

SAFETY RESEARCH AT THREE FINNISH EXPLOSIVES FACTORIES

JORMA KARHULAHTI

Defence Forces Research Centre
P.O. Box 5
FIN-34111 Lakiala
Finland

ABSTRACT

The target of this research was to solve if the company has a possibility and realistic qualifications for the safety inspection of the own operation. The other target was to look out how the authorities take an attitude to the internal control. In this research models for the system of the internal control and for the estimate of the developed safety level have been developed.

This research, which has been done in three Finnish explosives factories, express that the companies have a possibility and qualifications for developing and making of the own safety work. In principle experience show the internal control system is a good method to develop safety level. On the other hand the authorities know usually the target of the inspection only on their own line of business. This is one reason that the authorities couldn't be willing to give more responsibility for inspection of own operation.

INTRODUCTION

We have many different regulations and orders that prescribe the work and the environment. At the same time the work and the processes of the industry have become more complicated. This development means that the authorities should have good knowledge of all the work that they have to inspect. The other problem is that the authorities don't have so much time to inspect all those work places as often than they want and should do. All this means that we have to find a new system that can give companies and authorities a better chance to guarantee the safety level in work.

In this research I have used the idea of the internal control system (Hovden and Tinmannesvik 1989), which means that the company itself works at getting a better safety level. It means also that when they have got the desired target they keep it.

In this research I have wanted to develop the method that could be a tool to get a better safety level and another tool that is useful to control how the company works to develop the work environment and all that the work system includes.

METHODS AND MATERIALS

The background for this study is based on the idea that the work can be split into the technical safety elements and the organizational safety elements. The argument for this idea is that we can find the following parts in the working system: human, organization, material, the machine and environment. All these parts include the potential possibility to be a reason for accidents (Reason 1990, Weaver 1980, Leplat 1978, Sheridan and Ferrell 1974). Still we must remember that local culture has its own influence on working methods and that it is one safety matter that we cannot control. The other one is the way people work, think and act with risk, which influence the safety level (Klen and Väyrynen 1984).

Report Documentation Page

*Form Approved
OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE AUG 1994	2. REPORT TYPE	3. DATES COVERED 00-00-1994 to 00-00-1994			
4. TITLE AND SUBTITLE Safety Research at Three Finnish Explosives Factories		5a. CONTRACT NUMBER			
		5b. GRANT NUMBER			
		5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S)		5d. PROJECT NUMBER			
		5e. TASK NUMBER			
		5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Defence Forces Research Centre,P.O. Box 5,FIN-34111 Lakiala,Finland,		8. PERFORMING ORGANIZATION REPORT NUMBER			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)			
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)			
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM000767. Proceedings of the Twenty-Sixth DoD Explosives Safety Seminar Held in Miami, FL on 16-18 August 1994.					
14. ABSTRACT see report					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	Same as Report (SAR)	12	

To control the safety level we have to find the defects. We also have to estimate the influence of defects and after that act on decreasing those effects that are against safety work and the safety work environment. Those changes influence the safety elements. Both of those safety elements have common parts and that is why we cannot separate these things from each other. These common results give us a new safety level (fig.1).

The second model was developed to control this internal control system. By using a safety analysis we can get an appraisal of the technical safety elements. To estimate the organizational safety elements we can use interviews and a questionnaire. When we connect both results, we get a new appraisal of the safety level. We have to remember both cultural and behavior at acts (fig.2).

Fig.1. The action model for the internal control system.

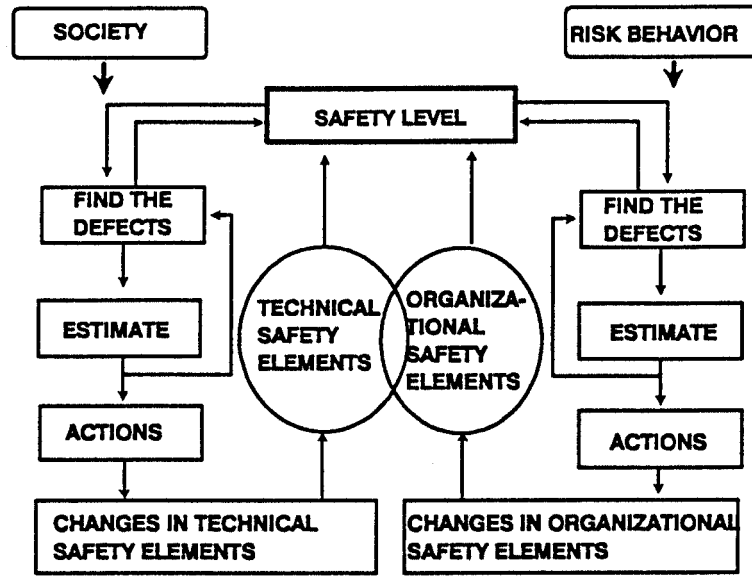


Fig.1. The action model for the internal control system.

Fig 2. The action model to control the internal control system.

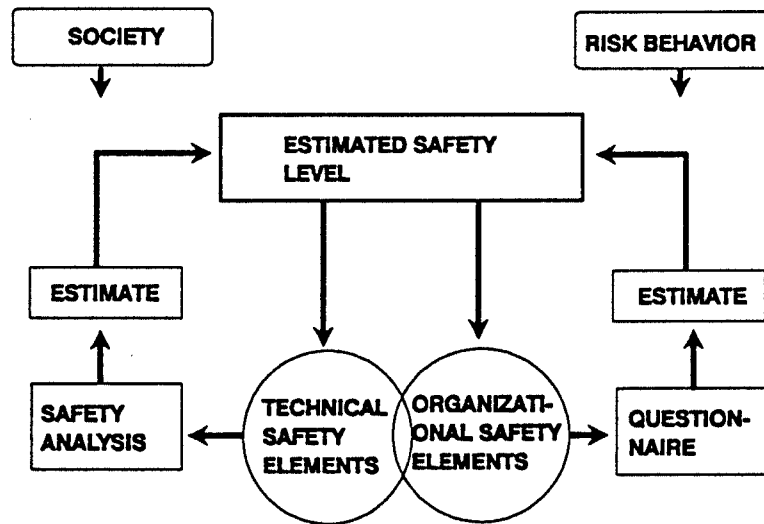


Fig 2. The action model to control the internal control system.

The research in the companies

At first we have to solve the organizational safety level because it is necessary to know how the company is in operation. I have solved this problem by first interviewing and after six and 12 months by completing the questionnaire with a group of people from three different personnel groups; upper and middle leadership and workers (Appendix 1).

The principle of this study was to allow the manager, after the results of the interview, to develop the safety level of the company by using his own methods.

In this research there were three different companies that make different explosive materials. The personnel groups in every company included 2-4 persons. It means that there was no possibility to use any special statistical methods to look at the results. That is why I have only taken the mathematical average.

This study used also two different methods of safety analysis. The first one was the hazard and operability study (HAZOP) and the other was the action error analysis (AEA).

The authorities in this research

The other part of this research was to see out how the authorities took to the idea of the internal control system. In this I have used two different methods. The first one was the interview (Appendix 2) and the second was to look at the inspection reports that they have made on those companies.

The interview was carried out with the administrative authorities and with the authorities that make practical inspections.

The reliability

The reliability of the research of the interview and the questionnaire came from direct and indirect feedback (table 1).

Table 1. The reliability of the research of the interview and the questionnaire.

FEEDBACK	THE DIRECT FEEDBACK	THE INDIRECT FEEDBACK
From the industry	The research of the interview and the questionnaire. The safety analysis in the companies. The information of the manager from the completed measures.	The knowledge from the interview of the authorities. The knowledge from the inspections of authorities.
From the authorities	The interview	The knowledge from the interview and the questionnaire in the companies.

RESULTS

The works of the managers

The managers of the companies have given information about the measures that they have completed (Appendix 3).

In company A they have discussed the report with the group that were in the research. They will give more information and training and the manager is also able to develop the personnel politics and make clearer the common policy of the company. They noticed that the safety audit gave more responsibility and accountability in personnel than the quality audit did. It also brought out new ideas and it's a good method to follow how the measures are realised. They saw that the influences of the new methods have a positive effect on the company, on the motivation of the personnel and on the knowledge of the personnel. This has a positive effect on the safety level.

In company B they have discussed only with the upper and middle leadership about the report. They have seen the problem that the highest manager wasn't with in the research. They don't know if this kind research should be done and who would have the responsibility to carry it out.

They believe that the safety system could have a positive influence like the quality control system has when it belongs to the system and is not a separated part out of the organization.

In company C the report has been given also to others outside the research group. They have completed the following:

- they have developed the new quality politics
- they have developed the internal safety inspections
- they have developed, their own action idea for all plants
- responsibility and accountability have been specified
- they have developed the internal quality control
- more open information
- they have researched the atmosphere of the quality control system
- they have a consultant who researches the tidiness and order program.

In this company they have had their own on going programs to develop the quality control system, but all those changes are in harmony with this research. When the quality control system is in function it makes at the same time a better safety level.

The safety analyses

Each company showed the scope where the safety analysis should be done. In company B there were two different work systems.

Every company has given the report from the actions that they have taken after the report of safety analysis.

Interviews and questionnaires in the companies

The results of the interviews showed that in the companies the knowledge is not always at the same level in the upper leadership, middle leadership and the worker levels. In this research

there was no total ignorance to the knowledge. Only in a very few questions were there negative results from one organization level.

In every company and every organization level they believe that they have the possibility and both technical knowledge and organizational qualifications to control their own work and work conditions. Still, in every company they need some kind of outside control and inspection. The reasons are the same as the authorities have when they say that some kind of control is necessary for the companies:

- every company must have the same duty
- the outside inspection/audit can see those things which are realities but we can't find those because they appear every day
- it makes the work more orderly and systematic
- we need roles from society
- they do not fully trust the responsibility and the accountability because there are also other values like economic values
- nothing happens voluntarily.

The questionnaire parts of the research express that the targets of the organization and the operation have become clearer. They have also given more attention to the planning and to the condition of the changes which they have made. They have developed more control orders to the changes in production which give a better safety level. The maintenance system, its activity and the orders have also been developed.

The self inspection has been handled by the company's leaders. The safety targets have been set and they also want to reach them. There is a direct correlation between the level of aims they have made and the way they have tried to find and maintain that level. In all companies there is a positive attitude to improve working conditions. This shows in the way they have actively tried to eliminate problems and possibilities which can create dangerous situations or cause accidents.

In all the companies they experience good relations between the authorities and the company. In the same way they experience that the inspections are useful to the company even if those inspections have more influence if their target could be the internal inspection system.

The companies have the following politics, in table 2.

Table 2. The policies of the companies at the beginning and at the end of this study.

Company	<u>Personnel policy</u>		<u>Quality politycy</u>		<u>Safety policy</u>	
	<u>At the beginning</u>	<u>At the end</u>	<u>At the beginning</u>	<u>At the end</u>	<u>At the beginning</u>	<u>At the end</u>
A	no	yes	yes	yes	no	no
B	no	yes	no	yes	no	no *
C	yes	yes	yes	yes	yes	yes

* On the part of the companies function

The interview of the authorities and the authorities' inspection results

The research has also shown that there are no great differences of opinion between the explosives inspection authorities and the occupational and health authorities. Maybe the latter is more eager to develop its own control system, but this can happen only on behalf of the administrative authorities.

There are also many things that are left undone in the authorities' opinions:

- mental occupational safety and health
- training and work initiation programmes
- the action of the workers and the following of orders
- orders, organization, ingrained habits
- transfer of information
- it's not so exact with the details.

The interview of the authorities showed that their knowledge from the companies is inadequate. They don't know

- what kind of politics the companies have
- what kind of targets the companies have for the environment and how those targets have been achieved
- they believe that the political and the environmental targets of the companies are the same as the authorities have laid.

Table 3 shows the authorities' inspection results from 1989-1991 in those Finnish explosives factories.

Table 3. The authorities' inspection results of the three Finnish explosives factories, 1989-1991.

OBSERVATION	Factory A	Factory B	Factory C
1. The orders in the inspection minutes has been followed (+)/ not followed (-)	+	-	+
2. The company has done its own safety work	x	x	x
3. Minor defects	x	x	-
4. Serious defects	-	-	-
5. They have given time table for action	-	-	-
6. The order to do the work for safety at once	-	-	-
7. They have stopped the work	-	-	-

DISCUSSION

None of the companies put a clear measure to develop the safety level. Still it's possible to see that in every company it has developed its own operations. They have qualifications for doing it right and safely. In the safety development of the company they pay attention to those are as the authorities make inspections.

The safety analysis showed that the personnel in the companies kept the orders and regulations. They have also planned the process so that it is technically minded. If the company has a quality control system, it has a favorable influence on the safety level. It also means that the level of knowledge is dependent on the politics or the area of the companies' politics.

The authorities believe that the explosives industry especially has a good safety level. Their knowledge of the industry and of the explosives industry is inadequate when the knowledge doesn't concern the technical system.

This research has showed that the internal control system is able to clear the changes in the company and their influences. The methods used in the chart of the technical safety elements and the organizational safety elements complete and illustrate the safety level of the company. It is still necessary to control from outside the company. But the inspection of the system is more effective than the traditional inspection of the authorities.

LITERATURE

Hovden, J. and Tinmannsvik, R.K., (1989) Internal control: A strategy for Occupational Safety and Health. Experiences from Norway. Internal Conference on Strategies for Occupational Accident Prevention. Stockholm, Sweden 21-22.9.1989. 9 p.

Klen, T. and Väyrynen, S. (1984) The role of personnel protection in the prevention of accidental injuries in logging work. *Journal of Occupational Accidents*, 6 (1984) 263-275.

Leplat, J. (1978). Accident analysis and work analysis. *Journal of Occupational Accidents*, 1:331-340.

Reason, J., (1990) The contribution of latent human failures to the breakdown of complex systems. *Phil. Trans. R. Soc. Lond. B.* **327**, 475-484.

Sheridan, T.B. and Ferrell, W.R. (1974). *Man-Machine systems: Information, control and decision Models of Human Performance*. The MIT Press Cambridge. 452 p.

Weaver, D.A. (1980) TOR analysis: An entry to safety management systems assessment. *Professional Safety* (9) 34-40.

Appendix 1.

The topics of the interview and of the questionnaire in the companies:

- the organization and its politics
- the premeasures
- the internal inspection system
- changes in the measures
- inspections
- the economic functions
- planning
- purchase and control
- production
- responsibility and training, education
- motivation
- the statistical methods
- occupational safety and health, work environment
- safety orders
- self inspection
- safety level
- authorities and inspection
- authorities and the problems of the company
- the quality control system.

Appendix 2.

The topics of the authorities' interview:

- the inspections and the control
- cooperation with other authorities
- the estimation of the company's functions
- how the authorities use their time (inspection, reports, education etc.)
- responsibility - accountability
- cooperation with the company
- the politics of the company and the work environment
- the quality control system in the company.

Appendix 3.

The questions to the manager after the report of the interview:

1. Have they acted after the results of the interview?
2. Have they made a timetable for the planning and measures?
3. How did the aims come true?
4. What kind of aims for development with the timetable has the company made?
5. How did these aims come true?
6. How did you follow this system?
7. What kind of influence did they have on
 - the procedures of the company?
 - the personnel of the company?
 - the safety level of the company?