ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Safety Implementation of Control Bonding For Exposure to Hazardous Chemicals

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ABSTRACT

Management and workers in small and medium-sized enterprises (SMEs) often find it hard to comprehend the requirements related to controlling risks due to exposure to substances. An intervention study was set up in order to support Two SMEs in improving the management of the risks of occupational exposure to chemicals, and in using the control banding tool and exposure model Stoffenmanager in this process. A 1-year intervention study was carried out, in which a mix of individual and collective training and support was offered, and baseline and effect measurements were carried out by means of structured interviews, in order to measure progress made. A seven-phase implementation evolutionary ladder was used for this purpose. Success and failure factors were identified by means of company visits and structured interviews.

Active training and coaching helped the participating companies to improve their chemical Risk management, and to avoid making mistakes when using and applying Stoffenmanager. The use of validated tools embedded in a community platform appears to support companies to organize and structure their chemical risk management in a business-wise manner, but much depends upon motivated occupational health and safety (OHS) professionals, management support, and willingness to invest time and means.

INTRODUCTION

In many small and medium-sized enterprises (SMEs), awareness of the long-term health impacts of exposure to hazardous sub-stances is low. 121 000 workers die every year as a result of occupational diseases caused by hazardous substances in India as per survey of (Source: Leigh J, Macaskill P, Kuosma E, Mandryk J. Global burden of disease and injury due to occupational factors), and roughly ~10 times more workers get an occupational disease.

~As per ILO Survey Occupational deaths in India in 2011 World is 1,40,973 deaths to occupational exposure to hazardous substances each year . For management and workers in SMEs, however, given their limited resources, it is not an easy task to comprehend the legal requirements related to controlling risks due to exposure to substances. Besides, it is not an easy task to uncover the company-specific burden of disease related to this exposure, and to show the benefits that may be expected from interventions to reduce exposure.

In various countries, tools have been developed that support companies in preparing risk assessments and in selecting the proper risk management measures. One type of such tool, which has gained substantial interest and adoption worldwide, is control banding. Control banding is a qualitative risk assessment in which categories (“bands”) of hazards are combined with

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categories (bands) of the exposure potential, in order to arrive at risk estimates and subsequently recommended levels of controls. Control banding approaches were first developed by the pharmaceutical industry in the late 1980s, and have found considerable application in risk management of substances. One more recent application of control banding is to enable companies to prepare risk assessments for nanomaterial's in the absence of firm toxicological and exposure data. Control banding may be applied when uncertainty on hazards and expo-sure is high, but where nevertheless, more or less reliable estimations can be made by grouping the substances used in hazard categories and the activities carried out in exposure categories.

1.1 THIS RESEARCH

The developers of Stoffenmanager in the Netherlands-TNO, ArboUnie, and Ernst & Young/BECO-have recognized the need for a more active approach and support to SMEs, in order to foster an active as well as a proper use of this tool. Therefore, a 1-year intervention project was started, in which active support was provided to Two participating companies both of them SMEs. The project aimed at improving the implementation of Stoffenmanager as well as chemical risk management in a wider sense. In order to find hints to enable the development of tailored support to companies willing to optimize chemicals management, the central research question addressed within the framework of this project was: "which characteristics of the tool Stoffenmanager itself, of the intended user and of the intended user's organization determine the success or failure of its active and successful implementation and proper use?".

1.2 THE CONTEXT OF WORKERS' HEALTH AND SAFETY

Globalisation of the neo-liberal economic system over the past three decades has increased global competition and opened up job opportunities in low-wage countries, lowered the cost of consumer goods in high-income countries, but also resulted in the reduction of wage controls, union protections, and workplace standards. In both poor as well as rich countries there are now more ''flexible'' work arrangements, fewer institutional protections, and greater job insecurity (Hogstedt, Wegman, &Kjellstrom, 2007). On the other hand, the recent waves of economic reforms in many poor countries have added to the complexity of informal labour markets, where high and sustained growth rates are not necessarily accompanied by increased growth in formal employment (Guha-Khasnobis&Kanbur, 2006). These changes also imply that a fundamental shift in employment relations and power has taken place (Amable, 2002; Benavides et al., 2000; Benach et al., 2002; Barten, Mitlin, Mulholland, Hardoy, & Stern, 2006).

1.4 STOFFENMANAGER: REGULATION, CAD DIRECTIVE

Steps:

1. Clean Company Strategy
2. Prioritization
3. Estimate exposure
4. Measurement of exposure

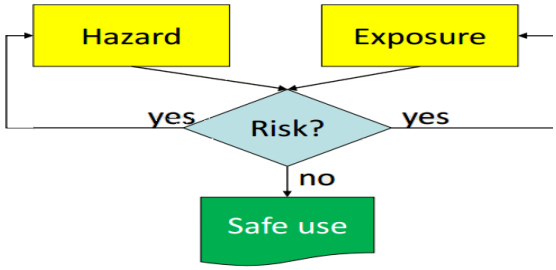

Fig:Using models in stead of measurements Principle is also used in REACH

NETHERLANDS: REINFORCING WORKING CONDITIONS ON DANGEROUS SUBSTANCES, THE VAST PROGRAMME

WHY REINFORCING

- one third of the companies is handling dangerous substances
- one fourth of the employees is exposed
- 40,000 different substances are handled
- estimated 17.000 occupational diseases and 1850 deaths
- employers in SMEs take insufficient

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responsibility
- lack of information in the chain 'producer, distributor, end-user
- SDS are too technical, too long and of poor quality
- lack of knowledge and skills in SMEs
- insufficient awareness of the risks
- lack of knowledge on possible control measures
- REACH regulation

VAST: RESULTS 2003 – 2007 CONCLUSIONS RELATED TO STOFFENMANAGER:

- Demo 27th October 2003 as part of VASt
- 10 sectors invested in sector version
- awareness: dangerous substances higher on agenda
- 15%◊ increase use of 'Risk assessment tools' 7%
- implementation?? Just started!!
- Stoffenmanager: hard to keep up to date, changing regulation and development of scientific knowledge
- assignment to developers in 2009 (TNO, ArboUnie, EY/Beco): long term assurance of independency, continuity, actuality and quality of Stoffenmanager

STOFFENMANAGER: VERSION 5.0

- In 2013 Stoffenmanager Premium became available (Version 5).
- Stoffenmanager registered trade mark

Fig: 5th version of StoffenManger

- In 2014 Stoffenmanager was transferred to Cosanta, a spinout of TNO and ArboUnie(version 5.5)
- Cut-off limit 35 products free –premium

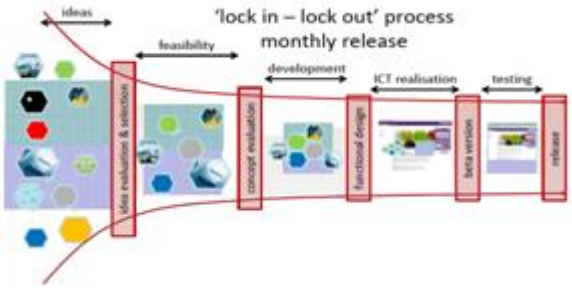

Fig: Future Development of Process

CONCLUSION 1: MORE THAN JUST A PLATFORM

- hosting environment (dedicated server) and SLA
- information security
- ESCROW for continuity users
- statistics for overview use
- Multilanguage for usability
- monthly updates for keeping pace with IT developments
- upgrading by implementation of state-of-the-art knowledge & developments for keeping attractiveness
- user-community for feedback on improvements and further development
- resources, and partners with expertise & experience
- not possible without a good business case –plan
- dedicated organization

3. MATERIALS AND METHODS

For both companies used the generic, free to use 'basic' version 5.0 of the online Stoffenmanager tool during the project.The project was structured as an intervention, encompassing three phases: preintervention (or preimplementation), intervention, and post-intervention

The baseline and effect surveys were carried out by

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International Journal & Magazine of Engineering, Technology, Management and Research
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means of telephone interviews. The actual intervention or implementation phase encompassed a mix of individual and collective training and support, in order to provide access to experts as well as to promote mutual exchange of experiences and mutual learning among the participating companies. No control group was used, as this was regarded practically impossible, given the very dynamic environment the companies operated in, involving many continuously changing technical, personal, and organizational factors as well as autonomous developments.

Stoffenmanager implementation evolutionary ladder with seven phases

Fig.. Stoffenmanager implementation evolutionary ladder with seven phases.PDCA, Plan-Do-Check-Act.

Fig. Intervention process

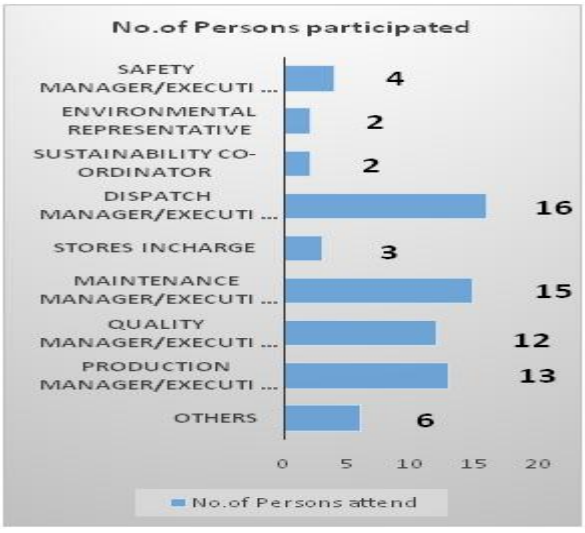

Fig. Sectors represented by the participating organizations (baseline measurement).

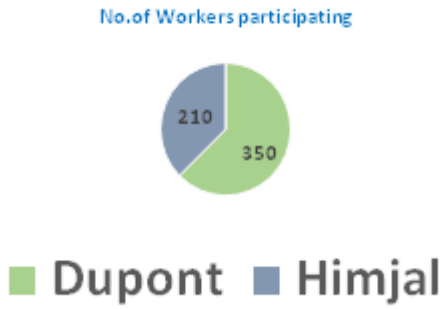

Fig. Size (number of workers) of the participating organizations (baseline measurement).

3.1.3. BASELINE SURVEY

- Prior to starting the intervention phase, in each participating organization a baseline survey was carried out. First, a structured interview protocol was developed, consisting of 48 questions, which focused on:general characteristics of the organization and of its representative in the project; (2) general occupational health and safety (OHS)-policies and policies to-wards chemicals within the organization; and (3) the organization's progress in, and experiences with, using Stoffenmanager. Most of the questions were either binary (yes/ no), or had a number of defined answering categories, e.g., number of workers, job title of the representative
- interviewed, etc. In addition, the interviewees could provide additional comments. The baseline measurement was carried out by means of a telephone interview, using the protocol developed. The answers were as much as possible directly fed into an Excel worksheet for storage and further analysis.

BASIC INFORMATION

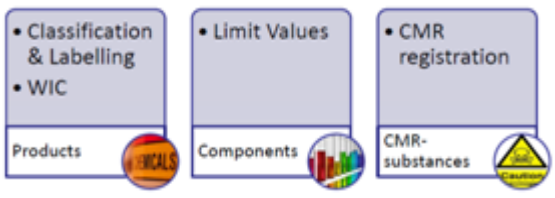

Fig: Basic Information

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FIG:PRODUCT CHART

RISK ASSESMENT: QUALITATIVE

- Five hazard classes (A-E)
- Four exposure classes (1-4)
- Three risk classes (I-III)

Exposure class \ Hazard class	A	B	C	D	E
1	III	III	III	II	I
2	III	III	II	II	I
3	III	II	II	I	I
4	II	I	I	I	I

Fig: Risk Assessment Matrix

4. ANALYSIS

In the description of the results, we will first focus on a number of characteristics of the group of participants related to chemical management, at the point of their entry in the project. Subsequently, we will describe their positions on the implementation ladder, at the start and at the end of the project, and on possible causes of the changes observed. Furthermore, we will describe and analyze the success factors and barriers that were identified, including finally the impact of the activities offered in the intervention project itself.

TABLE 4.1

State of affairs on chemical management e baseline survey

- 95% prepared a general risk assessment
- 100% had some kind of registration of the chemicals that they used
- 100% measured exposure of Chemicals
- 60% already knew Stoffenmanager by name before the start of the project
- 80% had logged in once, and had taken a look at the model
- 40% already used Stoffenmanager's qualitative model (risk prioritization)
- 60% of them found it very complicated

4.2. POSITION ON THE IMPLEMENTATION LADDER

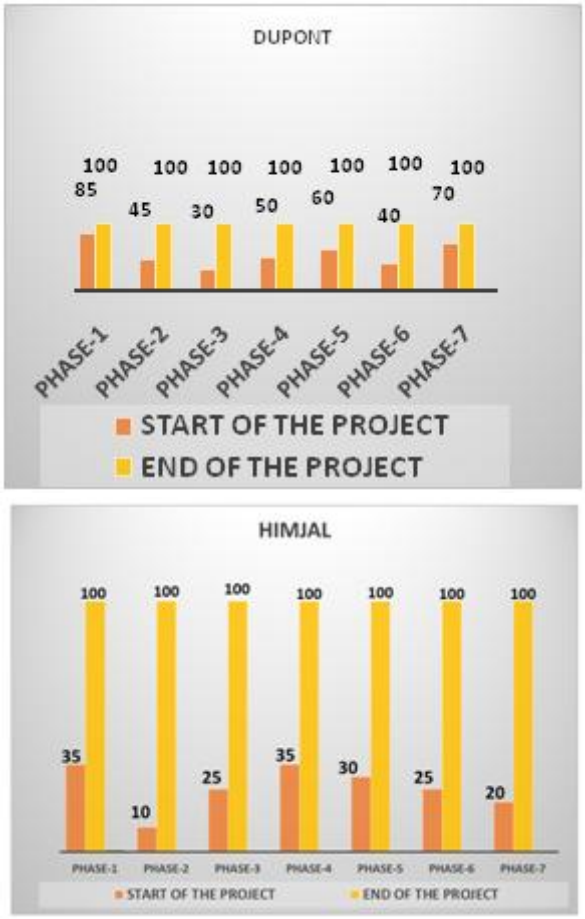

Fig. HIMJAL IMPLEMENTATION LADDER

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4.3. FAILURE FACTORS

The effect survey at the end of the project, by means of telephone interviews among the Two Compani,indicated that any kind of bottlenecks still remained. Bottlenecks reported by more than one participant were: (1) in the company the expertise to learn to do more than just putting product data in the Stoffenmanager model i.e., preparing risk assessments was lacking; (2) input data were not always available, and (3) some limitations of the Stoffenmanager tool itself, such as easily assessing the exposure to mixtures of substances, and a relative lack of guidance in the tool, e.g., on which "next step" should be taken after making an exposure assessment.

They reported that they had not been able to find sufficient time to take part in the project as actively as they would have wished, being a significant cause for the bottlenecks remaining. Further explanations given by companies were the representative in the project leaving the organization without taking care of proper transfer of knowledge, and the economic crisis that forced some companies to shift priorities.

Further information on the type of barriers that hindered companies in actively and properly using Stoffenmanager and in securing a responsible chemicals' management has been distilled from the remarks made by companies and the observations made by the coaches during the company visits.A number of barriers that were observed relatively frequently, will be described below.

4.3.1. TIME INVESTMENT NEEDED

Both companies visited (97%), preparing risk assessments for exposure to substances supported by the use of Stoffenmanager in this case was assumed to be part of the overall job, i.e., the employer did not explicitly allocate a specific amount of time to perform this task. The task of preparing risk assessments entails the entire process of making an inventory of substances present at the workplace, gathering data on these substances, prioritizing situations that need exposure assessment, assessing exposure (either by carrying out measurements or by using a model such as Stoffenmanager), evaluating the result, selecting control measures, and estimating their effectiveness.

The participating companies used 148s of products and substances. Thus, the task involved a lot of manual work to fill the database and a large effort related to searching for all the input data needed. Therefore, several companies decided to make use of internship trainees, or temporary workers.

4.3.2. TRACEABILITY OF INPUT DATA

The physical chemical data of the substances used that have to be entered in the Stoffenmanager model appeared to be hard to find for 91% of the companies visited. This held especially true for the substances vapor pressure. Besides, occupational exposure limits (OELs) of the substances were hard to find. As only for 148 unique substances an OEL is available in generally accessible databases, companies had particular problems with finding OELs for the more exotic substances.

Although principally, companies should be able to retrieve much of the information needed from the Safety Data Sheets (SDSs) that the supplier provides, when products that contain various components are used, it frequently occurs that vapor pressures and OELs of the individual components are not stated. In fact, five companies explicitly reported that the low quality of the SDSs they received constituted a barrier to them.

4.3.3. LOWAWARENESS AND LOW COOPERATION OF WORKERS OR PURCHASING DEPARTMENT

In order to prepare reliable exposure estimates, sufficient sup-port from the workers in collecting information on product use and activities carried out is essential. Both companies visited, this support was judged sufficient by the companies representative. Similarly, sufficient support from purchasing

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International Journal & Magazine of Engineering, Technology, Management and Research
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departments in providing information on products and substances purchased was reported by 85% by both companies.

4.3.4. LITTLE GUIDANCE IN STOFFENMANAGER

90% of both companies representatives interviewed during the company visits answered that the questions, the structure, and the routing of the Stoffenmanager model was sufficiently clear to them. However, 60% reported to the coaches to have problems determining the next step after preparing a risk prioritization or an exposure calculation. Thus, it seemed that the model structure provided too little 'guidance' to this group of users. Moreover, it was felt problematic that no error reports are given in case of a faulty or missing input.

4.3.5. LITTLE UNDERSTANDING OF EXPOSURE AND OF RELATED PROFESSIONAL TERMS

Roughly half of the participants reported to have problems in understanding specific terms and issues that are familiar to expo-sure scientists, such as distinguishing between a task-based versus a daily average exposure, the influence that the vapor pressure of a substance has on exposure, and the difference between assessing individual components and entire products. In addition, if the company had carried out exposure measurements, they found it hard to understand the reasons why the exposure calculations made by Stoffenmanager deviated from the results of the measurements. The concept of using a 'percentile' value in the model obviously was not instantly clear to all of the participants.

4.4. SUCCESS FACTORS

Similar to the barriers described above, information on the success factors that contributed to using Stoffenmanager successfully, and to securing a responsible chemical management, have been distilled from the remarks made by companies and the observations made by the coaches during the both company visits. A number of factors that were observed relatively frequently are described below.

4.4.1. INTRINSICALLY MOTIVATED OHS-PROFESSIONAL

In 80% of the companies visited, health and safety related to using substances was a top priority for the management and the OHS professional. The importance of having an OHS professional in the company that is intrinsically motivated. However, it was the impression of the coaches that in fact, in practically 100% of the cases this seemed to be one of the major factors.

4.4.2. EXTERNAL INCENTIVES

External incentives to make a start with preparing exposure assessments and improving chemicals management as a whole were reported to be a decisive factor by 60% of the companies visited. In particular, visits made by the Labor Inspectorate, and audits held by major clients were reported. In all of these cases, the companies management provided support to, and trust into the OHS professional in "doing what is needed" to meet the requirements of the Labor Inspectorate or those of major clients.

4.4.3. STOFFENMANAGER SUPPORTED BY THE LABOR INSPECTORATE

In close connection to the aspect mentioned above, the fact that the Dutch Labor inspectorate explicitly recognizes and supports Stoffenmanager as a reliable and sufficiently conservative 'Tier 1' model was regarded very important by 90% of the both companies visited. The incorporation of Stoffenmanager as well as a few other models, such as ECETOCTRA, in the relevant REACH guidance documents provided a further incentive to rely on the model.

4.4.4. STOFFENMANAGER OFFERS A STRUCTURE

The simple fact that using a model such as Stoffenmanager provides a manner of getting a 'grip' on the complex issue of implementing a responsible chemicals management was a major reason to use this model for 80% of the both companies visited. Stoffenmanager and similar tools provide a way of getting an 'overview' of the problem, and the model

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provides validated outcomes, as well as valuable indications for taking control measures.

4.4.5. DATABASE WITH SUBSTANCE DATA

Although not yet implemented in the general Stoffenmanager version (by contrast to a few sector-specific versions), 71% of the both companies visited would like to have a database that contains basic data on the substances used, such as their vapor pressure and OEL. In these companies it was felt that such a database would make a successful implementation of Stoffenmanager easier. To that end, this is in fact not a 'true success factor' yet, but a 'future' success factor. Those companies that did not wish such a database either did not use many different substances, or had filled their Stoffenmanager database already.

4.4.6. ADDITIONAL FACTORS

A few additional success factors reported infrequently i.e., by less than three participants included: the companies representative possessing some basic level of knowledge on chemistry, an active sector association that organized an active exchange of information and knowledge, and finally, the support provided by the Stoffenmanager Implementation project itself. The latter factor will be dealt with below.

4.5. PROJECT AND PROCESS EVALUATION

In the effect measurement survey by means of telephone interviews among both companies, a number of questions were included on the project activities.

It appears that the activities most valued, were those activities in which direct, face-to-face support was provided by the coaches, during the joint training meetings and the company visits. On those occasions, the companies representatives were given the opportunity to practice using Stoffenmanager, and to pose questions to the coaches present. Considerably less appreciated were the opportunities to get online support, i.e., the LinkedIn group that was established for mutual support, and the project documents and 'internet links' provided at the project website.

5. DISCUSSION

To the best of our knowledge and in line with the information in recent papers in this field, this study was the first in its kind, being (1-year) intervention project, providing active support to a large group of participating both companies. The project aimed at improving the implementation of Stoffenmanager as well as chemical risk management in a wider sense, and at finding hints to enable the development of tailored support to companies that are willing to optimize chemical management.

It is important to note that the project did not involve a 'representative' sample of the Dutch companies. A relatively 'motivated' subsample of companies was involved, as participation was obviously voluntary. Therefore, it was not surprising to see that in a large majority of the participating organizations health and safety related to using substances was a top priority.

In addition, it was decided not to involve a control group receiving no training and support, as one of the major aims of the project was finding the success factors and barriers related to improving substances' management, rather than measuring improvements quantitatively. To this end, the authors feel that the project has provided valuable information `that may be used in developing tailored support to companies.

Preparing a general risk assessment, a chemical register and exposure assessments are all legal obligations under the European Union's Framework Directive on Occupational Health & Safety and the Chemical Agents Directive. This may partly explain the relatively high percentages of participants that had done so. However, recent figures from the Dutch Labor Inspectorate show that on average, only 50% of the Dutch companies/ organizations have made a general risk assessment, and only w20% have prepared one or more exposure assessments for chemicals. Thus, the participants seem to constitute a relatively advanced subpopulation of the Dutch companies and organizations. Obviously, the organizations joining a project like this were interested

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in doing so just because they had become aware of the need for improving their chemical management, and of the opportunities for support that this project offered. This may be less of a problem than one might expect, because we have looked at the relative progress the participants made, each starting from their own position on the seven-phase implementation ladder. Despite this, this fact might imply that a random sample of companies would have made less progress during the project, or would have had even more difficulties with certain aspects of the Stoffenmanager model, although this seems rather speculative.

The seven-phase implementation evolutionary ladder that was developed, was specifically designed to enable assessing the participants progress in using Stoffenmanager as a tool in improving substances' management. Therefore, although the implementation ladder has not been described in the literature before, it provided a means to assess progress in a well-structured manner and as objectively as possible. It appeared that significant progress had been made by most participants, by comparing their level of implementation at the baseline measurement and at the end of the project.

5.1 BACKGROUND:

Management and workers in small and medium-sized enterprises (SMEs) often find it hard to comprehend the requirements related to controlling risks due to exposure to substances. An intervention study was set up in order to support Both SMEs in improving the management of the risks of occupational exposure to chemicals, and in using the control banding tool and exposure model Stoffenmanager in this process.

5.2 METHODS:

A 1-year intervention study was carried out, in which a mix of individual and collective training and support was offered, and baseline and effect measurements were carried out by means of structured interviews, in order to measure progress made. A seven-phase implementation evolutionary ladder was used for this purpose. Success and failure factors were identified by means of company visits and structured interviews.

7. CONCLUSION

Active training and coaching helped the participating companies to improve their chemical risk management, and to avoid making mistakes when using and applying Stoffenmanager. The use of validated tools embedded in a community platform appears to support companies to organize and structure their chemical risk management in a business-wise manner, but much depends upon motivated occupational health and safety (OHS) professionals, management support, and willingness to invest time and means.

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