related	["falling onto his/her foot", "piece falling", "steel", "onto the left foot", "falling onto the left", "falling of the piece", "onto the right foot", "crack", "piece, left", "the item cut"]
		Slip and Fall-Related	["stairs", "of the stairs/ladder", "while descending the stairs", "from the stairs", "while descending, his/her foot", "slipping of the foot", "slipping while descending", "fell to the ground", "while descending", "while ascending, his/her foot"]
	Cutting Tool-Related Errors	Grinding Wheel-Related	["motor", "grinding wheel", "of the grinding wheel", "with the grinding wheel", "while grinding", "the grinding wheel", "of the motor", "grinding wheel cutting", "motor", "loss of control"]
		Utility Knife-Related	["plastic", "cut his/her finger", "to cut", "a cut occurred", "his/her index finger", "thumb", "cutting of his/her finger", "cut his/her hand", "stitches", "cutting his/her finger"]
		Angle Grinder-Related	["angle grinder disc", "machine", "occurrence of a cut", "bursting onto the left", "of the machine", "on his/her leg", "cut on his/her finger", "while grinding", "while the machine was operating", "while cutting a piece"]
		Screwdriver-Related	["screwdriver", "of the screwdriver", "while tightening", "battery-powered", "puncturing", "bumper", "injured", "slipping onto the left hand", "of the vehicle", "causing injury"]

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