A Study of how repeated Accidents, Investigations and Recommendations Affect Safety

Project work submitted in partial fulfillment of the requirements for the MSc in Human Factors and System Safety

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INTRODUCTION

Background
On the 13th of June 2004 two Combat Boat 90, CB 90; from the 1st Amphibious Regiment, Amf 1, collided just north of Sollenkroka Brygga in the archipelago of Stockholm. In the collision one CB 90 ran into and up on the other, causing the instant death of two Marines who where standing in the gun mount on the deck of the first boat. The Swedish Accident Investigation Board, SAIB, investigated the accident and after one year and nine months published their findings in the report "Report RM 2006:01 "The Collision between two Combat Boats 90, north of Sollenkroka Brygga, Vindö, AB län, on the 13th of June 2004". In the report, the board made five recommendations to the AF.

After the accident the Commanding Officer, CO, of Amf 1 and the Boat Commander, BåtC, of the second boat was brought to trial by the judiciary system. The CO for breaking the Occupational Safety and Health Act and the BåtC for recklessness at sea and involuntary manslaughter. The indictment of the CO was rejected and the BåtC was convicted for the accused crimes. Both sentences were then appealed to higher court. In May of 2008, higher court upheld both sentences.

In May of 2006, a film from an incident that occurred at the Regiment in 2004 was played in the media. Marines were filmed during a shooting exercise wearing improper clothing, i.e. they were naked. The film and the ensuing media interest put focus on the safety culture. Although not a breach of safety rules per se, the question was raised if the incident was a sign of a culture not in accordance with standards in the AF, AF. The HQ launched an investigation into the incident; the investigation involved a large number of personnel at the Regiment. The investigation presented its findings in a report that was published in September 2006.

In the spring of 2007, two years and nine months after the fatal CB 90 accident and one year after the revelation of the shooting incident a consulting firm, ACTEA Consulting, was brought in by HQ to make a renewed risk assessment of the amphibious system and investigate the culture in a broad sense at the Regiment. Their task was:

> Many serious accidents and incidents have occurred in the amphibious system, the reasons for which must be elucidated so that operations can be accomplished in accordance with the Supreme Commanders intentions regarding safety.
>
> To reach these goals operations shall be safety guaranteed for a long time and the safety culture shall be analyzed and improved.
>
> The safety culture in the organization with the latent problems that, under certain circumstances, can cause incidents and accidents shall be identified, analyzed and documented. Concrete actions shall be suggested as a basis for measures within the SwAF.
>
> The project shall include a deep analysis of the safety culture and suggestions to improve it in order to reach a long term reasonable level of safety. It also includes identifying and mapping existing processes as well as latent problems and analysis of the use of existing safety tools.

> The expected result of the project is a scientifically analyzed and documented description of the safety culture in the organization and suggestions of concrete measures to minimize risks and problems. (Actea, 2007, p. 3)

The firm published their findings in the report: "Final Report: Safety Analysis of the Amphibious System". Actea gave eight recommendations and suggested six areas where more research is needed. As this is written, one year and six months after the report Amf 1 have made an analysis of the report but no actions have been taken as a direct result of the report (personal communication mj A .Blom, head of safety Amf 1, September 2008), HQ has started to analyse the report (personal communication, ltcmdr M. Greigård, HVK September 2008).

Problem

The media interest in both the accident and the trial was huge, resulting in both newspaper articles and major features in the two largest investigating journalism shows on national television. The disclosing of the shooting incident gave the newspapers and the television shows another opportunity to replay the CB 90 accident.

The SAIB investigation, the shooting incident, the culture investigation, the trial, the large media interest in the accident and the trial, and the perceived constraints in the training of boat crews and the tactical use of the CB 90's put an enormous strain on the organization. On top of it all the Regiment, in October 2005, one year and four months after the CB 90 accident changed its main base, to Berga south of Stockholm. During the preparations, the completion and after the move the Regiment still solved all its major missions and tasks, putting even more strain on the organization and its personnel.

Intention

In this project work it is my intention to find out what actions has been taken to increase safety after the Sollenkroka accident. It is also my intention that, through research, find out if these actions have had any impact on safety, i.e. has safety increased, and to make suggestions as to what can be done to further increase safety.

In the discussion I will take into account research from Dekker (2006), Vaughan (1996) and Snook (2006), to see if their findings can explain some of the safety problems at Amf 1.
I also intend to analyze the pressure that the organization has been under ever since the accident and find out which impact the ever increasing demands, investigations and research into the organization and its culture has had on safety.

Acronyms and definitions

In this work I have used the Swedish acronyms for military units and denominations. In cases where there is a widely acknowledged or official English acronym it has been used, for example CB 90, in these cases the Swedish acronym is mentioned below. For acronyms and denominations that are not military I have used official English acronyms or, where there are none the Swedish ones.

AF:	The Swedish Armed Forces, www.mil.se
SAIB:	Swedish Accident Investigation Board, a Swedish government agency tasked with investigating accidents and incidents. www.havkom.se
Amf 1:	1st Marine Regiment. www.mil.se
HQ:	Headquarters, the headquarters of the AF. www.mil.se

CB 90:	Combat Boat 90, a fast troop transport and "gunship" boat used by the Swedish Marines. In Swedish, Stridsbåt 90, Strb 90.
SÄKINSP:	The Safety Inspectorate of the Armed Forces, handles safety inspections and audits. Develops and maintains safety regulations and instructions.
SjöI:	The Naval Safety Inspectorate, a part of SÄKINSP, is responsible for the inspection of all naval ships and boats and the audits of units' safety management systems.
ACTEA:	A Management Consultant Company
RegO:	Regimental Order, orders from the CO to individuals, parts of or to the whole regiment.
TNT:	Tactical Nautical Training Team, team consisting of CB 90 trained officers with the stated purpose to support, evaluate, standardize and develop CB 90 training and operations.
DIUS/M:	The naval forces safety reporting system
MSS:	AF Ground Warfare School, responsible for, among other things, fast rope safety and training.
BRM:	Bridge Resource Management, also called MCRM Maritime Crew Resource Management.
BåtC:	Boat Commanding Officer
AG Strb:	HQ working group for CB 90 Safety, constituted after the Sollenkroka accident.
FMV:	The Swedish Defence Materiel Administration, a Swedish government agency tasked with developing, procuring, implementing and maintaining defence materiel such as the CB 90.
SSS:	AF Naval Warfare School
STCW 95:	Standards for Training, Certification and Watch keeping for Seafarers which is the International Maritime Organizations, IMO, regulations for the competence of sailors.
G 10:	The section of Amf 1 regimental staff that handles, among other things, safety. Consists of a number of officers and civilian personnel, among them two responsible for safety at sea (boats and ships), one for traffic safety, one for training safety and one for work environment.
SMS:	Safety Management System.
MI:	The Inspector General of the Naval Forces, the naval forces consists of the Navy and the Amphibious Corps.
FMMS:	AF Safety Management Manual, MI manual for safety
ICAO:	International Civil Aviation Organisation
MAIIF:	Marine Investigators International Forum

Organisation

In order to understand the organisational elements of the text it is necessary to explain Amf 1 internal organisation and put Amf 1 into the larger context of the AF.

Under the CO of Amf 1 there are five units: the Amphibious battalion which trains marines and units, two training groups tasked with training the Home Guard in Amf 1 area of responsibility and a Garrison unit who takes care of, among other things the training facilities. In the Amphibious battalion there is a small staff and five companies. Staff –, ranger –, rifle –, logistics – and a CB 90 training company. The regimental staff consists of ten sections. One of these, G 10, handles, among other things, safety.

The HQ consists of a number of sections and commands among these are plans and policy, budget and finance, training and procurement, personnel, operations, intelligence and security,

communications and public affairs and a legal department. In this organisation safety is handled by a safety section within the operations department, and reports to head of operations. The SÄKINSP is organised in the HQ staff and reports to the chief of staff AF. CO Amf 1 is commanded by operations concerning operations, by training concerning training, personnel concerning personnel and so on.

METHOD

This work has been done in two steps; firstly I conducted a document study and secondly I conducted qualitative research at the Regiment. In the first phase I studied the investigation report from the SAIB regarding the Sollenkroka accident, the investigation report from the investigation into the shooting, the ACTEA investigation report and also orders and instructions given at Regimental level. In the second phase I conducted qualitative research consisting of interviews with officers from the Regiment.

Disposition

Document study

In the document study I establish which recommendations that the reports gave and what measures where taken and which orders where given, both on HKV level and on the Regimental level, in effect of these recommendations. I also establish which level in the organisation, i.e. HKV or Regiment, that where the subject of the recommendation.

Interviews

I then proceeded to interview personnel at the Regiment. The interviews where semi structured, i.e. they where focused on several issues that I found to be of certain interest in the document study. Besides these issues the informants where given the opportunity to express their concerns and views on safety in general and specifically regarding the CB 90 system.

In order to evaluate the implementation and impact of recommendations, measures and orders on different levels in the organization I interviewed officers from four different organizational levels at the Regiment. The levels stretching from the sharp end to the blunt end (Dekker, 2006), from instructor-, platoon-, company- and battalion level to the regimental staff.

Discussion

In the discussion section I discuss five topics which I have found to be important after my studies of the three reports and the interviews conducted. These are (1) recommendations and how they are constructed, (2) drift and how it shows in the organization, (3) safety culture, (4) pressure and its impact on safety work at the Regiment and (5) vertical communication within the larger organization.

RESULTS

Documentstudy

SAIB, Report RM 2006:01 The Collision between two Combat Boats 90, north of Sollenkroka Brygga, Vindö, AB län, on the 13th of June 2004
All recommendations in the report are directed to the AF, not directly to Amf 1, this means that HQ is supposed to give Amf 1 orders regarding measures and actions to be taken regarding the recommendations.

Below are the summary and recommendations of the report, followed by HQ and Amf 1 measures.

> On Sunday 13th of June 2004, five CB 90's was returning to their home base at Amf 1 on the island of Rindö after a weeklong exercise in the Stockholm archipelago. Weather was sunny and clear with weak to moderate winds. The CB 90's was marching in a column at 30 to 35 knots when they came into the sound at Sollenkroka. There was one or two Marines standing in the gun mounts on deck of the CB 90's. At the lighthouse Branten the first boat reduced speed to about two knots to reduce swells in consideration of a moored sailing boat. The crew of the second boat did not notice the manoeuvre in time and as a result drove into and up on the first boat. The two Marines in the gun mount of the first boat were killed instantly.
> The investigation shows that the risk of such an accident was imminent even at the entrance to the sound at Sollenkroka. The distance between the boats was too short in proportion to their speed. The crew of the second boat was not aware of this risk.
> The crews did not have any instructions concerning safety distances, separation, methods for estimations of distance and speed adjustments when driving in line or of communications between the boats when manoeuvring to reduce swell.
> The accident was caused by the regiment's lack of safe and complete methods for driving CB 90's in columns. This meant that the instructors did not have enough guidance when training the crews and that the crews did not receive enough knowledge concerning driving CB 90's in columns.
> The risk of rear-end collisions when making long marches with CB 90's was known in the naval forces since an earlier risk inventory. Actions had been taken to reduce the risk of rear-end collisions caused by fatigue. However, all of the actions suggested in the inventory had not been taken.
> It has been difficult to get a clear picture of the training received by the crews. The fundamental CB 90 training was conducted with instructors from last years CB 90 class, course literature was not always used; the training was built on mouth to mouth tradition. After examination the students strengthen their knowledge and proficiency as CB 90 crew members in the units of which the CB 90 is a part. In the company of which the crews belonged there weren't any officers with CB 90 training. During the exercise in question the crews did not have commanders which were CB 90 trained.
> In the work ascertaining the reason for the accident, SAIB has had problems in finding out how the CB 90 operations are managed and run. The regulations are complex, not complete and sometimes contradictory. Several examples of this is accounted for in the report. There has also been insufficient implementation of the rules and regulations.
> At the time of the accident a first safety audit had been conducted at the regiment. SjöI did not pass the regiment in the audit. Furthermore the CB 90 operations were not a part of the audit, which was determined in consultation between Amf 1 and SjöI. It has also come to our knowledge that the boundaries between the supervising entity, SjöI, and the supervised

organization are unclear. Inspectors from SjöI are placed in parts of the organization of which they are supposed to inspect. This shows that the independence between supervisor and supervised is not enough.

SAIB gives the following recommendations to the AF, AF shall regarding the last recommendation, *RM 2006:01* R5, consult with the Maritime Administration:

- AF should do a renewed risk inventory of CB 90 operations accompanied by a plan for actions, follow-up that necessary safety enhancing actions are taken, verify their effect on safety, when needed create a new plan of action and document the stages in the process. *(RM 2006:01 R1)*

A renewed risk inventory has been made and different suggestions for actions have been made to MI. Analysis of these suggestions is ongoing. When the analysis is finished MI will formulate tasks so that the necessary plans will be developed. How follow-up and verification shall be done must be described in these plans. (personal communication Ltcdr M Greigård, HQ, October 2008)

Regarding the first recommendation, RM 2006:01 R1, the HQ ordered the ACTEA investigation referred to below. This investigation seems to bee the action taken regarding R1. In the HQ task description to ACTEA the recommendation is not mentioned, however the mission statement to ACTEA mentions "… several serious accident and incidents …" (ACTEA, 2007) which implies that the Sollenkroka accident is among these.

- AF should revise rules and regulations regarding training of CB 90 crews and operations with CB 90's, put the rules and regulations in manuals and other instructions. Make sure that the rules and regulations become better known in the whole organization and become routine in training and operations with CB 90's. *(RM 2006:01 R2)*

In the case of R2, Amf 1 and HQ has revised a large number of rules and regulations regarding both training and operations with CB 90's, most of which are stated in Amf 1 RegO 060509. The ordered measures were also put in the training and operation manuals for the CB 90. MI has, in March of 2006 decided which CO is responsible for developing safety related training on which type of vessel. CO Amf 1 is in this decision responsible for the CB 90. (Amf 1, 2006) (Greigård)

- AF should examine the possibility to use officers with CB 90 training as instructors and for further development of the training of CB 90 crews. *(RM 2006:01 R3)*
- AF should work so that most of the officers and commanders that has CB 90 crews in their organization shall have CB 90 training and, that there should be experienced CB 90 officers that has direct responsibility for the progress of the crews during their [the crews] tour of duty. Such an officer should be present at exercises to support the CB 90 crews.*(RM 2006:01 R 4)*

Regarding R3 and R4 Amf 1 has suggested to HQ that a TNT should be set up at the regiment. The team would consist of CB 90 trained officers who would be dedicated to follow and evaluate CB 90 training and operations. Amf 1 was ready to implement the team, including recruitment of officers, in April 2004. HQ was unable to approve the suggestion because of monetary reasons. (personal communication, Maj A. Blom, Head of Safety Amf 1, September 2008)

HQ is today planning to instigate a TNT which will be organizationally placed at HQ and to be used at all units who trains CB 90 crews. (Greigård)

- AF should make sure that the supervising entity, the Naval Safety Inspectorate, and its personnel are organizationally clearly separated from and, in all respects, are independent from the supervised organization. *(RM 2006:01 R6)* (p. 5 – 7)

This recommendation does not concern Amf 1, however, the safety inspectors of the Naval Safety Inspectorate still organizationally belongs to the units they are tasked with inspecting. No inspectors belong, however, to Amf 1.

Investigation Group for investigating certain training conditions and attitudes at Amf 1

Below are the summary and recommendations of the report.

> On the weekend from the 5th to 6th of July in 2004, an exercise with training rounds (tracer) for the Carl Gustaf recoilless rifle took place at Myttinge shooting range. Some of the soldiers that carried out the exercise wore helmets and hearing protectors and nothing else, i.e. they were naked.
> The initiative to carry out the exercise had; most likely, come from the soldiers themselves and no one came to any physical harm or injury. There were no form of coercion or bullying connected with the exercise.
> The cause is judged to be a spur of the moment decision were the officer in charge did not realize that the exercise was ethically unsuitable. He could not in full judge the consequences of his decision and could not withstand the soldiers wish to carry out the exercise naked.
> It is the investigating groups' opinion that other breaches of the AF common value ground could happen again under similar circumstances if no actions are taken.
> The underlying cause is a leadership problem on all levels, and a question of how personnel matters are handled strategically on the central level. Due to the lack of older experienced personnel, younger officers has to take too much own responsibility. If the underlying causes are not corrected the conditions for future breaches remains. (p. 1)
>
> Recommendations
>
> - The placement of the personnel department should be considered in the process with the ongoing review of AF central command structure.
> - Personnel matters should be getting the same attention as equipment matters.
> - AF HQ should revise the personnel frameworks of the units in order to reach a sufficient amount of officers on the platoon level. The age structure [regarding officers and instructors] on the platoon level should also be revised.
> - AF HQ should, together with unit commanders, analyze the consequences when removing personnel from the units.
> - Methods and competence for personnel placement at the units should be revised.
> - AF HQ should use this report as a learning example on a commander's conference.
> - AF HQ should, together with the units Information Officers (IO), use this event as a starting point for discussions concerning information handling.
> - Reality based training concerning CO's responsibility and actions in personnel matters should be implemented.
> - Reality based training concerning ethics and morals for conscripts as well as officers should be implemented.
> - Training at the Officers Academy should contain practical leadership exercises.

- Routines concerning ammunition handling at Amf 1 should be revised.
- The use of safety regulations at Amf 1 should be revised.
- Training regarding the benefits of using the safety reporting system should be carried out at Amf 1.
- All units [in the AF] should ensure that the individuals' qualifications to carry out certain exercises are documented. (p.18 – 19)

Amf 1 has taken measures to recommendations three, nine, ten, eleven and thirteen. Amf 1 considers the rest of the recommendations to be directed to AF in general or other parts of the organization. Amf 1 has, however, analyzed all of the recommendations and taken measures where suitable and possible.
Regarding reality based training concerning ethics and morals; recommendation nine in the report, Amf 1 considers the ongoing value ground project in the AF to be the basis for such training, at Amf 1 the results from the project is continually used for discussions and training regarding morals and ethics.
The use of safety regulations and ammunition handling at Amf 1 was audited by the AF Safety Inspectorate in May of 2008.
The AF Naval Forces safety reporting system DIUS/M is not yet fully implemented at Amf 1, training and information has been done on a large scale during 2007 and spring and summer of 2008. (personal communication, Maj A. Blom, Head of Safety Amf 1, September 2008)

This report was presented to deputy CO of the Armed Forces. I have not found that any actions have been taken as a direct result of the report. Several of the recommendations is, however, handled within the transformation of the human resources restructuring in the Armed Forces.

ACTEA Consulting, Final Report: Safety Analysis of the Amphibious System

The study by ACTEA was conducted partly because of the first recommendation of the SAIB report into the Sollenkroka accident. (personal communication, cmdr H. Undén, head of safety HQ, November 2008).

Below are the summary and recommendations of the report.

> The study showed that there were large differences in the safety culture and of the way the different parts of the system "thought" about safety. Added to this there are areas with obvious risks.
> The study showed that the Amphibious systems purpose and goals are poorly communicated. There is little knowledge and understanding about the systems purpose and goal.
> The system has a very strong group culture which; regarding loyalty, was very homogenous. However the interpretation of loyalty and its underlying values varied a great deal which made the result extremely heterogeneous in the group as a whole.
> There are obvious risks in this culture, among them the reluctance to compare one self with other organizations with the same kind of operations, the expressed desire to deliver so as to not disappoint other parts of the system (for example not complain, not cancel). There is an obvious "I can do it" attitude. This could lead individuals to take bigger risks and ignore problems (for example inadequate maintenance) than they usually would.
> The study has also identified a palpable hierarchical structure with varying status among the subunits. Certain key functions felt that they had not been prioritised and therefore was low on the "status ladder" (among these the CB 90 and logistics units). Risks in this kind of culture is evident in the wish of units low on the scale to show that they are "worthy" by

taking bigger risks to get a higher status. This can also be expressed in a wish to "deliver at any cost", even when purpose and goal is neither expressed nor ordered. The study also showed a high confidence in the management although it [the management] seldom questioned dangerous situations. There could be a peer pressure not to question as this could be construed as a weakness in certain subcultures with a high status. There were also signs that certain subgroups cultures were isolated.

The study also showed a considerable lack of communications both horizontally and vertically, and also in the understanding of processes and formal responsibility. This has been especially evident in the logistics and medical functions and in the combat boat system.

The processes are badly defined and hard for individuals in the system to follow and utilize, which means that the processes contains risks and attitudes which has been described above.

Of significance is the scarce use of the safety reporting system. Knowledge of how the system works and its benefits are low. The few reports that are in the system has not been evaluated and followed up, this means that the system couldn't be used for "lessons learned" and to prevent accidents.
There are a number of activities that is considered dangerous and hazardous. The report specifically points to the Boarding Team and the trial and evaluation unit.

Among the recommendations in the report, "benchmarking" with other parts of the maritime sector concerning safety, the necessity to develop a positive culture regarding safety reporting and the use of the safety reporting system stands out. The report also recommends adapted training regarding safety cultures and attitudes for all officers.

The report also recommends training in risk management. (p. 5 – 6)

The report continues with recommendations and suggestions of countermeasures, these are divided into two groups, areas where, according to the report, there is need for further investigation and where measures should be taken immediately. The report also suggests methods for implementing recommendations and suggestions.

Areas that need more investigation and research

1. Examine the Boarding Team operations for risks and benchmark with pilots among others.
   We see a very high risk in the operations of the Boarding Team. We suggest that the operations is examined in detail with the use of observation and benchmarking with others who conducts this type of boarding, for instance the Maritime Administration, the European Maritime Pilots Association and other organizations.

The Boarding Team is training according to stipulated goals. The Team has had informal contacts with the Maritime Administration and has trained fast roping with the help of MSS. The Regiment feels that the HQ should appoint an Armed Forces representative for boarding, the whole responsibility for development of procedures, tactics and safety regulations should not be handled at platoon level. (personal communication, Maj. A. Blom, Head of Safety Amf 1, September 2008)

2. Observe and analyse the work with the new crew configuration for the CB 90.

We recommend that observations and interviews are done with the help of BRM and maritime evaluation tools to determine how well the new paradigm fulfils demands on and routines for maritime safety. After this train instructors and crew.

Amf 1 has adopted the new training schedule for the armed forces, the effect of this is that the ability of the boat crews has been somewhat lowered regarding the driver and the navigator and has been considerably raised regarding the BåtC. Large parts of BRM are already incorporated in the training of the BåtC. The Regiment considers the new crew configuration to be a significant improvement. The new configuration is in part a result of an HQ working group for CB 90 safety. (Blom)

3. Benchmarking with other maritime systems.
   We are of the opinion that it would help to study other maritime system inside the AF to compare the systems and see how far "good practise" can be transferred in both directions and to help determine routines and procedures for "good practise".

Amf 1 has participated in AG Strb which has compared different maritime systems. The Regiment has also trained instructors for the course Fast Vessels which is held under the authority of the SSS. SSS is certified for this course by the Maritime Administration according to STCW 95 regulations. (Blom)

4. Analyze the ergonomics on the bridge in the CB 90 regarding accidents involving personnel on the bridge.
   We are of the opinion that it would be helpful to investigate how the operators' environment could be developed with a human factors perspective to facilitate both operational and maritime safety.

The Regiment considers the ergonomics of the CB 90 bridge to be a HQ/FMV commission, Amf 1 is eager to participate when being called upon. (Blom)

5. Examine "Safety Management"/the Safety function based on how work should be reorganized so that focus is on safety.
   We consider it necessary to investigate to what extent a reorganisation, with the focus on maritime safety, safety reporting, safety management and its adjoining systems, could be made and what the consequences of such a reorganization would be.

There are no regulations or principles of how a safety function should be organised at a Regiment or Flotilla. FMMS states that there should be a Safety Officer at the unit [regimental or flotilla] staff and that the safety officer shall have direct access to the CO, besides this there is nothing directing the organisation of the safety function.

6. Investigate and suggest methods for follow-up and tuning of safety and safety attitudes.
   We are of the opinion that tools for both safety analysis and attitudes measurement should be implemented to give regular and practical data, which gives management the possibility to check the organizations "health" regularly and to develop a system for continuous improvement.

Amf 1 has started a process to improve the quality assessment in the organization. There are also internal and external audits of the SMS which could function as a health check of the organization. (Blom)

The safety reporting system should be the most important tool in the improvement process. There is, however, not enough resources at HQ level to manage the safety reporting system.(personal communication Cap. J. Welander, Traffic Safety Officer Amf 1, September 2008) I conclude with his assessment. When I investigated the sinking of a CB 90 in autumn of 2006 it showed that there were three safety reports in the system regarding the same problems as led the boat to sink. None of them had been acted upon prior to the sinking; all of them were a HQ level action item. (Author)

7. Complement the selection of boat crews with suitable BRM criteria (those that are measurable.
   We are of the opinion that the selection criteria for boat crews should be examined and tested [sic] for an appropriate attitude towards maritime safety (BRM oriented). (p. 14 – 15)

Amf 1 has since the middle of the 1990's worked with the selection of boat crews, specifically the BåtC and the navigators. This work started as a result of the high number of trainees that didn't get through the training programme. As much as 30 – 40% of the trainees failed to pass the exams. Because of this Amf 1 changed the training methods and started to develop a selection process. The training was changed with help from the Swedish Air Force who, in the 60's and 70's, had the same problem. Parallel to this the development of a selection process began in close cooperation with AF Recruiting Centre which handled the selection for combat pilots. Today the selection process includes a psychological evaluation, a test which measures the selectees' simultaneous capacity, an interview with an experienced CB 90 officer and an evaluation board consisting of psychologists and officers from the Regiment. Today almost 100% of the trainees complete the training. The selection process is under constant improvement. (personal communication Cap. H. Frössen, dep. CO CB 90 Company, Amf 1, September 2008)

Areas where measures should be taken immediately:

1. Adapted training in BRM and "Safety Management"
   We are of the opinion that all officers should participate in regular BRM courses and regular BRM refresher courses. We are also of the opinion that a specially adapted BRM training course should be introduced to all personnel. This course should be directed against certain critical issues, for example the corps spirit, so that the "I can do it" attitude is redirected towards safety, so that a real "blame free culture" is adopted, so that "challenges" is understood to be positive and not negative and that reporting is done in a good way and is understood. Such an adopted BRM should have a high priority, be early in the training schedule and take advantage of the best aspects of both army (Marines) and nautical (Navy) culture. Such a modified and (maybe) shortened BRM type of course would markedly raise the safety consciousness. It would also contribute to create a "shared mental model" within the organization – and markedly increase the homogeneity in the safety thinking.
   Another advantage would be the development of a common "toolbox" for safety, where one would get away from solving safety issues with rules and regulations (which the organization regarded as both needless and unnecessary).
   Other advantages would be the creation of a "common vocabulary" for safety work, which would render a simpler and plainer communication and mutual, objective, commonly acknowledged evaluation models.
   A course in "Safety Management" theory and praxis for the for the management would create a better starting point for understanding and decision making, lead to a

greater awareness about human error and give the opportunity to develop effective safety tools and an effective safety climate.

Amf 1 has started to train several officers in BRM, including the deputy CO. However, there has been budget cutbacks and a shortage of space on the available BRM courses at SSS so too few officers had had the chance to participate. Amf 1 wants the HQ to develop a special adapted course that can be held locally at the Regiment. (personal communication, Maj. A. Blom, Head of Safety Amf 1, September 2008)

FMMS stipulates that unit management; ship management and boat commanders shall receive training in MCRM. (HQ, 2008)

HQ has stated a process to develop an adopted BRM course which would better suit BåtC and instructors in the naval forces. (personal communication, cmdr H. Undén, November 2008)

2. Mentoring

   Establish a mentoring system for the younger officers so they can try problems and ideas, especially in areas where they miss expertise and where they can confront difficult decisions which would cause delays or postponement of activities.

Due the personnel situation in the AF, Amf 1 has difficulties in establishing a working mentoring system; also the Regiment has requested more personnel for this purpose. (Blom)

3. Apply already safe routines, models etc. which are already in use in the merchant marine and in the Navy.
   Apply the same established safety praxis and routines as in the rest of the maritime sector. (This will create three positive results, a. Develop a mutual praxis that will facilitate job rotation, b. Contribute to the development of a "shared concept" – model and a common culture and also, c. Promote interoperability and understanding).

Amf 1 has participated in AG Strb which has compared different maritime systems. The Regiment has also trained instructors for the course fast vessels which is held under the authority of the SSS. SSS is certified for this course by the Maritime Administration according to STCW 95 regulations. (Blom)

4. Use the nautical knowledge that exists within the amphibious system so as to use the available experiences.
   There is a whole lot of maritime competence and experience in the system. We are of the opinion that this could be used better in training as well as during operations. Establish and develop a "Nautical Training" team which focuses on evaluation and coaching from a maritime perspective. These should maybe function as mentors, guides, safety analysts and sources of competence.

   Establish and develop a "Nautical training" team which should be focused on evaluation and coaching in a maritime perspective. These should maybe function as mentors, guides, safety analysts and sources for competence.

Amf 1 has suggested to HQ that a TNT should be set up at the regiment. The team would consist of CB 90 trained officers who would be dedicated to follow and evaluate CB 90 training

and operations. Amf 1 was ready to implement the team, including recruitment of officers, in April 2004 as an action taken regarding recommendations three and four in the SAIB report.. HQ was unable to approve the suggestion because of monetary reasons. (Blom)

HQ is today planning to instigate a TNT which will be organizationally placed at HQ and to be used at all units who train CB 90 crews. (Greigård)

5. Structure checklists (SOP) with participation from the users.

   We are of the opinion that an improved system with standard routines and checklists should be developed with the full cooperation from the operators this would make the routines and checklists user friendly, usable and enhance the understanding for the use of such checklists and their purpose.

New checklists are under development at the Regiment by the users as this is written. (personal communication Cap. H. Persson, Safety officer (Sea), Amf 1, September 2008)

6. Develop a system with work rotation which would render possible for officers from the Regiment to serve in other systems, both to benchmark and to enhance mutual understanding and interoperability. Naval officers from other systems should also rotate through the Amphibious system for the same reasons. All parties would be exposed to new ideas and impulses which would help the improvement process.

The 3rd Naval warfare flotilla is regrouping to Amf 1 during 2008 which would make work rotation possible in 2009. (Blom)

7. Get to know and use the safety reporting system so that advantages can be derived from it.
   Train and use the safety reporting system on all levels of the organization to create a correct picture of risks, to use the system not just to "fix" problems but also to use it as a training tool to avoid that the discovered problems lives on. With other words; to use it as a "lessons learned" system. Such a use is ineffective without the attitude changes suggested above.

The Naval Forces safety reporting system DIUS/M is not yet fully implemented at Amf 1, training and information has been done on a large scale during spring and summer of 2008. (Blom) At HQ level there is not enough resources to manage the safety reporting system which shows in the large number of reports that is left unhandled by the safety department at HQ. (personal communication Cap. J. Welander, Traffic Safety Officer Amf 1, September 2008)

The ACTEA report is still being analysed at HQ by a specially tasked group. No actions regarding the report have yet been taken.

All of the above recommendations, except three in the report regarding the shooting incident, is directed to the AF not to Amf 1 directly. Several of them, for instance instigate a TNT, personnel matters in the organization, training at the officers academy, benchmarking, ergonomics, the safety function, BRM/MCRM courses, mentoring, work rotation and the safety reporting system, are recommendations that points to problems that the Regiment can't solve without more resources or in close cooperation with higher authorities. Several suggestions regarding resources, primarily human, have been sent to HQ without results. HQ has, according to Amf 1, not done anything tangible, regarding most of the recommendations, especially the ones in the ACTEA

report. The Regiment is unsure about to whom several of the recommendations is directed and which recommendations the Regiment are supposed to act upon. Clear and direct orders or instructions' regarding the reports and recommendations has not been given by HQ. (Blom)

HQ has taken actions regarding most of the recommendations; the recommendations that has not, or just partially, been addressed are under consideration. (Greigård)

Many of these actions and considerations have, however, not been communicated to and/or understood at the Regiment.

Interviews

With the interviews I intended to validate the implementation of the measures and orders given, and also the conclusions in the ACTEA report. The interviews were conducted with officers from different levels at the Regiment; instructors, Platoon commanders, Company commanders, personnel from battalion management and from G 10 were interviewed. This sharp end – blunt end (Dekker, 2006) approach also gave me the possibility to determine differences between levels in the organization.

The informants where given questions about the Amphibious systems purpose and goal, group culture, mentoring, safety reporting, safety work, safety system processes, safety improvements since the Sollenkroka accident, safety analysis's and safety attitudes after the Sollenkroka accident. The informants where also asked to comment on perceived pressure due to the large number of investigations, questionnaires and interviews that had been conducted at the Regiment since the Sollenkroka accident.

The question about system purpose and goals comes from the ACTEA reports conclusion (ACTEA, app. 2, p. 12) that the systems purpose and goals are poorly communicated and poorly understood in the organization. Poorly communicated and understood goals and purposes leads to questions about to what extent the management guides and directs the creation of culture, if an organization cannot communicate its purpose and goals, which are at the very core of organizational culture and which should have a large impact on the organizations core values, the organizational managements impact at the sharp end can be questioned.

In the interviews I intended to find out if there had been any changes since the ACTEA report where presented. The result where that the informants from the instructor and platoon level still had difficulties to express the Amphibious systems purpose and goals. Their views were not consistent with each other, or higher management's views, and lacked a mutual understanding on the issue. On the higher levels however a coherent view of the goals where evident which I associate with an, at the time, ongoing project, on company and battalion level, to describe the Amphibious system in the future. My interviews therefore confirms the ACTEA reports conclusion "…that there are few proof of a "shared mental model" in terms of goals …". (ACTEA, app. 2, p. 12) Progress is, however, being made in the ongoing project.

The question and following discussions that were of the most concern to the informants was about group culture and group hierarchy. During the interview the informants were shown the culture hierarchy graph from the ACTEA report and asked to comment on it. (ACTEA, 2006, app. 3, p.7) The informants confirmed the ACTEA reports conclusion:

> "That there are a number of potential attitudes and to attitudes related behavioural problems that supposedly can be linked to such a hierarchy, among these a wish to show that personnel

> in the lower parts of the hierarchy are just as competent as those higher up (and therefore raise themselves) which could be evident in a bigger risk taking, ignoring unsafe circumstances to get the job done, ignoring or adjusting to unsafe materiel, keeping a high tempo and omission to question unclear or unrealistic goals." (app. 2, p. 7)

Several of the informants concluded that management confirmed and enhanced the cultural hierarchy; this is especially evident in such things as the order in which commanders get to speak at meetings, who gets certain missions and duties and, above all, who is excepted from certain duties. These phenomenon's can, at first glance, seem small and insignificant but they seem to uphold the culture hierarchy.

The IG report focuses to a large extent on personnel matters, placement of personnel, age structure, and the number of personnel on the "sharp end" (Dekker, 2006). On the same premise the ACTEA reports recommends "Establish a mentoring system for the younger officers so they can try problems and ideas, especially in areas where they miss expertise and where they can confront difficult decisions which would cause delays or postponement of activities." (ACTEA, app 2, p. 16) I therefore asked questions about which impact older, experienced personnel had on the way work was conducted, and if the officers felt that they had access to experience in their daily work. The IG reports concludes:

> The younger officers today don't have any older colleagues that share their own mistakes and slips as officers. The younger officers are instead extremely at the mercy [sic] of their own limited knowledge and experience. The older and more experienced officers are nowhere to be found. Role models are hard to find. (IG, p. 16 – 17)

This was to a large extent confirmed by the younger informants. There is, today, no effective mentoring system in force on Amf 1, and I dare to conclude, in the Armed Forces as a whole.

The next area I focused on in the interviews was safety reporting, both the ACTEA and the IG reports has conclusions and recommendations concerning deficiencies in safety reporting.
A functioning safety reporting system is the engine that drives and promotes improvements in a safety management system; if the reporting system does not work, the safety system does not work. The informants where well aware of the benefits of a safety reporting system, that it supports learning from errors, that it can be used for lessons learned etcetera. However, the informants agreed that the system do not work properly, for example, that feedback is poor or nonexistent. The notion mentioned in the Investigating Group (2006) report: "There is a common notion among the instructors that a report will result in punishment, or alternately, that materiel and/or equipment will be taken out of use [which will reduce the effectiveness of training and create big problems for the units]" (Investigating Group, p. 14) is not evident in the interviews. This means that the training in "… the benefits of using the safety reporting system …", (IG, 2006) which was a recommendation in the Investigating Group report and also mentioned in the ACTEA report has been carried out at Amf 1 and that the results of the training is good. The attitude of the personnel regarding the benefits of the system has changed for the better. The technical system for safety reporting is, however, not fully implemented and not in full use.

In the interviews, I asked questions intended to investigate if the SAIB recommendations after the Sollenkroka accident had had any impact on safety and attitudes among officers towards safety regarding CB 90 operations. The informants are concordant in that they feel that safety concerning CB 90 operations have been considerably increased since the accident, and that this is especially evident in the new rules regarding separation of boats during operations. The rules are followed and the authority of the BåtC is not questioned in this or in any other respect, which

was common before the accident. None of the informants had any doubt of the competence of the boat crews. This is also an improvement from the time before and around the accident.

The informants where also asked to comment on perceived pressure due to the large number of investigations, questionnaires and interviews that had been conducted at the Regiment since the Sollenkroka accident. They where also asked about the interest from the media and what influence this has had on the Regiment. The informants were concordant in their views that, yes, there had been a lot of investigations, questionnaires and interviews since the Sollenkroka accident. That they had, when conducted, hampered operations and training. The impact was, however, smaller than the informants had imagined before the investigations was conducted. The huge media interest, indeed media witch hunt, took a huge toll on the informants. They feel that the picture of the Regiment and its personnel painted in the media where unfair and one sided. The media witch hunt also affected the informants on a more personal level, several mentioned that they noticed heightened stress levels at work and that the pressure from the surrounding society increased. This where evident in that they, when the accident or the Regiment were mentioned in the media, often had to defend their choice of profession and the Regiment to friends and associations. This affected daily work and operations, in this the informants where in accord, they, however, did not feel that safety deteriorated because of this. Regimental management was, during this time, focused on safety and safety processes, which, according to the informants impregnated the whole organization.

DISCUSSION

Recommendations

There are many recommendations in the reports that have not been fully addressed or not addressed at all. Specifically the recommendations that are general in their format and directed to the Armed Forces. Sidney Dekker addresses the problems in writing recommendations in his book The Field Guide to Understanding Human Error (2006). According to Dekker recommendations can aim high or low on the causal chain, low being close to the operators and high, higher up in management.

> Recommendations low on a causal chain aim for example at retraining individuals … or at denoting them or getting rid of them in some other way. Other low-end recommendations may suggest to tighten procedures, presumably regimenting or boxing in the behaviour of erratic and unreliable human beings.
> Alternatively, recommendations can aim high, at structural decisions regarding resources, technologies and pressures that people in the workplace deal with. High-end recommendations could for example suggest to re-allocate resources to particular departments or operational activities. (2006, p. 175)

Recommendations that aim low on the causal chain don't deal with the bigger systemic problems, after implementation of the low-end recommendation the "potential for the same trouble is left in place". (Dekker, 2006, p. 175). High-end recommendations on the other hand have the possibility to deal with systemic problems higher-up in the hierarchy of the organization. According to Dekker (2006), low-end recommendations are easy to implement and give a low effect on future safety and high-end recommendations are hard to implement and give a high effect on safety. The majority of the recommendations in the reports are high-end. They are aimed at the whole of the Armed Forces and very generally formulated. They need a great deal of interpretation as to both the way in which they need to be addressed and the preferred outcome when implemented. Formulated in this way recommendations are very hard to act upon.

Dekker (2006) has developed a criteria to use when developing recommendations called the SMART acronym:

- **Specific**. You want your recommendations to be clearly specified. Which parts of what organisation do you want to do what and when?
- **Measurable.** You want your recommendations to somehow contain "measurable" criteria for success. This will help you and the organization see if it is indeed implemented, and monitor the effects once it is.
- **Agreed** (or at least agreeable). You want your recommendations to take into account legitimate organizational concerns about production or efficiency, otherwise you will not get any traction with those responsible for implementation and achievement.
- **Realistic.** While your recommendations may be difficult, and challenging to the typical worldviews of those who need to get to work with them, you need to keep them realistic-that is, doable for the person responsible for implementing them.
- **Time-bound.** You want the implementation of your recommendation to have some kind of suggested expiration date, so decision makers can agree on deadlines for achievement. (Dekker, 2006, p. 174)

None of the recommendations in the reports fulfils the whole SMART criteria, in fact very few of them fulfils even a part of it.

All of these criteria can hardly be answered in one short recommendation. A system with a short recommendation, as the ones in the reports, accompanied with an appendix where each of the items in the criteria is laid out in further detail can be the answer to the problems organizations face when trying to implement recommendations. In the work with recommendations the "Agreed" criteria seems to be the most important, understanding creates motivation which in turn creates a willingness to change. Important in this case is understanding and agreement on all levels, otherwise the "sharp end" and the "blunt end" (Dekker, 2006) will have different opinions of what is doable and what is not.

Early in 2008 I investigated a grounding with a CB 90 in the archipelago of Stockholm, the investigation and the recommendations where acknowledged by G 10 Amf 1 as easy to understand and the recommendations as easy to implement. (personal communication, A. Blom, head of safety, Amf 1, April 2008) This was mostly due to the "Agreed" criteria in the SMART acronym which I used in the investigation and the process of developing recommendations.

Examining investigation manuals from ICAO (2001), NTSB (2002), MAIIF (2008), US Army (1994) and the US Coast Guard (2004) shows that they reveal nothing more than rudimentary instructions about developing recommendations. Besides Dekkers work I have not been able to find anything with substance concerning this question. The importance of recommendations however is without dispute, NTSB (Sweedler, 1995) claims that 80 % of the more than 12.250 recommendations the agency has issued since 1975 have been implemented.

The types of recommendations given in the reports, that are not specific, measurable, agreed upon, realistic and time-bound, leaves the door open for interpretations of what they really aim for. More developed recommendations, with the help of the SMART criteria and my own suggestions above, would give the receiving organization a better chance to further enhance safety.

Drift

Diane Vaughan (1996) describes in her book The Challenger Launch decision what she calls normalization of deviance. Which, according to her, led to the explosion of the space shuttle Columbia. Scott Snook (2000) in his book about the shootdown of two U.S. Black Hawk helicopters over northern Iraq by friendly fire from two U.S. F-15 fighters describes what he calls practical drift as the reason for the tragedy. They, from very different perspectives, describes complex organization with well developed, well tried and documented routines, well trained and experienced personnel which, slowly and inevitably, in small steps and influenced by a large number of factors has transformed from a safe organization to an organization with multiple incentives for an accident. When this transformation takes place it is hard to recognize and therefore hard to fix or stop. The signs that can be observed are, by the involved personnel, interpreted as something normal and something that has to happen. The reasons for this are several, among them is pressure to produce and produce on time, reduced resources and that the organization loses its institutional memory, i.e. the explanations of why the organization does what it does.

The most obvious examples of drift in the reports are the repeated remarks about experienced officers that should serve in different capacities. This is evident in recommendations three and four in the SAIB report and in three, four, five, ten and fourteen in the IG report as well as number two and four in the section of the ACTEA report that lists areas where measures should be taken immediately. Experienced older officers who mentor, trains and, indeed, raises the younger personnel are a commodity in short supply. With lack of mentoring younger operators tend to "invent the wheel" again. Institutional memories of earlier mishaps and mistakes have

disappeared with older personnel and learned experiences have not been documented. Why certain things are done in a certain way are therefore lost in the fog of history. Without this knowledge it is easy to cut corners and, for example, omit small checks and controls. Thus creating drift and launching the organization on its inevitable and slowly drifting path towards disaster.

Safety Culture

The ACTEA report is focused on safety culture and suggests a number of measures that could be taken to improve the existing culture. Safety culture is a wide field and I wont elaborate on it any further, there is however one phenomenon that I would like to call attention to. Several of the informants called my attention to it and I was myself aware of it since my time as a company commander. A small unit at Amf 1 has a remarkable safety history, since its operations began there has been only one serious accident and then the organization was in another system, another unit, with procedures outside of its control; procedures which they had questioned without result. The unit trains and operates special operations divers, an activity that is complex, physically demanding, has a high safety standard and is inherently dangerous. Studying the units' activities I see several of the central concepts of High Reliability Theory (Rochlin, La Porte, Roberts, 1987); leadership commitment, redundancy, decentralisation, creation of safety culture and learning. It is remarkable how the units discipline changes from very formal to informal dependent on the type of operations the unit are performing. This change comes effortlessly and without effort, and, to a bystander, with only minimal command influence.

It could be argued that diving is such a specified and dangerous activity, that what I have described is only natural and shows nothing but self preservation. What I also have noticed in this unit is that the "culture" of diving spills over from the diving activities to everything the unit does and, probably as a result of this, they are on the top of the cultural hierarchy described in the ACTEA report. A deeper understanding of this phenomenon would certainly help Amf 1 in creating a safety culture of this kind in the rest of the organization. The signs of a High Reliability Organisation, HRO, are visible, but that does not answer the important question of how this culture is created. After studying reviews on safety culture (Guldenmund, 2000, Choudhry, Fang & Mohamed, 2006) I find no research or explanation that could help in understanding how this culture is created. The reviewed research is very much directed at describing, operationalize, characterize and conceptualize safety culture or, indeed, culture in a much broader sense. Much work has been done to find and describe means to asses safety culture, its underlying reasons and causes such as attitudes and core values. I have not, however found any research that has explained what it is, at the operational level, that creates a positive safety culture. Some scholars have described the elements they believe to be involved in the creation of a positive safety culture, Choudry, Fang & Mohamed (2007) summarize them as;

> … management commitment to safety; management concerns for the workforce; mutual trust and credibility between management and employees; workforce empowerment[i.e. stop work authority]; and lastly continuous monitoring, corrective action, review of system and continual improvements to reflect the safety at the work site. (p.1005)

I miss, however, a clear description of how it can be accomplished. This subject clearly needs to be addressed. The culture in the diving unit should be researched in order to determine what it is that makes it so successful regarding safety and, indeed, also regarding training objectives and operational goals. There is reason to believe that god, or outstanding performance, in one area also affects or depends on performance in another area. If this is true then safety culture should not be treated as an entity but as an aspect of the overall organisational culture.

Pressure

I was convinced when I started this project work that external pressure had hampered safety work at the Regiment, I found, however, no signs of this. Instead I found that the heads-up that the accident had given the regiment had strengthened its safety commitment and enhanced the roles of its safety officers and the safety processes. The repeated investigations, interviews, questionnaires, the media witch hunt and the judicial proceedings had off course had impact on the personnel's and, especially, the staffs' workload and it can be argued that the increased workload has hampered safety work. I have, however, found no signs of this.

Communication

When studying the recommendations and what actions that has been taken in regards to them the difference between what the HQ has actually done in regards to the recommendations and the Regiments perception of the same stands out. Several of the informants also pointed out that HQ seemed to be doing nothing regarding the recommendations. This has created an "us and them" attitude at the Regiment; better information from the HQ to the Regiment would solve this problem.

CONCLUSIONS

Recommendations, formulated as the ones in these three reports, are hard to act upon. With the suggestions given in this work and the SMART (Dekker, 2006) acronym I conclude that that recommendations could have a much larger impact on safety than they have today.

Amf 1, and indeed the whole of the Armed Forces need to nurture its institutional memory. Older experienced officers closer to the actual training of the soldiers would create better natural mentoring and transfer of experience. This would in turn help in avoiding drift.

Safe activities, in this case diving, needs to be researched to be able to explain how their culture is created and maintained. Understanding what makes these cultures work could help in building and maintain others.

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