Identifying the bottlenecks in learning from incidents

From reporting an incident to verifying the effectiveness of the remedial process

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Keywords: organisational learning, incident, accident, learning process, survey, bottlenecks, continuous improvement

ABSTRACT

Many incidents have occurred because organisations have failed to learn from the lessons of the past. This means that there is ample room for improvement in the way organisations analyse incidents to identify technical, personal or organisational weaknesses and generate measures to remedy these weaknesses and prevent re-occurrence. The process from reporting an incident to verifying the effectiveness of these measures is called the 'learning from incidents process'. In order to become safer, organisations use the outcome of incident analysis to optimise their primary, risk management and/or consequence mitigation process. However, organisational learning should not be limited to these processes alone but should also involve an evaluation of the 'learning from incident process' itself. An organisation with an effective 'learning from incidents process' sustains a process of continuous improvement that allows it to become intrinsically safer. To improve the learning from incidents process it is necessary to gain insight into the steps of this process and to identify potential or actual learning barriers. To analyse where the bottlenecks arise a model of eleven steps in four stages is proposed. This study describes how this model is used in a survey to locate the barriers and applied in three exploratory case studies in a range of industries. The results show that firstly not all organisations have the eleven steps formally organised and secondly that differences exist in what is formally arranged in an organisation and in how these steps work in practice. Whereas steps such as incident reporting and analysis are usually arranged and performed, follow-up steps in the process are often only arranged on paper or performed on a local level. The implications for the effectiveness of the 'learning from incidents' process are discussed.

1. Introduction

Despite all efforts, many organisations have problems in reducing the number of incidents and this can be partly attributed to the failure to learn the lessons from accidents that had occurred (Kletz, 1993; Jones, Kirchsteiger, & Bjerke, 1999; Kjellen, 2000; Kletz, 2001). Even if learning from incidents is not only focussed on prevention of recurrence but also at making an organisation inherently safer, the learning from incidents process should also be target for improvement. Many incidents and accidents have a complex background (Wagenaar & Groeneweg, 1987; Perrow, 1984). Because of this complexity, preventative measures hardly ever consist of a single, straightforward intervention which makes the evaluation of the effect on safety initiatives equally problematic.

The term incident refers to the combined set of occurrences of both accidents and near misses (van der Schaaf, 1992). Both are preceded by the same set of failure causes and only the presence or absence of defences and recovery mechanisms determines the actual outcome (e.g. normal situation, near miss or accident) (van Vuuren, 1998). Incidents are symptoms of the failure causes, the end-result of unwanted deviations from the normal process. Learning should therefore not only be aimed at learning from an incident itself, but also at learning from the outcome of an incident analysis(Carpenter, Hendershot, & Watts, 2004; Carroll, 1998). Identifying the unwanted deviations and learning from them adds to a safer and more reliable process, which also will result in fewer incidents (Reason, 1990; Groeneweg, 1998). To improve the learning from incidents process it is necessary to gain insight into the steps of this process and to locate learning barriers.

A traditional approach to learning from incidents is that when the analysis is performed with care and lessons are formulated this will lead to the prevention of incidents (Blanco, Lewko, & Gillingham, 1994; Lawton & Parker, 2002; van Vuuren, 1998; Kontogiannis, Leopoulos, & Marmaras, 2000). However to effectively learn from incidents some follow-up steps and actions that lead to effective interventions are necessary (Lindberg 2010, Le Coze, 2007) and the learning process itself should be evaluated.

In this paper a model is presented that allows the analysis of steps in the learning from incidents process and to locate bottlenecks in this learning process.

In the first section of this paper we will present a model of the learning from incidents process and in section 3 and 4 we will discuss the methods and findings of a survey and some exploratory cases in which the model was applied. In sections 5 and 6 strengths and limitations will be summarized and some issues for future research directions will be discussed.

2. The learning from incidents process

A model was developed based on expert opinion, an overview of existing systems used by large, mainly petrochemical and petroleum companies and a literature review. The main purpose of the model is to enable the identification of bottlenecks in the learning from incidents process. Firstly, we will introduce the model and its backgrounds.

2.1 Background

We regard learning from incidents as a variation of learning by doing or experiential learning (Kolb, 1984). Kolb describes experiential learning as a cyclical process, consisting of four stages: doing, reflective observation and analysis, conceptualisation and decision making. This cycle is followed-up by a new cycle of hopefully improved doing, etc.

The cyclical nature of 'learning by doing' implies that learning from incidents is different from a educational process, where the curriculum already determines what is to be learned, and how that learning content is disseminated to the target group. In problem-oriented learning, learning is achieved by using existing problems and realising improvements (Kolb, 1984). In this way, incidents can be regarded as interesting warning signals and as opportunities for learning. The learning from incidents process can to some extent be compared with the evaluation of the effectiveness of implementation of recommendations of an audit or a risk-analysis. The outcomes are part of an iterative process: a plan of action is made, the actions are performed, actions are evaluated and based on this evaluation new lessons are formulated. This sequence is also known as the plan-do-check-act cycle by Deming (Deming, 1982)(also attributed by Deming himself to Shewhart, (Shewart, 1939) with roots dating back to the work of Galileo and Bacon on the scientific method in the 17th century). In recent years, Deming changed the C in his cycle to S (Study) (Deming, 1993), because in his view the results should be studied and causes of failures should be investigated rather than checked alone. Similar loop models for experiential learning can also be used to describe and analyse collective learning process, such as organisational learning (Swieringa & Wierdsma, 1992; Zwetsloot & Allegro, 1994).

According to Kolb, learning by experience should lead to adaptation of 'doing', and changes of behaviour. Cognitive progress alone is thereby regarded as incomplete learning, as long as the lessons learned are not leading to changes in actual practice (Kolb, 1984). Models for experiential learning are also suitable for analysing problems resulting from the potential differences between what has been said or written and day-to-day practice (what is actually done). Managers are all too often only learning 'talking and thinking; then they learn according to what Argyris & Schön (1979) call espoused theory. They thereby neglect theory-in-use. In contrast, operators are often sent to training sessions where they learn to do something but the attention paid to improved understanding and knowledge can be minimal (Swieringa et al., 1992; Zwetsloot, 1994).

Another aspect of learning is that learning processes can address different 'levels' of learning ((Piaget, 1969),(Argyris & Schön, 1979; Senge, 1990). A well-know distinction is between single loop learning and double loop learning (Argyris et al., 1979) related to Gregory Bateson's concepts of first and second order learning (Bateson, 1972). In single loop learning the basic characteristics of the situation remain constant, but the existing situation or processes are improved. In double loop learning the values of the theory in use will be evaluated and changed as well (Argyris et al., 1979; Argyris & Schön, 1996). An important kind of double loop learning is the learning through which the members of an organization may discover and modify the learning system. This so called learning to learn (also called Deutero learning by Argyris & Schön) enables an organisation to continuously improve (Senge, 1990).

To analyse how companies with a safety management system are supposed to learn from incidents and where bottlenecks in that learning process occur, a model is developed. This can be used as a framework for analysing the learning from incidents process. A further step, in a follow-up project will be to analyse the bottlenecks, identify their causes and ways to eliminate them, thereby improving the learning form incidents process.

2.2 The 'learning from incidents' model

The learning from incidents process consists of eleven steps, divided into four stages: incident investigation and analysis, planning of interventions, intervening and evaluating. The quality of each step depends on the drivers, methods, resources and output (Baguley, 1994). The output of one step is input for the next step and communication through the stages and steps is necessary. This includes feedback to earlier stages if there is a mismatch between the intended and the actual outcome of that stage.

Each of the four stages leads to a result (gate) that is considered a vital input for the next stage in the learning process. The result is necessary but not sufficient for an effective learning from incidents process. When these results are suboptimal or non-existing, the next stage can still be performed. It is for example possible that management formulates recommendations even in the absence of a proper investigation. How effective these interventions are where steps have been skipped, will be discussed separately.

This model shows that bottlenecks can arise in each stage and at different steps. The stages are described below.

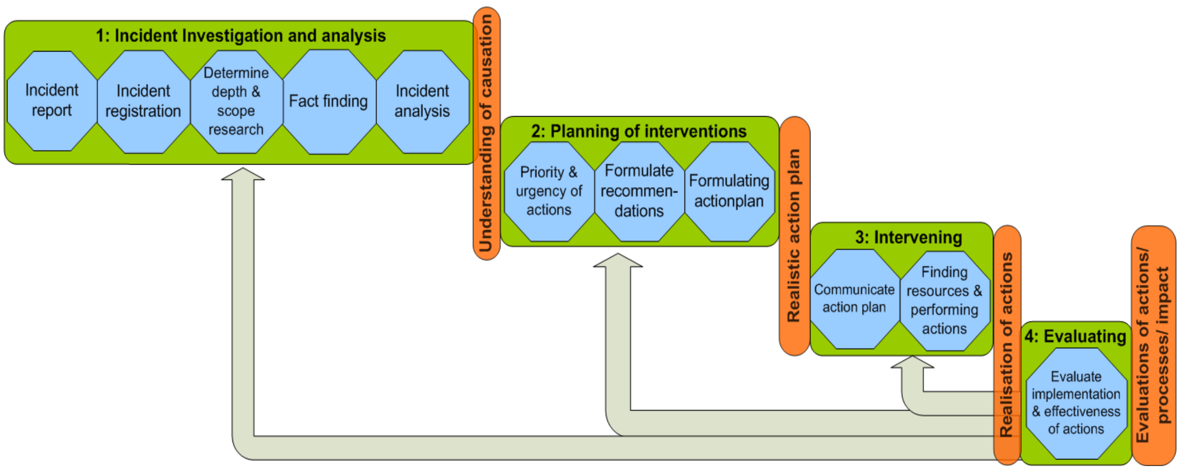

Figure 1: learning from incidents process

First stage: Incident investigation and analysis

When searching literature on learning from incidents, an extensive amount of papers on reporting and analyzing incidents is found. To learn from incidents a necessary condition is that they can be and that they are reported. To enable reporting some reporting system is required (Armitage, Newell, & Wright, 2007; D'Souza, Koller, Ng, & Thornton, 2004) and a no blame culture should be present (Firth-Cozens, 2004; Hopkins, 2006).

Learning from incidents requires an understanding of their causation, including underlying causes (van Vuuren, 1998), and of options to prevent future recurrence. This is the vital output that any incident investigation should deliver.

Second stage: Planning of interventions

Less research has been carried out on the nature or quality of the recommendations based on the outputs of the incident investigation process. Part of this planning process is also to prioritize and select those options that are expected to be most effective, and identify them as the recommendations requiring priority (Bhimavarapu & Doerr, 2009).

Actions that are formulated based on the recommendations and that are included in the action plan should preferably be specific, measurable, attainable, relevant and a specific date to start the intervention should be included. The result of the planning stage is a realistic action plan, which is based on a good understanding of (underlying) causes and their remediation.

Third stage: Intervening
The third stage is aimed at the realisation of the action plan, through the implementation of the interventions. A first requirement is that the people who are responsible for the actions, and those who are supposed to contribute to them, should be informed and have ownership of the actions (Barret, Haslam, Lee, & Ellis, 2005). Resources, especially time, money and (human and technological) capabilities might be vital to perform the actions as intended. It is important that the action plan and its objectives are communicated throughout the organisation (Bahn, 2009), especially to demonstrate the willingness to improve safety and to share the 'lessons learned' already from the investigation and planning process. The result of this stage should be: the realisation of the actions.

Fourth stage: Evaluating
The evaluation stage involves multiple levels: it should be evaluated whether the actions are performed or not and whether the actions taken were effective or not (second order learning).If an action was not fully realised or not fully effective the reasons thereof should be identified. They form the lessons about the 'learning from incidents process" as such and are the key to improving the learning capability of the organisation (deutero learning). The results of this stage are an evaluation of actions, processes and impact on the organisation and if possible on its safety performance. Where relevant, the evaluation should lead to improvements of the other three stages.

The model was used for analysing the learning from incident processes in organisations from a range of activities, with the aim to arrive at answers to the research questions:
- Which steps are formally arranged in the organisations?
- How are steps performed in daily practice?
- In which steps of the learning from incidents process are the most important learning bottlenecks located?
- Is there a difference between the formal arrangement of the learning from incidents process (espoused theory) and how this actually takes place in practice (theory in use)?

3. Method
This section describes two collection strategies that were used to answer the research questions: a survey amongst safety professionals and exploratory case studies in three organisations.

3.1 Survey
A survey was developed based on the analytical framework. The survey was used to ask safety professionals which steps of the learning cycle were organised in their organisation, which steps of the learning cycle were performed effectively in their view in daily practice and to locate the most important bottleneck in the learning cycle.

For all steps two questions were asked in the same format. The first question was dichotomous (yes/no) and the second question was in the form of a 4-point scale (Bad/Insufficient/Sufficient/Good).

The questions were:
- 'Is this step formally arranged in your organisation?' Yes/ No

- ‘How does this step work in practice in your organisation?’ Bad/Insufficient/Sufficient/Good

After the two questions there was for each step a blank field in which participants were given the opportunity to elaborate on their response. At the end of the survey the participants were asked to indicate in which of the eleven steps they believed the most important bottleneck existed in their organisation.

3.2 Participants

Participants in the present study were all safety professionals All members of the Dutch network of safety professionals (NVVK) (*N*=2.200) were approached by e-mail. Five sectors were selected and in addition to the call two participants from the personal network of the authors were approached for each sector and asked to distribute the hyperlink of the survey within their sector and ask others to participate. A total of 649 completed surveys were returned, corresponding to a response-rate of about 30%, of which 246 responses were from safety professionals of the selected sectors. Other responses, for example of consultants, government workers and researchers were excluded from this analysis.

Table 1

Number of respondents for each sector and the size of the company

	Number of Subjects	Less than 50 employees	50-100 employees	100-250 employees	250 or more employees
Chemical Industry	74	4	13	12	45
Construction	56	12	8	8	28
Metal Industry	68	6	6	15	41
Transportation	24	1	2	3	18
Waste management	23	2	3	10	8
Total	245	25	32	48	150

3.3 Case studies

To gain more specific insights into the location of bottlenecks in the learning from incidents process and the origin of those bottlenecks, three exploratory case studies were performed. The case studies existed of a document study and interviews with representatives of operational employees, supervisors and top-level management.

The document study mainly focussed on whether steps were formally arranged: the espoused theory. Two researchers on occupational safety with a background in psychology and in methodology of research, independently studied an overview or report of incidents on the location, a procedure or description of the learning from incidents process if this was available within the organisation, documents related to two incident analyses and evaluative studies or follow-up studies related to an incident. Based on these documents the researchers rated whether a step was formally organised or not. If the document gave no indication this was confirmed during the interviews.

The main objective of the interviews was to gather qualitative data about the organisation and how they performed the steps in daily practice. A semi-structured interview format was used, based on the analytical framework. The interviews focussed on how steps are organised in daily practice and on finding bottlenecks in learning. Within a company all interviews were planned on a single day, taking each 60 minutes. One senior manager/ director, the SHE manager, a shift supervisor and a representative of the employees at operational level were invited. Each interview started with a question about the critical step according to the interviewee. After this, each step was discussed briefly and one stage of the learning from incident process was discussed in-depth. One of the authors was present in all interviews. Some of the interviews were performed with a second researcher as well.

3.4 Participating organisations

The three participating companies were all organisations with over 300 employees, from different sectors: chemical industry, waste & energy and transport. They were selected on their size and availability during the timeframe of the study.

4. Results

This section deals with the main results for each of the research questions. The results of the survey and the case studies will be discussed for each question separately.

4.1 Internal consistency of the survey

Internal consistency of the survey was tested separately for each stage by Cronbachs alpha (Cronbach, 1951) on the items that measure whether the stage is arranged and on the items that measure weather the stage is well performed. Cronbachs α ranged from .650 to .878. Overall, alpha for all items (N=22) was .921. An alpha > .70 is indicative for a high level of internal consistency of the items: e.g. they all measure the same construct. The alpha being less than 0.70 might be due to the limited number of items in the stage (N=2).

Table 2

Internal consistency for the four stages

Stage	Arranged Cronbachs α	Performed Cronbachs α
Incident Investigation and Analysis	.707	.878
Planning of interventions	.710	.802
Intervening	.650	.725
Evaluating		
Overall	.844	.920

4.2 Espoused theory

For each stage frequencies on whether the step is formally arranged are collected and the percentage on how much of the stage is indicated as arranged is calculated. The mean percentages are shown in Table 3. The majority of stages is formally arranged and earlier stages are more often officially arranged than later stages ($p<.05$). For Transport and Waste management mainly the first stage is formally arranged ($p<.05$). After identifying the causation of an incident (Gate 1), the further steps are not formally described ($p<.05$). This decrease is slightly less in chemical industry, construction and in the metal industry, but still statistical significant ($p<.05$).

Table 3

Percentage of each stage that is formally arranged

	Chemical Industry %	Construction	Metal	Transport	Waste Management	Total
Incident Investigation and Analysis	79.1	80.0	80.0	79.1	78.1	79.26
Planning interventions	69.2	62.3	68.5	54.5	42.9	59.48
Intervening	59.2	50.0	59.8	43.2	38.1	50.06
Evaluating	52.3	50.0	51.8	27.2	23.8	41.02

As shown in Table 4: when the steps are studied separately, a decrease in the frequencies for latter steps is found ($p<.05$). The first step, incident report is formally arranged in almost every organisation, whereas the last step, evaluation is formally arranged in less than half of the organisations ($p<.05$). The decrease is larger in the sectors waste management and transportation, where the last step is only officially arranged in about 25 % of the organisations ($p<.05$). The distribution of frequencies in the metal sector differs significantly from the distribution in the other four sectors (Kolmogorov-Smirnov, $p<.05$).

Table 4:
Number of respondents and percentage per sector that indicate the step as officially arranged

	Chemical Industry		Construction		Metal		Transport		Waste Management		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Incident report	65	88	46	82	54	79	21	88	21	91	207	84
Incident registration	65	88	44	79	52	76	20	83	21	91	202	82
Determining Scope	51	69	26	46	37	54	15	63	10	43	139	57
Fact Finding	56	76	36	64	45	66	16	67	17	74	171	70
Analysis	50	68	32	57	36	53	15	63	13	57	146	60
Recommendations	49	66	31	55	41	60	14	58	16	70	152	62
Prioritize	41	55	27	48	35	51	9	38	13	57	125	51
Action plan	45	61	28	50	39	57	13	54	8	35	133	54
Communication	38	51	24	43	35	51	11	46	6	26	114	47
Intervention	39	53	22	39	32	78	8	33	10	43	111	45
Evaluation	34	46	23	41	29	43	6	23	5	22	97	40

The case studies support the results: many procedures, reports and systems existed about how the steps should be performed. The steps in the planning stage, from the results of an analysis to an action plan proved to be difficult to separate, and are hardly ever separately arranged.

From some of the interviews it can be concluded that all eleven steps are formalized but not operationalised, and the measures or the learning process are not evaluated. Evaluation of measures applies often only to the action itself and not to its effectiveness in preventing future incidents. What is formally arranged is the need to check if an action is performed or not.

4.3 Theory in use

Scores on how well a step of the learning from incidents process is performed in daily practice are collected. The mean value of each stage is calculated and t-tests are performed for differences between sectors. The highest possible score is 4.00, indicating that the safety professionals believe the step is performed 'good' in daily practice. Values of how effective each stage is performed are highest in the chemical industry and relatively low in the construction sector.

The mean value on how well the first stage is performed is significantly higher for the chemical sector in comparison to the other four sectors ($p<.05$). This difference exists also for the second stage ($p<.05$), except for the transport sector, which does not score significantly lower than the chemical sector. The values for the third stage are higher for the chemical sector in comparison to the waste and the construction sectors ($p<.05$).

There is also a difference between the construction sector and the metal sector. The value on how well the step is performed is lower in the construction sector for the first, second and the third stage (*p*<.05). For the first stage, the value is also low in comparison to the transport sector (*p*<.05).

Table 5
Mean values on how well the steps and stages are performed

	Chemical Industry	Construction	Metal	Transport	Waste Management	Total
1. Incident report	3.48	2.72	3.00	2.95	2.90	2.91
2. Incident registration	3.58	2.96	3.32	3.05	3.00	3.18
3. Determining Scope	3.20	2.54	2.92	3.05	2.62	2.87
4. Fact Finding	3.27	2.72	2.88	3.18	2.86	2.98
5. Analysis	3.20	2.54	2.82	3.06	2.71	2.87
Investigation and Analysis	3.35	2.70	2.99	3.06	2.82	2.98
6. Recommendations	3.16	2.54	2.74	2.94	2.81	2.84
7. Prioritize	2.96	2.41	2.68	2.76	2.76	2.71
8. Action plan	2.96	2.37	2.82	2.82	2.29	2.64
Planning of interventions	3.03	2.44	2.75	2.84	2.62	2.74
9. Communication	2.81	2.27	2.68	2.81	2.14	2.00
10. Intervention	2.89	2.64	2.84	2.56	2.62	2.71
Intervening	2.85	2.46	2.76	2.69	2.51	2.65
11.Evaluation	2.42	2.23	2.34	2.38	2.05	2.28

Results on the individual steps show that earlier steps in the learning cycle are carried out, even though improvements are possible. However, follow up steps are more often neglected. T-tests are performed to compare the mean values for each step between sectors. The mean values of steps 1 and 2 are significantly higher in the chemical industry than in the transport sector (*p*<.01). The difference between the chemical industry and the waste and metal sectors are significant until step 6 (*p*<.05): recommendations, and in the waste sector differences arise again in step 8 and 9 (*p*<.01), when the action plan is formed and communicated. Differences between chemical industry and construction are significant for all steps except the evaluation (*p*<.01). Differences in the other sectors arise mainly in step 8 and 9 when the action plan is formulated and communicated. The metal- and transport-sector have higher scores than the waste management and construction sectors (*p*<.05).

These results are again supported by the case studies. Indications on the quality of the steps that were performed is also given. Some of the qualitative information was gathered through the survey, by the option to elaborate on an answer. The results indicate that in all stages improvements are possible. The main concerns in the investigation stage are the choices of which incident has learning potential, a right method and for the right persons to investigate and analyse the incident. An overflow of actions and a lack of coordination in these actions seem to result in learning bottlenecks for the planning stage. In addition, since the planning steps are difficult to separate, and seldom separately arranged, they were also not separately performed, however the result of this stage: an action plan was usually obtained. The most important bottlenecks in the third stage but also throughout the other stages of the learning process seem to originate from a lack of communication. Results from analyses or actions are hardly fed back to employees. The case studies indicated that especially the latter steps are often locally performed and not communicated through the organisation. Actions that are performed are now often not visible to operational staff and only applied to one team or department. Communication on the steps is also indicated as a hindrance in learning, because even when all steps are functioning, transfer between the steps is crucial.

4.4 The main bottlenecks

Most participants indicate that in the last stage, the evaluation, the most important bottlenecks arise, as is shown in Figure 2. This is consistent with the results from the previous questions that indicate that the safety professionals are less satisfied on how the evaluation step is performed. In the survey as well as in the case studies it is indicated that if an evaluation is performed this is not aimed at preventing reoccurrence or at evaluating the quality of a remedy, but only whether it is performed or not. The reporting of incidents is also by many indicated as a location for important bottlenecks, mainly in the sectors construction, metal and transport. Results from the case studies and the qualitative information from the survey show that this is indicated as a critical step before learning can occur and that motivation or trust to report incidents are not always present. In the transport sector as well as in the chemical industry the interventions step is also indicated as an important step in which bottlenecks arise. In Table 6 results are presented for each sector separately.

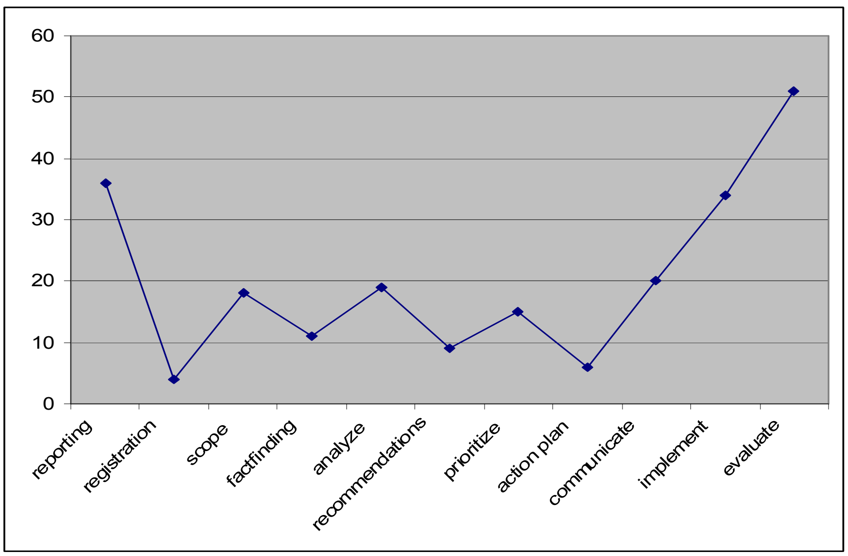

Figure 2: frequency on main bottlenecks

Table 6

Percentages for main step in which bottlenecks arise

	Chemical Industry	Construction	Metal	Transport	Waste Management	Overall
1. Incident report	7.4	20.8	23.3	21.0	8.7	16.1
2. Incident registration	1.4	1.9	1.7	5.3	0	1.8
3. Determining Scope	2.9	17.0	8.3	5.3	4.4	8.1
4. Fact Finding	2.9	11.3	3.3	0	4.4	4.9
5. Analysis	5.9	7.5	10.0	10.5	13.0	8.5
6. Recommendations	5.9	0	5.0	0	8.7	4.0
7. Prioritize	5.9	9.4	6.7	0	8.7	6.7
8. Action plan	4.4	3.8	0	5.3	0	2.7
9. Communication	7.4	9.4	8.3	5.3	17.4	9.0
10. Intervention	20.6	5.7	11.7	36.8	13.0	15.2
11.Evaluation	35.3	13.2	21.7	10.5	21.7	22.9

4.5 Comparison between theory in use and espoused values

The theory in use and the espoused values are compared by comparing the results of which steps are formally arranged and on whether the steps are performed well in daily practice. The results are presented in Table 7. There are differences between how the stages are officially arranged and how they are performed ($\underline{p}<.05$). These differences are larger in the last stage, except for the transport sector ($\underline{p}<.05$). The first stage for example is often arranged but less often performed well in daily practice ($\underline{p}<.05$).

Table 7

Percentage of stages that are arranged (A) and well performed (P)

	Chemical Industry		Construction		Metal		Transport		Waste Management	
	A	P	A	P	A	P	A	P_	A	P
Investigation and Analysis	79.1	88.0	80.0	64.3	80.0	73.2	79.1	72.7	78.1	74.3
Planning interventions	69.2	68.7	62.3	48.6	68.5	63.1	54.5	59.1	42.9	65.1
Intervening	59.2	56.2	50.0	47.8	59.8	58.0	43.2	47.7	38.1	52.4
Evaluating	52.3	35.4	50.0	32.6	51.8	35.7	27.2	27.2	23.8	28.6

The second and third stage appear to work well in daily practice for transport and waste management, even though they are not always formally arranged. An overall comparison is shown in Figure 3 below.

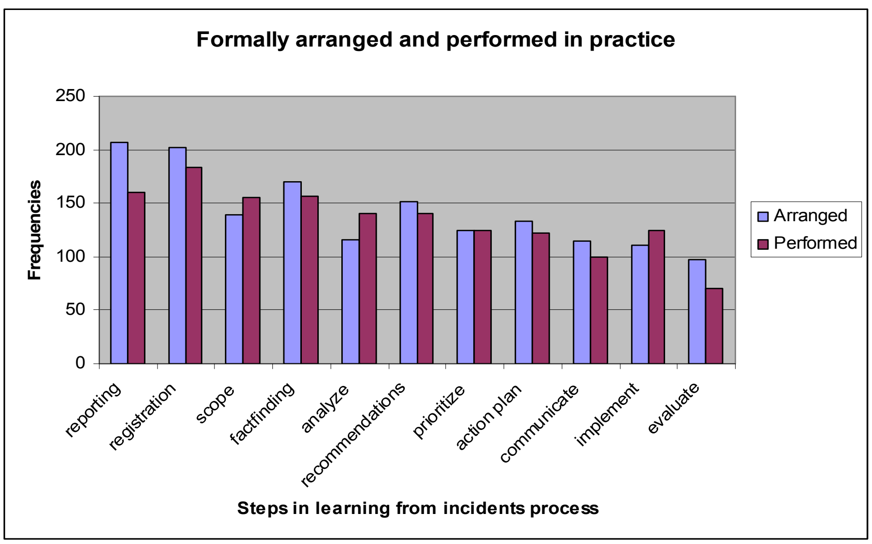

Figure 3: Overall comparison in what is arranged and what is performed well

5. Discussion

The results in the previous section show that there's ample room for improvement in the learning from incidents process. The model of the learning from incidents process helps to locate bottlenecks or learning disabilities and when using the model in combination with qualitative data collection strategies it gives indications about the type of bottlenecks and their origin as well. It helps to analyse the way in which the learning from incident process is organized and it gives insight into the activities performed to do this. The model that has been developed is a framework for analysis and the steps should not be implemented or formalised as such. Organisational learning should be embedded in an organisation and a learning cycle cannot function on its own.

The generalisability of the results is limited by context and method. The model has shown to work well in identifying the main bottlenecks for Dutch organisations in five sectors. It would be interesting if the results could be replicated in other countries and other sectors. In this paper, results for five sectors are described. Data for other sectors are still being collected and will be analysed later. Another interesting application might be to ask employees and managers to participate in the survey to get a broader representation from the organisations. The current results reflect on the opinion of safety professionals. They often play an important role in the learning from incidents process, for example in investigating incidents. Results might therefore be somewhat biased.

Results do show that improvements are possible in all steps. In the current approach all steps are treated equally important in arriving at the end-result of a stage, but some steps might be more critical. For the first stage, determining the scope of the investigation might for example be less critical compared to gathering the right facts and analysing an incident. This can be considered for further development of the model.

In addition, if the process is organised and the actions are performed this does not necessarily mean that the organisation has learned. The framework is not aimed at studying the learning loops or the context in which the learning process should be embedded. Moreover, communication on the steps and through the organization during the whole process might still hinder learning. Not only should the steps be carried out, but how they are carried out and how they form input for a next step are important factors as well.

6. Conclusion

The purpose of this study is to locate bottlenecks in the learning from incidents process and to see which steps are formally arranged and well performed in daily practice.

Organisations have implemented many systems and procedures for preventing incidents: they formally arranged most of the steps. This does however not always function well in daily practice. Results show that bottlenecks arise in all stages and all steps. Some professionals indicated that reporting of an incident is the most problematic step. The amount of professionals that indicate that a step is performed well or that the step is arranged decreases after the first stage, when actions should be formulated and even more after the second stage, when the actions should be communicated and implemented. The most important bottlenecks arise in the evaluation stage, since it is often only evaluated whether an action is performed or not and the effectiveness of an intervention is not considered.

An interesting result is that some of the steps are in daily practice better performed than they are officially arranged. The participants mainly indicate that bottlenecks are located in the steps that are not well performed, even though they are usually arranged in the organisation. These results indicate that to learn from incidents, formalising a learning process in itself is not sufficient. The official learning process might differ from the “real” learning process, and formalising and structuring the process in writing does not necessarily improve safety. Extensive incident analysis or the implementations of numerous actions have limited impact if the learning process is not completely performed. A false sense of effectiveness exists, but whether the system in use is functioning and actually effective is not evaluated. As long as evaluation does not take place and changes to the system are not applied, learning from incidents will be limited and incidents keep happening.

To allow an organisation to continuously improve and to become safer, an effective 'learning from incidents process' is needed. Further research into the origins of the learning bottlenecks and on how to resolve them will be carried out, to optimise this learning from incidents process. This research will be aimed at the bottlenecks in the process, but also at the context in which the learning process exists, such as the culture and the structure of an organisation.

7. Acknowledgements

This work was in part financed and supported by the Ministry of Social affairs and Employment (SzW). The authors wish to thank the department of Health and Safety at work of the Ministry for many stimulating discussions. The authors wish to acknowledge also their colleagues at TNO Work and Employment, in particular Niek Steijger, Jakko van Kampen and Ellen Bos for adding their knowledge and for their assistance in performing this study. The authors also would like to thank the Dutch association of safety professionals (NVVK) for spreading the call for participation in the survey and they wish to thank the companies participating in the survey as well as in the case studies. This paper presents the opinion of the authors, and does not necessarily reflect any position or policy of SzW.

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