Integration Technique of Event Progress in Order to Visually Confirm the Connection Between Cases of Accident

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Abstract

Preventive measures to prevent the recurrence of the accident, institution, culture, etc. The product is made on the basis of factors that are able to analyze the accident, trends, lessons learned, it is possible to extract the knowledge that leads to the prevention of accidents is a useful. Analysis decipher deeply accidents by experts is mainly for processing power and memory ability of human is difficult, the analysis of the accident the current analysis of the factors that spans between cases, most analysis of cross-sectional case has not been made.

In this paper, we propose a visualization system for the development of accident to visually represent the relationship between accidents. In the description of the accident, it is a system that extracts the progress represented by the unit of principal and predicate, to integrate the flow of the accident by the consolidation of progress. To extract such damage case is large, and progress noteworthy example, and cause and progress should cut off of frequently lead to injury or danger from cases that have been accumulated by linking progress the same, the number of progress is small help me.

In this paper, we will report it to develop a format for recording the progress of events, performance evaluation can be applied to case studies accident RISCAD, progress was confirmed to be able to extract.

1. Introduction

Occurrences of accident and disaster cause the damage significantly to economical effect and human beings and environment because of using hazardous material in the industrial plant such as chemical and nuclear plant. Implementation of measures for disaster prevention and security level improvement is strongly desired.

Fire White Paper "Recent Trends and Current Status on the industrial complex disaster"(Fire and Disaster Management Agency, 2009) was published by Fire and Disaster Management Agency explains that the number of accidents had increased in recent years, but have been decreasing in 2008 and 2009 after peaking in 2007, but the number of accidents was increasing every year after 2008.

The direct cause of the accident occurrence in fiscal 2009 is that the number of human factors on management or manipulation plane surface is 84 (47.5% of the incidence of the total) and the number of physical factors on facility degradation and failure of equipment is 87 (49.2%). The physical factors and human factors account for most of the total in that. It is necessary to prevent accident occurrences because of trend increasing accidents (High-Pressure Gas Safety chamber of Commerce security distribution group of Ministry of Economy and Trade and Industry, 2012) for other industry too. However, there is a problem how to analyze the factors behind the accident is insufficient.

The National Institute of Advanced Industrial Science and Technology enforced the requirements questionnaire about RISCAD (Yuji Wada, 2003) which was constructed by it (AIST, 2008). The questionnaire gets answers from 46(24.2%) of 190 chemical companies. 28 (61%) offices answered question 1 as to have made database individually. 21 (79%) of them has the search function by accident type (fire, explosion, leakage, etc.), and 11 (39%) DB has the search function by process and facilities, and 10 (36%) DB has the search function by material name. The database was found to have remained in the 2-3% degree to have analyzed detail such as understanding cause including the organizational factors by time series.

DB is not utilized enough because the effective usage technique is not to be established. The conventional analysis method is good for reader to understand an accident case in details because the analysis is the technique to decipher deeply. But the analysis between cases has been done only statistical analysis according to the category because analyzing the trends and connection between cases is difficult (Japan Petroleum Energy Center).

However, there is enough room to improve the total technique from collection to analysis of accident cases to realize to permit problem search by logging history of accidents and near-miss accidents. So as we propose an integrated event progress expression method for accident so that it can consolidate the progress of different accidents and express comprehensively.

This progress expression technique has below advantages in addition to as much as possible for the conventional method which enables visualization and sharing of information.

1) Frequency analysis of progress

There are measures to safeguard the progress leading high frequently to the accidents and the near-miss accidents as a way to prevent accidents. That is based on an idea to prevent the accident by blocking the connection of progress because of the accident is lead from series of event progress. However there was no means to calculate statistically progress path whether or not to shut off in the conventional accident analysis. Our technique integrating event progress can remove factors of progress causes the accident statistically by integrating progress of events and analyzing frequency of progress paths. There is an expect to reduce possibility of the accident occurrences by blocking path of progress has more possibility to lead the accident because of for example frequent progress often means that the event progress is occurring frequently. On the other hand, our method is expect to find out the accidents to be prevent because they causes a lot of damage although they are low frequency.

2) Risk prediction by superimposing progress path

Near-miss is an event that did not lead to an accident, it is difficult to say that fully utilized because it is neglected compared to accidents. It is difficult for conventional analysis to determine quantitatively a near-miss leads or not to accident even though it happens high frequent. However if an analyzing near-miss case reveals to have progressed to accident by superimposing the past event progress, we expect that our technique reveals that potential risk has possibility to lead to accidents and makes it easy to implement measures.

Summarize to say that, our method has features to realize trend analysis between many accident cases and to acquire noted case and new knowledge. We aim to realize a tool which can visualize the relationship between cases by integration of the accident cases and which can analyze or learn the factors and trends between cases. This paper explains idea of integration of event progress, and describes the format and the procedure making data to express the integration of event progress, and reports the result of evaluation of method.

2. Progress graph of accident

The progress graph is visualizing accident flow. It has advantage to share by many people and to facilitate the understanding of the accident flow.

The understanding of the accident flow is expected to lead improvement of early response capacity at the time of occurrence abnormality, and to lead to the damage mitigation and accidents prevention. And therefore the progress graph is public at the same time as the accident report to help reader understand the accident flow.

Moreover, it also used in the risk predicting training to respond to the accident recurrence (Naohumi Nakamura, 2011).

3. Expression of accident progress

In conventional expression of accident progress, phenomenon and things are defined as event, accident occurrence is defined as final event. And what one event causes another event is defined as progress. Many methods expressing the accident progress expresses accident flow by connections of progress. Fig. 1 shows an image of expression of accident progress.

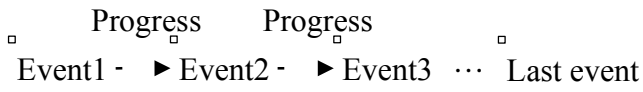

Fig. 1 Relationship between event and progress

4. Presentation of progress

Conventional method displays progress of an accident case as series of events for integrating event progress. This method separates an event to a subject and a predicate and expresses an event using the subject and the predicate. The method expresses progress of events as integrated series events. Subject means subject or object of an event and predicate means action or behavior of the subject. The Integration progress is realized by integrating same the keyword as the smallest unit linguistic words which means the subject or the predicate. Fig. 2 shows mono progress of our method. Fig2 shows an example to show a single progress in this method.

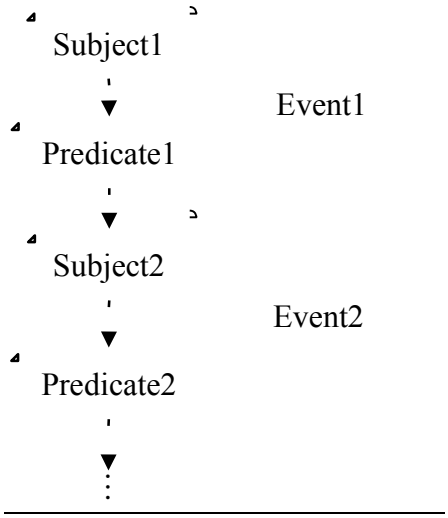

Fig. 2 Our progress displaying method

Progress integration is to integrate subject or predicate in an event with same keyword. The example of progress integration shows Fig. 3. Fig. 3 shows to integrate progress where both predicate1 and predicate2 affects Subject3.

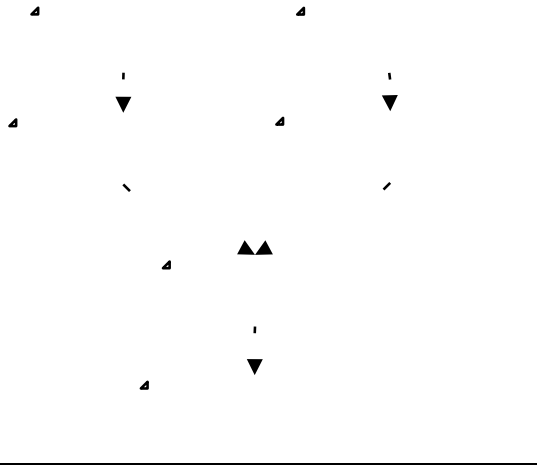

Fig. 3 Example of integrated progress

Branch of progress is one subject and predicate in an event is separated to other subjects or predicates. Example of branch shows Fig. 4. Fig. 4 shows the result of frequency of the branch from predicate1 to subject2 is a%, the result of the branch from predicate1 to subject3 is b%.

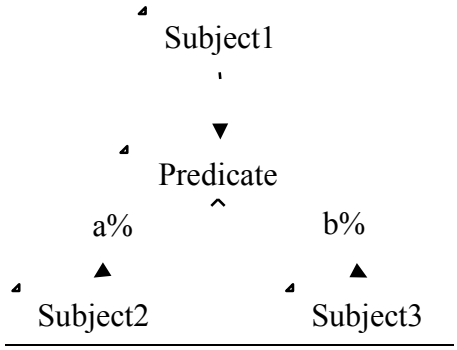

Fig. 4 Example of branched progress

5. DB Schema

5.1 Design Policy

Our data stored format is required to be designed which can store as much information as possible about the accident in order to take advantage of business sites accidents database using this method. To apply stored data as DB is desired to store as much as possible the information of the accident in order to utilize as DB for reader. PFA method which is used in RISCAD also procedures to stores as much as possible the information that can extracted from the information source as accident report. PFA method which is used in RISCAD also takes procedure to amass as much as possible the information that can extract from the information source as accident report. So economical load such as times and costs are desired to be low for making DB.

We propose a DB schema that can store structure of the integrated progress according to above assignments.

5.2 Data groups to integrate progress

To realize our system requires deciding data items using drawing integrated progress graph. There is a difficult problem on extracting data items to make uniform formats because of the formats are different on each accident reports DB. Burdens for operator to input data into format becomes large against policy defined in 5.1 because of complexity to make uniform format is able to apply to DB has different format. Thus we first tried to extract common items which is items exists in different DB commonly and make integrated progress format base on the common items. But it was difficult to define common items definitely because of the difference of format of each accident report DB. To solve the problem, we defined requisite item as items required to draw the integrated graph among items may be exists in different DB. We defined arbitrary item as items except requisite item. The arbitrary item is items which can be added arbitrary because of items reside in different formats of DB are different.

It is possible to apply this integrated approach to draw graph if fill data in requisite item by definition of requisite item and arbitrary item. And the arbitrary item completes lack of integrated progress graph using requisite item data.

Fig. 5 is example shows relationship between the requisite item and the arbitrary item using 3 different formats of accident reports.

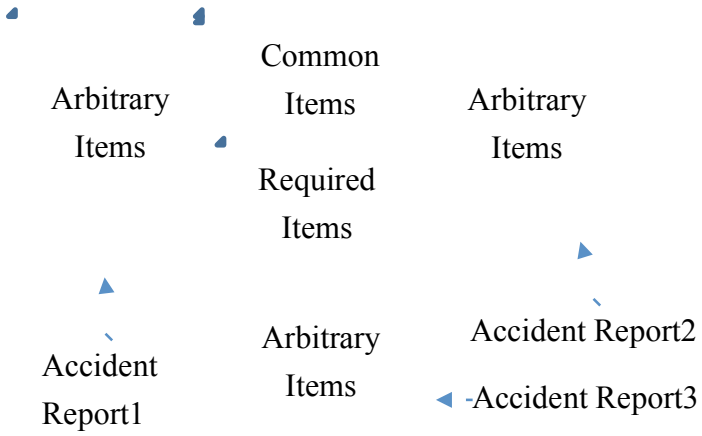

Fig. 5 Image of relationship of items

A) Necessary Item

Necessary items are category has items to make integrated progress event graph. This category has case ID, event ID, progressed event ID, and subject, predicate. Explanation of these items is below.

i.Case ID

This CaseID is id means to identify case uniquely.

ii.Event ID

This EventID is id means to identify event uniquely.

iii.Progress destination ID

The progress destination ID is an id means next d progress event.

iv. Subject

It is keyword means subjective or objective word of such as people, material, equipment and device etc. in the progress event.

v. Predicate

It is keyword means action or predicate of the subject.

B) Arbitrary item

This arbitrary item is item to record descriptions which complements necessary items for people can understand easily in detail.

This arbitrary item had better to make complement items, for example, time and location, reason, behind factor, complement of subjective and predicate etc. The complement of subject and predicate is items to describe as free description for complement because it is difficult for worker to understand subject and predicate of necessary items are keyword to inform necessary of them.

6. Progress sheet

Progress sheet is a sheet to describe extracted items which are defined in chapter 5 to make accident case DB. Our system make integrated progress graph based on the progress sheet. There are columns to describe appropriate extracted items and rows to describe individual progress event in the progress sheet.

7. Procedure to make event progress sheet

Following description is procedure of our method to make event progress sheet.

Step 1 Preparation of analyzing accident cases

There prepares accident reports for analyzing.

Step 2 Decision of arbitrary items

Deciding arbitrary items by referencing B) of 5.2.

Step 3 Confirmation of progress

Unit of progress is a clause which contains one subject and predicate. Extracting individual events back from final event of the accident reports. Marking and confirming individual event contains one predicate and subject.

Characteristic of Japanese language may drop subject. To find principals from the previous description of relevant location Principals for the predicate based on the context of the Japanese at that time.

Step 4 Describing of required items

This step extracts require items by following below at Step 4-1~Step 4-3.

Step 4-1 Describing of capital and predicate

This step describes the subjective and the predicate in individual events which were confirmed on Step 3 to progress sheet in order of events forward from the final event.

The way of extracting capital and predicate is extracting only words which have central means. Confirmation of that extracted words were list up in keyword table. If exact matched keywords are existed, the matched keywords must be applied to subjective and predicate. If similar extracted words are existed, these words integrated into keywords. If there are no matched words, new keyword is registered to keyword list.

Step 4-2 Describing Event ID

This step describes Event ID into a record with the subjective and the predicate which were extracted in Step 4-1.

Step 4-3 Describing progress destination ID

This step describes progress destination ID based on events before Step 4-2 to progress sheet.

If there are record which progress destination ID is blank and has correspond record described, the progress destination ID column is input id correspond Event ID. Progress destination ID of final event should be blank because final event has no next event to progress. If parallel progress is, their progress destination ID should be same progress destination ID.

Step 5 Input arbitrary items

This step extracts and inputs arbitrary items.

If there are descriptions which correspond with the arbitrary items decided in Step 2, the descriptions are extracted and input to progress sheet.

Step 6 Determination of the end of analysis

If there is no event to extract, this analysis finished. On the other hand, if there remains event to be extracted, analysis goes back to Step4.

8. Evaluation experiment

8.1 Evaluation method

This paper described that our method requires accuracy and ease and completeness to utilize as accident case database. This evaluation evaluated about completeness and accuracy. On the other hand easiness is difficult to evaluate because it depends on the subjective. Subjective evaluation of author felt it has easiness for worker to analyze.

8.2 Evaluation reports

Evaluation experiment was applied to accident reports which were selected from RISCAD.

8.3 Comparison of completeness

To evaluate whether coverage of relationship between accident cases which made by experts is complete or not. This evaluation compared with the number of nouns and verbs on requisite word and arbitrary word after extracting nouns and verbs of description of analyzing accident cases. The reason evaluated by words of noun and verb is that they are the words of part of speech necessary to explain events and

progresses.

8.3.1 Evaluation procedure

This section shows the result of comparison with nouns and verbs which were applied morphological analyzer MeCab (Taku Kudo, 2004) to before and after writing of 5 reports of RISCAD.

Table 1 Extraction rate of RISCAD

Report No	Based writing		Extracted writing		Extraction rate [%]	
-	Noun	Verb	Noun	Verb	Noun	Verb
7364	92	9	66	1	71.8	11.1
7666	195	25	117	18	60	72
7720	104	12	62	8	59.6	66.7
7721	47	2	24	0	51.1	0
7722	95	16	41	8	43.2	50
Total	533	64	310	35	57.2	39.6

8.3.2 **Discussion**

Result of accuracy evaluation was confirmed to be extracted with keep relationship of progress by visually. Completeness of word of the major part of speech by applying our method to 5 reports in RISCAD was 57.2% in noun and 39.6% in verb and total was 57.8% which were calculated from extracted words where there were 310 nouns and 35 verbs from base reports and 533 nouns and 64 verbs after analysis.

Content of the verb and noun is different from before and after the analysis is the reason why words indicating the flow were omitted and elaboration of the description when word extraction.

9. **Conclusion**

This paper reported our proposal of integrated progress method to analysis between accidents. In this paper, we proposed out method to extract data for integration of accident progress. Evaluation experiment reveals that there is no problem in reality and ease, accuracy in evaluating result of applied to 5 cases on RISCAD.

Our method is required to systemize because the result is difficult to display of integrated event progress inevitably is too wider than conventional method. Thus we developed prototype system integrated event progress. Our system was confirmed to

be realized as of Fig. 6 showed a part of our system.

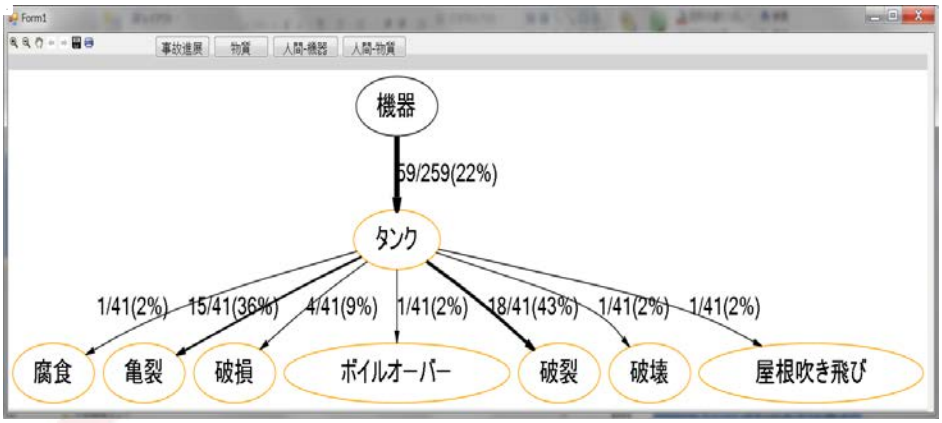

Fig. 6 Output of integrated event progress

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