Competence transfer in Nammo Raufoss AS

Study and proposed action

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1. INTRODUCTION

Specially tailored materials (buildings and equipment) and personnel with a high collective level of competence in handling explosives and the processes for producing these characterize today's explosives industry. Handling explosive products is associated with risks that can usually be dealt with, but incidents that have serious consequences for personnel and materials do occur from time to time. Investigations into the causes of such incidents have often found that these have been due to human error and lack of necessary competence and training [1]. A common view within the explosives industry is that the cause of accidents in recent years can be divided into 80% human and 20% mechanical error. This is in sharp contrast to 15-20 years ago when the cause could be divided into 20% human and 80% mechanical error [2].

This result may indicate that the general competence in the industry in the form of know-how, attitudes and experiences is not adequately transferred between generations and the trend toward flatter and more compact organizations amplifies this. Competence transfer and downsized organizations have been recurring topics in the explosives industry and several projects mandates during previous FEX courses have addressed these topics [3, 4, 5].

This project work is part of FEX 2005, and originates in the assignment put forward by Hans Frode Homb [6], where a few general recommendations have been given through a survey of how competence transfer. The project team comprised Peder Arnt Kraby, Terje Hatlelid and Eirik André Løkke, all employed at Nammo Raufoss AS.

2. IMPLEMENTATION OF THE PROJECT MANDATE

The project team has chosen to limit the study to Nammo Raufoss AS, as through development, production and testing a complex product portfolio of pyrotechnical articles, ammunition and rocket motors, this company is a good example of a typical company in the explosives industry.

The mandate has been implemented through:

- A survey of the scope of competence transfer in a group of employees who are 56 years and older.
- Interviews in selected departments regarding experience with training and competence transfer.

3. FINDINGS

3.1 Scope of retirement and need for competence transfer

In order to form a picture of the scope of competence transfer in Nammo Raufoss AS, we decided to implement a survey of the current situation with regard to employees who are 56 years and older. We registered their position, work area and competence. Personnel in this age group will probably have to be replaced within the next 6 years. We have assumed that the possibility to choose a contractual pension is maintained. The list of 100 people we were given was exactly 20% of the company's workforce.

We have categorized this group as follows:

Status:

- Operator
- Salaried worker

(The distribution is approx. 50/50)

Competence:

- Level A: Competence is easy to replace (no or very short training period).
- Level B: Competence transfer is required. A replacement has been appointed. Competence transfer has been started or completed.
- Level C: Competence transfer is required. No replacement has been appointed.

Function:

- Handling explosives
- Support section
- Staff function

The interviews were carried out via telephone or personnel interviews, preferably with the person in question's immediate superior. Wherever possible, colleagues and personnel familiar with the person in question's competence and function were contacted and the person in question himself / herself was also given the opportunity to comment. However, it proved to be difficult for each person to define and assess his / her skills and to specify the skills and knowledge that he or she must pass on.

It must be pointed out that the replies given are subjective views that may vary, depending upon who the respondent is.

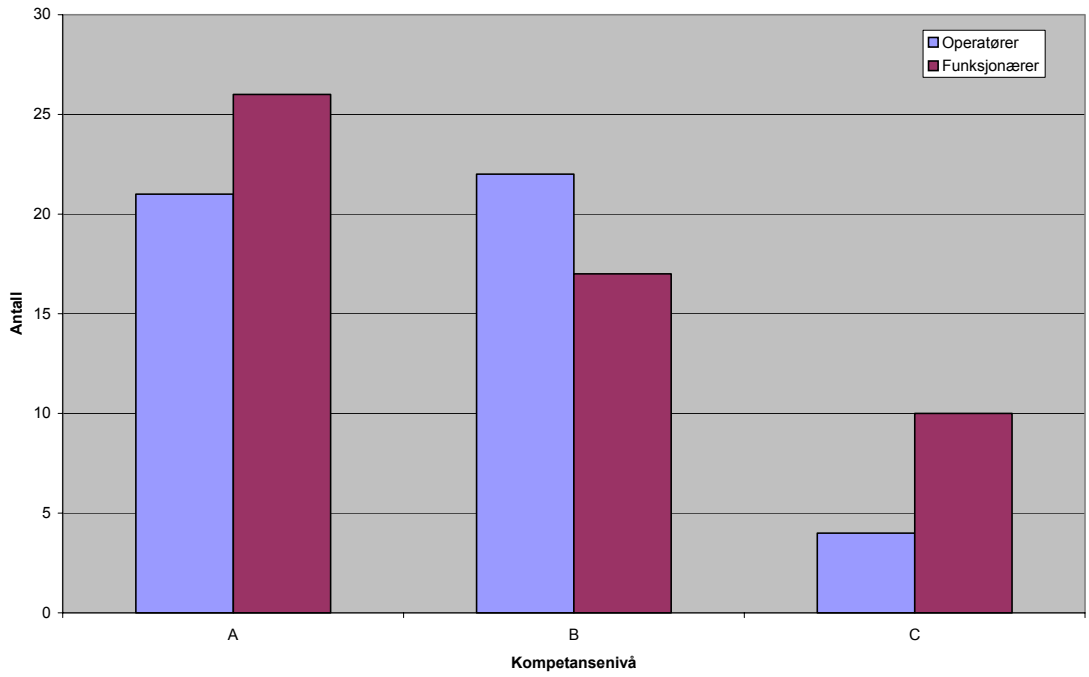


Figure 1: Number of different competence levels (A, B and C), and the distribution between salaried workers and operators.

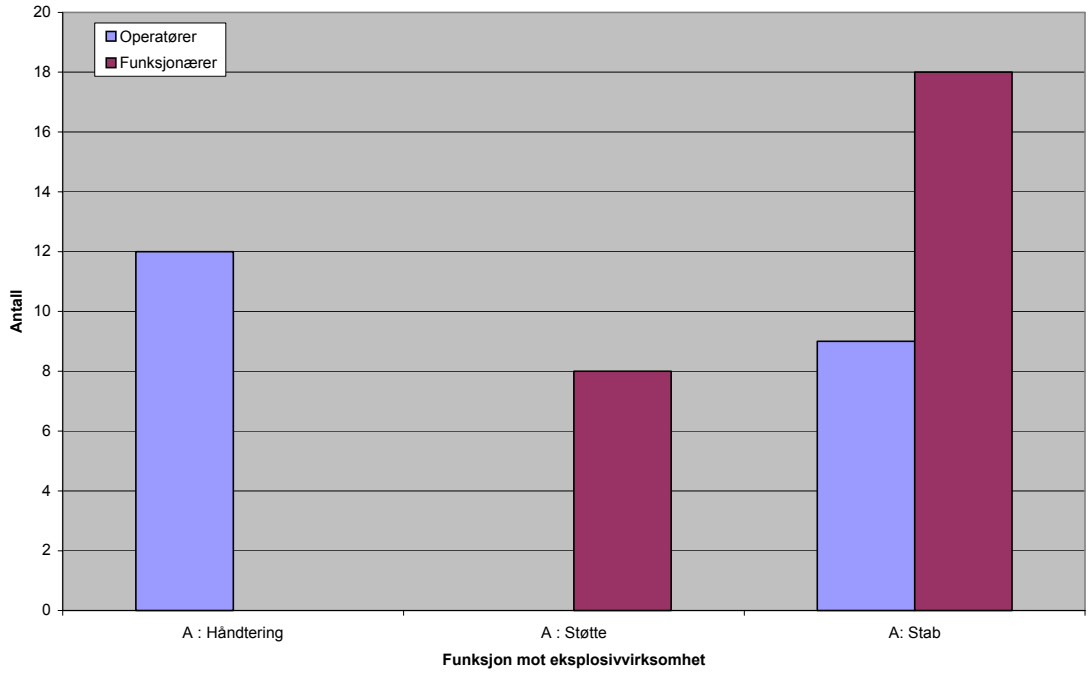


Figure 2: Distribution of competence level A between salaried workers and operators

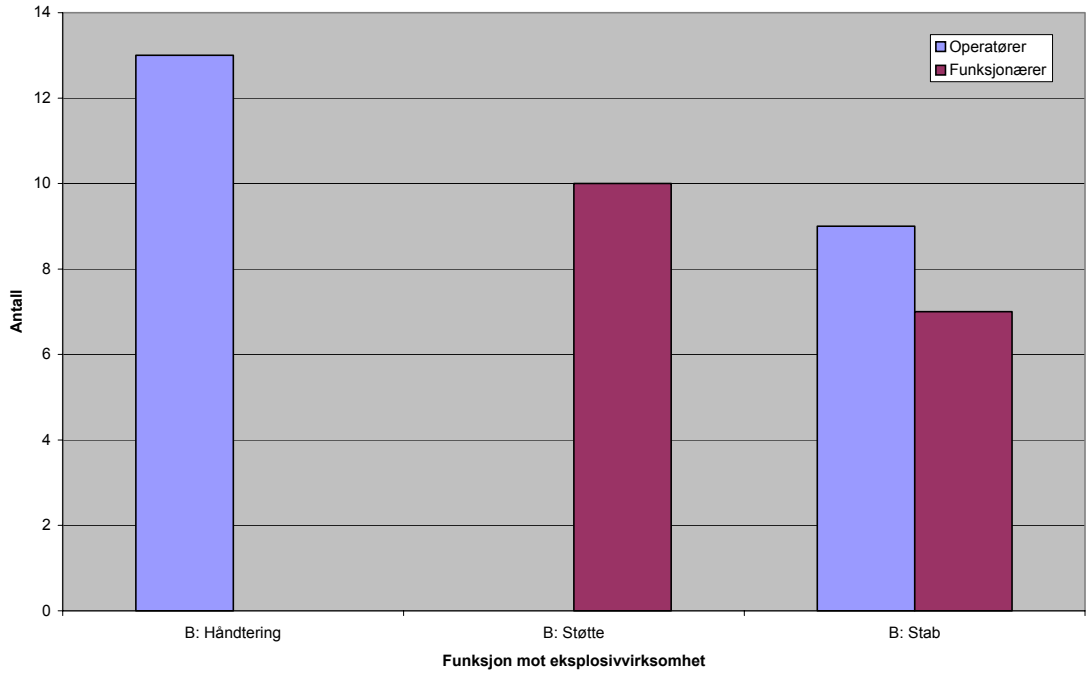


Figure 3: Distribution of competence level B between salaried workers and operators

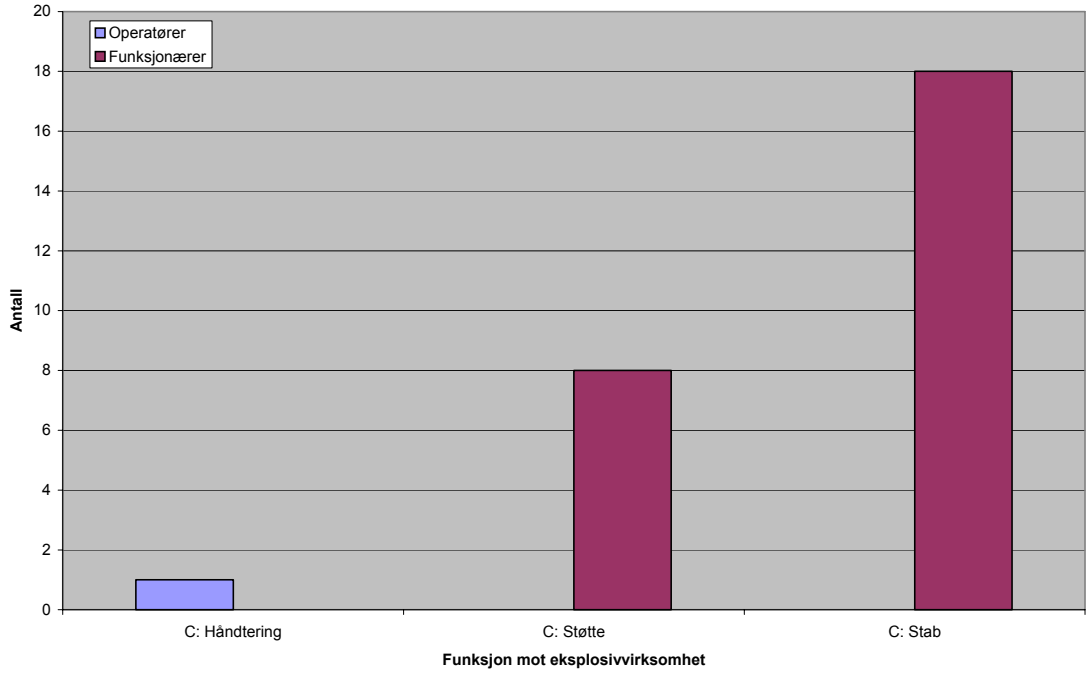


Figure 4: Distribution of competence level C between salaried workers and operators

3.2 Questionnaire regarding experience with training and competence transfer

In order to study how training, competence and exchange of this is experienced today, three questions were sent to five selected departments, three production departments that work with explosives (medium calibre ammunition 1MF and 1ML and rocket motors 1RFE) and two support departments (logistics and design / development) that work closely with the explosives units. The department management were assigned the responsibility of discussing the questions with the personnel in the departments and giving feedback to the project team.

The project team's own experiences regarding training and competence transfer were also grouped with the answers givens from the various departments.

3.2.1 Question 1: What is the general competence and training like in your department?

Production departments:

- All personnel have good knowledge of HSE and work descriptions.
- All operators have Basic I and II, and most have subject B and a few have subject A.
- Training in use and understanding of product safety data sheets could be improved.
- The level of competence with regard to products and technology could have been higher. Knowledge of products and technology has deteriorated in the last 5-10 years.
- Training lacks systemization
- Less time for training new operators in the various work descriptions, as there are fewer operators in the last few years.
- Practical vocational training must be documented better.

Support departments:

- The employees have good general competence with regard to language, computer equipment, HSE and products.
- Vocational training through external courses is well taken care of through own department / the training department.
- Internal courses regarding safe handling of explosives. The structure and effect of explosives is slightly more varied and depends upon the various departments.
- There is no structured training of salaried workers and the requirements set for this.
- There should be a better survey of competence and the requirements that must be set to fill the various functions in the organization.
- There should be better training in the requirements relating to and use of personal safety equipment. This also applies to understanding and use of HSE data sheets.
- Should be more open to and employ new technology both with regard to technical aids, product and production methods.

3.2.2 Question 2: How is competence transfer taken care of in case of resignation/retirement and workforce reduction?

Production departments:

- Theoretical education in accordance with Nammo Raufoss AS internal control step 2.
- Review of work descriptions for each operation or machine.
- New operators team up with more experienced operators in production.
- Job rotation in key work operations

- Have a ”no. 1” and ”no. 2” operator for special machines and operations so that there is always a back-up available if one is away due to resignation/retirement or illness.

Support departments:

- Newly recruited salaried workers should be allowed to the greatest extent possible to team up with experienced personnel, but in practice there is very little overlapping between two people in the same job.
- Knowledge is based very much on the individual and there is very little management of this on the technical side.
- A marginal workforce means that the company is very vulnerable if people are absent.
- People seem to be more important than competence when replacing individuals.
- No plans for competence transfer when a person leaves or retires.
- 1RK has developed a database, a type of experience bank, which does not depend on individuals.

3.2.3 Question 3: Do you have specific suggestions for possible improvements in training and competence transfer?

Production departments:

- Revise Basic I and II
- Regular refreshment of theoretical and practical knowledge, e.g., every 3rd – 5th year.
- Make operators sit an approved test in order to be able to work in the explosives industry.
- Use employee appraisals between operators and supervisors as part of the competence survey, competence transfer and establishment of experience databases.
- Increased use of tools, which mean that the company works more systematically with regard to training and competence transfer, e.g., STRAK and 6-sigma.
- Improve written work descriptions through visualization.
- Use electronic aids in production in order to visualize tool assembly or the product in a 3-D model.
- Have practice models or ”kits” available.
- Experience bank regarding near misses and incidents.
- Establish the possibility for individual operators to register their experiences in a database.
- More use of job rotation.
- Mentor scheme
- Give the possibility to function in the ”new” job situation and ensure that there is back-up in the department.
- Strengthen competence among maintenance personnel with regard to general knowledge about safe handling of explosives and the relevant products found in own department.
- Salaried workers in support functions who participate actively in explosives departments should take part in an ALLEX course.
- More participation of salaried workers in production.
- Use competence transfer sessions in a better way than today in order to improve work descriptions and products. The 6-sigma tool can be used to a greater extent here than today.

Support departments:

- Formalize salaried worker training with regard to working in areas where there are explosives.
- Identify competence that may be lost when a person leaves or retires.
- Identify what competence the company needs in future.
- Establish plans and routines for competence transfer and replacement of key personnel (contingency plans).
- Ensure that there is an overlapping period for the replacement when someone leaves/retires.
- Improve documentation of own competence.
- Competence databank for each department.
- Use STRAK tool in departments and for individuals.

4. DISCUSSION AND RECOMMENDATIONS

4.1 Scope of competence transfer

The survey of the 56 years and older group indicates that competence transfer is generally taken care of, but this is done at local level. Existing routines are used very little and the work appears to be random and not particularly synchronized, when you look at the organization as a whole.

Around half of the employees are regarded as having competence that requires special measures to replace and a replacement has been designated for around 70% of these (refer to figures 1, 2 and 3)

With regard to the remaining 30%, however, only half of these have functions directly related to the explosives industry. This involves a total of 9 employees compared with the total of 100 employees (refer to figure 4). Only one of these 9 is an operator.

4.2 Theoretical training and competence transfer

Strengthened and more formal theoretical training is one of recurring points in many of the answers in the survey. Training of operators and salaried workers at Nammo Raufoss AS has been illustrated in annex 1 and 2.

In accordance with Nammo Raufoss AS' internal control step 2, employees who shall work in explosive areas shall take two basic courses before they can work independently. These courses include, among other things, acts and regulations, health, safety and environment, product know-how and the company's organization and policy (Basic I and II). In addition, a supplementary course dealing with the composition and qualities of explosives is mandatory (step II).

This is in the process of being changed so that these courses are mandatory for all new employees at Nammo Raufoss AS, regardless of whether they will be handling explosives or not. This also applies to salaried workers, but in practice this is not followed up to the same extent as for operators. This means that salaried workers do not receive this training, but that this is very much left up to each department and is less formal. Feedback from the various departments, however, indicates that it should be required that salaried workers working in explosives departments or as support to these must take part in Basic I and II and also the ALLEX course.

It has also been pointed out that all newly employed salaried workers, who shall co-operate with or take part in the production departments should be involved in the production work for a period in order to learn the special conditions to which he or she must relate. This includes in particular situations involving work routines, safety instructions and other HSE matters.

Training of new employees in Nammo Raufoss AS could be improved in the initial phase. We envisage that a Basic I course that lasts for 2-3 working days and focuses on the following subjects:

- Explosive goods
- Safe handling of explosives
- Building requirements
- Processing

- Acts and regulations
- Responsibilities
- Risk factors and effects for the most relevant products in the various departments. Expert personnel from development and production should be used in this training.

In addition, the following aspects should also be included in Basic I:

- Demonstrations of different products, reactions from various stimuli, shock, fire, etc.
- Understanding and use of product safety data sheets
- Tour of several departments

Basic II is mainly kept as it is in the individual departments.

Personnel working in explosives departments, including maintenance personnel, should have regular repetition of some of the content of Basic I and II, with emphasis on safe handling of explosives and near misses that have occurred. The refresher course should be concluded with a theoretical and practical test to document competence.

As far as knowledge about products / technology in the various production departments and their effect is concerned, it was commented that the level of competence among the operators could have been improved. One observation was that product know-how had deteriorated over the last 5 – 10 years. A contributing factor to this is lack of participation by the product managers, which is due to increased workload and fewer employees. This means that there is less time for salaried workers to be present on the production lines, which means that we can lose important communication between operators and planners, product managers, development and quality personnel, among others. This communication has previously been a good contribution to mutual training and quality assurance and should be strengthened.

Technology and product know-how is generally good among the salaried workers, but there should be more structured and systematic training. In connection with this it was commented that the company should be open to and use new technology both with regard to technical aids, products and production methods.

Good knowledge about the products is not an initial condition for making good quality products under safe conditions, but it helps increase understanding and creates a holistic way of thinking in the departments. One of the aims should be that through increased knowledge about products / technology personnel can be more involved and be assigned greater responsibility. This importance of this was emphasized especially for operators, where the level of competence with regard to this was regarded as being lower than among salaried workers.

4.3 Practical training and competence transfer

In all of the production departments interviewed, training in each work operation begins with the process engineer in charge or the supervisor reviewing the written work description. One of the suggestions for competence transfer is a more visual work description with available empirical data for the operation in question.

Another measure is to use electronic aids in the production areas in order to visualize tool assembly or 3D-models of products, at the same time as the tool / machine / product is available for testing. This would give a much better understanding of the operation sequence and method.

A third measure is to have practice models or ”kits” available. These mean that you don’t have to rely on using ordinary products to practice on and therefore there is less pressure for time during the training situation.

Experience workshops can also be used in a better way to improve work descriptions and product production. The 6-sigma tool can be used to a greater extent here than it is today.

Competence transfer, where new operators team up with more experienced operators in the production areas, is organized to a great extent so that the new operator observes the operation in question first, then participates together with a more experienced operator and finally takes over the operation himself / herself. The training time for more general and simple work operations may take from one day to one week. Using a mentor in the form of an appointed experienced operator may strengthen this arrangement. The responsible line management must consider who is suitable. Operators with Discipline A are currently an untapped resource.

As far as more special and demanding work operations are concerned, however, all the production departments have the arrangement that a replacement for an experienced specialist operator is appointed in good time. These two then work closely together so that the competence is exchanged. The training time in such cases varies, but in one case the younger operator has teamed up with the older operator for more than one year. Feedback from the production departments is that this arrangement seems to works well.

In two of the production departments (1MF and 1ML) there is widespread use of job rotation, especially in the key work operations, both within the line, between the lines and between the departments. This creates a holistic understanding, greater flexibility and less load for each operator. The disadvantages of job rotation are that some operators are less confident with new work and therefore this increases the risk of poorer product quality and delays in the line.

The principle of having a ”no. 1” and a ”no. 2” on special machines and operators, so that there are always two experts available, has also been practised. However, the experience is that this may be difficult to implement in practice in some cases, as ”no. 2” is not given the opportunity to work on the special machine or operations due to a marginal workforce.

4.4 Survey of competence and systematic competence transfer

A survey of competence and systematic plans for transfer of competence transfer has also been mentioned in several of the replies. This also reflects the results of the survey carried out on the 56 years and older group.

A survey of the competence among salaried workers and an assessment of the company’s future competence needs must be used to a greater extent today. This must be seen in relation to the objectives and strategies of the company and each department. This also includes a definition of which positions, products, machines and production methods that require special competence. The Human Resource Department’s competence survey and definition of job categories and job elements in co-operation with the Norwegian Defence is a good start.

Furthermore, employee appraisals can also be used as a tool to register and increase awareness about the competence each worker has, whether he / she is an operator or salaried worker.

In order to ensure continuity in competence transfer, we recommend that the administration make a list at regular intervals of personnel who are approaching retirement age. For example, this may be done every 2nd year, and be sent to the relevant management in the company. Each manager must decide and report back whether competence transfer is necessary and whether any measures must be taken.

However, each manager must be required to develop (contingency) plans for replacement of key personnel and resources must be allocated so that these are executable. In some cases, this means overlapping is necessary so that knowledge, which is difficult to document, may be transferred. The Human Resources Department plays an important role here, both as initiator, support and driving force behind implementation.

Introduction of electronic registration of personal information would establish a more accessible competence database. Moreover, increased use of tools, such as STRAK and 6-sigma, would enable systematic and more structured work methods with regard to surveys, training and competence transfer.

4.5 Experience databases

Use of experience databases in competence transfer is also mentioned frequently in many of the replies from the various departments.

An example of this is an experienced database that is not person-dependent, which has been established in 1RK. Each employee works systematically with notes, minutes of meeting and relevant documents, which are registered in this database. The example from 1RK, with regard to a personal electronic archive, should be developed further. A suggestion with regard to this has been that personnel could register their experiences in such databases.

Documentation of near misses and incidents can also be registered in this database and thereby can help be an important element in strengthening the HSE work.

It is important to make such experience banks readily available to everyone, e.g., through use of the Product Data Management system (PDM).

5. CONCLUSION

The survey of the 56 years and older group indicates that competence transfer is more or less taken care of at Nammo Raufoss AS, but that this is done differently from department to department. Existing routines and tools are not used enough and the work seems to be rather random and not very synchronized, when looking at the organization as a whole.

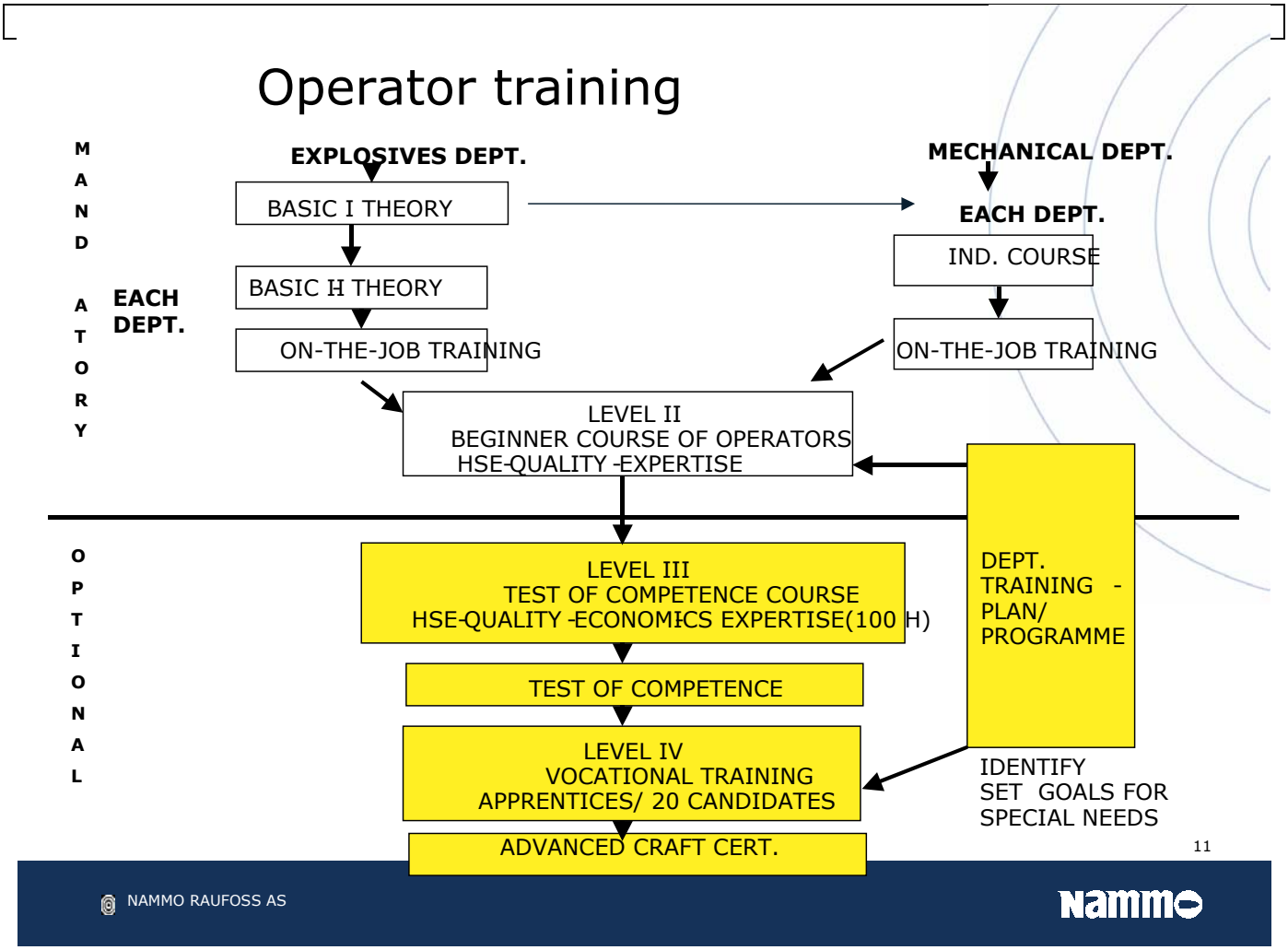
Based on the answers given there are many ways in which to exchange competence, both at organizational level and between individuals. Elements that are important for being able to strengthen the competence transfer work are:

- Strengthened and more systematized theoretical training.
- Salaried workers who shall work in and with explosive areas must have taken the Basic I and II and ALLEX courses
- Regular repetition of theoretical training with emphasis on safe handling of explosives and on past near misses and incidents. Repetition must be concluded with a theoretical and practical test to document competence.
- Improved work instructions using visual and electronic aids. Use 3D models, training objects and ”kits” for the purpose of training.
- Increased use of job rotation both between lines and departments.
- Improved survey of competence in the company and definition of the positions, products, machines and production methods that require special competence in the future. Tools such as STRAK and 6-sigma can be used to a greater extent than today. This will enable systematic and more structured work methods.
- A list of personnel approaching retirement age shall be made at regular intervals in order to ensure continuity in competence transfer. The Human Resources Department plays an important role here as initiator, support and driving force behind implementation of this.
- (Contingency) plans should also be developed for replacement of key personnel and resources must be allocated so that these are executable.
- Establishment of experience databases that are readily available, e.g., use of the Product Data Management system (PDM).

6. REFERENCES

1. Personal communication with Hans Wallin, NAMMO Vingåkersverken AB
2. Personal communication with Hans Frode Homb, NAMMO Raufoss AS
3. FEX 2000 project assignment, ”How shall experience be transferred between two generations – an interview and survey”, Nils Roman, Kurt Karlsson and Perry Lundqvist
4. FEX 2003 project assignment, ”How shall middle-management’s explosive know-how be maintained in a constantly changing organization?”, Helena Stenmark, Kjell Enevoldsen, Helena Bergman, Torgny Carlsson, Ann Kjemtrup
5. FEX 2004 project assignment, ”Safety in explosive areas in a streamlined organization”, Anne C. Syljuåsen, Per Olav Stangjordet, Jostein Lundgård, Morten Dyrud, Knut R. Kristensen
6. Project assignment text (suggestion no. 1) FEX 2005, Hans Frode Homb

Annex 1 Operator training



Annex 2 Salaried worker training