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OIL SPILL RESPONSE IN FINLAND AND THE CO-OPERATION WITHIN BALTIC SEA COUNTRIES

Abstract

Finland as one of the Scandinavian countries in northern part of Europe is situated by the Baltic Sea, the largest brackish water basin in the world. It is located between Russia and Sweden and its neighbouring countries include also Estonia and Norway. The area of Finland covers a significant part of the Baltic Sea, the northern side of the Gulf of Finland, the northern part of the Baltic Proper and the eastern side of the Gulf of Bothnia. The total length of the Finnish coastline without taking into account thousands islands, capes and bays is about 1,200 km. About 80% of Finnish exports and imports are carried by marine transport, and all Finnish harbours can freeze in the winter. Therefore safe navigation routes and routines, adequate ability to respond oil and chemical spills even in winter conditions and good cooperation with neighbouring countries in this respect, is a necessity for Finnish authorities.

This paper gives an overview of oil combatting organization, legislation and readiness in Finland based on national resources and international agreements. The Baltic approach to oil combatting and cooperation between Baltic Sea countries is discussed mainly based on the work of HELCOM (Baltic Marine Environment Protection Commission) Helsinki Commission, which is the main international body in the Baltic Sea.

During the past 15 years, a lot of laboratory studies, field tests and methods development for combatting oil in cold conditions has been carried out in Finland. This work and the outcome of similar development in other Scandinavian countries is also shortly presented in the paper.

1. GENERAL

The response area of Finland covers a significant part of the Baltic Sea, the northern side of the Gulf of Finland, the northern part of the Baltic Proper and the eastern side of the Gulf of Bothnia. The total length of the Finnish coastline without taking into account islands, capes and bays is about 1,200 km. Due to the thousands of islands and the broken shoreline, the total length of the shoreline that can be affected in oil spills is about 16,000 km. The narrow fairways, which make navigation difficult especially in wintertime and in high sea conditions, are also significant to Finnish waters. About 80% of Finnish exports and imports are carried by marine transport, and all Finnish harbours can freeze in the winter. Therefore, navigation that is as safe as possible in ice conditions and an adequate capability to combat oil in connection with marine accidents in wintertime as well is a necessity for Finnish authorities.

During a normal winter, the northern part of the Gulf of Bothnia gets its ice cover in November, and the ice time lasts about 5 months. The Gulf of Finland is also normally covered with ice for a 3-month period, and the ice conditions especially in the eastern part of the Gulf can be very difficult even in springtime due to pack ice caused by prevalent western winds. The maximum solid ice thickness is normally from 0.4 to 1.0 m, but the main navigational difficulties are caused by pack ice, which can be several metres thick. All ice in Finnish waters is one-year ice, and due to the low salinity of the Baltic Sea, the salt channels are much smaller than in ocean ice.

2. THE OIL SPILL RESPONSE ORGANIZATION IN FINLAND

2.1 General

The environmental emergency response at sea in Finland is based on relevant Finnish laws and regulations, which specifies among other things in a comprehensive way the responsible authorities, their obligations and the deviation of their task when combatting against oil pollution at sea and on land. The legislation does not yet cover other harmful substances than oil as well. However the governmental authorities, which are responsible for oil combatting at sea, take care of Finland´s international obligations for other kind of pollution incidents at sea, too.

Finland is a signatory to five major international conventions relating to marine pollution:

- The Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention)
- The agreement on mutual assistance between Finland, Norway, Denmark, Sweden and Iceland (Copenhagen). Under the terms of this convention, the Nordic countries will take joint action in the event of accidental spill in the marine environment.
- The Finnish-Soviet cooperation agreement for the recovery of oil and other hazardous chemicals in accidents affecting the Baltic Sea area. Finland and Russia have agreed bilaterally to honour this agreement in practice for the present.
- The Finnish-Estonian agreement on the cooperation in combatting against pollution incidents at sea.

- The 1990 International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC). While this agreement outlines the same basic duties and responsibilities as the multilateral agreements listed above, its scope is global.

2.2 International co-operation

HELCOM, Helsinki Convention

As far as the co-operation within oil spill response among the Baltic States is concern, Helsinki Commission (Baltic Marine Environment Protection Commission) is the main body, and all Baltic countries including the European Commission are contracting parties to the commission. Up to the end of 1999 it had a permanent committee called the Combatting Committee, which dealt with combatting matters, both oil and other harmful substances. From the beginning of 2000, the Maritime Committee and Combatting Committee have been put together under the name the Sea Based Pollution Group, which has in practice the same obligations as the former two separate committees. Decisions taken by the Helsinki Commission are regarded as recommendations to the governments concerned. These HELCOM Recommendations are to be incorporated into the national legislation of the member countries.

The main recommendations that deal with oil combatting are as follows:

- RECOMMENDATION 1/1: Measures to Ensure the Use of Reception Facilities for Wastes for Ships
- RECOMMENDATION 1/8: Recommendation on Minimisation of the Use of Dispersants, Sinking Agents and Absorbents in Oil Combatting Operations in the Baltic Sea
- RECOMMENDATION 6/2: Restriction of discharges from oil refineries
- RECOMMENDATION 10/5: Guidelines for the establishment of adequate reception facilities in ports
- RECOMMENDATION 11/13: Development of national ability to respond to spillages of oil and other harmful substances
- RECOMMENDATION 12/5: Promotion of the use of safer tankers while carrying oil
- RECOMMENDATION 12/6: Development and use of oil drift forecasting
- RECOMMENDATION 12/8: Airborne surveillance with remote sensing equipment in the Baltic Sea Area
- RECOMMENDATION 12/9: Follow-up studies in connection with major oil spills
- RECOMMENDATION 17/11: Reception facilities.
- RECOMMENDATION 17/12: Measures to abate pollution by oil and other harmful substances in cases of grounding, collision, sinking of a ship or other maritime casualty
- RECOMMENDATION 17/13: Use by the Baltic Sea states of the manual on co-operation in combatting marine pollution within the framework of the Convention on the Protection of the Marine Environment of the Baltic Sea Area,
- RECOMMENDATION 19/8: Application of the "no-special-fee" system in the Baltic sea area
- RECOMMENDATION 20/5: Minimum ability to respond to oil spillages in oil terminal

HELCOM has drawn up a combatting manual, which is a practical guide to the contracting parties and above all to the combatting authorities for co-operation among the Baltic countries. It is now only in paper form, but there are plans to make it available on the Internet. HELCOM also organises combatting exercises focussing on co-operation or special areas of combatting on a regular basis. There have been special exercises for shoreline cleaning, combatting in shallow waters, the combatting of dangerous packed goods and one oil combatting exercise in ice conditions as well (in the Gulf of Bothnia outside the city of Oulu, 1994)

Other international agreements

The northern European countries have signed the **Copenhagen Agreement**, which is a treaty between Denmark, Finland, Iceland, Norway, and Sweden on co-operation in combatting marine environment incidents.

Finland also has bilateral agreements with **Russia and Estonia**, which are our neighbouring countries in the Gulf of Finland.

The Copenhagen Agreement and the bilateral agreements are consistent with and complementary to the Helsinki Convention. They are forums to handle matters of regional importance in combatting maritime pollution incidents. Regular exercises are also conducted in accordance with these three agreements.

2.3 Responsibilities

The national responsibilities in oil combatting is divided mainly between governmental and local (municipalities) authorities.

The Finnish Ministry of the Environment has the supreme responsibility for the management and supervision of the oil pollution response. The Finnish Environment Institute operating under the Ministry, is the competent government oil pollution combatting authority. It is in charge of measures against pollution incidents at open waters and whenever severity of an incident so necessitates. The Institute is also the nationally appointed competent authority, that is empowered to request and give international assistance in combatting marine pollution caused by oil or other harmful substances.

Finnish Environment Institute with its staff is leading combatting activities on open sea, in public fairways and also in other areas if the spill is of such magnitude that the local authorities are not reasonable able to cope with it. When a vessel gets into a situation which includes a pollution risk, the Finnish Environment Institute may within the Finnish territorial waters or even outside the territorial waters as the international agreement concerning intervention provide, when it considers it necessary, give an order to undertake such rescue and salvage activities which are intended to avoid or limit the pollution risk. The Finnish Environment Institute may also give an order about salvage activities. Before undertaking these activities, the Institute will consult with the owner of the vessel, with the responsible maritime inspector, with the representative of the

insurance company in question and with the representative of the salvage company as far as it can be done without causing undue delay.

Among other things it belongs to the responsibilities of the Finnish Environment Institute to purchase and to develop governmental oil combatting equipment and to decide which combatting methods are to be used. Mechanical removal of pollution is strongly preferred and use of chemicals for oil combatting requires an advance approval of any chemical and a decision of the Finnish Environment Institute for each case. The Institute advises regional and local authorities on their combatting organization and their contingency plans.

Each municipality is responsible for arranging combatting oil spills in its sea and land area. The municipality´s Response Commander (usually a fire marshal) is leading an oil combatting action. If a spill is a concern of several municipalities, the regional fire marshal may take the position of the Response Commander for all action and coordinate joint efforts of municipalities and regional government authorities. In large land spill situations as well as in beach cleaning combatting action may also be led by the Regional Environment Centre.

Different organizations are liable to assist the Finnish Environment Institute and other above mentioned oil pollution combatting authorities on request. These organizations include: Governmental authorities like the Finnish Maritime Administration, Coast Guard, Defence Forces (especially the Navy), Institute of Marine Research and local oil combatting organizations. Private companies as salvage companies are also liable to assist with resources at their disposal.

2.4 National Oil Pollution Fund

Finland has implemented special financial arrangement for combatting oil spills. The acquisition and maintenance of municipal oil combatting equipment is subsidised through a **special oil pollution fund.** Central government is also entitled to these equipment subsidies. The capital for the fund is raised by a levy of FIM 2.20 on each ton of oil imported to or transported through Finland. The charge is doubled if oil is transported in a single hull tanker; this measure is aimed at making the cost of such transport prohibitive.

3. MATERIAL READINESS IN FINLAND

3.1 Material and temporal preparedness

HELCOM Recommendation 11/13 (1990) on the development of the national ability recommends among other things adequate response measures and readiness times for them. The Contracting Countries should be able for spillages of oil and other harmful substance

> "(i) to keep a readiness permitting the first response unit to start from its base within two hours after having been alerted;

(ii) to reach within six hours from start any place of a spillage that may occur in the response region of the respective country; to ensure well organized adequate and substantial response actions on the site of the spill as soon as possible, normally within a time not exceeding 12 hours,"

The first responders in Finland for open sea incidents are the patrol vessels of the Finnish Frontier Guard. There is normally such a vessel on patrolling duty on every sea area. Those patrol vessels are able to start measures needed to secure a casualty against further harms like sinking, leaks or fire and also to make the first booming around it. One of those patrol vessels, Merikarhu is an oil recover vessel and able to some missions needed because of a chemical spill, too. Municipalities have about 70 oil combatting boats of a length of 10-15 metres and a couple of hundreds smaller boats, whose readiness fulfills two hours demand on coastal waters on ice free conditions. From those municipal boats12 boats have among other things stiff-brush oil recovery system fitted permanently inside vessel.

Further the Baltic Sea countries should respond to major oil spillages

"(i) within a period of time normally not exceeding two days of combatting the pollution with mechanical pick-up devices at sea;"

In Finland there are eleven Government owned ship-size vessels with an oil recovery brush system fitted permanently inside vessel. The vessels are multipurpose vessels, manned and used by several different authorities and normally used as supply vessels, patrol vessels, for fairway maintenance, etc. They are situated along the coast so that theoretically most of the places can be reached by one of them within six hours from start from their home port. There is however some areas outside such an radius and one of the most important shortcomings is the lack of one vessel in the eastern part of the Gulf of Finland.

Name of vessel	**Length**	**User**	**Home port**
Halli	60 m	Navy,	Turku
Hylje	54 m	Navy,	Upinniemi
Merikarhu	58 m	Finnish Coast Guard,	Helsinki
Letto	43 m	Finnish Maritime Administration,	Oulu
Linja	35 m	Finnish Maritime Administration,	Pori
Sektori	33 m	Finnish Maritime Administration,	Mariehamn
Kummeli	28 m	Finnish Maritime Administration,	Savonlinna
Oili I	24 m	Finnish Maritime Administration,	Helsinki
Oili II	24 m	Finnish Maritime Administration,	Turku
Oili III	24 m	Finnish Maritime Administration,	Mariehamn
Oili IV	19 m	Finnish Maritime Administration,	Vaasa

The first seven vessels have an ice class and can also operate in ice conditions. However, their normal oil combatting equipment, in-built brush collector with sweeping arm booms, cannot be used in ice. But these vessels can be used as platforms when

using ordinary skimmers to collect oil among ice, rope mop, and other skimmers or when using special auxiliary equipment designed for ice conditions.

Because of long distances it takes three days before most of those vessels will be on the same place anywhere on the Finland`s response region. Before that, within 12 hours one of those vessels will quite likely start combatting measures in the Gulf of Finland, in the Archipelago Sea or in the Gulf of Bothnia. Then, in general it is quite certain that there is at least one vessel within 24 hours and two vessels within 48 hours in use anywhere on the Finland's response region. Finally, after three days the total sweeping performance of government owned oil recovery vessels is about 14 square kilometres per day (2 knots velocity during 12 hours) and exceeds well the requirement of HELCOM guidelines (4,5 sqkm/day).

3.2 Methods

Especially Finland's northern geographical location places special requirements on recovery and cleanup methods. Development efforts have focussed on improving operational efficiency at low temperatures and in icy conditions. In practice, the ability to recover high-viscosity oil is a basic requirement. Cleanup operations often take place in temperatures that are below the point at which oil becomes a solid. In these cases, conventional surface skimming equipment designed for the recovery of light oil is inadequate.

Stiff brush skimmer technology has proven a reliable oil cleanup method at low temperatures and for heavy oil. In this method, oil-laden water is running through rotating brush units and oil is swept up by brushes. Floating oil and tar balls adhere to the brushes, which are scraped clean. The oil is then pumped into the vessel's holding tanks. Besides its high capacity for mechanical recovery, this method collects only small quantities of water, normally less than 5%, which is an important advantage. There are various mounting options: the recovery units can either be fitted permanently inside the vessel, or installed at the front or on both sides of the vessel using hook attachments. Even if permanently mounted, these units take up relatively little space, so that the vessel can be in normal use when it is not needed for cleanup operations or oil combatting exercises.

4. COMBATTING OIL IN COLD AND ICY CONDITIONS

4.1 General

The Finnish Environment Institute and the Finnish companies that are manufacturers of oil combatting equipment have made numerous micro and macro scale laboratory tests to develop new and improve existing combatting methods and equipment. Most promising new methods are tested also in full scale. Based of the research work, below is a presentation of the major technical development work regarding oil combatting in cold and icy conditions that has been conducted in Finland during the past 15 years:

4.2 Technical development in Finland

Ice Cleaner (Ice bow)

The Lori Ice Cleaner is designed to operate in broken ice at sea, in lakes, rivers and ports. Its recovery process is carried out by a two stage brushing and water pumping system. The actual operational equipment owned by the Finnish Environment Institute has the following parameters:

- Total length 14.25 m
- Moulded breadth 6.00 m
- Operational draft 0.85 m
- Displacement 25 tons
- Material aluminium
- The maximum thickness of ice blocks, where the unit can be used, is about 0.5 metres

The Ice Cleaner is designed to be a removable unit attached to the bow of a tugboat, icebreaker, etc.

The Ice Cleaner has been tested in 1991 with 1.2 tons of different types of oil, Russian crude oil and two Norwegian emulsions. As a conclusion of the tests it was evident that the bow can collect oil among ice, but the capacity was low perhaps mainly due to the small amount of oil allowed to be used in the tests. During the test, oil rather soon spread to a large area in the broken ice field, building thin oil layers to the ice blocks, from which it was difficult to detach. The first prototype of the Ice Cleaner was used in the last stages of the second Antoni Gramsci spill 1987, and the operational equipment is now a standard instrument used, when there is a threat of an oil spill in icy conditions.

Combined shoreline cleaner and ice cleaner

A rotating brush with a pump inside the bucket possible to use with typical excavators has been developed for cleaning up oiled shores or oil on water in icy conditions. In the tests conducted by the Technical Research Centre of Finland (VTT) the recovery rates in broken ice conditions were about 50%. In shoreline cleaning, the recovery rate was better, in some tests even 80%.

Development of the suction technique

The method has been developed for removing heavy oil from the bottom tanks of a sunken or grounded vessel. The equipment consists of a vacuum pump, oil separation, hose and heating units. With the same special hose, high-pressure steam can be transported to the heavy and perhaps solid oil in the tank and then by the suction technique to pump the oil via the separation unit to the tanks of the recovery vessel. The Finnish Environment Institute has two such complete units, and they have been used several times in connection with accidental grounding and emptying oil tanks in sunken vessels.

Ice Saw

Ice saw, a combined cutting wheel and an amphibian vehicle. It is capable of cutting a 120 cm deep and 15 cm wide channel in the ice with the speed of 1 km/h. The device is used for weakening river ice in order to prevent floods caused by ice jams and to prevent the spreading of oil spill under the ice in fast ice conditions.

Field Tests

Different types of equipment and methods have also been directly tested in field tests in order to give an opinion on the usefulness in real situations. Especially in the HELCOM exercise in 1994 outside the city of Oulu on the ice of the Gulf of Bothnia the following methods were tested.

- Use of compressed air in order to steer and remove the oil below the ice field
- Use of a propeller stream to direct the oil to the direction desired
- Use of ice booms to prevent oil from drifting to undesired directions
- Use of oil wells for collecting oil.
- Use of a remote operated vehicle (ROV) for searching oil under the ice

New constructions

Three skimmers of new design have been developed in Finland for ice conditions in last two years. One, developed and tested in laboratory by the Finnish Environment Institute is intended to be used as an auxiliary equipment in an oil recovery vessel. Two others, developed by private Finnish enterprises are separate skimmers, which can be used from any floating platform. We have the intention to test these three inventions during this winter. The tests will be reported later.

4.3 Development in other Baltic Sea countries

Other Nordic countries, especially Norway and Sweden are faced the same problems, marine oil accident can happen also in cold and icy conditions. There has been much research work and development of combatting techniques in those countries. In Norway a large project, which has the aim to develop methods for oil collecting in ice, even in arctic conditions has been going on for several years and is now near to be completed.

In Denmark heavy oil pumping and offshore booming has been developed and Germany has been active in developing combatting vessels which are capable to work also during chemical spills.

5. FUTURE PROSPECTS

5.1 Methods

There are plenty of weak points in the oil combatting technology, still. Darkness, adverse wether conditions, ice, oil's tendency to spread rapidly at water surface and to stick fast to rigid materials are main challenges, perhaps.

For many reasons, it is quite likely that an oil spill occurred at sea will become a disaster ashore. Therefore we should now look at possibilities to develop cleaning methods for shorelines, too. If there would be such mechanical devices, which apply to recollect,

efficiently enough, main amount of oil on various types of shoreline without harming environment, a remarkable amount of handwork and money may be saved.

Although the mechanical recovery of spilled oil from nature is the method, that is most unanimously accepted, it is not always feasible. All other methods may be more controversial, but they can often fulfil the caps, which leave outside reach of mechanical collection methods. For instance a bioremediation is always the final cure by nature to the environment. In what extent that or other controversial methods like dispersing or burning shall be applied, varies case to case, inevitably. Therefore, little by little we will have more knowledge from research to be able to select optimal tools to overcome oil pollution.

5.2 Keeping casualty figures low

Sea traffic in the Gulf of Finland has almost doubled during the last five years being in 1998 about 80 million tons of cargo wherefrom about 40 million tons were different oil cargoes per year. It has been estimated, that sea traffic will be twice so much in 2010 in the area; 160 million tons of cargo including a share of 80 million tons of oils per year.

With the growth of sea traffic also the probability of oil spills may be doubled, if a level of precautionary measures against accidents will stay as it has been. If the occurrence of oil spills in the Gulf of Finland would be the same as it was estimated in a HELCOM study in 1995 and 1997 for the Baltic, it means that after the year 2010 there will be about 6-7 oil spills per year in the Gulf of Finland.

Main amount of those spills will be about some ten tons of oil consisting spills caused by bunker oil of all types of vessels. Maximum size of those bunker oil spills will be 100-200 tons. Probability of a cargo oil spill of a single hull tanker will be once per year and an oil spill caused by cargo oil from a double hull tanker accident will occur once per four year. Size of cargo oil spills varies from some hundreds of tons till thousands of tons of oil.

The said estimations seems high when compared with the real occurrence of pollution incidents since last ten years in the Gulf of Finland. Estimations were based on an old statistic from era before nineties, when spills were of a higher occurrence than later in the Baltic Sea. For checking it seems to be needed to compare an average global spill occurrence with the spill occurrence in the Baltic Sea.

According to International Oil Spill Statistics 1998 in the world it has occurred oil spills of over 10 000 US gallons (> 34 tons) during last eight years 1991-1998 about 23 oil spills from oil tankers and about 21 oil spills from other vessels in average per year. In the year 1996 the global maritime transport was about 4.8 milliard tons including 2.3 milliard tons liquid bulk and 2.5 milliard tons dry cargo. In the year 1997 through the Baltic Sea ports was transported about 518 million tons of cargo. So the share of the Baltic Sea from the global maritime transport was about 11 per cents and the share of Finland about 1.7 per cents when measured as cargo. Corresponding shares from oil spills would be 4-5 oil spills per year in the whole Baltic Sea and in Finland an oil spill between 16 months. In the reality oil spills of magnitude over 34 tons has occurred in the

Baltic Sea much less, about 1-2 oil spills per year and in Finland one such an oil spill every 39 months (four oil spills in Finland during last 13 years).

Why the spill occurrence in the Baltic Sea and especially in Finland has been so little? Broken and shallow coastal zone in the northern and western coasts and sometimes difficult weather conditions requires a comparatively high level of maritime safety. Long fairways through the archipelago are well build and marked. Land based radar network covers the coast and use of the pilotage service is obligatory. Merchant vessels are quite new and with a modern navigation equipment. Tanker are normally with double bottom. In spite of all that casualties like groundings occur frequently, but consequences of them are not normally very bad. Because of the generality of casualties the authorities and private companies get often practise and keep trained to overcome practical difficulties. Salvage and pollution combatting are initiated promptly and in order to prevent all leakages during refloating.

Maritime conditions for some of new planned ports are quite challenging ones. The growth of transport emphasizes needs of land based vessel traffic service and automatic identification systems as well as an efficient preparedness for salvage and pollution combatting. Double hull tankers and escort service for big tankers in fairways are also ways to keep casualty and spill figures low in the Gulf of Finland in the future, too.

6. CONCLUSIONS

The co-operation within Baltic Sea States has a long history and has developed during these years to an useful and powerful network when marine oil and chemical spills are concern**.** Every country along the Baltic Sea is obliged to help its neighbouring countries in case of pollution accident and the readiness of that is kept in good level organizing exercises every year, both bilateral, trilateral and the whole Baltic consisting exercises.

Due to the increasing traffic, especially oil traffic in Baltic, each country has to reconsider the oil pollution risk in its response area and develop and modify its contingency plan accordingly.

In Finland the heavy traffic increase cross the Gulf of Finland between Tallin (Estonia) and Helsinki (Finland) (over 6 mill. passangers/year) and oil traffic along the Gulf of Finland (80 mill. ton/year, estimation year 2010) causes severe risk to the marine environment in Finnish waters. Finland, Russia and Estonia are now planning an uniform vessel traffic control system to the Gulf of Finland consisting different manine routes to ships bound to and from St. Petersburg. Also Finland must increase its oil combatting capacity expecially in eastens part of the Gulf of Finland and put more efforts to develop oil combatting methods which are usefull also in heavy and difficult weather conditions.

We are also faced still unsolved problems when oil combatting in ice conditions is concern. Despite severe attempts, laboratory and field tests to find adequately efficient solutions for combating oil in ice and cold conditions, progress has been slow and we are still waiting for techniques and equipment which can be successfully used in a really big oil spill in ice. We now have the capacity and devises to combat small spillages in

ice conditions, but in case of a big spill, we normally must wait until the ice melts and then recover the oil with the aid of open sea techniques. The main shortcomings and recommendations from the viewpoint of Finnish authorities are, therefore, as follows

- Much work is needed to develop real operative response methods in ice
- The location of oil under (snow-covered) ice is a problem
- If the oil sinks, it is very difficult to find and collect
- Reliable combined oil and ice drift models do not exist
- To succeed you must have many alternative methods
- In situ burning could also be a useful tool in the Baltic Sea.

Additional information, please find from Internet:
Homepage: http://www.vyh.fi/eng/intcoop/regional/response/prevent.htm