NORDREGIO
Nordic Centre for Spatial Development

Early Warning and Civil Protection

When does it work and why does it fail?

Christer Pursiainen (ed.) assisted by Per Francke

NORDREGIO REPORT 2008:1

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Nordregio
P.O. Box 1658
SE-111 86 Stockholm, Sweden
nordregio@nordregio.se
www.nordregio.se
www.norden.se

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Cover photograph: Christer Pursiainen
Layout: Liselott Happ-Tillberg
Linguistic editing: Mark Waller
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Preface

This study is about early warning in the context of civil protection. The concept of civil protection as used by the European Union refers to the protection of people, the environment and property in the event of man-made, technological and natural risks or emergencies. Early warning is an essential element of any functioning civil protection system.

This study, combining several points of departure as well as levels and units of analysis, provides a general framework for discussing the issue of when does early warning work in relation to civil protection and, more significantly perhaps, when does it fail, and for what reasons. Moreover, it offers some detailed case studies in fields such as climate change related floods and spatial planning, sudden sea water rise, electricity blackouts, and maritime safety in cross-border context.

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Beside the text, the study includes several original maps prepared for this project. The credit and copyright for these maps, if not otherwise indicated, go to Patrick Lindblom and Johanna Roto from Nordregio.

Finally, the authors want to make it clear that all possible mistakes and misunderstandings, as well as interpretations, arguments, conclusions and policy recommendations contained herein remain however the sole responsibility of the authors of the respective individual chapters. The Commission is not responsible for any use of that may be made of the information and analysis contained herein.

Stockholm, January 2008

About the contributors

Emilio Cocco holds a PhD in Sociology of International Relations at the University of Trieste. He is Assistant Professor and Senior Researcher in Sociology of the Environment and the Territory at the University of Teramo.

Per Francke is a Researcher at Nordregio, Stockholm, and has an MSc in Urban and Regional Planning with a Major in Human Geography, Stockholm University.

Sigrid Hedin is Senior Research Fellow at Nordregio, Stockholm. She holds a PhD in Social and Economic Geography from Uppsala University.

Timo Hellenberg coordinates the CIVPRO Civil Protection Network and serves as a Chairman and CEO of the Hellenberg International Ltd. He is a Doctor of Political Science from the University of Helsinki.

Johanna Kentala worked during the project period as a Researcher for Hellenberg International Ltd., and from January 2008 she works as a Researcher at Nordregio, Stockholm. She holds an MSc in Political Science from the University of Jyväskylä and is a PhD student at the University of Tampere.

Richard Langlais is Senior Research Fellow at Nordregio, Stockholm. He holds a PhD in Human Ecology from Göteborg University and a BA (Honors) in East Asian Languages and Literature from the University of Alberta.

Patrick Lindblom is a Researcher at Nordregio, Stockholm. He holds an MSc in Biology as well as a BA in Business Administration from Stockholm University.

Christer Pursiainen was during the project period Senior Research Fellow at Nordregio, Stockholm, and from January 2008 he works as Senior Adviser to the Council of the Baltic Sea States. He is a Doctor of Political Science and Docent in International Relations at the University of Helsinki.

Hannu Rantanen is Research Manager at the Emergency Services College in Kuopio, Finland. He is a Licentiate in Philosophy, Information Technology, from the University of Kuopio.

Johanna Roto is a Researcher at Nordregio, Stockholm, and holds an MSc with a major in Human Geography from Helsinki University, with a minor in Planning and Community Studies from Tromsø University.

Giulio Tarlao is a Researcher at the Institute of International Sociology of Gorizia and Lecturer of Sociology of Environment and Territory at the Faculty of Economics of the University of Trieste. He holds a BA in Political Science at the Faculty of Political Science of the University of Trieste and an MA in Sociology of Culture at the Faculty of Sociology of the University of Essex and a PhD in Sociology of International and Territorial Phenomena at the Department of Human Sciences of the University of Trieste.

Veli-Pekka Tynkkynen is Senior Research Fellow at Nordregio, Stockholm. He holds a PhD in Planning Geography from the University of Helsinki.

Executive summary

This book is about early warning in the context of civil protection. The concept of civil protection refers to the protection of people, the environment and property in the event of man-made, technological and natural risks or emergencies. Early warning is an essential element of any functioning civil protection system. But when does early warning work in relation to civil protection and, more significantly perhaps, when does it fail, and for what reasons? The study provides a general framework for analyzing these issues. Moreover, it offers some rather detailed case studies in such fields as climate change related floods and spatial planning, sudden sea water rise, power disturbances, and maritime safety in cross-border context.

Early warning and civil protection: a framework for analysis and action

The introductory Chapter I starts by defining the concept of early warning in the context of civil protection. It defends a rather wide understanding of the concept, consisting of five 'phases' of an 'early warning system'. Early warning starts with risk assessment, followed by prevention, which in a way should prove that the early warning system works. The third phase is that of monitoring the risks in order to detect possible early warning signals. The fourth phase is the dissemination of warnings. Finally, early warning includes response, in the sense that response can be more or less timely.

The issue is to single out early warning signals as early as possible in order to have more reaction time for preventive action, preparatory measures or a timely response. While some emergences are impossible to forecast or prevent in due time, their possibility can be taken into account in risk assessment, and thus we can always prepare for them in advance.

Early warning does not always work. This failure can be a result of individual or simultaneous failures within one or several of the above-mentioned phases. Sometimes risk assessment fails, because even when the information would have been available, it had not been recognized as an early warning signal of a potential risk. Sometimes weak or even clear early warning signals were lost because of the surrounding 'noise'.

On other occasions we might have had a good understanding of the risks involved, but for some reason this did not lead to preventive action being taken. Or even when some risks had been included in the risk assessment, these risks were not reflected in the monitoring systems which in turn focused on the wrong indicators; or the monitoring of these risks either failed or malfunctioned.

Even if early warning signals are monitored and identified, they do not always result in warnings being given; the uncertainty related to some signals may be high, and especially if warning would mean considerable material, political or other costs, the fear of false warning may prevent the identified signals to become warnings. Sometimes warnings are triggered but are simply not believed by authorities or the people at risk, or for other reasons not followed by an early response.

The issue then is to ask what explains when an early warning signal is or is not identified, and what explains whether this signal leads to successful early action or not. The chapter makes an effort to pinpoint the main bottleneck factors in civil protection early warning.

It starts this effort by discussing 1) 'human factors' by asking why, on occasion, do those who should be able to provide early warning not identify these signals, or neglect them, or interpret them wrongly? The chapter first focuses on the limits of a human being's capacities, particularly related to information processing. It argues that we should always include some kind of systemized 'imagine the unimaginable' working method. This is best materialised by systematised scenario building as well as by enlarging the group responsible for risk assessment, thus making it more heterogeneous and allowing more room for alternative interpretations.

The chapter also discusses human limitations from the perspective of so-called situation awareness, thus focusing on a human being's limited capacity to handle information when functioning in a highly developed technical environment. Enhancing the technological systems' ergonomics from the perspective of the human capacity to process information, including crisis situations, is necessary.

The second category of bottlenecks is related to 2) 'technological factors'. From an early warning failure perspective, technology becomes crucial mainly in two cases. First is that the necessary technological equipment is missing even if it could be available. Second, sometimes an early warning technology is not functional or is of the wrong type, and at the same time the whole early warning system may be based on this technology. The potential disturbances or errors at one point of the early warning chain may break the whole system.

The third category to be discussed are 3) the 'historical factors'. This refers here especially historical analogies, meaning the use of an image of the past to shed light on present or future developments. While learning from past experiences is natural and mostly useful, a negative effect might in some cases be that resources are not apportioned according to the most rational risk assessment but on the basis of past or most recent tendencies. In acute crisis situations, in turn, cognitive shortcuts help one to quickly make sense of confusing events, offering a diagnosis on the basis of a past event which is perceived as sharing similar features. However, again, if a faulty historical analogy is used as a cognitive shortcut to define the current case, it either misdirects or at least narrows and constrains the analysis of the situation.

4) A good 'safety culture' means giving the highest priority to safety over other factors, for instance, profit-making. It should also be reflected in the organisation's willingness to raise safety concerns and to learn from errors, incidents and accidents. If a safety culture fails, it automatically means that some potential early warning signals are, or can be, dismissed or downplayed.

The formal 5) 'organisational and legal factors' are discussed at length in the introductory chapter. While some kind of an institutionalised early warning system usually is in place in every country, there are gaps to be identified. To function, this system requires clear-cut legislation, which defines the division of responsibilities, coordinative mechanisms, bodies and mutual assistance systems between different ministries and agencies as well as non-state actors.

The chapter deals also with the 6) 'political and economic factors' of early warning. Public policy for disaster reduction starts with political commitment, which is needed for the effective coordination of the relevant national agencies, creating the legal frameworks and continuous funding. Political commitment in turn culminates in the issue of allocating economic resources to early warning purposes, which makes the political and economic factors unavoidably intertwined. In practice however decision-makers have to make priorities where often there is no politically neutral way to do so, while the risks involved are rarely unambiguous and isolated from other risks and tasks.

A separate challenge are 8) the 'international factors' of early warning. While the legal mandate for early warning lies at the national level, international cooperation in this field remains strong and often needed. The chapter discusses coordination problems in international cooperation, especially resulting from the non-harmonised national systems. Beside lacking common legal and organisational framework, also lacking political will to cooperate is often present as the nations states defend their sovereignty.

Finally, the introductory chapter discusses 9) 'cultural and societal factors.' It takes up such issues as the different cultural and societal norms concerning risk knowledge, risky behaviour and risk tolerance. Furthermore, an essential precondition for early warning is the level of civil society self-organisation. This self-organisation is closely related to the notion of social capital in the relationship between the authorities and the public. There should be enough social capital, especially trust, embedded in the society and consequently in early warning systems such that signals and warnings lead to action by the national authorities and the population alike.

The chapter concludes that in real life situations all possible factors are in different combinations always intermingled and overlapping. Furthermore, many bottleneck issues are such that there is no way to find any final and unambiguous solution to avoid them in all possible situations. Nevertheless, the result of this analysis can still function as a practical toolbox, which helps to pinpoint the most obvious reasons of early warning failures and help the practitioners to develop the early warning systems so that at least some of them can be avoided. It proposes that the main national competent civil protection authorities should implement this type of evaluation. Given the huge scope of early warning issues, in practice this evaluation could be started within one specific issue area, the purpose being to identify the issue area-related bottlenecks and to find solutions in respect of how to avoid them.

Case study: Climate change emergencies and municipal planning

Chapter II puts the question 'Why is an early warning signal ignored, even when it is clearly received?' To illustrate this kind of case, the chapter discusses in detail the planning and building of Sjöstaden (Sea Town), a highly modern housing complex in Mariestad, on the eastern shore of Vänern, Sweden's largest and Europe's third largest lake.

The municipality of Mariestad has been planning and proceeding to build an impressive lakeside housing complex for almost the entire decade since 2000, to present. Part of it is being built out onto the lake surface, and supported by pillars and piers. At the same time, the area has been described by new national climate change vulnerability studies as being within one of the zones that is most at risk not only for flooding, but also for its increasing frequency and seriousness.

Although the actual construction of the Sjöstaden project is only in the initial stage of its planned multiple phases, the media have become more strident in asking why the municipality is going ahead with it. The general atmosphere that has been generated around the case can be summed up as implying that the municipality, in the media's view, is being irresponsible in the face of the threat of climate change impacts.

As part of Mariestad's strategy for the future the municipality is working to 'brand' itself, building on its vision of being 'the pearl of Vänern.' Building and developing new waterfront housing areas that offer residents, especially newcomers, attractive lakeside living on the shore of Vänern is an integral part of that strategy. The project was first discussed in early 2000 – that is, before climate change became a high-level and widely discussed theme in the Swedish political discourse – as a town renewal project that would develop and extend the old harbour area. The more specific strategy that the project would be a contribution to the vision of attractive seaside housing emerged in the municipality's planning documents in 2003. In order to materialize that vision, Mariestad launched an international architecture competition for the development of the project.

The building site, however, is one of the specific areas identified as among the most flood-prone in Sweden. Despite the direct early warnings provided by the Swedish Commission on Climate and Vulnerability, and intensive media and other public attention, Mariestad has decided to continue with its Sjöstaden project.

The municipality does not consider that it underestimates the flood risk. Since there already are existing buildings at levels where there are risks of floods, something would have to be done to make sure that the water level was controlled. Therefore, new methods for tapping Vänern must be developed in any case. This is necessary to avoid being forced to abandon existing parts of Mariestad. The most crucial issue for the municipality, then, is to work together with other stakeholders to reach agreement on the water level of Vänern. The regulation of the water level of Vänern must be adapted to the 'new climate' and cooperation is needed in order to establish this level.

The County Administrative Board, the regional body for the government, is against the Sjöstaden housing project and the fact that it is being planned in an area with a high flood risk. The municipality's rationale for building Sjöstaden, according to the County Administrative Board, is that it wishes to expand the population and improve the local economy. One way to attract new inhabitants is to offer attractive housing that is situated, for example, close to water.

The competent national-level civil protection authority, the Swedish Rescue Services Agency, considers that the County Administrative Boards in general have so far been passive. The Swedish Rescue Services Agency is working on the mapping of floods and stability for the municipalities, but their officers report that occasionally when they deliver a new map to a municipality they get the response that it is 'idiocy'. Municipalities that have been faced with floods tend to work more proactively, but here, as well, technological measures, or 'technical solutions,' are used to 'secure' areas so that it remains possible to build in areas of high risk. Thus, the belief in technological solutions remains high.

The chapter argues that Mariestad is in a state of denial about the fundamental issue underlying its current framing of the situation; rather than dealing with the early warning signals it is receiving about the risk of serious recurring floods in the future, it is consistently and persistently projecting the image that the problem is merely one of the assignment of responsibility and the bearer of costs. The impression is that whatever the problems, humanity will 'triumph over nature' and that 'you cannot let nature conquer you.'

The case contradicts the contemporary dictum from the various discourses on sustainable development that 'local is best,' and that those in the community are those who know most about how to solve local problems. At the same time, the case also illustrates the difficulties that arise when attempts to translate the scenario-building activities of large-scale projects, such as those undertaken by the

International Panel for Climate Change to perform global and, when possible, national-scale assessments of climate change, to the local level.

The case highlights most clearly that even when the technical, informational and procedural aspects of civil protection early warning are of the highest quality, they may still not lead to the result expected or desired by its transmitters, the senders of the signals. It also shows that even when such high quality signals are fully received and acknowledged by the appropriate addressees, they may nevertheless be processed and utilized in such a way that the senders' intentions, perversely, may even produce an outcome opposite to the one desired. The clear signals of the impending danger of flooding, rather than serving as pragmatic, functional implements of rational infrastructure planning, encounter instead the multiple rationalities of local agendas embroiled in multi-level governance battles.

Case study: Sudden sea level rise in the Gulf of Finland

Chapter III describes the early warning mechanism and emergency management procedures that were used in tackling the severe flash flooding incident on 7-8 January 2005, caused by rising sea waters in the Gulf of Finland. The study, focusing mainly on the Finnish experience, asks what kind of early warning signals were used, how the main actors received information about the incident and whether the overall early warning mechanism and inter-agency communications were successful.

The overall risk perception of the emergency management authorities involved in this case was affected by the tsunami disaster in South East Asia, which took place on 26 December 2004. A week later, Northern Europe faced severe weather conditions unlike anything before. The emergency management and civil protection authorities of the Nordic and Baltic countries were still following the news of the large casualties and victims from the Nordic countries within the tsunami region. This alert and the readiness to overcome the tsunami disaster brought about upgraded readiness within administrative responses when facing the natural phenomenon of this extraordinary magnitude in their own backyard.

A violent storm formed over the British Isles and moved east to central Finland. Several countries were affected by the storm including the United Kingdom, Norway, Denmark, Sweden and the Baltic countries. The strongest winds occurred south of Finland and the biggest problem was the rise in sea level, which was as much as +197 cm in Hamina in southern coast of Finland. Waves reached 8 m level and individual waves even 14-15 m.

The chapter reconstructs the early warning chain. The Finnish meteorological forecasting institutes were able to anticipate the emergency and took it seriously even if the sea level forecast models produced unlikely figures. Essential in the successful early warning was not the well established procedure – in fact, in many ways this was an exceptional pilot case of early warning cooperation between different institutions and authorities – but rather good personal relations between the representatives of public authorities and other related actors.

After the first warning signals had been received and verified, it seems that the Finnish emergency management system worked rather smoothly. The national flood response system generated its operational preparedness, and the flow of information proceeded to all relevant actors through the standardised channels. The Government Situation Centre informed ministers about the events and in this way the higher national level, that is, the emergency preparedness leaders were convened. Within

the private and business sector, which owns most of the critical infrastructures, the situation was also taken seriously and involved preparatory measures.

The seriousness of the situation was affected by the 'nuclear factor', that is, the water threatened the nuclear power plant in Loviisa on the south coast of Finland. Although the sea level has never been so high in Loviisa before, it remained below the critical level and the power plant was not closed down. In the Leningrad nuclear power plant, located in Sosnovyi Bor not far from St. Petersburg, Russia, the nuclear power plant increased its preparedness, too, for closing the power plant down if the rising sea level were to risk its safe functioning. This was finally not needed. However, the experience gave reason soon afterwards to increase safety cooperation between the Finnish and Russian nuclear authorities on building an estimation system for water level in Sosnovyi Bor that would be linked to the Finnish forecasting network.

All in all, large-scale flood and storm damage was avoided, but water cut off roads and traffic in the coastal areas. In the centre of Helsinki the sea rose to the main market place Kauppatori and floods forced their way into hundreds of houses in Helsinki and elsewhere. According to post-emergency evaluations in Finland, action was taken in time. However, the authorities admitted that there was a need for considering updating the preparedness plans. By contrast, in Estonia, where the damage was perhaps even bigger than in Finland, the storm showed clear failings in the preparedness of the authorities.

The chapter concludes with some lessons learned. One of the key concepts of early warning regards the information flows and the possibilities to extend and transmit the information through the 'noise' of different actors and channels. In this case the information flow worked along existing guidelines and there were no disruptions recorded. Furthermore the meteorological institutions were able to make successful forecasts of the rising sea level during working hours on Friday, which was just good luck. However, the institution who sent the first early warning signals does not have 24/7 services, and if the forecast had been available for the first time during the weekend, the warning could not have been made in time. This kind of system still does not exist.

As to the issue of responsibility, the chapter states that the legislation in Finland regarding early warning and response is regarded as being clear enough by the authorities. The action is taken in the field and the authorities are well aware of their responsibilities, at least this was the case at this time. As to the technical aspects of early warning, different early warning system can prove to be crucial in order mobilise adequate resources for an active and suitable response. For instance, a sea level rise could and should be tackled with an automatic system that would directly inform the environment and the rescue authorities on certain sea level rise values through the Emergency Response Centres. This already partly happens but is not totally implemented.

Finally, the chapter concludes that if there are areas that are known to be flooded from time to time, there should be plans about how to work on these areas when the flood warning comes (building barriers and planning of evacuations). Flood risk must therefore be taken into account in the community planning.

Case study: Coping with power disturbances

Chapter IV discusses the issue of power disturbances, illustrating the theme with three short case studies. Modern society is highly dependent on electricity. Loss of power would instantly affect a wide range of key infrastructure operations vital to a

modern society. Due to increasing energy dependence, a major blackout in urban areas would virtually paralyse the whole society.

Energy is a central area of European integration. The way in which the system now operates is often beyond the original design parameters, mainly due to market liberalisation. Originally the system was designed, built and operated under public ownership in a non-competitive environment. Market developments have substantially complicated the situation, because the grids now have to move power in ways they were not originally designed to do, which resulted in higher cross-border exchanges with short-term commercial objectives. All this has resulted in a huge multi-scale, distributed, highly interactive system, over which no single entity has complete control, or the ability to evaluate, monitor, and manage it in real time. The system is highly efficient and economic at best but involves a number of vulnerabilities with the increased potential for trans-border propagation of disturbances.

The chapter starts by discussing the three main components of power system. First, the Physical Component consists of power generation, transmission and distribution. Generation is the means of converting other forms of energy into electrical power. Transmission includes moving power from a power station to near where it is used. Distribution involves taking power from the transmission system to end users. In this part the European and Nordic systems are described.

Second, the chapter discusses the Monitoring and Controlling Component, consisting of Information Technology-based devices and software. The continuous balancing of supply and demand within a grid is managed by control areas and reliability coordinators across the area, who forecast demand, monitor system conditions, and direct the operation of generation and transmission facilities.

Third, the chapter analyzes the Management and Coordination Component, consisting of the operators and other actors as well as legislation, procedures and standards. Upon the emergence of the Internal Electricity Market in the European Union, the leaders of the regional transmission organisations have recognised the need for an European Union-wide harmonisation of network access and conditions for usage, especially for cross-border electricity trade.

The chapter goes on to discuss power disturbances. The modern electricity arrangement of systems cannot be guaranteed to function automatically. Despite all measures to make the electric power system more robust, major disruptions cannot be totally ruled out and will continue to happen. The most critical factors affected are those on the health sector and emergency services, as well as communications, transport and finance. Also the effects on economy are usually high. While it is obvious that within the electricity community the typical technological risks are well recognised and there are procedures to cope with them, in the rest of society it seems that the actual risks brought about by a long-lasting blackout are not clear. Without a clear understanding of the risks the preparedness is not directed to right targets or will be undersized and insufficient. Preventive measures are needed both in protecting the electricity system against various disturbances and in making society less vulnerable to blackouts.

Monitoring and forecasting for possible power disturbances is manifold and has a varying time scale. Information sharing and dissemination of warnings are needed throughout the process but are especially important when any actor has meaningful information about the situation. Response activities in major accidents and especially in large scale emergencies, in which the coping mechanisms of the community is overwhelmed, will include different functions undertaken by different organisations. The responding organisations may themselves be affected by the

disaster, so causing additional demands. Communicating with the public and the media is a vital issue in effective emergency management. Correct, timely and well-composed information can re-assure people and help them plan their own actions to cope with problems. The media has an essential role in shaping the outcome of the crisis and it often has the ability to either make or break implicated actions.

Case study: The North Adriatic Sea and the Gulf of Finland in comparative perspective

Chapter V discusses maritime safety and early warning systems in two rather similar maritime areas of Europe, characterised by the need for cross-border cooperation: the North Adriatic and the Gulf of Finland. The chapter starts by arguing that the sustainable development of the coastal areas depends on the quality of the marine environment, and it appears clear that maritime safety should be included as a strategic issue in the perspective of sustainable development of coastal areas. The social implications of marine and coastal exploitations and environmental protection bring about a number of risks and safety issues that fall into the responsibility of the many local government bodies.

The Adriatic and the Baltic regions are excellent comparative case studies because an ambivalent condition of inclusion and exclusion from the European dimension can be observed. On the one hand, they are border seas situated by EU's external frontiers while on the other they are truly European, inner, maritime spaces that both divide and connect European countries. The Baltic and the Adriatic regions reveal a set of common socio-cultural and political-economic issues that are extremely significant in the European perspective for the coexisting dynamics of European integration and post-communist transition constantly interact and overlap.

The obvious similarities of the regions refer to the physical characteristics of the maritime spaces – both the North Adriatic and Gulf of Finland are internal waters rather than open sea – but even more they refer to the political features of the lands overlooking those maritime spaces. In fact, in both cases the lands belong to different countries – making thus cross-border cooperation a key issue in the view of enhancing maritime safety – and, more important, in both cases these countries belong to different political systems. In the North Adriatic case, there are three main actors: a founder of the European Union (Italy), plus a new member (Slovenia), and a non-member (Croatia). Similarly in the Gulf of Finland case, there are three countries involved: an older member of the European Union (Finland), a newer member (Estonia) and a non-member (Russia). A further point in common is that in both cases we have countries that up to the recent past used to be united: Slovenia and Croatia were part of Yugoslavia, and Russia and Estonia were part of Soviet Union. The latter point is significant from the cross-border cooperation perspective.

There are clear differences as well. While the situation in the Gulf of Finland is characterised by difficult winter-time ice conditions, it is no surprise that ice conditions are not an actual risk to the navigation in the North Adriatic. However, in terms of the fundamental human action in the maritime traffic, one may find that the greatest risk to maritime safety in both areas is the increasing risk of major oil spills.

Regarding the human actions to guarantee maritime safety in both areas, the factor of cross-border cooperation becomes important. Apparently a higher level of cooperation does not exist between the countries once united, that is, in the North Adriatic case between Slovenia and Croatia, and in the Baltic Sea case between

Estonia and Russia, but amongst countries separated up to recent past by ’systemic‘ cleavages: Italy and Slovenia, Finland and Estonia.

Cross-border cooperation seems to work better in the Gulf of Finland context than in the North Adriatic Sea. A strategy to avoid a clash of national safety cultures and the ultimate key to success in the Gulf of Finland was the strictly professional or functional level (maritime administrations and vessel traffic operators) of the parties leading the cooperation, thus avoiding the ‘high politics’ disagreements. In the Northern Adriatic safety cooperation has not been this deep, but the common political future, inside the European Union, of all three parties makes this area better equipped with possibilities for cooperation on both political and professional levels to enhance the safety of maritime transportations.

Another factor in the area of human actions is the role of technology. Overall similarities in the technological devices employed both in the North Adriatic and Gulf of Finland can be detected, that is, the Vessel Traffic Service and the Automatic Identification System. In the case of the countries of the Gulf of Finland they have developed a more advanced trilateral ship reporting system, that is the Gulf of Finland Mandatory Ship Reporting System.

All in all, the most striking difference, between these two cross-border cooperation and sea areas, seems to be the depth of cooperation. Considering that there is no connection between the European Nordic and the Southern dimensions, the establishment of a scientific and professional cooperative networks on maritime safety culture could certainly enhance such a dialogue and best practice exchange.

List of acronyms

AC	Alternating Current
AIS	Automatic Identification System
BOOS	Baltic Operational Oceanographic System
CABVG	County Administrative Board for Västra Götaland
CECIS	Common Emergency Communication and Information System
CI	Critical Infrastructure
CIIP	Critical Information Infrastructure Protection
CIP	Critical Infrastructure Protection
CIWIN	Critical Infrastructure Warning Information Network
DC	Direct Current
DEW Line	Distant Early Warning Line
DJP	Document of Joint Procedures
EFAS	European Flood Alert System
EFFIS	European Forest Fire Information System
EMERCOM	Ministry of the Russian Federation for Affairs of Civil Defense, Emergencies and Disaster Relief
EMSC	European Mediterranean Seismological Centre
ENI	Ente Nazionale Idrocarburi
EPCIP	European Programme for Critical Infrastructure Protection
ETSO	European Transmission System Operators
EURDEP	EUropean Radiological Data Exchange Platform
FIMR	Finnish Institute for Marine Research
FMI	Finnish Meteorological Institute
GDACS	Global Disaster Alert and Coordination System
GIS	Geographic Information Systems
GOFREP	Gulf of Finland Mandatory Ship Reporting System
GPS	Global Positioning System
ICT	Information and Communications Technology
IEM	Internal Electricity Market
IMO	International Maritime Organization
INMARSAT	International Mobile Satellite Organization
IPCC	Intergovernmental Panel on Climate Change
ISDR	International Strategy for Disaster Reduction
ISPS	International Ship and Port Facility Security Code
ITC	International Trade Centre
kV	Kilo Volt
LNG	Liquefied Natural Gas
MIC	Monitoring and Information Centre
MOSE	Modulo Sperimentale Elettromeccanico
MRCC	Maritime Rescue Coordination Centre
NAO	North Atlantic Oscillation
NGO	Non-Governmental Organisation
NIMBY	Not In My Backyard
North AdriaticPAN	Northern Adriatic Ports Area Network

NWAHEM	North-West Regional Administration for Hydrometeorology and Environmental Monitoring
OSCE	Organisation for Security and Co-operation in Europe
PPP	Public-Private Partnership
PSSA	Particularly Sensitive Sea Area
RAKEL	Radiokommunikation för Effektiv Ledning
RSU	Rescue Service Unit
RTO	Regional Transmission Organisation
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SCCV	Swedish Commission on Climate and Vulnerability
SMS	Short Message Service
SOLAS	International Convention for the Safety of Life at Sea
SOPS	Agreement between the Republic of Slovenia and the Republic of Croatia on Border Traffic and Cooperation
SRSA	Swedish Rescue Services Agency
SRSA/NCO	Swedish Centre for Lessons Learned from Incidents & Accidents
STT	Finnish News Agency
STUK	Finnish Radiation and Nuclear Safety Authority
SYKE	Finnish Environment Institute
TETRA	Terrestrial Trunk Radio
TSO	Transmission System Operator
UCG	Coast Guard Unity
UCTE	Union for Coordination of Transmission of Electricity
UN	United Nations
UPS	Uninterruptible Power Supply
VTS	Vessel Traffic Service

CHAPTER I
Early Warning and Civil Protection: a Framework for Analysis and Action

Christer Pursiainen

Our information about the world is largely shaped by different kinds of disasters and accidents. We hear about natural catastrophes such as tsunamis, earthquakes, hurricanes, forest fires or floods. Or we learn about technological emergencies, say an electricity blackout, a fire in a chemical factory or an oil spill from a tanker. We are told to be prepared for terrorist attacks in public spaces, potentially with radiological, chemical or biological substances. Our routines may be changed because of the threat of bird-flu. In addition, we are aware that all kinds of every-day accidents and emergencies are constantly happening around us.

This is the world of civil protection. More formally, the concept as used by the European Union (EU) refers to the protection of people, the environment and property in the event of man-made, technological and natural risks or emergencies. Early warning is an essential element of any functioning civil protection system. But what are the connections between the notions of early warning and civil protection, when does early warning work in relation to civil protection and, more significantly perhaps, when does it fail, and for what reasons?

This introductory chapter, combining several points of departure as well as levels and units of analysis, discusses these questions by proposing a typological framework that pinpoints and systematizes the main early warning 'bottlenecks' in relation to civil protection. While, in practice, no panacea exists where early warning failures can be completely avoided, this study defends and cultivates a holistic, multi-dimensional approach to the evaluation and development of early warning concerning civil protection.

1. What is civil protection early warning?

In every-day civil protection or rescue services language, the notion of early warning is often understood as being synonymous with the alarm systems directly connected to the emergency situation, often predominated by the technological dimension of early warning (e.g. Halonen, Verboeket and Hedin 2006). From a wider perspective, however, early warning is much more than simply acute emergency communication via some technological equipment or system. Indeed, most relevant early warning literature and practical models – which usually focus on large-scale natural disasters – adopt a rather broader definition of early warning, understanding it as a complex early warning system consisting of several interrelated dimensions, elements and phases (e.g. United Nations 2006; Basher 2006).

1.1 How early is early?

Early warning is, by definition, about the temporal dimension of warning, and thus we can start by asking when early warning starts and when it ends. From this perspective, a natural starting point for any early warning system is *risk assessment*, often also called risk mapping, risk analysis or risk knowledge. This refers to identifying and, if possible, quantifying the high-risk areas, vulnerabilities, likelihood of damage and so forth. Obviously, if we do not have a clear picture of the risks we may face, it is not possible to try to recognize, prevent or mitigate potential emergencies in advance.

The second phase of early warning is, logically, that of *prevention*, which in a way should prove that the early warning system works. After identifying the risks, several kinds of measures can be undertaken, including legal, planning, technological, institutional, socio-economic and other kinds of preventive solutions. If for instance a territory is identified as being a high-risk area for flooding, a protective wall can be built or the specific historical nature of the floodplains taken into consideration during land use or drainage planning.

The third phase is that of *monitoring* the risks in order to detect possible signals with respect to a potential forthcoming or occurring emergency. Monitoring can include the measurement of storm, radiation, water levels or almost anything, and can be undertaken both by human beings or technical equipment, or, as is usually the case, by both.

The fourth phase is the *dissemination of warnings* by, to and between the authorities (operative, decision-makers etc.) and the people at risk or the public at large. Compared to risk assessment, this phase refers rather more specifically to acute emergencies. This may include the use of emergency number alarms, fire alarms and other signals, alarms in the traditional and electronic media, and so on, in order to prevent or mitigate the consequences of an emergency situation.

Finally, early warning includes *response*, in the sense that response can be more or less timely. As such, this phase should again prove the effectiveness of the early warning system, because even if not all emergences can be completely prevented, early warning should give extra room for at least some mitigating and preparatory measures, such as evacuation or preparing the necessary equipment for a response.

If we accept that an early warning system consists of these phases, then the early warning time span becomes considerably longer and the whole concept much more multi-dimensional than if we were to understand it as being strictly defined by communication in an acute crisis situation. In this context, then, early warning, for instance with respect to climate change consequences, can occur over a period of decades. Time series data collected over several decades have given an impetus for preventive and mitigating actions, such as changes in human behaviour, energy policy, or infrastructure design.

On the other hand, there is no factual difference between the concepts of early warning or mere warning in the sense that an early warning signal can precede, or sometimes immediately follow, the actual event, thus helping to prevent or mitigate the emergency. In fact, a few seconds or the last few minutes before the imminent danger or disaster can make a huge difference in some cases. In other cases, the first few minutes or hours after a disaster might be the most important ones in reducing its impact on people, environment and property.

Early warning does not need to end here, however; it might be needed even after the initial disaster phase. In so-called complex disasters, a natural disaster may be followed by the high probability of a technological, health or socio-economic

disaster; or a technological disaster is followed by an environmental or economic catastrophe, for instance. This probability, properly understood, may provide room for preventive action or help in the preparation for potential forthcoming 'follow-up' disasters.

1.2 Is early warning always possible?

In the conflict early warning literature, some scholars, and perhaps most notably Vetschera (2005), have suggested that every future societal crisis will generate signals at an early stage and should thus not surprise a close observer with the necessary detailed knowledge. According to this view, even when unexpected discontinuities do occur in the context of social systems, they do not happen overnight but instead invariably announce their arrival in advance. As such the issue is to recognise often pale or weak signals, so as to be able to transform mere factual information into an early warning signal of a forthcoming crisis. The closer a signal is to the outbreak of a crisis, the more specific the signal will be and thus the more easily identifiable it will be. However, as the critical issue in conflict early warning is often about having enough reaction time, early warning bottlenecks primarily emerge as factors that shorten reaction times.

This same basic idea can be applied to early warning concerning civil protection. The point is to single out early warning signals as early as possible in order to have more reaction time for preventive action, preparatory measures or a timely response. The question remains whether civil protection risks, such as natural or technological hazards, are identifiable in advance in the same way as are violent societal conflicts? Does every emergency situation emit an identifiable signal enabling us to prolong reaction times, or do some emergencies simply happen suddenly or indeed randomly?

Complexity and chaos theories have proposed that in many cases systems are nonlinear dynamic where the behaviour of the system is not causally deterministic, but rather random, caused by the exponential growth of errors and uncertainties. In civil protection (or Homeland Security) literature, Bellavita (2006) has applied this notion by differentiating between four kinds of spaces, where an emergency can take place. The *known* is a space where cause and effect are understood and predictable. The *knowable* is a space where cause and effect relationships may be difficult to derive or understand, but researchers and experts with sufficient time and resources can determine this relationship. The *complex* is a space where we can understand cause and effect only retrospectively: what appears logical after the fact is but one of many other logical outcomes that could have occurred. And finally, the *chaotic* is a space so turbulent that cause and effect are unknown.

So we have to acknowledge some reservations in our ability to identify civil protection early warning signals. Obviously, it is not possible to forecast all possible emergencies, even if we had all the potential resources available. The situation becomes even more complex because stakeholders often disagree about how to perceive a risk. Sometimes there is simply no unambiguous interpretation available about what is known or knowable. Furthermore, in many cases early warning is necessarily probabilistic, while at the same time the probability characteristics are poorly understood, and consequently false warning rates are high (Basher 2006, p. 2172).

These observations remind us of the need to prepare for discontinues, to 'imagine the unimaginable' as far as possible. Much, however, can be done based on what we already know or could find out about, and indeed many post-disaster evaluations of unexpected events note that the failure of early warning was rather due to lack of

imagination than lack of knowledge – a point made after the 9/11 catastrophe, for instance (The 9/11 Commission 2004).

While some emergences are impossible to forecast or prevent in due time, their possibility can be taken into account in risk assessment, and thus we can always prepare for them in advance. Or through applied scientific research it might be possible to render more issues within the space of the complex to be relocated into the space of the knowable, or for knowable issues to be relocated into the space of the known, thus widening the space of recognized cause-effect relations. This would make it possible to be better prepared to identify early warning signals and thus to act accordingly.

2. Early warning bottlenecks

Even in cases where the cause-effect relations are known and recognized, early warning does not always work. This failure can be a result of individual or simultaneous failures within one or several of the above-mentioned phases. Sometimes risk assessment fails, because even when the information would have been available, it had not been recognized as an early warning signal of a potential risk. Sometimes, and usually only when it is too late, one notices that weak or even clear early warning signals were lost because of the surrounding 'noise'. On other occasions we might have had a good understanding of the risks involved, but for some reason this did not lead to preventive action being taken; thus, the risks are accepted for economic or other reasons connected to the preventive action. Or even when in principle some risks had been included in the risk assessment, these risks were not reflected in the monitoring systems which in turn focused on the wrong indicators; or the monitoring of these risks either failed or malfunctioned, and as such it became unable to recognize early warning signals. Even if early warning signals are monitored and identified, they do not always result in warnings being given; the uncertainty related to some signals may be rather high, and especially if warning would mean considerable material, political or other costs, the fear of false warning may prevent the identified signals to become warnings. Sometimes warnings are triggered, but they are simply not believed by authorities or the people at risk, or for other reasons not followed by an early response.

The issue here, then, is to ask what explains when an early warning signal is or is not identified, and what explains whether this signal leads to successful early action or not. Hence, in focusing on the negation of a successful early warning, the question becomes: what are the bottlenecks with respect to civil protection early warning systems? Naturally, we can find several factors that potentially contribute to early warning failures, which however are somewhat difficult to define precisely and keep separate from each other, as they necessarily variously intermingle and overlap each other. Indeed, almost all evaluation reports drafted nationally and internationally after large-scale disasters – such as Chernobyl in the U.S.S.R. in 1986, 9/11 in the United States in 2001, or the East Asian tsunami in 2004 – note that an early warning failure was the consequence of a combination of several simultaneous errors.

How could we analyse early warning failures, given that they are overlapping and intermingled? In order to make sense of the different types of early warning failures it seems a reasonable challenge to try to pinpoint and treat the different bottleneck factors methodologically as more or less individual factors, in order to understand them and perhaps take them into account more systematically in

developing the early warning strategies for civil protection. The results of this investigation are summarised in Table 1.

2.1 Human factors

When early warning fails, the so-called human factor is probably always involved in one way or another. Sometimes it plays a crucial role. Let us imagine that in principle the institutional, economic, political, technical and other similar circumstances would allow for early warning signals to be detected. The issue then is that why, on occasion, do those who should be able to provide early warning not identify these signals, or neglect them, or interpret them wrongly?

The limits of human rationality

The object of the literature on the human factor is human performance, affected by many attributes such as age, physical health, state of mind, attitude, emotions and so forth. If one omits the intentional human factors that may lead to early warning failures – such as sabotage or intentional negligence – most of the literature of interest from our point of view focuses on the limits of a human being's capacities, particularly related to information processing. By so doing, the psychological and cognitive approaches to human behaviour challenge the idea of people behaving rationally.

Rationality is usually understood to include the notion that people gather the proper amount of information to form their desires, beliefs and assumptions, and then act accordingly (Elster 1986). However, psychological and cognitive tests, applied especially to (crisis) decision-making, have proven that for several reasons a person unavoidably overlooks some of the alternatives, or refuses to perceive given information (Stein and Welch 1997; Vogler 1989).

The nucleus of the problem is a person's view of the environment, which varies from person to person according to their belief systems, values, state of mind, experience, knowledge, and so on. The facts of various situations are not seen in the same way by everybody; the facts do not 'say' or 'tell' anything by themselves, instead a person has to select them, put them in order and classify them, to give them meaning, and finally to act on the basis of the knowledge thus accumulated.

Information processing is selective. Striving for consistency in adopted attitudes or belief systems can lead to situations where a person closes his mind from controversial information. Faced with critical information a person is inclined to misunderstand it, to deny it or to leave it totally unprocessed. If the trust in an advance presupposition is strong, it is also possible that a person will be inclined to make a decision before he has sufficient information at his disposal. All information is interpreted whenever possible so that it supports existing beliefs, though it might just as well support any other interpretation of the situation. So a person remains blind to the necessity for change in his beliefs or assumptions. When finally this necessity is recognized, a person often chooses the first alternative that offers a way out, and instead of radically changing his views just adds some exceptions and superficial changes to his existing outlook.

These notions may explain why early warning signals are not identified or why they are interpreted wrongly. If, for instance, the water level of the Gulf of Finland suddenly rises to a much higher level that was thought possible, it might be difficult to imagine that this could happen and take the appropriate measures, even if early warning signals would show the opposite to be the case. But this is exactly what happened in January 2005, causing a major emergency, as discussed in Chapter III of

Table I—1 Bottlenecks in civil protection early warning.

Phases / Factors	Risk assessment	Prevention	Monitoring	Warning	Response
Human factors	Limitations of a human being to receive information which contradicts existing beliefs and values		Situation (un)awareness problems, related to a human being's physical and psychological limitations in interaction with technology (attentional tunnelling, requisite memory trap, data overload, out-of-the-loop syndrome etc.)		Stress-related problems in making decisions in a crisis situation
Technological factors	Non-utilization of all the available technological know-how in order to attain information on risks	Missing detection systems		Poor or missing connection between the detectors and the people/property in danger	Lack of automatic response systems (such as sprinklers, automatic off switch for gas supply etc.)
	Too strong technology dependence				
Historical factors	Historical experiences/analogies constraining or narrowing the identification of new threats		Wrong cognitive shortcuts (poor historical analogies) leading to an inaccurate diagnosis and consequently then to an inappropriate or delayed response		
Safety culture factors	Unwillingness to raise safety concerns and to learn from errors, incidents and accidents (fear of punishment, loss of reputation, economic losses etc.) Unwillingness to allow outside inspection and sharing safety-related information with the inspectors and the general public 'Normalization-of-deviance' factor: a safety problem is tolerated, because it did not cause a serious accident the first or second time it occurred				

Organizational and legal factors	Improperly institutionalised early warning system, bad leadership and/or biased institutional routines (for instance, decision-making and reporting practices), leading to un-recognized risks or ineffective prevention, monitoring, warning and response, unclear decision-making structures Organizational rivalries, lack of communication and coordination within and between organizations, too "closed" organizations Poorly designed institutional/organizational structure; for instance, too centralized or decentralized, too rigid not allowing for flexibility, obscure organisation, leading to ineffectiveness, avoidance of responsibilities etc. Lack of organizational learning from previous crises and emergencies, leading to repeated mistakes				
		Missing or outdated preventive regulations		Unclear mandate for raising the alarm	
Political and economic factors	Lacking political commitment for the effective coordination of the relevant national agencies, creating the legal frameworks and continuous funding				
	The difficulty to make 'neutral' cost-benefit calculations, too little emphasis on resilience, problematic public-private partnership				
International factors	Uncoordinated or lacking international cooperation, no agreed upon standards Lack of political will to cooperate or to assist				
Cultural and societal factors	Low risk knowledge, risky behaviour and high risk tolerance Lack of social capital and low level of civil society self-organization				

this volume. In order to identify the early warning signals in this situation the relevant actors had therefore to be able to question the earlier risk assumptions connected to the rise in water level. As the discussion in Chapter III shows, this was done rather successfully in Finland, whereas the Estonian authorities did not first take the extraordinary weather forecasts seriously, thus resulting in a delay in preparedness.

Information processing becomes particularly challenging in situations that cause stress, such as a crisis, an unmanageable workload, anxiety or fatigue and so forth. In many early warning cases the issue is to decide whether or not to act on the basis of available information under cases of uncertainty. The decision to act may incur significant costs, such as shutting down a nuclear reactor[1] or mobilizing a number of rescue forces, but so might inactivity, if the early warning signal proves correct. In other words, early warning signals are seldom unambiguous and there are often incentives to interpret the available information in various ways, and cost-benefit calculations have to be made in a stressful situation.

Cost-benefit calculations do however demand the rational weighting of the pros and cons of the alternative action lines. It is also often pointed out that stress situations are such where a person especially fails to behave rationally. In cognitive psychology, it has been noticed that in stressful situations the number of misjudgements and miscalculations rapidly increases, risk-taking inclinations become more frequent, the consideration of relevant facts becomes highly selective, the difference between what is essential and what is irrelevant disappears, the ability to abstract from details weakens, and it becomes more difficult to tolerate complexity (Flin et al. 1997; Nicholson 1992, p. 127ff.).

The counter-hypothesis to these assumptions about the increased limits to rationality is that it is expressly in crisis-like situations that a person tends to think rationally and afresh. Whereas routine operations do not challenge standard procedures, in a crisis situation we have to question basic assumptions. On the other hand, we cannot claim that relying on normative principles of appropriate behaviour, the use of analogies and other cognitive shortcuts in crisis decision-making are 'irrational'. Indeed, when huge issues are at stake, 'rational' cost-benefit calculation appear almost impossible and norms and analogies help focus on essentials. A synthesis of these approaches suggests that, particularly in a crisis situation, decision-makers initially narrow down the menu of possible choices on a cognitive basis and then weigh the various remaining alternatives according to the model of instrumental rationality (Mintz 2004).

Should we consider all these limits of human behaviour in light of the early warning phases presented above, it seems that the first problem is that the existing belief systems and assumptions narrow the scope of risks to be considered. While, as pointed out earlier, it appears that we should always include some kind of systemized 'imagine the unimaginable' working method in risk assessment, it is difficult to do in practice because of the limits of an individual human being's belief system. This is perhaps best materialised in practice by systematised scenario building as well as by enlarging the group responsible for risk assessment, thus making it more heterogeneous and allowing more room for alternative interpretations. These same limitations – a human being's inability, or sometimes resistance, to receive or interpret correctly even obvious information from the environment that contradicts existing beliefs – can become important in more acute crisis situations. A person's beliefs or presumptions may prevent him from identifying early warning signals, even if he is directly monitoring them. It might therefore be wise to avoid monitoring

[1] Nuclear reactor shutdown, for instance, may cost something like a Million euro per day.

systems where all critical information is filtered through one person alone whose belief system or basic assumptions necessarily always narrow his ability to receive and process information objectively. The same notions could also be considered in relation to response situations, where stress may make rational decision-making especially challenging. Crisis decision-making systems, while striving for efficiency, should perhaps not be too 'closed'; there should be always room for considering several alternatives and interpretations of a situation.

Bad situation awareness

Basically the same issues as above but from a slightly different angle can be discussed from the perspective of so-called situation awareness. Compared to the extensive debate on the cognitive limits of rational decision-making, this more narrowly focused debate within the human factor literature mostly concerns ergonomics. Most often the focus here is not on human factors as such but on a human being's limited capacity to handle information when functioning in a highly developed technical environment. The issue is the interconnection between a human being and technology. Situation (or situational) awareness here is a term recently popularized by the crisis and disaster-related literature, focusing on situations where human control is required but where, at the same time, situational dynamism and complexity makes control difficult.

Situation awareness has been defined in numerous ways. Being originally an aerial warfare term it has become popular not only in all aviation-related contexts but also in many other fields. A widely accepted definition of (successful) situation awareness includes three levels: obtaining data from the environment (sensory perceptions); understanding what this data means, based on knowledge or experience; and finally being able to make predictions about what will happen (Endsley 1988, 1993, 1995; Salas et al. 1995; Harrald and Jefferson 2007). Thus, should early warning be successful, all of these elements of situation awareness should be present. However, most of the literature on situation awareness is actually about situation unawareness, about human failure to understand a situation correctly, which then leads to poor or ill-informed decision-making and behaviour (e.g. Bolstad, Costello and Endsley 2006).

One of the most discussed phenomena of this kind is so-called attentional (or cognitive) tunnelling. In a possible early warning situation, for instance, the number of data sources can be high and their relative importance may change. If we then, for one reason or another, do not allocate our attention between the channels of information, or diagnostic hypotheses, or task goals, in a maximal way, the result may be a fixation on one specific element while becoming blind to the other elements. Cognitive psychologists and people studying and designing human factor-sensitive products have tried to discover what leads to this tunnel effect and how to avoid it. (Wickens 2005)

One easily imaginable situation is when a faulty hypothesis of the nature of a nuclear power plant malfunction, based on the low probability of the real cause of the malfunction, guides the action of the operator to deal with the situation, potentially with disastrous consequences. Or let us imagine the problems facing a pilot incapable of anticipating a forthcoming danger because he relies too much on one type of technical information or one technical source of information at the expense of other information sources; a pilot may, for instance, be unable to receive even clear visual early warning signals if the technical data tells him that everything is in order. A third example could be that of a situation where a crisis signal is obscured by a simultaneous event, such as an unrelated or secondary equipment problem, and the

signal of a forthcoming catastrophe may remain unnoticed, because attention is 'tunnelled' to the equipment problem alone.

Another phenomenon is a so-called requisite memory trap, referring to the limited working memory capacity of a human being, concerning how much short-time information such as numbers, variables and so on a human being can hold in his mind simultaneously. Often, the operation of a technical system – as in the case of Air Traffic Controller, for instance – requires a significant level of memory usage by the operator. While people differ in this respect, and working memory can be developed by training, every human being has his limits in this sense. Sometimes this is not understood properly by technical system developers from the perspective of exceptional situations. While the system can work perfectly in normal conditions, it occupies all of the working memory of its operator, which may mean that he does not notice possible signals intimating a crisis situation before it is too late.

A slightly different type of a human-technology problem is that of data overload, or rather its overly complex presentation. If a system, such as a computer interface or a control board for potentially dangerous machinery, allows for too many variables and simultaneous functions, it can lead both to failures in information processing in normal situations and in crisis situations. Let us imagine a situation where the control board of a nuclear power plant signals an alarm via several blinking lamps simultaneously and thus the priority of the next step to be taken becomes unclear. The opposite case may be that of the so-called out-of-the-loop syndrome, where a highly automated system removes the operator too far from the elements he controls, to the point where he looses touch with them. (Moulton and Forrest 2005)

These instances are not human factor problems as such but technological or design problems relating to those technical systems with which a human being has to interact. Thus, basically making the technology simpler or introducing human factor safeguards to necessary technological systems may help. In any case, enhancing the technological systems' ergonomics from the perspective of the human capacity to process information, including crisis situations, is necessary. Prolonged testing might be needed both in trying to locate the possible human factor bottlenecks in civil protection-related systems. In any case the human error component should be eliminated from the systems or be controlled as much of possible. The other side of the coin to the development of technology is the proper choice and training of the system operators.

2.2 Technological factors

Science and technology-oriented applied research have a central role in the forecasting and mitigation of natural and other hazards, forming the basis for risk assessment and prevention (NERC 2006). If we look at the phases of monitoring, warning and early response, we can say that there is a kind of technological predominance in current early warning debates when dealing with these issues. In modern societies, civil protection early warning could hardly be possible without highly developed technological solutions. Indeed, for most people the notion of early warning in civil protection is probably synonymous with different kinds of technological sensors, detectors and surveillance systems, on the one hand, and technical warning systems such as the European emergency number 112, on the other. At the same time, a debate has arisen on how in the midst of all the exciting technical and scientific issues regarding civil protection, it is important not to lose sight of the fact that the task is that of responding to the real social problems caused by the emergencies (e.g. Colombo and Vetere Arellano 2002, p. 79).

Early-warning technology is a rapidly developing field. General technological developments, including satellite and other monitoring and communications techniques, have mean we can find equipment-based technological solutions to monitoring, detecting and analysing almost anything, be it radiation, drinking water quality, air quality or specific substances in the air, water level, smoke or heat, air, road and sea traffic, storms and hurricanes, earthquakes, tsunami, oil spills, or health-related threats such as pandemics. There are several specific geographic localization and information systems available to define exactly where a given emergency takes place and who should receive early warning. Satellite and other wireless communications systems help to move early warning information speedily between the authorities and to the people at risk, thus giving more room for prevention, warning and early response. There are automatic damage mitigation and response systems, which turn on emergency lighting and exit signs, create loud audible warnings, turn on sprinkler systems, unlock emergency storages and equipment cabinets, start automated control of elevators and air-conditioning systems and so on. (Disaster Warning Network n.d.) More and more new technological solutions, such as using mobile SMS messages as early warning tools (Lirneasia 2005), are constantly being introduced.

With technology we can also overcome some typical early warning bottlenecks, such as break up of communication between the monitoring phase and early response. Hence, in some types of emergencies, technological development has made it possible to automate the link between early warning detection and its communication to the users. For instance, in Japan the meteorological authorities, working on the assumption that 'every second matters', offer emergency earthquake information directly to railway operators, fire departments and other key institutions and to the public; and to lessen the damage to people and households, a system has been introduced which automatically cuts off gas supplies to avoid fires (Trends in Japan 2006).

Missing technology

From an early warning failure perspective, technology becomes crucial mainly in two cases. First is that the necessary technological equipment is missing even if it could be available. While the use or non-use of technological solutions always depends on other factors, such as available economic resources, a new technological solution often becomes topical only through contrafactual reasoning ('this could have been avoided if…') after a disaster. Thus, post-disaster reports usually conclude that this or that technological dimension of early warning could be introduced or improved. Perhaps in this sense every early warning failure reveals some gaps. The tsunami catastrophe in 2004 is a clear case where a technology-based early warning system, based on measuring with sensors the sea water level changes and warnings distributed automatically via satellites, might have contributed in saving many lives. Active development of these kind of early warning systems started in different parts of the world only after this huge catastrophe took place, even if there was both technological knowledge and risk knowledge available concerning tsunamis even before.

However, even in this case, as in all surveillance and detection systems, the potential problem is that high-tech solutions become useless, if they are not connected to an effective 'end-to-end' warning system, which is not always possible and can be difficult using technological means only. For instance, we can build a Pacific tsunami detection system, based on rather complex high technology, but then the question arises of how to build up the infrastructure to broadcast the potential warnings produced to remote areas and the people in danger (see BBC 2005).

A special case is when there are technological solutions available but not for all people at risk. The threat of terrorism, for instance, has undoubtedly accelerated technological development and the marketing of individualised early warning equipment. Mobile phones can be equipped with biological and chemical attack sensors, detecting anthrax and other dangerous elements in the air. In addition, scientific medical research has made it possible to prevent pandemics by self-medicating counter treatments before consulting doctors. (Lieberman 2005; The Medical News 2006) Introducing this kind of early warning equipment brings several problems, however. One is that they may trigger false alarms and create panic, and self-medication may be an unnecessary overreaction and perhaps even dangerous to some patients. They are also undemocratic in the sense that early warning is dependent on whether we can afford the equipment or medication. The moral dilemma is then is whether or not these undemocratic early warning devices should be promoted or not.

Too strong technology dependence

But there is the other side of the coin, too. If we assume that an early warning technology is in place, another kind of early warning failure, which can be derived from this technological dimension, is that sometimes an early warning technology is not functional or is of the wrong type, and at the same time the whole early warning system may be based on this technology. If early warning strategies are predominantly based on high-tech automated solutions, the potential disturbances or errors at one point of the early warning chain may break the whole system. Indeed, the dilemma of technology is that while it seems to open the way to almost unlimited possibilities for improving early warning, the more developed the technology gets, the more vulnerable it might be to disturbances and vulnerabilities from malfunctions and sabotage. This is further complicated by the *functional interdependencies of technological infrastructures* in modern societies, especially based on information and electricity infrastructures (see e.g. Gheorghe et al. 2006; Lukasik, Goodman and Longhurst 2003). In fact, in many cases the practical advice is that expressed by the manager of London Underground following the 2004 terrorist attacks: “invest in your staff, rely on them; invest in technology, but do not rely on it” (quoted according to Lewis 2007).

2.3 Historical factors

History can have a crucial impact on early warning, as each situation in one way or another has a history on many levels. The historical factors are also intermingled with those discussed above, namely the human limitations to handle information. In this context, such issues can be perhaps best discussed in terms of historical analogies, meaning the use of an image of the past to shed light on present or future developments. Historical analogies are used for different purposes, including learning, persuasion, manipulation, rhetoric and prediction. Their use is widespread, especially in politics, and in other fields such as civil protection.

Decision-makers use the past either politically or cognitively (Brändström et al. 2004). This avowedly political use means that a decision-maker intentionally chooses an event from the past to describe the current or forthcoming event. Sometimes, this kind of usage can be useful in explaining a complex situation to the general public, but often this is done simply to advance a certain political line or project. Depending on which historical analogy is chosen, we can stimulate different policy approaches to the same issue. To start the Iraq war in 2003, for

instance, the slogan was used about the need to avoid ‘another Munich’, and it was opposed by those who sought to engender caution by speaking about ‘another Vietnam’.

Historical analogies are also frequently used in the field of civil protection. In the ‘politics of civil protection’, intentional use is as widespread as in any political field. When in September 2000, in the Sverdlovsk region in the Russian Federation, there was a nuclear power plant emergency situation, a famous representative of the environmental movement in Russia afterwards announced “We were just half an hour from another Chernobyl” (The Russian Environmental Digest 2000), thereby criticizing the authorities who tried to downplay the severity of the issue. Or in the United States, when trying to emphasise the severity of Hurricane Katrina, some local politicians called it ‘our tsunami‘, thus motivating even more extensive support programmes, compared to those used if it had been interpreted as just another hurricane. (Steinberg 2005)

Over reliance on the past experiences

From the early warning perspective, politically utilised historical analogies may play a crucial role in the context of risk assessment and prevention when directing attention to certain risks. It is clear that 9/11 has focussed significant emphasis on preventive airport security, the East Asian tsunami kick-started the process of the development of more effective surveillance and warning system for underwater earthquakes, while the MV Prestige oil tanker accident of 2002 placed the risk of oil spillages at the top of the risk agenda in many countries.

While learning from past experiences is natural and mostly useful, a negative effect might in some cases be that resources are not apportioned according to the most rational risk assessment but on the basis of past or most recent tendencies. Therefore, we should emphasise the need for critical understanding when using historical analogies in risk assessment. A focus on past issues should not lead us to downplay other issues that might be essential when the next catastrophe takes place. While learning from the past, risk assessment should try to recognize different types of threats. Thus, instead of over-relying on a focus on recent emergencies, a more balanced approach to risk assessment should be based on the so-called all-hazard ideology, adopted at least in theory in most EU countries and by the EU itself.

Wrong cognitive shortcuts

A cognitive use of historical analogies is less intentional. In acute crisis situations, in particular, such cognitive shortcuts help one to quickly make sense of confusing events, offering a diagnosis on the basis of a past event which is perceived as sharing similar features. The cognitive use of historical analogies is relevant especially in the monitoring and dissemination of early warnings. It can help us to analyse the situation quickly and anticipate the possible consequences. However, if a faulty historical analogy is used as a cognitive shortcut to define the current case, it either misdirects or at least narrows and constrains the analysis of the situation.

For instance, there were several early warning systems that identified the earthquake resulting in the East Asian tsunami in 2004, and the corresponding earthquake warning was released. However, as large-scale disastrous tsunamis are rather rare (even if tsunamis as such are not rare at all), no working tsunami early warning system existed at that time. The countries and people at risk were therefore not alerted to the dangers posed by a possible tsunami but were instead warned of a

coming earthquake. Today, any similar earthquake would result in a concurrent tsunami warning, even at the risk of a false alarm.

Historical experiences also direct the actions undertaken for rescue operations. In Sweden, as in many other concerned countries far away from the disaster area, the 2004 tsunami was initially interpreted as being likely to mirror previous natural catastrophes, such as the earthquakes in Iran and Turkey. Swedish politicians, officials and rescue services understood it first and foremost as a 'normal' catastrophe far away from Sweden to which the Swedish rescue troops could be deployed to help local victims if asked through existing UN mechanisms. Only after a considerable delay did it become clear that the nature of this crisis was rather different to anything that had previously occurred, that is to say, it was also a Swedish national crisis, as thousands of Swedish citizens were also likely to be victims. Thus, the civil protection authorities were not initially mentally prepared to begin a major evacuation operation to rescue Swedish citizens because they relied on faulty historical analogies to construct their understanding of what had happened and to whom. (Katastrofkommissionen 2005)

2.4 Safety culture factors

In contemporary theoretical discussions on institutions and organisations, mostly in sociology, political and administrative sciences and economics, the main issue is not the formal features of organisations, nor is it limited to decision-making from the perspective of rational choice situations. Instead, contemporary institutionalism usually focuses on such things as values, norms, trust, and cognition when explaining the features of an institution.

Of these factors we could highlight especially the organisational safety culture. Safety culture is most often related to complex high-risk industries, such as the aviation or nuclear industries (rather than to whole societies). Indeed, its etymology is usually traced back to the Chernobyl nuclear accident of 1986. Here, the International Atomic Energy Agency identified 'poor safety culture' as one of the factors contributing to the catastrophe (IAEA 1986). Since then the concept has established itself, but its use has remained somewhat ambiguous.

The general trend is that the use of the concept and methods of safety culture promotion has in recent years been widened from nuclear safety and aviation to other similar fields and beyond. While it has been noted that, for instance, some cases of maritime disaster early warning have failed because the concept of safety culture has not been properly applied or introduced to that field of activities (Toivonen 2003), Chapter V of this volume discusses the developing cross-border maritime safety culture between the Finnish, Estonian and Russian authorities. Recently it has been noticed that the traditional health care culture, for instance, shares with other industries many of those aspects that could be defined as exhibiting a 'bad' safety culture, such as a reluctance to acknowledge human fallibility and a punitive approach to errors. Instead, motivating hospital personnel to report errors and near misses, using safety data to learn and to reform current practices, and discussing other similar issues from a safety culture perspective can considerably improve patient safety. (AHRQ 2007; McCarthy and Blumenthal 2006)

Unwillingness to raise safety concerns

According to a review of the literature on safety culture, a variety, even a chaos, of definitions can be found (Hui et al. 2002). Nevertheless, the general safety culture

literature shares some common features. A good safety culture means giving the highest priority to safety over other factors, for instance, profit-making. A good safety culture should also be reflected in the organisation's willingness to raise safety concerns and to learn from errors, incidents and accidents. It should not only be the individuals' or the leadership's responsibility, but it should be expressed in shared safety values, attitudes, perceptions, competencies, and patterns of behaviour among the whole group of members of an organisation. Consequently, leaders and decision-makers should not dismiss safety concerns coming from 'below'. In a practical sense, within some high-risk industries such as the nuclear industry, the existence of a safety culture often entails a willingness to submit to outside inspection and the sharing of safety-related information with outside inspectors and with the public.

Normalization-of-deviance factor

If a safety culture fails, it automatically means that some potential early warning signals are, or can be, dismissed or downplayed. It has been proposed that one of the main reasons why this happens is the so-called normalization-of-deviance factor. This means that an existing problem, which was initially understood as a safety problem, is tolerated, because it did not cause an accident the first or second time it occurred. After a while, a second and third problem may occur, and they will also be tolerated for the same reason. Individually these problems may not, in fact, lead to any serious incidents, but if they happen to coincide, the result can be catastrophic. This is what, apparently, occurred at the nuclear power plant disaster in Harrisburg, Pennsylvania, USA, in 1979. The cause was not a single failure or error but a series of mechanical, electrical, and human failures, whose existence or possibility were known in advance but were all tolerated as they did not seem to be the cause of any significant risk by themselves (Lochbaum 2004). As noted previously with regard to Chernobyl, one of the major causes of the accident was said to be the lack of safety culture in the responsible organisations, which led to an inability to remedy important weaknesses, even though they had been known long before the accident (Lederman 1996).

2.5 Organisational and legal factors

Moving to more formal organisational factors of a possible early warning, we can in principle differentiate early warning or civil protection organisations themselves and those organisations where an emergency can take place, as they are of rather different nature. Often they overlap, however, since different kinds of high-risk industries have the early warning systems embedded in their organisations. Another somewhat confusing issue is that in an early warning system, as with any system, it is almost impossible to picture the organisational characteristics involved without their necessary overlaps with legal, cultural, economic, political, technological, human and other factors. In particular, the early warning organisation is necessarily in many ways inseparable from the legal basis or framework, which defines the characteristics of the organisation and within which it operates. Therefore, this section discusses the organisational-legal factors in combination, pinpointing the main success and bottleneck factors that obviously need to be taken account in any discussion of civil protection early warning.

Improperly institutionalised early warning system

The first obvious question here is whether there exists an institutionalised early warning system in the first place. Indeed, we can distinguish certain issue areas where

the organisational framework for risk assessment, preventive action, monitoring, warning or response is missing. Often these kinds of gaps are identified only after they have become obvious through an early warning failure in a major emergency or disaster, or when the perceived risks are growing. The incentive to build up tsunami early warning systems all over the world after the 2004 East Asian tsunami illustrates the former case. The need to build up a more developed and coordinated cross-border maritime safety early warning and control system in the Gulf of Finland, where oil transports from Russia have been rapidly growing illustrates the latter case (see Chapter V of this volume; Nikula and Tynkkynen 2007). In other words, there are always gaps to be found in the institutionalisation of early warning in different fields and geographic areas.

However, in most countries and within most issue areas the answer is that of course there exist early warning systems, which are supposed to deal with most of the identified risks and vulnerabilities. In general, each country has a competent authority responsible for civil protection (European Union n.d.). However, an effective civil protection system is necessarily cross-sectoral and multidimensional, starting from proper spatial and physical planning and preventive solutions, and ending with effective restoration. Therefore, in a wider sense, the national civil protection system in different combinations includes national, regional and local authorities, often also non-state actors such as voluntary organisations, and private or public companies.

The existence of some kind of civil protection early warning system in a narrow sense is usually included in the responsibilities of the competent civil protection authority, but because an early warning system has to be based on multilevel and cross-sectoral cooperation, one authority cannot bear the whole responsibility. It is, however, often reminded that the overall responsibility and authority for coordination of early warning should be assigned to one national authority, and even that there should be "One political leader or senior government official empowered by law as the national decision maker" (EWC 2006, p. 9).

Hence, the civil protection system as a whole requires clear-cut legislation, which defines the division of responsibilities, coordinative mechanisms, bodies and mutual assistance systems between different ministries and agencies as well as non-state actors. Post-disaster analyses almost without exception note that decision-making and responsibilities were not clear enough, which may have a crucial impact on early warning success too. Thus, the widely accepted recommendation is that in order to work, the 'warning dissemination chain' should be enforced through government policy or legislation, and the functions, roles and responsibilities of each actor should be specified in legislation (c.f. EWC 2006, p. 7).

Non-institutionalised risk assessment system

As was discussed above, an effective early warning requires and effective risk assessment system. If there is no clear understanding about the risks, it seems impossible to try to prevent them, or to monitor the early warning signals of those risks, or to understand the warning signals properly, or to be prepared to early response if they anyway are coming to a head.

Risk assessment may fail in principle in two ways. First, there might not be resources, institutions, scientific and technical experts and so on who would do the risk assessment. That is, there is not enough knowledge generated about the risks, such as characteristics, location, frequency or probability of vulnerabilities, hazards, disasters and accidents. This can be the result of several factors. The society's level of scientific and economic development may hinder the development of institutions, which would gather data and analyse it; or the priorities defining the resource

allocation in applied scientific and technical research might be inappropriate. Second, however, often the case is that there is a lot of risk knowledge, which is not used by 'end users' and 'stake holders'. For instance, geographers may have developed accurate flood maps, which are not used by communities to guide their land use planning. On the other hand, the scientists and analysts, if not cooperating with the local communities and practitioners, may not focus on right indicators or priorities in their risk assessment efforts.

In order to become effective, the risk assessment must therefore become institutionalised, well coordinated with and embedded within the civil protection system and the communities in question. The recommendations (c.f EWC 2006) in this respect usually include the establishment or empowerment of one national organisation, who would coordinate the key national agencies involved in hazard and vulnerability assessment, cooperation with scientific and research community, cooperation with civil society and private actors, and so on. There should be national standards for a systematised data collection and its sharing, national programmes for developing know-how in different fields of civil protection risk assessment, and proper institutional and financial resources for that. The communities – such as municipalities, public organisations, industries – should be obliged by legislation to prepare risk assessment and contingency plans, including hazard and vulnerability maps.

Missing or outdated preventive regulations

From the perspective of prevention and mitigating the consequences of disasters and accidents, based on proper risk assessment, the main legal instruments are the regulations of those activities that may cause a disaster or emergency or may be an object of them. This concerns such things as spatial planning, land use, traffic safety, safety norms of equipment and so forth.

While safety aspects to some degree are routinely taken into account in most issues of physical and spatial planning, from the perspective of large-scale disasters and emergencies it becomes too often evident only post factum that land-use planning procedures lack any incorporation of risk assessment or hazard mapping. Hence, legislation regarding a plan for land use planning should be elaborated, where risk assessment should be carried in areas, which are, for instance, prone to floods and flood-related hazards, such as landslides and soil erosion, avalanches and so forth. Often, lack of zoning laws or norms concerning land use, or lack of building codes and their enforcement contribute to making a disaster much more damaging than would have to be the case. Thus in many natural and technical disasters, the post-disaster evaluation concludes that victims and injuries could have been avoided, or at least reduced, with a more suitable location or a better method of construction of houses, roads and so on. (Colombo and Vetere Arellano 2002, p. 81-87; Colombo 2000a, p. 8; Theofili and Vetere Arellano 2001, pp. 6, 10; see also EWC 2003)

It is not always enough that zoning laws and similar regulations and hazard mapping systems are in place. Sometimes they exist but do not correspond to the parameters of an emergency when it happens, thus showing that the risk assessment phase partially failed. Post-disaster evaluations have noted that the hazard zoning was in many cases inefficient as the destroyed houses or roads were in zones that should not have been in danger. Thus these types of zoning procedures and regulations should be regularly reviewed in cooperation with lawyers and hazard specialists to match possible changing conditions, due for instance to climate change. There is a strong need to re-examine and periodically check the legal preventive measures, such

as building safety codes or land use regulations. (Colombo 2000a; Theofili and Vetere Arellano 2001, pp. 6, 10, 12, 15; Colombo and Vetere Arellano 2002, pp. 79-87)

It is also important that the regulative systems include clear mandates for monitoring and controlling that the regulations are followed. For instance, in Chapter V of this volume, dealing with maritime safety, notes the positive development as the result of the so-called Paris Memorandum (Paris Mou), which authorises a Coast Guard to stop a vessel in the case its crew is undermanned or not sufficiently trained. The preventive purpose of this mandate is that the ship owners have realised that it is in their economic interest to sail vessels complying with all regulations, since the costs for training and manning of the personnel is lower than the loss of having the ship stuck outside port.

Ineffective organisation

If we suppose that an early warning system exists, the next issue should be to evaluate its organisational effectiveness in order to pinpoint potential early warning bottlenecks. Perhaps the first question then is at what level of governance the risks are to be regulated. For instance, when we have to deal with complex interconnected and interdependent systems such as the electricity grids, whose malfunction or failure can cause extensive crises, the issue is whether the right level of early warning system should be "sub-national, national, bi-national or tri-national, regional, international" (Gheorge et al. 2006, p. 308).

In general, evaluating civil protection systems we first come across the basic organisational solution. We could notice that national systems remain distinct even in countries that are historically, politically and culturally close, or which are neighbours. Thus, in the Baltic Sea Region, for instance, differences of history, culture, basic political and administrative systems, size, location and other specific problems are reflected in individual countries' respective civil protection cultures.

National systems can be compared by looking at several variables. From what could be called a 'hierarchy perspective', the issue is whether civil protection is led, coordinated and organized by a central national authority, or whether the regional and municipal authorities have considerable legal and operational responsibility in this area. Other comparable variables include whether or not voluntary organisations or private rescue services are an integral part of the official civil protection system. Or we can also compare the systems to see whether close cooperation exists between the civil protection and military authorities. (Cf. Pursiainen, Hedin and Hellenberg 2005) These national differences in organising civil protection are all reflected in early warning strategies in different ways.

According to the widely shared 'early warning ideology', early warning should, as far as possible, be based on community participation and cooperation with the local decision making, civil society and private actors. (e.g. EWC 2006; ISDR 2003) This is probably a good starting point, but it does not however seem possible or rational to recommend any general best practice, which would just be simply fit all conditions. Where the political system is organised in a hierarchic way, with sparse administrative and financial resources at the local level, or where civil society is weak, it seems not reasonable to jump immediately over from a centralised system to a decentralised one in crisis management and early warning systems, even if this might be the best goal in longer run. Instead, the rule of thumb might be that local cultural, societal, political, financial, technological and other conditions and resources are crucial in determining the exact organisational and cooperation models utilised in early warning systems.

From a more 'horizontal perspective' we could notice that the issue is about whether the early warning system should be centralized in terms of dealing with all types of emergencies, or whether it should be based on more autonomous units. In most cases, the specific type of vulnerability dictates the nature of the early warning system. That is why the early warning systems, while to some extent integrated into general disaster or emergency early warning systems, are at the same time issue-area related. Thus flood early warning systems have a separate system from forest fire early warning, and radiation early warning systems are designed separately from extreme weather early warning systems. In practice, in most cases a comprehensive national early warning system consist of several issue-area specified 'sub-systems', which, in order to become effective, have to be coordinated especially in terms of information sharing as one type of emergency often has a spill-over effect beyond its original emergency field. Thus a natural disaster easily becomes a technological disaster, or an environmental disaster becomes a health problem, and so on.

As with any organisation however an early warning system has to meet several organisational requirements. While it seems to be impossible to make any clear-cut recommendation on how the national early warning system and its updating should be organised in detail, as it depends largely on technological and financial conditions and resources, basic political and administrative solutions, societal traditions and so forth, a few general criteria for any such organisation are available. To be efficient, an organisation should be characterised by a clearly defined mandate, tasks and goals, clear divisions of responsibility, clear leadership and decision-making structures, clarity in the chain of command, clear communication systems and, where appropriate, responsiveness to organisational change. These features can partially be defined through legislation, though they are closely related to other factors and conditions such as cultural/societal/organisational traditions and values.

Furthermore, almost every post-disaster evaluation report points out, even if the organisation for early warning and crisis management is at place, its functioning is dependent on continuous maintenance of training, financing and updating of equipment (e.g. Colombo 2000a). Another important feature of an effective organisation is that there is an institutional system for learning from past experiences. Post-disaster and post-emergency evaluations should be an organisational routine and the evaluation results should be taken into account in developing each of the above discussed 'phases' of an early warning system. While learning is principle takes place at the level of an individual, these individual experiences should be collected, critically evaluated and investigated, and the obvious lessons should be included into the routines and structures of the early warning system in order the individual learning to be transferred into organisational learning. It has also been proposed, for instance, that there should be a central 'library' established to store all disaster information, for 'lessons learned' purposes (EWC 2006). Most of the data should be available not only to governments but to the public as well.

Lacking communication and coordination

Because an early warning system is necessarily based on multisectoral and multidimensional solutions, those organisational or institutional biases that are constantly raised in early warning debates include the lack of communication and coordination within and between authorities. In other words, organisations are often too 'closed' with no mechanism for automatic information flow between authorities. This may be the result of many things such as a basic organisational design fallacy, overlapping responsibilities with no clear idea of decision-making chains, organisational and bureaucratic rivalries, and biased practices and routines.

If the early warning system is not integrated and coordinated, the early warning signal may not be received or identified even if the monitoring system as such is in place. For instance, two organisations may have individually important information, but it becomes an early warning signal only if these two information sources are put together. Therefore, it is generally agreed that an integrated surveillance and information system should exist to ensure that the collected data is properly shared, analysed and processed to enable the recognition of possible early warning signals.

That the threat of bioterrorism and pandemics illustrates the need for coordination is at the same time obvious but it is often neglected. The contagious diseases involved in both can spread quickly; carried by people, animals, food products etc., within a country or from one country or even one continent to another. As such, the importance of public health systems' collaboration efforts in particular with the civil protection authorities has been emphasised in this context. For instance, a local health centre may encounter a case that could easily be interpreted as an individual or local unexplained health problem. However, if a system exists in which it is possible to compare similar symptoms that have been identified elsewhere, this individual case turns into an early warning signal of a threatening widespread health crisis.

Thus an integrated and flexible network of early warning actors may turn out to be crucial, especially in the early warning phase related to monitoring the risks and tripping the alarm.

Unclear mandate for raising the alarm

While risk assessment, prevention and the monitoring functions of early warning are often diversified and flexible, based on the normal functions of society, warning and response systems are usually more strictly organised by the authorities, and subordinated to the highest national civil protection authorities.

One of the organisational-legal issues is that of the system and mandate for raising the alarm when a signal has been identified. The starting point usually is that there should be a legally empowered competent authority to disseminate the warning messages. The warning processes should be standardised, agreements and interagency protocols should be in place to ensure the consistency of warning, warning system partners should be aware of the respective responsibilities and division of labour, communication responsibilities should be clear, and so on. In practice this should be organised in terms of warning centres staffed at all times (24/7). It should be staffed by trained warning professionals, who can estimate the needed level of warning and respective recommendations, as well as the target group. The communication and dissemination systems should be tailored to the needs of the individual communities and target groups. The communication with the public or the people at risk should be two-way to allow verification. (EWC 2006, pp. 6, 7)

However, the development of technology has brought a new trend in early warning, which challenge these 'best practices'. The warning systems have become in part privatised and 'individualised'. This development can be motivated by arguing that there can be cases where officials do not react in enough time, whereas private companies or civil society actors are quicker to raise the alarm. While there can be different opinions about the issue – that is, whether this is a desirable or undesirable development – and it remains difficult to hinder this development by legal means, several organisational and legal problems may follow. Basically, as the task of raising the alarm belongs to a national authority, it will then be responsible for any false warnings, for the accuracy and authenticity of the information as well as for related costs. Public warning is a particularly sensitive issue, because of the panic-factor. If a

private company takes this role the problem becomes one of liability and other legal issues.

Yet, the role of the private companies may vary greatly depending on the issue area. In many cases, it would be wise to utilise private sector resources. (EWC 2006, p. 7) In most cases of the so-called Critical Infrastructure Protection (CIP), for instance, a tight public-private partnership is a necessity. While the question of how the responsibilities will be exactly divided between the different stakeholders remains a practical issue, some kind of coordinative institutional solution is usually needed. For instance in fields such as Critical Information Infrastructure Protection (CIIP), the general "trend in CIIP early warning points towards establishing central contact points for the security of information systems and networks" for specific sectors, small and medium-sized businesses and so forth, often called Computer Emergency Response Teams (Abele-Wigert and Dunn 2006, pp. 398, 399). If this type of institutions does not exist, early warning is more or less bound to fail.

Unclear decision-making structures

The organisation that takes care of responses in connection with civil protection emergencies is usually in place. However, what may work on paper does not always work in real life emergencies, especially if they are not simple fires but more complex and unusual disasters. In many cases the result of a post-disaster evaluation is that the operational response organisation has been over complicated. Only an actual disaster reveals that the division of duties and responsibilities has to be simplified and clarified and that the lines of command have to be strengthened and made clearer. (e.g. Colombo 2000a)

This does not mean that the response system should not rely on local resources. Instead, as mobilisation time is always a critical parameter and locally organised response forces are usually quicker to respond to emergencies in their neighbourhood than an outside assistance force, the strengthening of the role and resources available at a local level should instead be encouraged, including the voluntary forces. However, the command chain and responsibilities of all types of organisations involved in the response phase must be clarified in advance in order to enable emergency operations.

In many cases the recommendation is that it is indeed important to call a state of emergency at an early stage, so that the local responsible disaster protection authority can take over the centralised direction of the emergency. This means that "the political and administrative direction in emergency operations is taken over by a small disaster protection leadership group in the county administrative authority chosen according to the situation, while the operation tactics are managed locally by local leaders of operations who are appointed ahead of time and appropriately trained." (Colombo and Vetere Arellano 2002, p. 84) It has also been observed that emergency plans should be regularly updated and revised, based on training exercises and analysis of real emergencies (Hervás 2003, pp. 74, 75)

However, while at operational levels the decision-making structures in an emergency situation can be clearly designed and well trained in advance, a major crisis situation is often characterized by the need for decisions taken at several levels simultaneously, even at the highest political level. If there are major strategic and tactical decisions related to early warning or early response in major emergencies, to be taken at the highest level the issue of crisis organisation in practice often becomes open to several alternatives.

One key assumption about crisis decision-making is that it differs from normal decision-making because it tends to become centralized. This thesis can be qualified

depending on the type of crisis and society, but it seems to hold true as a general tendency. In crisis literature, here exist different opinions about the pros and contras of this centralization. Another contradictory issue is that whether we should rely on the normal institutions in crisis situations or to form ad hoc groups because formal decision-making structures can be seen as too clumsy in a crisis situation demanding flexibility and imagination. Even when the explicit decision-making philosophy is usually to rely on normal institutions in a crisis situation as well, the group or situational dynamics may often lead to improvised and spontaneous solutions in forming the main decision-making unit that contradict both the normal-time decision-making practices as well as those designed for a crisis situation. (Forsberg and Pursiainen 2006, pp. 248-252)

2.6 Political and economic factors

The political salience of civil protection has undoubtedly increased in recent decades. Traditionally a crisis was often understood in terms of foreign and security policy tensions, but contemporary challenges increasingly include different types of civil emergencies, disasters and risks. Consequently, the ability of decision-makers to lead, and their political credibility in so doing, is often considered from the perspective of how these crises and risks are managed. Crisis management has become an essential feature of contemporary governance and political leadership.

Indeed, it is generally held to be the case that public policy for disaster reduction, including early warning, starts with political commitment, which is needed for the effective coordination of the relevant national agencies, creating the legal frameworks and continuous funding. Without a favourable political decision in this respect an early warning initiative is doomed to remain poorly coordinated, under-financed and ineffective. (ISDR 2003; Buchanan-Smith 2000)

Biased cost-benefit calculations

Political commitment culminates in the issue of allocating economic resources to early warning purposes, which makes the political and economic factors unavoidably intertwined. Why then is the level of economic resources invested in disaster early warning, preventive and reduction systems usually insufficient?

While early warning for disaster reduction is a legitimate matter of public policy at the highest national level, as well as at regional and local levels, the motivation for a long-term political commitment often takes place through the demonstration of cost-benefit relationships and other value assessments of early warning services. Indeed, several detailed cost-benefit studies show that the economic benefits of risk-reduction measures that were or could have been taken seem significantly to outweigh their costs. (UK DFID 2004, p. 46) It is paradoxical that in the end reduction strategies always work better than strategies based on financing response and relief strategies, even if the latter receive “almost all financial resources” (NERC 2006, p. 3). The recommendation therefore is that the economic benefits of early warning should be highlighted to senior government and political leaders (by civil protection authorities and experts) by using practical cost-benefit demonstration methods, examples and case studies, and in that way pay the way for early warning to be integrated into national economic planning (EWC 2006, p. 9). The same recommendation could be directed to local decision makers as well.

In practice however the decision to invest in early warning systems is more problematic. Decision-makers have to make priorities where often there is no politically neutral way to do so, while the risks involved are rarely unambiguous

and isolated from other risks and tasks. Often political disagreements exist over the salience of risk factors or their different elements and their cause-effect relations. While the result, retrospectively, would be poor agenda-setting and the negligence of available analysis, faulty decisions or a paralyzed decision-making system, this often becomes obvious only after the disaster.

In a municipality, for instance, we may accept the fact that there is an increase in climate change-related threats such as floods or extreme storms, but since preventive action is not cost-free, municipal decision-makers and politicians have to balance between several stakeholders: should we invest in preventive climate change strategies or should we invest in health care or jobs, for instance, and how can the right balance be found between these needs?

This is well illustrated by a case of a Swedish municipality analysed by Langlais et al. (see Chapter II of this volume), where the local politician and officials refuse to review they plans to build a lucrative 'Sea town' in an area which all the experts define as an extremely flood-prone area in the future due to the climate change. However, rather than dealing with the early warning signals the municipality is receiving, it is consistently projecting the image that the problem is merely one of the assignment of responsibility and the bearer of costs. Thus, the clear signals of the impending danger of flooding, rather than serving as pragmatic, functional implements of rational infrastructure planning, leads to multi-level governance battles between different stakeholders. As Langlais puts it: "Nature's signals arrive in time, only to dissipate in the chaos of politics."

The risk tolerance of the society becomes a political issue, since politicians have to limit economic and other resources allocated for early warning purposes. They have to anticipate the public reaction and their decisions are necessarily based on their perception of how they best bolster either their personal political success or, if they are more altruistic, how they best defend the interest of those groups of society they draw their support from.

While these political and economic factors express themselves most clearly in the decision-making over whether or not to take preventive action, they are also crucial when deciding whether or not to sound the alert in the case of a possible emergency. In many cases, warnings are based on technical information and the monitoring of risks and are thus automatic. Larger risks however often require a political decision to be taken, triggering action to be taken on the basis of a warning. The political decision-makers thus may receive the warning, but if it is likely to create panic or generate significant costs, they often become wary of choosing between different courses of action. Crisis-related decisions usually have to be made in a situation characterised by an element of surprise or much uncertainty regarding the background and future development of the situation. It is therefore difficult to estimate the likely outcome of the decisions made. Decision-makers may have to think about the costs of overreaction, and they may be reluctant to act if they have to rely on vague or unsubstantiated information. Linkages to other decisions and political projects may become important and there can also emerge political differences between the decision-makers on how to interpret and react to an early warning signal.

Wrong balance between protection and resilience

From the perspective of prevention and preparedness, an important discussion is that about protection vs. resilience, raised in connection of critical infrastructure protection (CIP) in particular and thus connected in many ways to civil protection issues. This is basically a question whether one should focus on securing

functionality of the society rather than on protecting individual infrastructures. Indeed, the current view of CIP in the EU emphasizes the protection of infrastructures and prevention of disturbances, such as disasters, and relatively little attention is paid to recovering from disasters. Indeed, from the perspective of the most recent CIP-related debates it seems that the concept of CIP is becoming somewhat outdated; the concept of CIP should be extended to Critical Infrastructure Resilience (CIR), of which CIP is an important part. (Cf. Pursiainen 2007a)

Complete protection can never be guaranteed. As Landstedt and Holmström put it, even the strongest walls inevitably fail, and when this happens swift damage control measures, recovery and reconstitution must be taken. For example, protection and resilience could be compared to a rigid stick and a flexible one, respectively. The former is harder to bend, but under severe pressure will snap and cannot be repaired. By contrast, the flexible stick is easy to bend, always regains its shape and is hard to break. Therefore, focusing solely on CIP alone may provide a false sense of security, which can turn out to be disastrous, as has been proven many times in history. (Landstedt and Holmström 2007) Boin and McConnell (2007) have expressed this by speaking about the "limits of crisis management and need for resilience."

A resilient infrastructure can be defined as "a component, system or facility that is able to withstand damage or disruption, but if affected, can be readily and cost-effectively restored" (George Mason University 2007). Often, achieving the desired level of protection is simply not cost-effective in relation to the actual threats. A small amount of extra protection might introduce a large amount of additional costs.

As full protection can never be achieved, we should ask whether the money could be better spent on making the proper preparations in order to ensure a graceful degrading of the infrastructure when disaster eventually knocks at the door. As de Bruijne and van Eeven (2007, p. 24) have noticed, a fringe benefit from a more resilience-based preparation approach is that these "measures are substantially less expensive than investments in specific infrastructure upgrades to avoid certain risk scenarios which may or may not occur." In short, these resilience measures encompass such activities or elements as protection, prevention, training, education, research, deterrence, risk-based mitigation, response, recovery and longer-term restoration. (Landstedt and Holmström 2007) It has been proposed that what is especially important here is to create 'societal resilience' capacity relying on joint efforts, training, continuity planning etc. of the whole society, including communities and businesses, rather than only enhancing the authorities' capacities or control (Boin and McConnell 2007). Schulman and Roe (2007, p. 43) have argued that the key to increased reliability in relation to resilience "lies not primarily in the design of large technical systems but rather in their management."

Landstedt and Holmström (2007) have pointed out that a good example of resilience in practice comes from the London Underground and bus bombings in July 2005. The next day, the trains and buses were running again and the city was open for business as usual – thanks to prior resilience plans. By contrast, hurricane Katrina in New Orleans in 2005 is an example of lack of resilience. Too much emphasis had been on terrorist attacks whereas all other threats, such as natural disaster, had been sidelined. So when the hurricane hit the preparedness was far from sufficient and the results were all the more devastating. An example that especially highlights the importance of resilience over protection alone is the fact that the telecommunications infrastructure in the affected area was not only disrupted (e.g. due to power blackouts) but was completely destroyed.

The ‘resilience-debate’ has so far remained somewhat academic and is only coming onto the more practical agenda as a concept frequently used in different seminars and conferences on CIP, perhaps to be found in the texts of the next generation of more official CIP documents. Some semi-official handbooks and action plans to this effect are already available (e.g. TISP 2006). From early warning perspective the question is how to find the correct balance between (economic) resources put on protective measure vs. resilience.

The dilemma of public-private partnership

Another important issue in connection with economic factors in civil protection is similarly related to critical infrastructures. These infrastructures, such as electricity, information and communications technology (ICT), transport, water and so on lay a basis for a functioning society, including safety and security. (See Pursiainen 2007a; see also Chapter IV of this volume, which discusses the problems that electricity disturbances, for instance, create for security and safety, and for the functioning of rescue services.)

However, this brings the private factor’s role into the picture when discussing civil protection in this context. While governments are usually legally responsible for safeguarding the critical infrastructures, most of the infrastructures are owned, administered and operated by the private sector. This is why public-private partnership (PPP) is considered as a major issue in safeguarding national infrastructure (e.g. Abele –Wigert 2006, pp. 57-58). While in the United States private industry traditionally owns most of what is defined as national infrastructure, its share being estimated as 85 per cent, in many European countries such infrastructures as water, energy, and railway transportation have previously often solely been taken care of by the governments. However, since 1980s there has been an ongoing process of the market liberalisation and privatisation of these infrastructures. The rapid development of the predominantly privately owned and operated ICT, and other sectors’ dependence on it, has complicated the situation. This has led to a rather ambiguous situation in terms of the real authority. De Bruijne and van Eeven (2007, p. 24) have noted that government authorities may have the overall responsibility for the reliable provision of services, but they lack the authority and resources to actually fulfil that responsibility. “Central governments bodies and policy makers involved in CIP to a large extent lack the technical expertise and the means to monitor or control CI operations.”

Globalization, with its tendency to move private companies outside the nation state, has moreover made the situation more complex from the perspective of the government control. The fact that national CI are dependent not only on other sectors but on situation of other countries’ CI complicates the situation, because no single country is either immune to effects or able to predict outcomes if neighbours suffered from serious infrastructure disruptions (cf. Mussington 2002, p. 25, 26), and thus the issue of how to organise CIP responsibilities between public and private actors becomes even more of a challenge.

Here we face the dilemma of common good. Indeed, de Bruijne and van Eeven (2007, p. 249) have argued that while PPP may seem self-evident and is celebrated by all parties, this ‘shallow consensus’ usually is broken when it becomes clear that the governments expect the private sector to make considerable investments beyond their cost-benefit calculations. As de Bruijne and van Eeven put it, the private parties “predictably resist taking measures that go substantially beyond their business continuity requirements, arguing that these threaten the viability of their business model.” de Bruijne and van Eeven further claim that this dilemma leaves

the governments with only two options: to provide the necessary resources itself, funded from public budget; or to increase regulation. According to de Bruijne and van Eeven, the first option is mostly impossible, mainly for financial resource reasons but also for the reasons related to the necessary separation of public funding from private rent-seeking use. The second option, adding regulation, would force the private sector to put more resources to deal with the protection or resilience of the systems they own or operate. Egan, among others, has proposed that, because markets are at present externalizing the CI risks, state regulation should mean establishing "liability rules based on the notion that organizations should internalize the costs of the risks they produce and that by internalizing them, they will make wiser choices about the technologies they use" (Egan 2007, 14).

However, de Bruijne and van Eeven (2007, p. 25) claim that here we would "come full circle" (from liberalisation back to state regulation). Indeed, they argue that when governments have the two options – that of providing the necessary CIP resources themselves, or by adding state regulation – most CIP strategies propose neither. Instead, national CIP strategies are usually confined to the status quo by advocating mere awareness raising, best practice exchange, and soft 'commitment power' efforts with regard to private actors.

In a way, the PPP in CIP is a typical dilemma in that it is worse than a mere problem, as there are no good solutions available. In these conditions, government involvement in practical CIP efforts in the private sector remains limited, an issue widespread in more academic debates though given less emphasis in practical PPP debates. As Robinson et al. (1998) notice, the natural starting point is that private industry determines investments in protecting the infrastructure from a business perspective. However, at the same time as the vulnerabilities are increasing, it has been noticed that while market liberalisation supports policies which emphasise the importance of low prices for consumers, one 'side effect' has been to reduce the funds available for investment in and maintenance of key assets (IRGC 2005, p. 1,2). Indeed, security has never been a design driver for market forces in their dealing with CI (Dunn 2006, p. 29-30). However, Robinson et al. propose that the key is that in order to have a proper security strategy it is important that industry has all the information it needs to perform risk assessment. The primary focus of industry-government cooperation should therefore be to share information and techniques related to risk management assessment, the identification of weak spots, plans and technology to prevent attacks and disruptions, and plans for how to recover from them.

Hurley (2000, p. 4) argues that in this cooperation the private sector's role would be to help government authorities in risk analysis and technical issues and so help them to arrive more quickly at practical, workable solutions to real challenges. Mussington (2002, p. 31), in turn, argues that this kind of information sharing should be non-hierarchic. Decentralised, confederated response and information sharing mechanism for enhancing information assurance seems to provide a more flexible means of meeting a fast-changing threat to infrastructure vulnerability than top-down methods of managing information assurance. However, Robinson et al. (1998) have further pointed out that in practice there are some barriers for this information sharing from the private sector side to that of the government authorities. From the private company's point of view, collaboration may include or require passing over classified and secret materials, proprietary and competitively sensitive information, liability concerns, fear of regulation, and legal restrictions. These issues make far-reaching PPP difficult in practice.

On the other hand, Hurley (2000, p. 4) sees a possibility here. The active participation of the private sector in development of CIP strategies would help in promoting general acceptance by the private sector of any regulatory approach that government may find necessary to adopt. In practice, according to Hurley, this PPP in the development of CIP strategies can occur in at least the following ways: providing comments on government regulations published in proposed for; participating in the work of advisory committees to government agencies; serving on voluntary groups that research and draft publications germane to ITC issues; and participating as speakers or panellists in forums.

The EU has clearly adopted the above-mentioned compromise, thus avoiding any far-reaching regulation of the private sector and confined to expressions such as "fully involving" the private sector in European Programme for Critical Infrastructure Protection (EPCIP). The Directive Proposal on the EPCIP of the EU Council 2006 stresses that "Effective protection requires communication, coordination, and cooperation nationally and at EU level involving all relevant stakeholders. Full involvement of the private sector is important as most critical infrastructure is privately owned and operated." (Commission 2006, p. 3)

Thus, this seems to confirm Andersson and Malm's (2006, p. 166-167) argument that PPP in its current form as structural cooperation between 'equal parties' is seen by both public and private actors as the most effective way to reach their goals. For government PPP provide means of engaging the private sector in public affairs and achieving guideline and standards without having to use strict regulatory means. For private actors PPP offers a flexible way of meeting government requirements while avoiding regulation.

However, Andersson and Malm admit that there is evidence that there are gaps in deregulated sectors of CI, which cannot be covered by PPP. In the case studies of this volume, this problem is constantly noticed. Thus, Landsted and Holmström (2007), dealing with electricity blackouts note that the "private sector, which operates in the open market under hard competition, finds it difficult to invest more in preparedness than is economically justified." Nikula and Tynkkynen (2007), in turn, discussing maritime safety argue that the bottleneck at the moment is the low standard of equipment on vessels, such as a lack of e-navigation readiness. However, ship owners do not see the need for this equipment, "without an international obligation," even if basically the question concerns relatively inexpensive investments. Similarly, Chapter V of this volume discussing, among other, maritime safety issues at the Adriatic Sea, notes that ship companies often put economic profitability before the safety issues, such as investing in professional crew, if the regulations would allow that. Thus, from the perspective of prevention and preparedness, the question again is that of finding the correct balance between the regulative efforts and other incentives for private owners and operators of critical infrastructures as to safety and security.

2.7 International factors

While the legal mandate for early warning for civil protection lies at the national level, international cooperation in this field remains strong, and deserves a special treatment here due to the specific challenges in this sphere. As the risks do not always follow national borders, many early warning systems are such that they can become effective only if they are regional or international. In many time, also international assistance from donors to recipients is needed in establishing or implementing early warning measures and systems.

However, the establishment of international (global or regional) early warning systems, whether in the fields of tsunami or terrorism or any other field, is not an easy task and almost always creates political conflicts and rivalries about the forms of the system, its ownership, and how to divide the costs and responsibilities.

Uncoordinated international cooperation

Political leaders' inability to enable effective cross-border and international cooperation in civil protection is often dependent on general political relations and situations existent between the countries involved or in the international system at large. Obviously closely interrelated political communities such as the EU cooperate in civil protection early warning much more eagerly than countries that posit their sovereignty against each other. If preventive strategies are to include extensive information sharing, cooperation between non-integrated countries might be difficult in sensitive fields such as energy or transport.

Even when there is international cooperation between civil protection and early warning authorities and other stakeholders, the various existing organisational solutions are bound to cause practical problems for cross-border early warning. For instance, while there is a need for joint planning and training in this field, the authorities may find it difficult to cooperate if the responsibility in one country lies at the central level while in another it remains at the municipal level. Or voluntary organisations from one country may find no counterparts in another country where this dimension of civil protection is not appreciated.

Attempts have been made to mitigate these cooperation problems by at least partially harmonising the national systems or training for cross-border and international cooperation within such organisations as the EU, North Atlantic Treaty Organisation and United Nations. Yet, it cases when there is a need for sending rescue forces to international operations, it may happen that a country receives an invitation from all of these organisations in an uncoordinated manner, and it remains the choice of the particular country to decide under which 'flag' it wants to participate.

As for the early warning systems in particular at the European level, the Community Mechanism for Civil Protection exists, which facilitates urgent response actions in the event of major emergencies and applies also in respect of early warning to situations where there may be an imminent threat of such emergencies. This includes the Monitoring and Information Centre (MIC), operated by the European Commission in Brussels, which is available on a 24/7 basis. The Common Emergency Communication and Information System (CECIS) facilitates communication between the MIC with national authorities. Within individual issue areas there are also fairly developed European level early warning systems exist in such fields as extreme weather (Meteoalarm), forest fires (EFFIS), floods (EFAS), earthquakes (EMSC, Geofon), and radiological disasters (EURDEP). The European Programme of Critical Infrastructure Protection (EPCIP) includes its own Critical Infrastructure Warning Information Network (CIWIN).

At the global level the United Nations (UN) provides a huge organisational framework for most global early warning systems in general and within several issue areas individually. The main UN organisation dealing directly with early warning issues is the International Strategy for Disaster Reduction (ISDR). The main documents and handbooks produced within its framework, such as the Hyogo Framework for Action 2006-2015 (ISDR 2007) or Developing Early Warning Systems: A Checklist (EWS 2006), are clearly characterised by a spirit of globalism, a focus on large-scale (natural) disasters and an emphasis on the need to assist

particularly the developing countries to deal with majors disasters. Yet, the recommendations are remarkably applicable to other contexts too, such as planning for early warning systems in the context of an industrialised developed EU country's national civil protection. Beside programmes and handbooks, there are several more concrete early warning tools available at this level, including the Global Disaster Alert and Coordination System (GDACS), which provides near real-time alerts about natural disasters around the world and tools to facilitate response coordination.

While the international level of early warning enables more effective coordination of international disaster assistance, the 'added value' to the national early warning systems in particular is obvious especially in respect of those hazards that have a clear trans-boundary character by enlarging the reaction time. For instance, the European system of floods early warning EFAS offers detailed information of the flood situation in one country, which may be crucial for preparations in a neighbouring country.

But we can legitimately raise the question of what kind of problems could potentially lead to an early warning failure connected to this international level. Obviously, since the regional or global early warning systems are supposed to inform several countries and the risks are often trans-boundary in character, the basis for coordination would be at least some level of harmonisation or the standardisation of warnings. This means that there should be a consensus between the international early warning system and the national authorities about some threshold parameters for warnings, procedures, damage evaluation, and advice on how to behave. This challenge was expressed in creating the EPCIP. Thus the Green Paper on the EPCIP from 2005 suggests: "Different MS [Member States] have different alert levels corresponding to different situations. At the present time there is no way of knowing whether, for example, a 'high' in one MS, is the same as a 'high' in another. This may make it difficult for trans-national companies to prioritise their expenditure on protection measures. It may be beneficial, therefore to attempt to harmonise or calibrate the different levels." (Commission 2005, p. 15)

Sometimes the international regulations and standards are in place but are not followed. To illustrate the practical problems of this kind, let us look at the partial failure of the warning phase of the biggest maritime accident of the modern time, the sinking of MV Estonia in 1994 in the Gulf of Finland, in which 852 passengers died and 137 were rescued from the water. This reveals what kind of systemic and residual warning shortcomings can take place in a crisis situation if the international warning mechanisms are not trained enough and thus not embedded in the early warning practices. In that case, the Mayday warning was issued by the rapidly sinking ferry, but it did not follow the existing international regulations, that is, the Ineternational Maritime Organization (IMO) and other related rules, as it was, firstly, not sent in English and, secondly, it was not sent on the general emergency frequency. It was unclear from the emergency message whether the distress warning concerned a big ferry with almost a thousand passengers or something else. Time was lost when the other emergency authorities and ferries located near enough to participate in the early response had to communicate with the sinking ferry and with each other about whether or not, and how, to respond to the emergency call. (Toivonen 2003) There is therefore a need for constant training and reinforcing the organisational rules and common standards at the international level as well.

Another example from maritime safety from the same area, the Gulf of Finland, reveals how it might be a challenge to build up an early warning system in the field of maritime safety that would resemble the air control systems. The growing criss-

crossing oil tanker and passenger traffic between Finland, Estonia and Russia has raised the functional need for this kind of a system. While a certain cooperative early warning system, the so-called Gulf of Finland Mandatory Ship Reporting System (GOFREP) has been established as a trilateral monitoring and reporting system, the sensitive issues of information sharing, responsibilities and territorial sovereignty have so far hindered this system to be developed into a so-called 'wise' system, which would make real time information about the ships, their route and cargo etc. available to the maritime safety authorities. (See Chapter V of this volume; see also Nikula and Tynkkynen 2007)

Lack of political will

One of the main forms of international cooperation is international assistance concerning donors and recipients of help. While international assistance is often understood as international response and relief, a widely shared view is that we should shift more international efforts and donor resources from response to face the challenge how to establish preventive and early warning strategies and systems especially in the developing world. (ISDR 2003) Indeed, many developing countries, in particular the least developed among them, "have limited capacities for effective early warning systems, and in some cases they are virtually non-existent". (Villagran de Leyn et al. 2006)

Climate change is again a good example here, where the issue is not that of a lack of early warning signals, but the problem of acting on the basis of these signals. Most of the risks are known but the lack of economic capacity means that the developing world is particularly vulnerable to climate change's negative consequences. Risks such as flooding could be mitigated by changing land use strategies or economic structures, but poorer communities suffer from their low adaptive capacity, since the change of strategies and policies can be prohibitively costly in the short-term. (IPCC 2007, p. 9)

Here international assistance may prove crucial in order to prevent a humanitarian catastrophe in countries affected by hazards such as drought or predictable natural catastrophes. However, even if the early warning signals could be identified in a timely fashion, politics plays a crucial role in determining whether or not the link between risk assessment and preventive action, or warning and response, functions efficiently. It has been suggested that the single most important factor that positively affects the use of early warning information in decision-making is the political will to respond. (Buchanan-Smith 2000, p. 27) Sometimes, the government of a country where the catastrophe is taking place wants to downplay the scale of the crisis, and sometimes it wants to exaggerate it – both for political reasons. On the other hand, the political relationship between donor governments and the recipient government is usually the key determinant of an international response. The role of the media, as a pressure tool from civil society, is often crucial here.

2.8 Cultural and societal factors

This discussion of early warning bottlenecks started by looking at the human factors. At the other end of the continuum are the general preconditions for early warning – culture and society in a wider sense. Societal and cultural traditions and values define how threats and risks are understood in the first place: what are the socio-economic dimensions of vulnerability, which methods are used to recognize an early warning signal, and how and with what tools is an early warning alarm

transmitted. For instance, in traditional societies early warning strategies might have been based on the observation of certain animal behaviour or other signals from nature, or on religious-based beliefs, whereas in industrialised or post-industrialised societies both the detection and warning systems are largely reliant on technological solutions. Even in the latter case, however, it is clear that the 'social component' and the 'cultural make-up of the community involved' are crucial in how the people adjust to risks and in defining the success or failure of early warning or mitigation programs (e.g. Theofili and Vetere Arellano 2001, p. 18).

Risk tolerant society

While globalisation and technologic development have somewhat harmonized societies and cultures across the globe, many differences remain that may prove to be essential preconditions for early warning successes or failures. Most notably, societies seem to be dissimilar as to their cultural and societal norms concerning risk knowledge, risky behaviour and risk tolerance. If the decision-makers and the people at risk do not think it important to locate risks and collect the available information, or if they are indifferent to obvious threats, it is clear that the risk assessment phase and together with it all of the other elements of early warning are doomed to failure.

While the concrete impact of these types of factors is generally difficult to prove in individual cases, some researchers have, for instance, claimed that high-risk tolerance contributed to the Hurricane Katrina early warning failure in New Orleans in 2005. The hurricane itself should not have come as a surprise in the way that earthquakes do and its severity could have been anticipated. Nevertheless, retrospectively, preventive actions were not taken, the evacuation was delayed and so forth. The main reason, the argument goes, is that "in Europe and in the USA the authorities do not, unfortunately, traditionally prepare for the worst-case emergencies. Things are different however in Japan, where disaster preparation behaviour is practiced extensively in the schools." (Geenen 2005; cf. Basher 2006, p. 2173)

If we take a more every-day civil protection issue such as accidents or the injuries caused by them, while the risks in general are well known, injury mortality is much higher in some countries than in others, even where they share basically the same physical and even socio-economic conditions. In most cases only rather deep-seated cultural and societal factors affecting behaviour can explain why they are not equally distributed in accordance with population size and other physical conditions. Take Sweden and Finland, which are comparable countries in their physical conditions and socio-economic factors, such as health and education systems. Yet, although the population of Sweden is almost twice that of Finland, the absolute number of annual deaths caused by injuries is almost the same. (NOMESCO 2006) Obviously the stock of cultural and societal rules and practices affecting the preventive behaviour of the population in these countries is one of the explanations for this phenomenon.

The early warning element in this example is that the lack of detailed safety statistics on high-risk places, groups, situations and so forth – even if its collection was possible – leads to a lack of knowledge-based preventive measures. In other words, in most cases of injury detectable early warning signals do exist. For instance, statistics may show that injuries take place in certain places and situations among certain vulnerable groups. But if society's or its authorities' risk tolerance is high, a need to create a system for collecting the detailed data for the basis of risk

assessment is not recognized, and consequently it is impossible to make interventions for preventive purposes. (Pursiainen 2007b)

Low level of self-organisation

Another and closely related essential precondition for successful early warning is the high level of civil society self-organisation. All over the world, even in lightly or non-urbanised and technologically remote areas, people at risk have usually organised early warning and preventive strategies and developed tools particularly in the face of repeating natural disasters. In more modern and post-modern societies, civil society is organised into non-governmental organisations, and in most countries (although not to same extent) the role of the non-governmental organisations in civil protection is recognised and appreciated. However, rather than given or stable, this self-organisation seems at least within some limits to be a variable.

While it seems clear that volunteers can play a crucial role in prevention – for instance, by educating people in safety matters – their role from an early warning perspective is often as important in the early response. According to a European-level survey, about 30 per cent of this voluntary work focuses on preventive strategies, while majority of voluntary activity focuses on response and relief and a small part on post-disaster activities. (THW 2007, p. 15) Post-disaster evaluation reports reveal that "Volunteers are often the basis of success of the first response measures" (Colombo 2000a, p. 13). Moreover, post-disaster evaluations have pointed out that the active involvement of the local population in the process of emergency response design and development was determinant for the efficiency of the emergency operations. In order to make this even better, training programmes that can be used in communities to support public actions during and immediately after an emergency would be needed. In general, the promotion of a broad-based public awareness scheme on disasters to obtain public support for actions to reduce their impacts is the general lesson learned from previous emergencies. (Theofili and Vetere Arellano 2001, pp. 7, 11)

However, if this self-organisation is for some reason missing or undermined, it may affect negatively to early warning. Indeed, we may find great differences between even neighbouring countries in the participation of voluntary organisations and civil societies in civil protection activities, based on their specific conditions, history and administrative cultures. If we compare the countries around the Baltic Sea, for instance, we may notice that while the Nordic countries and Germany significantly rely on voluntary organisations, followed perhaps by Poland and Estonia, in other neighbouring countries such as Russia, Latvia or Lithuania civil society organisations are rarely connected to official civil protection systems (Pursiainen, Hedin and Hellenberg 2005).

Nevertheless, it is not only that the cultural and societal background may or may not create preconditions for a successful early warning, but that the early warning systems should be adapted to the existing cultural and societal conditions as well in order to become successful. Thus, the widely shared 'early warning ideology' emanating from contemporary debate is that an early warning system must be 'people-centred'. An early warning system must be based and designed on the needs, priorities, capacities and cultures of those at risk. It should utilise and develop community capacities, create genuine 'local ownership' of the early warning system and be based on a shared understanding of needs and purpose. From the authorities' perspective, while they are responsible for public awareness raising, education and information, they should also work with the public and learn from the

public. Effective early warning systems should be embedded in the communities they serve. (Basher 2006; Villagran de Leyn et al. 2006)

This kind of citizen 'ownership' can raise bottom up awareness in terms of community initiatives that should be supported by authorities. While the main legal responsibility of early warning should be retained by the civil protection and other authorities, all elements of a society such as public institutions, private companies, individuals and so on should be encouraged and perhaps obliged to take preventive action. This is best realised at the local community level. In discussing the prevention and preparedness strategies, the focus is usually on general awareness raising, identifying the local specific disaster-related conditions and problems, introducing self-help strategies and technologies, building social capital and confidence within the local community between the different actors, and reaching a reasonable social consensus about what should be done and by whom. (see e.g. DRH Database 2007a-c; Disaster Warning Network n.d.)

Lack of social capital

This self-organisation is closely related to the notion of social capital in the relationship between the authorities and the public. There should be enough social capital, especially trust, embedded in the society and consequently in early warning systems such that signals lead to action by the national authorities and the population alike. If there is a lack of social capital, this is directly reflected in political leaders' ability to engage public opinion and civil societies and encourage public-private partnerships to support risk prevention and mitigation. In a crisis situation this may lead to a lack of information, poor information flow or dissemination and failed crisis communication within and between the authorities representing different organisations as well as between the authorities and the people most at risk.

Situations where the authorities issue warnings, which are not believed, are common and happen not only in societies where there exists tensions between the rulers and the ruled but in any democratic society too. An evaluation report on the disastrous 1999 Austrian avalanche notes that although forecasts and warnings of an extreme event were issued, people ignored the warnings believing that the extreme values predicted were improbable and so they were unprepared for evacuation. (Colombo 2000a, p. 2) And when a warning has been issued or when an emergency actually takes place, it is important that the public is already informed or trained about what to do, and that they follow the authorities' instructions (Theofili and Vetere Arellano 2001, p. 13; EWC 2006, p. 8). People at risk must believe that the authorities issuing a warning are acting professionally and for the benefit of the society, even if false warnings cannot be avoided.

The role of the media, as part of society, is essential. While communication through the media is important, the media may play also a somewhat negative role by, for instance, exaggerating an event and spreading rumours, thus creating harmful overreactions among the population. Such phenomena can be avoided by working close with the media and with the scientific community to inform the public already before a disaster comes ahead. (Theofili and Vetere Arellano 2001, pp. 13, 19)

3. Conclusions

This analysis took up the challenge of building a typological framework to pinpoint and systematize the main early warning bottlenecks in relation to civil protection. It did so by differentiating, first, between different phases or elements of the early warning process, and second, by looking at the various potential factors causing early warning failures. While discussing each of these factors individually, this article defends a holistic, multi-dimensional approach to the evaluation and development of early warning in respect of civil protection.

The list of potential early warning bottlenecks discussed above is not, and perhaps never can be, comprehensive, detailed enough and final. Also we have to take into account, as mentioned in the beginning of the analysis, that in real life situations all possible factors are in different combinations always intermingled and overlapping. Furthermore, it was argued, and hopefully demonstrated in the course of analysis, that many bottleneck issues are such that there is no way to find any final and unambiguous solution to avoid them in all possible situations. Nevertheless, the result of this analysis can still function as a practical toolbox, which helps to pinpoint the most obvious reasons of early warning failures and help the practitioners to develop the early warning systems so that at least some of them can be avoided.

To propose this type of analytical framework implicitly suggests that there should be an agent capable of looking critically at early warning systems from the perspective of the critical factors. While there are several alternatives, a good way to start would be to provide the main national competent civil protection authority with the mandate to implement this type of evaluation. Given the huge scope of early warning issues, in practice this evaluation could be started within one specific issue area, the purpose being to identify the issue area-related bottlenecks and to find solutions in respect of how to avoid them.

CHAPTER II
Climate Change Emergencies and Municipal Planning: the Case of Mariestad in Sweden

Richard Langlais with the assistance of Per Francke and Sigrid Hedin

We know that early warning is a useful form of information for guarding against threats and guiding our efforts to prepare for crises and emergencies, but we know little about why it can sometimes remain ignored. This occurs even in situations where the early warning is well formulated and the reception of its signals is confirmed, fully and without distortion. Why is an early warning signal ignored, even when it is clearly received? It is tempting to think that the problem lies with the characteristics, or quality, of the signal, or with those individuals who are involved in its reception. Although that might indeed be the case in some situations, we enquire here into a case that defies such ready explanations.

When substantial resources are dedicated to providing early warning that is of the highest quality attainable, it is all the more discouraging for the providers when it is occasionally discovered that its potential users remain unperturbed by its contents and its implications. The case discussed here, the planning and building of Sjöstaden, a highly modern housing complex in Mariestad, on the eastern shore of Vänern, Sweden's largest and Europe's third largest lake (Figure 1), defies the usual logic of early warning, and provides a number of instructive insights into why early warning can sometimes fail in achieving its intended results.

The Sjöstaden case involves flood risk, which, in the current Swedish context of producing vulnerability studies, is seen as being exacerbated and given new significance by the anticipated effects of climate change. Media coverage between 2001 and late 2007 (as this study goes to press), including not only newspapers, but also TV and radio, has portrayed the case with growing incredulity; it is used as both an engaging story in its own right, and as a pressing illustration of several larger issues for society. In our view, the municipality deserves unbiased study, in order to enquire into the rationales and rationalities that both elected and appointed officials are operating from as they attempt to fulfil their mandates in the public interest. Notwithstanding that aspiration, a clear insight that emerged early in our study was that, Nature's signals arrive in time, only to dissipate in the chaos of politics.

The case is discussed in more depth below, but its central elements can be briefly described as follows. The municipality of Mariestad has been planning and proceeding to build an impressive lakeside housing complex for almost the entire

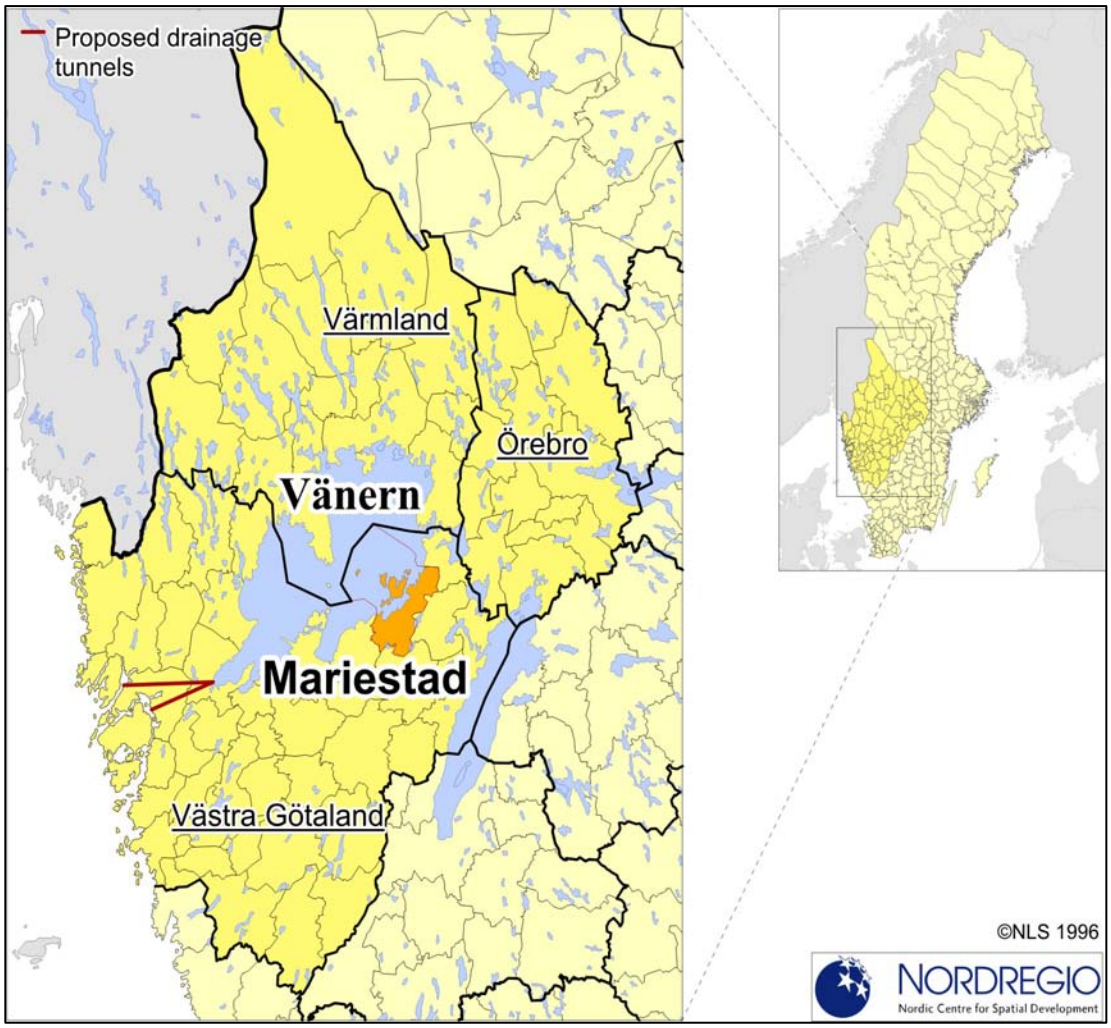

Figure II—1 Lake Vänern and surrounding counties with proposed drainage tunnel alternatives.

decade since 2000, to present. Part of it is being built out onto the lake surface, and supported by pillars and piers (Figure 2). At the same time, the area has been described by new national climate change vulnerability studies (Miljödepartementet 2006, p. 175ff.) as being within one of the zones that is most at risk not only for flooding, but also for its increasing frequency and seriousness.

Although the actual construction of the Sjöstaden project is only in the initial of its planned multiple phases, the media have become more strident in asking why the municipality is going ahead with it. The municipality's representatives have been cast in an unfavourable light by journalists. The municipal administration, meanwhile, has been alluded to in prominent debate articles as one of the reasons for the national government's consideration of changes to the powers that Swedish municipalities will have in deciding limits for their own plans. The general atmosphere that has been generated around the case can be summed up as implying that the municipality, in the media's view, is being irresponsible in the face of the threat of climate change impacts.

Figure II—2 Computer-generated image I of the housing project Sjöstaden. (Mariestad Municipality 2007)

In this study, we consider the case from the perspective of early warning, and search for the rationalities that are at work in the municipality. We ask: Why is the municipality of Mariestad refusing to change its plans in response to its receipt of early warning signals provided by previous experience and new scenarios based on scientific premises?

In the following section, there is a discussion of theoretical aspects of early warning related to floods and climate change. That is followed by a brief description of some of the details of the Sjöstaden project. Two empirically-based sections follow; one provides an overview of the media analysis we performed as part of the study, while the ensuing section summarizes the interviews that were held with several interview respondents. That section indicates the range of rationalities that permeate the present discourse surrounding the issue of floods in the case of Sjöstaden. The study ends with a discussion that unites the theoretical and empirical material, as well as several concluding remarks.

1. Early warning, floods and climate change

Although some writers have placed the beginnings of the concept of early warning in the 1970s, with the onset of international disaster relief and global environmental monitoring ambitions (Schmeidl and Piza-Lopez, 2002), at least one contradiction to that claim is the Distant Early Warning Line (the DEW Line) of advanced radar stations that stretched across arctic North America, from the 1950s and for several decades into the Cold War. Mentioning it has not only a historical dimension, but also an instructive one, for it establishes a precedent for a number of the traits of early warning that are highlighted here, in addition to those mentioned as premises of the more disaster relief-oriented type.

The notion of early warning is surprisingly undeveloped as a formal term in the sense developed here. When it comes to its specific application with regard to flooding, there are several further refinements that are worth considering. One regards time, another, distance; there is the fact of precedent and the probability that comes with the aspect of cyclical periodicity, and then there is the unpredictability of the particular. Finally, there are two kinds of so-called Doppler shift, which make the apprehension and processing of the signals into a process filled with insecurity. Each of these refinements make the maintenance of a preventive attitude toward flood risk more problematic and less taken for granted.

Let us take up each of the refinements mentioned above in turn. Time, with regard to floods and established town-sites, such as in the case of Mariestad usually refers to decades and even centuries. If a town has managed to become permanently established, it has evolved in accordance with a certain understanding of the time periods that are involved in accepting risk and living with a threat. The inhabitants and their authorities speak in terms of, for example, 'twenty-five-year' and 'one-hundred-and-fifty-year floods,' and so on. The idea of the short-term and the long-term has a different meaning than in its more usual contexts, such as financial markets, politics and health care. The short-term can easily refer to a thirty-year period, and the long-term to a correspondingly extensive hundred-year span. Such time-spans, however, can make it difficult to avoid passivity with regard to any sense of urgency that even so-called short-term scenarios try to convey.

Distance is another aspect that can contribute to lethargy and short-sightedness, especially when the watersheds involved are literally much larger than the horizons of town-dwellers. Experience with implementing the "European Water Framework Directive" in northern Europe, for example, definitely indicates that this can be the case (Hedin et al. 2007). When the source of flooding is distant, the 'out of sight, out of mind' attitude can be difficult to guard against. At the same time, the fact that many other towns and areas might seem just as threatened, and in an equally diffuse way, makes the burden seem shared, or perhaps not as dangerous; there is the possibility of an increased sense of security, even if false, when there is company. The threat of displacing the ordinary seems less likely, even unreal. It was this sense of the far-off, ever so distant, threat that made the isolated arctic outposts of the DEW Line seem so absurd and irrelevant to many, even though their actual importance no doubt was indisputable during at least part of their period of operation. Their provision of warning at a distance increased the time available in the case of unanticipated attack and, in other words, made 'early' not have to be so early as otherwise would have been the case.

The fact of precedent makes the relation of early warning to the phenomenon of flooding unusual when compared to most other categories of early warning use (the rise of group conflict, new epidemics, tsunamis, etc). The precedent is connected to the often (but not always) cyclical, or periodic, aspect of large-scale flooding; it asserts that floods have already occurred, and they will occur again. A town that is situated in circumstances that have led to major floods during its history can almost certainly look forward to at least some level of re-occurrence in the future.

The predicament of such a town reminds us of a boxer in the ring; being in the ring means there is no other outcome than the one where a punch is guaranteed to come. The probability of this is extremely high. To explore the analogy further, the boxer who has been punched before will encounter another punch again, if not today, then soon. At the same time as that knowledge can be relied on with utter certainty, some other variables, dependent not only on the style of the opponent, but also on the way the boxer responds to each jab, are part of the scenario. For

example, the opponent may dance around tantalizingly for long periods, until a major punch is thrown, or instead prefer a style that is regular, consistent and pounding. The details of each punch and the extent of their impact cannot be known in advance; there is the unpredictability of the particular. The boxer on the receiving end might successfully dodge the hardest impacts or crumble under the first major onslaught. The variations are nearly infinite, which makes the sport's followers nearly religious in their appreciation, while its few basic facts make it reliable: the facts are that the punches will come, and some of them will be devastating.

To return to towns and the risk of flooding, they usually have a high probability of repeated flooding; they've had them before, and they'll have them again. That cyclical aspect provides certainty, even though the particulars of each event may vary greatly, as well as the response.

Each of the aspects of civil protection early warning — time, distance, the fact of precedent, the probability that comes with cyclical periodicity, and the unpredictability of the particular—briefly discussed above, is part of a complex interplay that affects the actors in any flood risk situation. They all affect not only the character of the signals that are received, but the way they are received and, subsequently, interpreted and (perhaps) acted upon. The certainties involved, those dealing with both the fact of the precedent and the cyclical periodicity of impending recurrences, make the past and the future active in the assessments of the present. The past and the future both become signal sources; the past sends signals that tell and describe that floods have happened and what they were like; the future transmits the knowledge, as the result of a dialectical relation with the past, that more floods will come in the future.

The first kind of Doppler shift[2] in the signals arises in that latter interplay. As we move on through time, the earlier floods move further and further away, and the signals become weaker. Simultaneously, the signals from the floods of the future become stronger, and more strident, as we move closer to their occurrence. The signals from the past become easier to forget, the ones from the future more difficult to ignore. Still, the recession of the signals from the past is also a weakening of their function as reminders, which may make it easier to ignore the future's signals. Below, where we examine the case of Mariestad, the varieties of responses to this situation are illustrated, and therefore much easier to envision.

That first type of Doppler shift has to do with the kinds of situations that in the last hundred years of planning and policy have come to be considered normal. The arrival of climate change awareness introduces one further main nuance, a second type of Doppler shift. Where climate change is leading to increased flooding[3], the Doppler shift itself, in its new character, becomes less familiar for those responsible for civil protection and spatial planning. The shift becomes more dramatic, since the signal is approaching more rapidly and strongly, and it is possible that this makes it less straightforward to interpret. In the face of such unusually strong signals of serious future flooding, it becomes even more intriguing to understand why some municipalities choose to ignore them, or at least appear to be doing so. Since ignorance or a lack of intelligence cannot be claimed as explanations, we must assume that there is rationality in their responses. In order to find indications of

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2 Doppler shift, or effect, named after Christian Doppler, a 19th century Austrian mathematician and physicist, could be defined in this context as the change in frequency of a signal as perceived by an observer moving relative to the source of the signal.

3 The use of the present tense is intentional, to reflect the paradigm shift implied in the IPCC's most recent findings.

what just such a rationality can include, as well as to learn more about the complexities behind such planning processes, the rest of this study regards the case of Mariestad's Sjöstaden project more closely.

2. Description of the Sjöstaden project

The case in the present study is the new housing project, Sjöstaden, which is being planned by the municipality of Mariestad. The municipality was founded in 1583, and is located in western Sweden, about a third of the way between the country's two largest cities, Göteborg and Stockholm. This puts Mariestad near the main infrastructure corridor that connects the two cities. The most important geographical feature of relevance for our study is that is situated on the south-eastern shore of the lake, Vänern, with a total of 140 kilometres of coast line and an archipelago. The municipality has 24,000 inhabitants, with about 16,000 of them residing in the actual town of Mariestad.

As a part of Mariestad's strategy for the future, the municipality is working to 'brand' itself, building on its vision of being 'the pearl of Vänern.' Building and developing new waterfront housing areas that offer residents, especially newcomers, attractive lakeside living on the shore of Vänern is an integral part of that strategy. Sjöstaden is not the only expression of that strategy, but certainly it is most prominent. The project was first discussed in early 2000 – that is, before the climate change became a high-level and widely discussed theme in the Swedish political discourse – as a town renewal project that would develop and extend the old harbour area. The more specific strategy that the project would be a contribution to the vision of attractive seaside housing emerged in the municipality's planning documents in 2003. In order to materialize that vision, Mariestad launched an international architectural competition for the development of the project.

The Sjöstaden housing complex is planned for approximately one thousand inhabitants. The original concept of renewing the old harbour area has now evolved so that part of the complex will be extended out into Vänern by being constructed on a pier (Figure 3). The building site, however, is one of the specific areas identified as among the most flood-prone in Sweden. In spite of that, the municipality of Mariestad was slow to acknowledge the issue, since it was regarded as rather problematic. Since the selection of the winning proposal in the architecture competition, the Sjöstaden project has been highly criticised, with one of the most common complaints being that the municipality is being irresponsible in not properly accounting for the flood risk in the planning process, and especially not since the work of the Swedish Commission on Climate and Vulnerability (Klimat- och sårbarhetsutredningen, herein SCCV) added the increased risk that could be expected due to climate change influence. Despite the direct early warnings provided by the Commission's reports, and intensive media and other public attention, Mariestad has decided to continue with its Sjöstaden project.

Figure II—3 Computer-generated image II of Sjöstaden. It is the area of white construction along the lakeshore. (Mariestad Municipality 2007)

The attitude and rationality of the municipality is perhaps expressed in its most concentrated and untainted form in the following quote from the "Environmental Assessment" (original in Swedish), which the municipality published as part of its preparations for the Sjöstaden project:

> "The municipality of Mariestad considers that the upper barrier limit according to the current water judgements shall apply, and that the state must be responsible for measures that result in the maintaining of the barrier limits that the water judgement dictates. Such measures are of great importance not only to the built-up areas along the waterfront in the municipality's more heavily developed town cores, but in the rest of the community as a whole, as well as for coming areas such as Sjöstaden. The municipality therefore has no intention of changing its recommendation for the lowest allowed foundation-laying level in its general plan." (Johansson et al. 2007)

The intricacies of this concise summation of the municipality's dominant rationality are explored below. An analytical overview of the media's treatment of the municipality's plans, as well as a presentation of interviews that were held with various officials with differing degrees and types of insight into the Sjöstaden project, provide an empirical basis for the reflections on early warning that follow in the concluding sections of this study.

3. The media's portrayal of the Sjöstaden project

Ever since the beginning of the planning for the new Sjöstaden housing complex, the issue of flooding has been present in different forms and magnitudes. For a number of reasons discussed below, Mariestad has become one of the Swedish

media's focal points for debate and criticism regarding planning in flood-prone areas. The issue has also gained much momentum due to its coupling to the suddenly intensified interest in climate change in 2006 and 2007. Both local and national newspapers have reported on the issue's different angles and perspectives. This section illuminates the contours of the media landscape surrounding the case of Mariestad by performing an overview of the media's approaches to the issue.

In the early summer of 2004, Mariestad launched an international architectural competition on the future development of the harbour area in Mariestad. It is interesting that even though the risk of flooding was known at that time, and was even stated in the programme for the competition, little or nothing regarding the risk for Sjöstaden was picked up on in either the local or national press. The competition's programme helpfully informed that the ground level would have to be raised at least one meter so as to comply with national building standards and as a preventive response to the flooding that had occurred several years earlier. Despite the transparent information approach on the part of the municipality, it would take at least another year or two before the matter received any noticeable attention in the media.

When in June 2005 the Swedish government created the Commission (SCCV) to study and report on the country's vulnerability in relation to climate change, it brought new recognition, at a much greater scale, of flooding issues to both the local and national press. As part of the SCCV's work, in November 2006 it released a report on flooding issues with regard to three of the Sweden's largest lakes, Vänern, Mälaren och Hjälmaren. That report changed the character of the debate surrounding flooding issues at the national level and had a particular impact on the process then underway in Mariestad.

The SCCV's report (Miljödepartementet 2006, p. 175ff.) stated that in the future Vänern would undergo increasingly serious flooding. At the same time, the SCCV questioned the building standards regarding permitted heights of building foundations above sea level, and proposed an increase of the level by 1.2 meters. The plan for Sjöstaden, the housing area being planned by Mariestad, is that it will be built 1-1.5 meters below the proposed higher level. The report also proposed possible technical solutions, such as increasing the outflow of water from Vänern to the North Sea, with the intent of stabilizing Vänern's surface level. One of the technical solutions considered is the construction of a 30-43 km-long tunnel (depending on the option chosen; see Figure 1) from Vänern westward to one of the fiords on the sea coast. That proposal has proven to be a central point in the succeeding debate and has in many ways influenced the response and action (or lack thereof) of many of the municipalities, including Mariestad, around Vänern.

The publication of the SCCV report clearly highlighted the issue of Vänern's flooding and its presumed effects, triggering an intensive media response. In the period leading up to the publication of the report, in autumn of 2006, the flooding issue had already become one of the centrepieces for media coverage in connection to climate change. When the report was released, it 'opened the floodgates' on the media's interest in anything to do with flooding. In the national newspapers, articles and debate pieces focused on the potential for flooding in the municipalities surrounding Vänern. In one such piece, a debate article by Birgitta Boström (2006), head of the Swedish Geotechnical Institute, published in the national newspaper, Dagens Nyheter, presented a rather dark future for the Vänern area. She highlighted the regional impacts, stating that the costs of not acting will be enormous, and that different technical solutions might be more cost effective by preventing future flooding of the areas surrounding Vänern. Following the article by Boström, the

coverage of the issue of flooding around the lake became more focused on the municipalities and cities along the shoreline, and their adaptation to rising lake levels. In a later article in Dagens Nyheter, Karlsson (2006) concluded that few municipalities were actually responding to the issue of flooding, since they were, in his opinion, remaining passive in their approach to adaptation to climate change, with the few actions taken being limited to the building of flood barriers. A general atmosphere of needing to take action was being generated.

In the local arena, in Mariestad, the media coverage to some extent followed the national press, beginning to home in on the story around the same time as the Commission was also holding hearings in preparation for the report on flood vulnerability in the area of Vänern. In connection with the launch of the report, several treatments of the subject were published in the press, as well as in the form of television journalism (Magnusson 2007). Sjöstaden, the new housing area in Mariestad, was now receiving heavy criticism from many quarters for not being planned in conformance to the level stated by the report. To add to the tension, the presentation of the Commission's report coincided with the public consultations on the Sjöstaden project.

Once again, it became evident that even though the project had been launched almost two years earlier, the groundswell of media attention represented the first major criticism that the project received. In the local newspaper, Mariestads-Tidningen, the journalist Stefan Östman (2006) reported on an interview with Mariestad's head of planning, who emphasized the municipality's position clearly and unambiguously. Mariestad, the planner stated, would not support any proposals to change the standards for flood risk and building levels and that it preferred instead to collaborate with the other municipalities surrounding Vänern in lobbying for the technical solution proposed in the Commission's report. In sum, Mariestad would not be altering their plans for Sjöstaden. Only a month later, in December, Östman (2006a) reported that "strong protests" were being raised by its future neighbours and others against the plans for the housing complex.

The analysis that preceded this overview of the media coverage of the Mariestad case repeatedly encountered a particular notion of interest. This was that technical solutions were being framed and presented, by various actors, as the preferred way of responding to the climate-change-related early warning signals of flood risk in the Vänern area. A disproportionately large faith in the notion of a long-distance drainage tunnel from Vänern to the sea was evoked by numerous Mariestad spokespersons in nearly mantra-like terms as their salvation. This can be linked to yet another track in understanding the municipality's position. Mariestad holds the national government solely responsible for the issue of rising sea levels and insists that the state is the only actor that should, or can, implement solutions in order to mitigate future flooding. In another piece (Östman 2007) in the local newspaper, Mariestads-Tidningen, a senior official claims that he and his colleagues had done their part and that it is up to the national government to solve the problem by implementing technical solutions to increase the outflow from Vänern. The conflict between Mariestad's municipal officials and the county and national government officials is clearly visible in the article, with Mariestad's viewpoint leaning toward short term solutions, and the government and the county representing long term ones. The county official also qualifies their position with an assertion that local representatives should, and must, act responsibly. The technical solution referred to over and over again by Mariestad's officers appears yet again; but at time of writing, it remains as only one of several possible solutions, and no concrete plans have been finalized.

The main issue by the end of 2006 had clearly become the question of responsibility, which in the media debate is characterized by a sort of 'blame game' between the different actors. The local debate about Sjöstaden moved onto the national stage in the spring of 2007, when it was highlighted in the national media. At the same time, Mariestad was transformed into the enfant terrible and often referred to whenever the problem of building in flood prone areas was discussed.

Mariestad is working hard in cooperation with the other municipalities in the Vänern area on the potential for a technical solution. This was acknowledged in an article by Peter Sandberg (2007a), in Dagens Nyheter, the national newspaper, where the affected stakeholders in the Vänern region are once again depicted as stressing the tunnel as the solution of choice. In yet another article by Sandberg (2007b), he interviews the head of Mariestad's technical department in Mariestad, whose statements come out seeming slightly contradictory. The technical department head mentions that Mariestad will not change its plans for the new housing area, since, he claims, the problem must be solved by digging a tunnel, which would increase the outflow. Later in the same interview, however, he concedes that if the water level increases as much as the Commission has indicated, Mariestad will be flooded on a major scale, even if another option, building dikes, is utilized.

During early summer and the ensuing months of 2007, Mariestad's flooding issue continued to receive intensive media attention. Mattias Areskog (2007), writing in Dagens Nyheter, concluded that two-out-of-three municipalities in the area around Vänern were ignoring climate change warnings and their accompanying predictions of increases in flood levels. The motives behind the Sjöstaden project are expressed more clearly in the article, where one municipal official is quoted as saying that Sjöstaden is aimed at attracting new people to Mariestad and was conceived as part of a vision to 'brand' the town as a place with attractive waterfront living.

Interviews of the same municipal officials could be found in numerous different newspapers and on television. One such official appeared on a national public service television programme, Vädrets makter (SVT1 2007), that dealt with climate change and rising water levels. The official was consistent with the position she had voiced in newspaper interviews, firmly stating that the municipality wants to develop attractive housing areas to entice new residents to the town, and that the municipality cannot and will not take responsibility for the rising lake and flood levels. That television interview was then followed up in the local press by an interview with the same official. Helene Magnusson (2007), the reporter and interviewer, asked the official about the television interview, and the official concluded that the interview was a good opportunity to market Mariestad. Yet again, we see an official who does not miss the opportunity to state that Mariestad can not be held responsible for flooding issues, but that the responsibility lies with the national government.

In the early autumn of 2007, Boverket (The National Board of Housing, Building and Planning) headed by their general director, Ines Uusmann, used the platform provided by an interview with a reporter (Casson 2007) from Dagens Nyheter to aim strong critique at those municipalities located in flood-prone areas. She railed against their lack of action and responsibility regarding construction in those exposed areas. Once again, Mariestad was singled out for the greatest share of criticism.. According to Uusmann, future legislative measures might have to be enacted to create a mechanism whereby municipalities would be forced to implement a more cautious approach when carrying out planning for flood prone areas. As Dagens Nyheter summed up the situation in July 2007: "Two out of three

municipalities in Västra Götaland [the County where Mariestad is located] ignore the flood risk when constructing new housing. But next year the law can force them to pay attention to climate change when making their plans." (Areskog 2007)

In order to sum up this overview of the media's treatment of Mariestad, it can be stated that from the earliest stages of the Sjöstaden project, the different perspectives that have been projected in the media display the conflicts between the local and the national authorities. It is clear that Mariestad regards the issue as one for the national government, with the added position that 'a technical solution,' especially the building of a long-distance tunnel to the sea from Vänern, is the only feasible option. The motives that appear in the media to explain Mariestad's persistence are linked to the municipality's economic development; the town's leaders consider the new waterfront housing area to be a vital part of their marketing strategy, as an appealing community with attractive lakeshore living. The municipality has put a positive spin on the fact that Mariestad and its Sjöstaden project have become one of the media's fixations by choosing to regard it as a marketing opportunity, rather than a problem. At the same time, however, Boverket will likely continue with its process of developing new legislative standards that force the municipalities to act and adjust to the future rising water levels. The basis for that view was only strengthened in October 2007, when the final report of Sweden's Commission on Climate and Vulnerability, with the title, Sweden and Climate Change - Threats and Opportunities (Miljödepartementet 2007), was published to much fanfare and acclaim.

4. The planning of Sjöstaden – different responses to early warning

When we consider the planning process for Sjöstaden, the new housing area that is being built by Mariestad, two major perspectives on how to respond to the concrete warnings of future flooding can be identified. Although there is a clear difference in the character of the local response, in Mariestad, from that in the level of government above it, that is, at the County Administrative Board for Västra Götaland (or CABVG), complex interplays of co-existing rationalities have nevertheless led to their both having approved the housing project, at least thus far. Both parties claim that they are aware of the risks. Mariestad concludes that the method for dealing with them is to control the water level of Lake Vänern, which would allow the municipality to continue to build on attractive land, even when it is subject to a marked flood risk. Major new alternatives for adjusting Vänern's level (such as the proposal to build a long-distance tunnel draining water to one of the western fjords on the ocean coast) are far from being decided upon, however, let alone built, or implemented. The CABVG, on the other hand, acknowledges that it is inappropriate to construct new buildings in such high-risk areas, since they are not safe enough. Nevertheless, the CABVG, too, has decided to let the project proceed. As the preceding section indicates, the media in Sweden have understandably been confused, which has in turn only served to increase their sense of alarm, in trying to make sense of the contradictory messages that have been emanating from the shores of Vänern.

Before analyzing this apparently paradoxical situation, to see what can be learned about the role that signals play in providing early warning about high levels of flood risk, the next section provides a sketch of views collected from the municipality and from the county in which it is located. As with the section on

media views the following section is not intended to deliver an exhaustive report from Mariestad, but to add a further indication of the rationalities that the flood risk early warning signals have to interact with when being apprehended by their receivers. It represents a composite digest and compilation of numerous views collected from interviews.

4.1 Views from the administration of Mariestad Municipality[4]

Sjöstaden is being planned for an area that is considered to be attractive because it combines lakefront living with proximity to Mariestad's town centre. The report by Sweden's national Commission on Climate and Vulnerability (Bergström, Hellström and Andréasson 2006), Water Levels and Flow in the River Systems of Lake Vänern and Lake Mälaren–Background Material for the Swedish Commission on Climate and Vulnerability, states, as mentioned as well in the section above, that the area faces great flood risk due to the probability that climate change will imply higher water levels for Vänern. Despite that warning, Mariestad has decided to continue with the Sjöstaden project. The inhabitants of Mariestad are both for and against the project. The inhabitants of the Old Town, for instance, are against the plans, since they would affect their lakeside view and disturb mobility patterns in the town centre. They reiterate the flood risk warnings as a convenient argument in support of their desire to stop the project.

The municipality's officials for the most part dispute the picture that the media is communicating. That media picture, according to the officials, is that Mariestad does not pay attention to the guidelines given in the Commission's report. The municipality counters that it is indeed aware of the flood risk and has been working actively with the question. Measures to mitigate a higher water level in Vänern were already taken, for instance, in 2003, when the level for the lowest building foundation was raised. The municipality maintains, however, that it does not have a mandate to decide on some of the important relevant measures, for example, the 'vattendomar'[5] or 'water judgements', which influence the regulation of Vänern.

The municipality does not consider that it underestimates the flood risk. Since there already are existing buildings at levels where there are risks for floods, even if the new project were not to be built, something would have to be done anyway to make sure that the water level was controlled. Moreover, new methods for tapping Vänern must be developed. This is necessary in order to avoid being forced to abandon already existing parts of Mariestad. The most crucial issue for the municipality, then, is to work together with other stakeholders to reach agreement on the water level of Vänern. The regulation of the water level of Vänern must be adapted to the 'new climate' and cooperation is needed in order to establish this level. A challenge here is that there are many stakeholders (i.e., power companies) that sometimes benefit by retaining water in Vänern for 'too long' a time. In

4 The authors thank the following respondents from the Mariestadt Municipality, who kindly allowed us to interview them in connection with this study: Mats Widhage, Trade and Industry Developer (Näringslivsutvecklare); Thomas Johansson, Director of Planning (Planeringschef).

5 A 'water judgement' determines how much water is can and should be drained from a lake, either via a dam or hydropower station, and the limits within which such water levels have to lie, and during which times those values are valid. A water judgement can also determine the maximum depth for ditches and canals.

addition, above a certain water level, it is not plausible that the land owners and municipalities would be expected to bear the costs that a flood would incur.

Moreover, the municipality stresses that all of the towns along the shores of Vänern will be affected if its water level rises. This implies that the issue is not a local problem, but a regional and even national one, and the municipalities have accordingly begun to cooperate on that question. Agreement among all the municipalities along the shores of Vänern, on the common lowest foundation level, must be reached.

It is felt that the coordination between the two County Administrative Boards, Västra Götaland and Värmlands, with jurisdictions in the area, and the municipalities, could be better. In March 2007, a joint meeting between the County Administrative Boards and the concerned municipalities was organised. According to Mariestad officials, the initiative came from the municipalities.

The municipality believes that the risk of flooding in the area where Sjöstaden is planned to be built can be handled by mitigation measures. One is to fill the site so that the appropriate foundation level is realized. In addition, a wall that was originally planned as a *'gestaltningsdetalj,'* or 'defining detail,' is now being reconfigured to perform the additional function as a water barrier in the case of a flood. The municipal officials characterize the cautious attitude of the County Administrative Board by saying that it has been caught by the 'spirit' of the Commission's report. They also rationalize their own approach by stating that there are other areas in Sweden that face greater flood risks than Vänern, for example, certain lowland areas along the coasts.

The architect from the firm *CH-Arkitekter*, who has been working with the planning of Sjöstaden,[6] claims that he is aware of the flood risks and has taken this aspect into consideration in his work. The only thing they, as architects, can do is to follow the recommendations and guidelines from the County Administrative Boards. If it would prove to be the case that those guidelines would not be sufficient, then the municipalities and architects cannot be held responsible for the consequences. On projects, technical solutions are relied on to minimize the risks in connection with building close to water. Because a rise in the water level of Vänern would threaten many of the cities and towns along its shoreline, he maintained that controlling the water level is the problem that has to be dealt with.

4.2 The County Administrative Board[7]

The County Administrative Board is against the Sjöstaden housing project and the fact that it is being planned in an area with a high flood risk. They would prefer that the municipality withdrew its plans for a project so close to the water. The County Administrative Board and the municipality have agreed, however, that building can be allowed if the foundation level is not below 46.50 meters. (See Figure 4) Since there are still two separate systems, one national and local, for measuring that level, clarification and harmonization remains to be performed. Meeting that level will also require substantial landfill.

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6 The authors thank Per Seiving, CH Arkitekter AB, Architect, for allowing us to interview him in connection with this study.

7 The authors thank Mehdi Vaziri, County Administrative Board, Västra Götaland Region, Construction Unit, for allowing us to interview him in connection with this study.

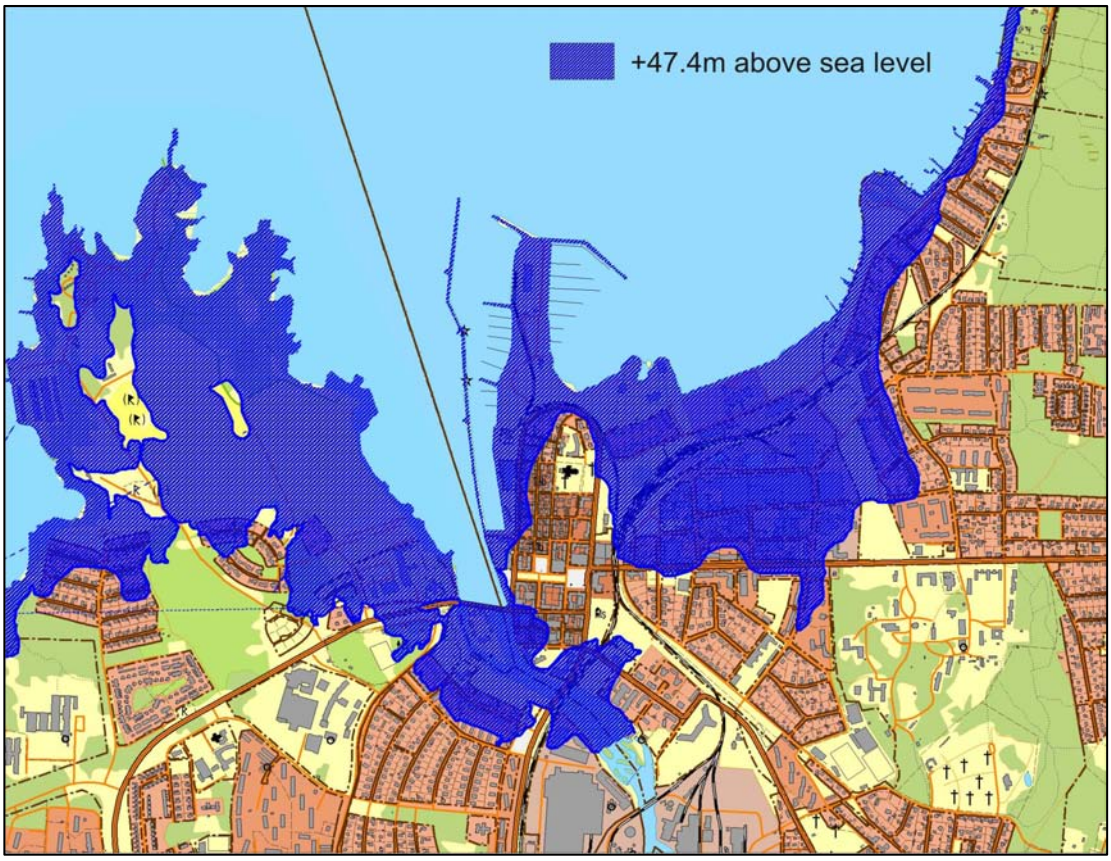

Figure II—4 Dark blue coloration shows flooded areas in Mariestad when Lake Vänern's level reaches 47.4 metres above sea level. (Mariestad Municipality 2007)

The municipality's rationale for building Sjöstaden, according to the County Administrative Board, is that it wishes to increase the number of inhabitants and improve the local economy. A way to attract new inhabitants is to offer attractive housing that is situated, for example, close to water. A problem with the Sjöstaden project, however, is that since it has been going on for so long and is such a prestigious project for Mariestad, it is difficult to stop. It has been used actively, for instance, in marketing the community as an attractive place to live. If, on the other hand, the municipality were to take the consequences of the report seriously and stop the project, it would show that they were willing to take responsibility for the safety of its citizens, and could therefore use that in a positive way as well. A review of the project in late 2007 (not available at the time of writing) will be important for its ultimate fate.

The County Administrative Board is already examining if the municipal plans pay attention to the health and safety of the inhabitants. According to a proposal brought forward by the SCCV, the County Administrative Board will probably also examine the municipality's detail plans in order to investigate if flood risks are dealt with in an appropriate way. Due to the increased risk of flooding, the responsibility of the municipality will increase, as will its duty to plan for the levels mentioned in the scenarios in the background material provided by the Commission. Existing settlements will also be affected by the new demands for flood risk mitigation measures, since the County Administrative Board has to approve any changes in plans. There will be no excuse, therefore, for using existing settlement as an argument for building new projects below the levels that are considered as unsafe.

The County Administrative Board is working in cooperation with the municipalities and several concerned companies (e.g.., *Vattenfall*) to develop new

drainage possibilities for Vänern. Even if new methods for tapping Vänern are found, the municipality is only postponing the problems by continuing the project. The County Administrative Board must also take into consideration what consequences a new tapping of Vänern might have for municipalities along the Göta River, which flows downstream from Vänern to the sea. There may be a potential conflict of interest, between municipalities on the shore of Vänern and those along the Göta River, concerning a new tapping strategy for Vänern, since the riverside communities are threatened by serious erosion and landslide risk entailed by increased discharge in the river from Vänern. In the Vänern district there are some forerunners among the municipalities, for example, Karlstad, which has been working more actively and proactively to address the new conditions that climate change is expected to entail.

4.3 The Swedish Rescue Services Agency[8]

One of the two respondents from the competent national-level civil protection authority Swedish Rescue Services Agency (SRSA) considered that the County Administrative Boards have so far been somewhat passive; they have long had the task of examining the municipal plans concerning natural conditions, but have not taken that assignment so seriously. The SRSA is working on the mapping of floods and stability for the municipalities, but their officers report that occasionally, when they are delivering a new map to a municipality, they get the response that this is 'idiocy'. Municipalities that have been faced with floods tend to work more proactively, but here, as well, technological measures, or 'technical solutions,' are used to 'secure' areas so that it remains possible to build in areas of high risk, as Arvika is doing, with its proposed system of floodgates and barriers. Thus, the belief in technological solutions remains high. The officers, though, tend to be more aware of risks, while the politicians have a short-term perspective ("This will not happen during my term of office"). A question for municipal planning is whether the public will choose to live in those buildings and areas once they are informed about the risks of doing so.

The position of one of the respondents was that even if the construction of a tunnel, as an alternative to increasing Vänern's drainage via Göta Älv, would be extremely expensive, it would still prove cost-effective. It is calculated that it would correspond to the cost of a hundred-year-flood, or, according to current estimates, approximately 5-6 billion SEK, or almost 1 billion USD (at present rates).

Our respondent felt that the presentation, on 1 October 2007, of the final report of the SCCV (Miljödepartementet 2007), may have prompted some segment of the population to realise how serious the situation really is. Our respondent felt that, until recently, at least, denial has been the dominant attitude concerning what the consequences of climate change may actually be. It is necessary that the state introduces new and stricter directives, targeted at the municipalities, in order to make sure that the latter respond seriously to the threat of flooding and that they stop allowing building construction in areas where there is high flood risk. Education is needed to raise flood awareness in the municipalities.

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8 The authors thank the following respondents from the SRSA, who kindly allowed us to interview them in connection with this study: Magnus Johansson, from SRSA/NCO – Swedish Centre for Lessons Learned from Incidents & Accidents, and Barbro Näslund-Landenmark, Natural Disasters/Flood Expert.

5. Discussion

As stated above, it is clear that the case presented here provides a thought-provoking example of civil protection early warning in disarray. In terms of signals, the metaphor can be extended by invoking the type of reception that they have undergone. What some might call clear signals, such as those from the reports produced by the SCCV, are encountering heavy filtering via the rationalities of those responsible for decision-making in the municipality. The result of such rationalized filtering of the signals is dissonance, distortion and tangible interference in the way that the information they carry is reproduced. What is most clear of all is that those involved in the Sjöstaden project do not make decisions based on ignorance, poor quality signals, or negligence. To the contrary, their choices appear highly rational, but strongly contextualized by a particular value paradigm.

The typological concepts that were presented in the introduction to this study are helpful for sketching the contours of the Sjöstaden value paradigm, with its particular mix of rationalities when related to discussion of flood risk. The concepts include *time* and *distance*; the *fact of precedent* and the *probability* that comes with the *aspect of cyclical periodicity*; then, there is the *unpredictability of the particular* and, finally, two kinds of Doppler shift, which fill the process of apprehension and processing of the signals with insecurity.

It is evident from the Sjöstaden case that the placing of different values on conceptions of time plays a significant role in explaining how the various actors and stakeholders interact. Municipal officials involved in the Sjöstaden case express a greater focus on what we call, given the life expectancy of such a major project, a short-term understanding of the values that it represents, even if the short-term is taken as representing a 10-30 year perspective. Their rationale is preoccupied with the needs of the present. The municipality wants to grow, create fresh economic activity and attract new residents, at the same time as it seeks to preserve the quality of life and the values that have sustained it thus far. The officials there are also caught up in the momentum of the project; there is a lot to lose by appearing to fail if it is not carried through to completion, on schedule, and in a form that is as close as possible to their original concept. The project remains trapped in the present. As a prestige commitment on the part of the municipality, it is seen as central to its strategy of providing attractive, contemporary housing on a beautiful waterfront site. The housing complex's packaging makes it difficult to unwrap; doing so would waste too much time, and the time to build the project is 'now!' The idea of 'climate change' remains diffuse and unspecified in time, and during its history of surviving occasional floods, Mariestad has persevered and even adapted to its experience. For the vast majority of the time, flooding is not something that is actually happening now, at this particular time, but in a nearly perpetual 'later,' and the challenges of the present are easier to see as more exciting and novel. Time, it seems for Sjöstaden's planners, is on their side.

The options that Mariestad does support in its philosophy of flood preparedness have much to do with the notion of *distance*. Not only is the area that is implicated in the various studies of flood hazard so large that it is tempting for Mariestad to maintain that there is no reason why it should be singled out to bear any extraordinary burden all by itself, but even those solutions that it is enthusiastic about shift the brunt of the action, the responsibility and the effects, somewhere else, comfortably far away. To borrow an epochal description from physics, the

notion of flooding is transformed into something that happens 'at a distance.' Regarding the size of the area, there are forty-nine municipalities around Vänern, and only a minority of them, (depending on the study consulted) are reacting concretely to the risk of flooding (Langlais et al. 2007, Areskog 2007). It need not be obvious to any of them that flooding is their 'fault', so why should any of them bear exceptional costs? Indeed, there is also the temptation for most of them to proceed as 'free-riders' in relation to the state, which they feel should finance whatever mitigation or adaptation measures are chosen. This sense of all of the municipalities' being in the same situation has also inspired many of them to meet to discuss a common approach to the early warning signals that they have all been exposed to. That approach, to insist that the state is responsible, is one that, so far, continues the tendency to keep the burden of responsibility as far away from their coffers as possible. Taking this line of reasoning even further, the option of including the European Union in such calculations has not yet been raised, as far as our study has been able to determine, but it is not difficult to imagine that that time is not far off. Nonetheless, dealing with flood risk and its costs remains, for the time being, as a national prerogative.

The aspect of distance is also part of the concrete technical solutions that Mariestad's officials are expressing a preference for. The boring of a long-distance tunnel not only moves the effects of flooding somewhere else, in this case to the far-off sea coast, but even the upstream end of the proposed tunnel(s), and the impacts of its construction, are on the opposite shore of the lake. None of the direct alterations will be visible from Mariestad. The other, second-most-popular technical solution, the building of dikes and so on, would create visible artefacts that would alter the local scenery and imply a number of other changes, but it would still shift the effects of its operation elsewhere. In other words, the construction of flood barriers would increase the need to release excess water downstream of Vänern, primarily into river valleys that have already reached the limits of what they can sustain, in terms of erosion, landslides and flooding.

A reminder is due here. It is important to recall that the present discussion is not concerned with sifting through the proposals to find the best solution, but instead to illuminate a number of the different views that the actors involved in Sjöstaden maintain, with the intention of showing their interacting, often competing, rationalities. It is felt that by better understanding those rationalities, we may be better equipped to understand why the early warning signals are being responded to in the way they have.

With regard to Mariestad and its development of the Sjöstaden project, the *fact of precedent* and the *probability* that comes with the *aspect of cyclical periodicity*, appear to play a negative role, when considered from the perspective of effective early warning. Mariestad's officials know what the floods of the past have been like, and the town has always managed to recover speedily afterwards. Even the knowledge that the floods will occur again, repeatedly, is almost reassuringly lulling. The difficulty appears to lie in processing and visualizing the scenarios that do not fit the past. The fate of the new housing development and even of the old town centre, which would both be inundated from floods at the levels predicted as a result of climate change, is made hostage to the result of cold cost-benefit calculations and political gamesmanship.

The negative role that preceding floods play in the planning for Sjöstaden connects unexpectedly with the notions of Doppler shift developed earlier in this study. In one sense, the general historical lesson from flooding, and the specific memory of floods that have occurred even within the last decade, is that the lesson and the memory

perform a function that is *in accordance with* our conceptual framework for understanding signals of early warning. As those events recede into the past, their signal weakens, which is in accordance with expectation. The Doppler shift regarding the awareness of new floods to come in the ever more quickly approaching future, on the other hand, is not in accordance with, nor leading to the effect that our model anticipates. Reiterating the main question of this study the intriguing thing is 'Why not?'

The signals approaching ever more quickly across the threshold of the Doppler shift are indeed being received in Mariestad loud and clear, as both the composite pictures we received from our overview of the media coverage and our own interviews have indicated. Mariestad's officials are indeed rational and focused in their decision-making, professional in their planning and astute in their judgements. Notwithstanding those characteristics, they still appear to be operating within a paradigm that is so strong that it does not recognize what is outside it. That paradigm is tightly coupled to the rationality of a particular political agenda, which has goals and a political philosophy that can only treat the early flood warning signal as an alien phenomenon that is eccentric and disturbing for the 'the real game' of battling over who will pay. As our respondents and the media coverage stated directly so many times, the municipality feels that the state should pay and have the responsibility, whereas the state and the state's regional representatives, the County administration, have been claiming that the municipality has the responsibility to protect its citizens and therefore to accept the burden of financing. Something that it seems that the municipal representatives did not anticipate, nor bargain for, was that the state has shifted its position on climate change, and responded to the municipalities' intransigence in a surprise move. The national government has immeasurably increased its engagement on the climate change issue, with one of the results being that it has announced that it is considering new legislation that would force the municipalities to comply with new flood and building limits that it would adopt. This would be a double loss for the particular municipality of Mariestad, for not only would it stand to lose in its insistence on continuing with the Sjöstaden project, but it would also have to forfeit some of its decision-making power in planning and implementing new projects.

6. Conclusions

Mariestad seems to be in a state of denial about the fundamental issue underlying its current framing of the situation. Instead of dealing with the early warning signals it is receiving about the risk of serious recurring floods in the future, it is consistently and persistently projecting the image that the problem is merely one of the assignment of responsibility and the bearer of costs. Although all of the interviews and most of the other empirical material we collected strengthen the description of Mariestad's position as being fully informed and aware of the flood risk and of the strength of the early warning signals, the repeated claims that the whole situation could be 'solved' through 'technical solutions' demonstrates a form of hubris. The distinct impression we received from the actors directly involved in the case is that whatever the problems, humanity will 'triumph over nature' and that 'you cannot let nature conquer you.' That confidence is most acutely expressed in the transformation of the issue into one of quarrelling over 'Who pays?' and of a battle of local prestige in defiance of 'the state' and its perceived unwillingness to take

responsibility for guaranteeing the safety and livelihoods of the citizens inhabiting the shores of Vänern.

The widespread questioning and surprise in the Swedish discourse over the approach that Mariestad is taking reflects a number of things. Although many other Swedish communities share the attitude of Mariestad, the specific timing of the latter's commitment to the Sjöstaden project has made it an irresistible target for its detractors. Its attractiveness as a location also makes it an eye-catching target for those who would publicize a more threat-focused perspective on climate change. The project's conveniently striking location serves as a perfect illustration of how building without taking into account the early warning signals from new climate-change-based scenarios can place infrastructure, home-owners and investors in jeopardy. The consistency with which those in authority in the municipality unanimously voice support for the project simultaneous with assurances that they are fully aware of the signals regarding flood risk is also a significant reason for the attention that the municipality has received, and, if we are to believe at least a couple of our respondents, even appreciated.

The case also contradicts the contemporary dictum from the various discourses on sustainable development that 'local is best,' and that those in the community are in the main those who know most about how to solve local problems (e.g., Ostrom 1990). At the same time, the present case also illustrates the difficulties that arise when attempts to translate the scenario-building activities of -large-scale projects, such as those undertaken by the IPCC to perform global and, when possible, national-scale assessments of climate change, to the local level. As has been frequently pointed out in the planning and scientific communities, that translation is often fraught with difficulties and contradictions, leaving it clear that much more work needs to be done. Finally, what the case highlights most clearly is that even when the technical, informational and procedural aspects of civil protection early warning are of the highest quality, they may still not lead to the result expected, or desired, by its transmitters, the senders of the signals. It also shows that even when those high quality signals are fully received and acknowledged by the appropriate addressees, they may nevertheless be processed and utilized in such a way that the senders' intentions, perversely, may even produce an outcome that is the opposite of the one desired. In other words, even the most reliable early warning about flood risk may lead, as has been the case to date regarding Sjöstaden's champions, to increased intransigence and an amplified determination to persist in completing an intensely longed-for project, almost in defiance of countervailing messages. The clear signals of the impending danger of flooding, rather than serving as pragmatic, functional implements of rational infrastructure planning, encounter instead the multiple rationalities of local agendas embroiled in multi-level governance battles. As we put it in the Introduction to this paper, *Nature's signals arrive in time, only to dissipate in the chaos of politics.*

CHAPTER III
Sudden Sea Level Rise in the Gulf of Finland in January 2005

Timo Hellenberg and Johanna Kentala

This case study describes the early warning mechanism and emergency management procedures that were used in tackling the severe flash flooding incident on 7-8 January 2005 caused by rising sea waters in the Gulf of Finland. The study, focusing mainly on the Finnish experience, is derived from interviews[9], analysis of the available documents and written materials, and on the other, by describing the emergency management cycle with cross-sectoral and cross-border dimensions. The authors have followed a chronological approach, which describes the early warning cycle from beginning to end and the subsequent recovery of society.

We ask what kind of early warning signals were used, how the main actors received information about the incident and whether the overall early warning mechanism and inter-agency communications were successful. Is there a need for improvement of the preparedness, early warning system and crisis communication? Evaluating the major challenges and lessons of this incident, we further ask which public and private instances should have an essential role in flood prevention. Should flood prevention be based mainly on local, national or intergovernmental cooperation or on a combination of these all levels? Should early warning signals be better connected to and coordinated with the decision making mechanism? Were the decision makers and operative actors able to read the early warning information sent by the Ministry of the Interior?

1. Risk perception

The overall risk perception of the emergency management authorities involved in this study was affected by the tsunami disaster in South East Asia, which took place on 26 December 2004. One week later, Northern Europe was facing severe weather conditions unlike before. The emergency management and civil protection authorities of the Nordic and Baltic countries were still following the news of the large casualties and victims from the Nordic countries in Thailand and within the tsunami region. This alert and readiness to overcome the tsunami disaster caused upgraded readiness within administrative responses when facing the natural phenomenon of this extraordinary magnitude in their own backyard.

The risk factor faced by the authorities in Sweden, Finland, Estonia and Russia was basically same as with the tsunami disaster: a sudden and unexpected natural hazard that trigged multiple risks for the critical infrastructures and tested the resilience of these societies. The difference between these two incidents is that whereas the tsunami was generated by unpredictable geological risk i.e. earthquake,

9 The authors thank Janne Koivukoski, Rami Ruuska and Taito Vainio, who kindly allowed us to interview them in connection with this study.

the flash flooding was caused by systematically and precisely monitored weather conditions.

The severe gale in the Northern Baltic took place on 7 January 2005. A violent storm formed over the British Isles and moved east to central Finland. Several countries were affected by the violent storm including the United Kingdom, Norway, Denmark, Sweden and the Baltic countries. The highest winds occurred south of Finland and the biggest problem was the rise in sea level, which was as much as +197 cm in Hamina.[10]

On 7 January the Finnish Institute for Marine Research (FIMR) received weather forecasts showing a strong winter storm approaching Southern Finland. FIMR had run an operational sea level model since autumn 2003, but no routine operational man-made forecasts were made before January 2005. When the weather forecasts showed a strong winter storm coming towards Southern Finland, the operational wave and sea level model forecasts were checked. They showed that something unusual might happen at sea. Results from Finnish and foreign models were viewed. The model results differed considerably from each other, as the highest model forecast for Helsinki was +240cm, which would be almost impossible, and the lowest model forecast was +95cm. At this point the experts began to analyse the situation. The man-made forecast stated that the sea level might rise by up to +150 cm in Helsinki where the previous record was +136. Furthermore, the forecast stated that the duration of the flood will be unusually long lasting for several hours and will include two peaks. The forecast also stated that the duration of the flood would be unusually long lasting for several hours and would have two peaks. (Alenius 2007).

2. Early warning

On Friday 7 January a severe weather outlook was issued for emergency authorities. A storm with winds of 25 m/s was forecasted for Saturday-Sunday night for southern and south western Finnish sea areas and high winds for land areas. The FIMR informed about the sea level forecast for the Gulf of Finland and the news releases were issued at 13.50 and 14.00 UTC. After the news releases the Finnish News Agency (STT) was notified three times of the forecast.

For the first time in the FIMR's operational history, an early warning signal was given to the Ministry of the Interior Rescue Department on the Friday afternoon of 7 January. The warning message stated that a severe flood with long duration in the Gulf of Finland would start early on Sunday 9 January, and would probably last until the afternoon of the same day. The early warning signal to the Ministry of the Interior followed instructions and local rescue services began to prepare actions against the severe flooding. Referring to Pekka Alenius from the FIMR, "good working contacts between public authorities helped to reduce economic losses caused by the flood". The sea level forecasting system used includes several models with different input data being automatically run four times a day. Observations and model results are saved on a database and foreign model results can be easily used for comparisons within the Baltic Operational Oceanographic System (BOOS). (Alenius 2007)

The Finnish Meteorological Institute (FMI) is responsible for collecting and delivering information to the authorities. It receives information on accidents from the

[10] For the locations of places in Gulf of Finland and the Helsinki area, mentioned in the text, see Figures 1 and 2.

Figure III—1 Places mentioned in the text of Chapter III.

Figure III—2 The Helsinki region with selected places affected by the flash flooding.

Emergency Response Centres which it then combines with weather information so that additional information, such as the locations of damage or rescue activity and storm tracks, can be shown on severe weather maps. The FMI decided to have extra personnel in the forecasting room for the entire weekend. Waves reached heights of up to 8 meters and there was a significant sea level rise in the Gulf of Finland by the Saturday evening of 8 January.

3. Situation awareness

In the Finnish context, the term 'situation awareness' is relatively new as it came into use more broadly after the Asian tsunami of 2004. Later, in 2006, the Finnish government established a warning centre for natural disasters. Organisations involved in the centre include the FMI, the FIMR, and the Department of Seismology of the University of Helsinki. An early warning system has consequently begun to be built up, which makes it possible to anticipate the likelihood of severe weather up to two weeks in advance. Early warning information is distributed via a severe weather outlook e-mail list, which has 150 members including the Ministry of the Interior, State Provincial Offices, Emergency Response Centres, Police, Finnish Maritime Administration, and the Finnish Border Guard. The severe weather outlooks promote rescue organisations to reallocate their resources, distribute personnel to risk-prone areas, to prepare rescue equipment, and to be ready to fix telecommunication breaks. A survey conducted by FMI in 2007 revealed that 80% of early warning outlooks were considered helpful for the preparation of rescue activities. (Heikinheimo 2007)

However, this was not the situation in early 2004. Following the first early warning signals from the FIMR to the Ministry of the Interior, the situation awareness of the Finnish emergency management agencies started to build on various assessments and predictions from the FMI's and the FIMR's forecast machinery. According to them an intense low pressure was moving across central parts of the country to the east during the night between Saturday and Sunday (8 and 9 January). The southwest wind would become stormy in southern and southwest sea areas. On the North Baltic Sea as well as on the Gulf of Finland the wind would blow around 25m/s with gusts of almost 30m/s, and the wind would become dangerously strong in the land areas of the southern parts of the country until Sunday. Rain would reach Southwest Finland on Saturday afternoon and rainfall was in places predicted to be over 20mm in the night between Saturday and Sunday. The storm was predicted to be as strong as was the Rafael-storm that caused wide economic losses in Finland and Sweden before Christmas 2004. It was expected that the strong wind would blow down trees and damage rooftops. In the central parts of the country snow and sleet would cause severe road conditions. Waves and sea level might reach new record heights during the night between Saturday and Sunday in the North Baltic Sea and the Gulf of Finland and there would be a risk of floods in many places on the coast of the Gulf of Finland., if the FMI weather forecast for the storm and calculated storm models would be correct. The predicted wave height on the North Baltic Sea was up to the record of 9 meters and on the Gulf of Finland the wave height may be 5 meters. Problems for the ship traffic could result especially from individual waves that may be as high as 16-17 meters. (FMI 2005a; MTV3a)

Regarding the flow of strategic early warning information received by the emergency management authorities to enhance their situation awareness (or later

situational knowledge), the sea level was predicted to rise to record heights in the Gulf of Finland. The maximum rise in sea level in Helsinki was forecasted to be over 120 cm and there was even the possibility of a rise of up to 150 cm. Based on this information, the authorities predicted the most likely the maximum value to be around 140 cm. That would be 4 cm more than the record of 136 cm. At that time the sea reached Helsinki city centre and caused alarming conditions to the critical infrastructures such as the President Palace, which is located by the quay. This earlier record height was measured on 27 January 1990. Records have been kept since 1904. (Itämeriportaali 2005a)

The situation awareness as a whole started to concern the research institutes themselves which were responsible of delivering the information. According to the Senior Researcher of FIMR, Kimmo Kahma, a wave height of 9 meters would exceed all the earlier forecasts of possible wave heights on the North Baltic Sea. Exceeding would be so great that FIMR gave out an exceptional rough sea and sea level rise warning. (Helsingin Sanomat 2005a) This was the first time FIMR issued this kind of warning. (Aamulehti 2005a) This exceptional action chosen by the FIMR protocol indicated the overall sensitivity of the whole forecast system, such as in this case of the record high waves where changes are dependent in the course of low pressure as well as of the wind. The record high forecast for the sea level rise would be due to the storm-related 'bathtub effect', which the storm causes when the whole Baltic Sea is on the move and water spills from one side to another, like in a bathtub. (Helsingin Sanomat 2005a)

Since the operational situation awareness was reached both at the central and regional levels of the Finnish rescue and emergency management context, the situational knowledge, i.e. deeper and comprehensive understanding of the duration and severity of the incident and its larger implications, started to emerge. While the news still warned on Sunday 9 January that on the North Baltic Sea the wind can be 28m/s and on the western Gulf of Finland 25m/s (YLE 2005b), the FMI announced that difficult weather conditions would be over by Sunday evening. Dangerous weather should have passed on Sunday evening at latest. (FMI 2005b)

On Saturday 8 January at 20.00 the FIMR expert Kahma estimated that the new record height of sea level rise would not be reached in Helsinki. The evening forecast stated that the sea level would rise 110-140cm higher than average and Kahma estimates that most likely the rise will be 130cm. On the North Baltic Sea FIMR's evening forecast still predicted a new record in wave height. Forecast was for 8m waves and individual waves of 14-15m. According to Kahma the highest waves were estimated to go farther south than was predicted earlier. (Helsingin Sanomat 2005d) Researcher Heidi Pettersson from FIMR called the forecasted waves the 'breakers of the century', since nothing like this had been measured at least in 45 years. The height of the waves was affected not only by the speed but also by the direction of the wind and how large a water area it moved. This time the wind blew from the south and so raised the breakers. North windstorms caused more harm on land areas in Finland, but did not raise the waves so much on the coastal areas. (Aamulehti 2005c)

4. Preparedness

The national flood response system generated its operational preparedness after the Rescue Service Unit (RSU) of the Ministry of the Interior received early warning about the rising sea level and oncoming storm from the FIMR and the FMI on Friday

afternoon 7 January. The message of the FIMR warning was that a severe flood with long duration in the Gulf of Finland is beginning on Sunday small hours on 9 January and will probably last until afternoon. (Alenius 2007) FIMR's Kahma called the first person on call, Senior Expert Rami Ruuska at the RSU and after that also Director of the Unit, Janne Koivukoski. Before the shift change at 16:15 on Friday afternoon Ruuska sent two SMS messages, one to the key persons in Ministry and the second one to the Minister of the Interior, Kari Rajamäki.[11] After the shift change, the person on call, Taito Vainio, contacted State Province Offices of Western and Southern Finland to inform them about the coming storm and to make the regions prepare adequately. The RSU followed the situation and passed the information to key actors.[12]

According to the Director-General of Department for Rescue Services, Pentti Partanen, the Ministry of the Interior made sure immediately, after it was announced by the FIMR about the storm, that the warning and flow of information would proceed to all actors as smoothly as possible. The information was sent to the rescue departments at coastal regions, to the Coast Guard and the Finnish Maritime Administration. Since the regionalisation of the rescue services in Finland, the responsibility of the operations is mostly with local and regional authorities. (MTV 2005b)

However, as the Ministry of the Interior had received the early warning information, the person on call in the RSU of the Ministry has a specific file that includes the necessary contact information for the all the key authorities that might be needed. In such a situation the first step is to contact the rescue departments and tell them about the situation and ask if they have received the information.[13] Because this flood warning affected several rescue departments, the information was first passed to the State Province Offices of Western and Southern Finland that further contacted the rescue departments on the affected areas and passed the information further.[14] After going to the rescue departments, the information was passed to Finnish Environment Institute and Ministry of Agriculture and Forestry as well as to the Government situation centre. The Government Situation Centre informed ministers about the events and in this way too the emergency preparedness leaders were convened.[15]

On Saturday 8 January the RSU of the Ministry of the Interior decided that a meeting of the emergency preparedness leaders would be held at 9 pm. Besides the preparedness leaders from the essential governmental agencies, the meeting was supplemented with experts from the FMI and the FIMR to give the most accurate forecasts of the storm. Representatives of the Coast Guard and the Police on call were also present. The State Province Offices of Western and Southern Finland were asked to give their reports on the preparedness of the coastal areas in the meeting.[16] The chairperson of the preparedness leaders is the convenor for the meeting of the emergency preparedness leaders. The chairperson in January 2005 was State Secretary Risto Volanen, who was also the key person to direct and coordinate the Finnish relief efforts for the tsunami disaster underway at that time. The role of the

[11] Interview with Rami Ruuska and Janne Koivukoski on 29.5.2007.

[12] Duty record of the Rescue Service Unit of the Ministry of the Interior.

[13] Interview with Taito Vainio on 25.5.2007.

[14] Interview with Rami Ruuska on 29.5.2007.

[15] Interview with Taito Vainio on 25.5.2007.

[16] Duty record of the Rescue Service Unit of the Ministry of the Interior.

meeting was to see that things were under control and that all the ministries are aware of their responsibilities and that all responsibilities are appropriately taken care of.[17]

At 9 pm in the meeting of the emergency preparedness leaders forecasts from the FMI and the FIMR were dealt with as well as the preparedness of the regions involved. The state of readiness was officially noted as well as the fact that at this point no special actions were expected from the side of the Finnish government. It was also decided that a more detailed communication, based on the most recent forecasts, would be given to the public. Also different branches of administration will be advised to prepare themselves with adequate resources.[18] One could assume that the shortcomings of the national crisis communications during the tsunami disaster had revived the readiness of the government authorities to activate and inform the public about the situation. This could be described as widened situational knowledge or as the mobilization of the first responders – citizens themselves.

Following the critical decision making mechanism, i.e. emergency preparedness leaders meeting on 8 January, the Ministry of the Interior advised citizens to be cautions and the rescue departments of the City of Helsinki and Southwest Finland recommended citizens to avoid going outdoors if possible.[19] This was also the first time when the ministry issued a warning and notice to the public by direct radio broadcast. (Koivukoski 2007)

The (emergency) preparedness leaders meeting paved the way for several other semi-governmental agencies to issue their own early warning signals and to raise their profile as the responsible agency to deal with. For instance, the Finnish Environment Institute (SYKE), which operates with the support of the Ministry of Environment and is responsible of the wide range of natural and man made risks, such as oil spills, announced that the storm would bring rains that could cause flooding in the rivers on the south coast and in southwest Finland. Water levels in rivers might rise around one meter and also lake levels can rise around 20 cm. (YLE 2005a) The Finnish Maritime Administration estimated that the storm would be the strongest in the last hundred years. The Finnish Maritime Administration urged mariners to stay in harbour or not to try to come to harbour from open sea until the storm was over. The Finnish Maritime Administration also increased its preparedness for the sea traffic control and monitoring. The Finnish Road Administration warned of poor road conditions in the southern and south western costal areas. (MTV3 2005c) Road conditions in central Finland were expected to become poor. (Helsingin Sanomat 2005d) In Estonia, the newspaper *Postimees* warned of the coming storm and forecasted a sea level rise in Pärnu of at least 2.4 m above the normal level and at the coastal areas in general at least 1.5m. Sea level was also predicted to rise on the coast of the City of Haapsalu, Estonia. (Helsingin Sanomat 2005e) These pieces of information from Finland and Estonia were added by the Government Council to the earlier situation picture, and as such served for the common cause of mobilising the wider society to deal with sudden flash flooding.

5. Relief and response

Besides the parallel experiences of the tsunami disaster, Finland was hit by the Rafael-storm couple weeks earlier. This may have prepared the authorities for this

[17] Interview with Taito Vainio 25.5.2007.

[18] Duty record of the Rescue Service Unit of the Ministry of the Interior.

[19] Duty record of the Rescue Service Unit of the Ministry of the Interior.

storm because the Rafael-storm made the rescue systems highly attuned and alert. (YLE 2005a) The first responders were the few governmental agencies that started their response operations already on 7 January after the first signs of severe weather conditions, and the West Finland Coast Guard and the Gulf of Finland Coast Guard were preparing for the storm by raising the alert. On 7 January their helicopters were on standby at Turku airport and Malmi airport in Helsinki, according to Lieutenant Jim Johansson from the Gulf of Finland Coast Guard. The Finnish Road Administration was also prepared for the storm and problems that it would entail. The amount of people working through the weekend was increased. The Chief of the Traffic Management Centre, Veli-Pekka Pelttari, estimated that trees and pylons would blow down onto roads and roads could be covered by rising water. (Helsingin Sanomat 2005a)

Within the private and business sector, which owns most of the critical infrastructures, the situation was taken seriously and with preparatory measures as well. The exceptions were the state-owned railway company *Valtion Rautatiet*, which was not prepared specifically for the storm, although there could have been problems if trees were to fall across rail tracks. The national airline carrier *Finnair* reported that the storm would not cause any disruptions to its operations. (YLE 2005b) Otherwise, the private sector was clearly hit by storm. During the previous Rafael-storm, the energy company *Fortum Oyj* had faced problems with the distribution of electricity, because the storm damaged power transmission lines, which were still being fixed in southwest Finland and in west Uusimaa.(Helsingin Sanomat 2005a) This case looked somewhat more alarming for *Fortum*'s business strategy. The company has elevated its storm preparedness in southwest Finland and in the region West Uusimaa. A hundred repairmen were ready mobilized if needed and 200 employees were ready to work on Sunday in case of widespread damage. (Helsingin Sanomat 2005c)

Large passenger ships operating in the Gulf of Finland were also prepared for being behind schedule because of the storm. Passengers were warned prepare for cancellations in the traffic between Finland and Estonia. High-speed ships between Helsinki and Tallinn would not operate if wave heights were more than 3 meters. (Aamulehti 2005b) The captain of the ship would make the decision to depart case-specifically, depending on the weather conditions. (MTV3 2005a) According to *Viking Line*, one of the two major ferry operators, storms were not expected to affect the operation of the large ships, but smaller ships might be delayed. According to the company's technical director Kaj Jansson, the situation was not as bad as was predicted. (Aamulehti 2005d) But *TallinkSilja*, the Estonian ferry operator, prepared for running late and for timetable changes.

In general, the storm situation was followed carefully within maritime traffic and ships were able stay in port to wait for the storm to subside. (MTV3 2005a) In large passenger ships trucks were strapped down on the car decks, whereas normally only their detachable rears would be secured. (Helsingin Sanomat 2005e) Mobile things such as bottles and dishes were also secured. (Aamulehti 2005e) The ships to Stockholm left normally on Saturday night, but *TallinkSilja* cancelled its operations from the Estonian harbours. The last high-speed ships running between Tallinn and Helsinki were in Helsinki before the storm was due to hit. (Helsingin Sanomat 2005c)

The City of Helsinki Rescue Department prepared for the storm and the flooding of the main market place Kauppatori by a new method, which was to dam up Kauppatori using massive paper bales a meter high. There are good experiences of the massive paper bales in Great Britain, where those had been used already earlier. Those are quicker to move and build than the traditionally used sand bags. In Helsinki the flood barrier was built first in Kauppatori, because the experience had showed that

sea level always rose there first. Other such places were the bridges of the islands Lehtisaari and Kuusisaari, which could be closed by police if necessary. Rescue department would get technical assistance and know-how from the Finnish Defence Forces conscripts and preparedness groups of the civil service departments of city of Helsinki as well as from volunteer groups when necessary. The City of Helsinki Rescue Department has group of 80 men ready on three-minute standby during weekends. (Helsingin Sanomat 2005b)

On Saturday afternoon of 8 January, the Helsinki's volunteer fire brigade built flood barriers in the city centre. (Helsingin Sanomat 2005c) It was predicted that while the water would rise to the main market place Kauppatori, the City Hall and the Presidential Palace would be safe since the predicted water rise is not enough to reach them. Since Friday on the 7 of January, units of the rescue department had been monitoring the sea level at nine different locations in Helsinki in several places.[20] Fire fighters were on call the whole night between Saturday and Sunday. (Helsingin Sanomat 2005c) The flood barrier in Kauppatori was 300-400m long. (Aamulehti 2005f)

In addition to the rescue department, the Police, Helsinki Water, the Port of Helsinki, the Public Works Department, the Environment Centre of the City of Helsinki, the volunteer fire brigades and the Finnish Defence Forces were on standby to prevent flood damage. For instance, Helsinki Water offered sand bags to members of the public, first responders, to tackle flash floods. (Helsingin Sanomat 2005c) It also started to seal off sewer overflows so that sea water would not get into buildings through drains. (YLE 2005b)

6. Winds of destruction

The storm that raged during the night was expected to calm down on the Sunday night, 9 January. According to the FMI, wind could still be dangerous on land areas in the southwest Finland and in the West Uusimaa region, especially on midday Sunday. The FMI estimated that the worst gales passed Finland from the south. The storm was at its worst in Great Britain, Denmark, southern Sweden and the Baltic countries. But Finland also was affected by it. (Aamulehti 2005d) The storm warning was in force until the Sunday evening, but according to the FMI, wind was gradually decreasing during Monday night. During Sunday night the wind would be on southern sea areas 16-23m/s, in Hanko gustily at 27m/s. (YLE 2005c)

In St Petersburg, Russia, the Emergency Ministry EMERCOM did not expect the storm to accelerate, but warned of strong winds. The water level in the river Neva was expected to rise 1.6 – 1.8 meters above average during Sunday morning (9 January) and for that reason the rescue services were on full evacuation alert, which would be materialized if the flood would be 2 m above the normal water level. In Kaliningrad there was warning of the wind gusts of 28 m/s and small ships were urged to come ashore. (Helsingin Sanomat 2005f) The Road E18 was closed to traffic during Sunday afternoon in Viipuri/Vyborg (Russia), and Vaalimaa frontier station (on Finnish side) was closed. Water rose over the E18 from Vaalimaa to Viipuri/Vyborg. (Helsingin Sanomat 2005g) In St Petersburg, the river Neva was 2.4 m above average. According to the authorities, large-scale damage was avoided. (Helsingin Sanomat 2005h) Six metro stations were closed because of the flood risk in St Petersburg. In Kaliningrad

[20] There were for instance units in Kauppatori, Vattunokka, Iso and Pikku-Huopalahti, Töölönranta and Kyläranta (see Figure 2).

the storm wind caused much damage to roofs and power lines. (Helsingin Sanomat 2005i)

In Estonia, the worst flood situation was in the Pärnu region. The sea surrounded the area on shore where most of the spa hotels were located. More than 200 tourists were evacuated in Pärnu region. (Helsingin Sanomat 2005h) Many of the tourists were Finnish retirees. Also an elderly people's home, school, kindergarten and psychiatric hospital were surrounded by water. The sea level was 3 m above average at its highest in Pärnu. By Sunday night (9 January) in Pärnu region there were 11 Estonians who had been taken to hospital because of hypothermia. The City of Pärnu estimated that the city would run out of drinking water before 9 pm on Sunday night. The sea level also rose in the city of Haapsalu. During Sunday around 60 people were evacuated there. On Sunday night about 15 per cent of Estonian houses were without electricity. (Helsingin Sanomat 2005j) The fire departments and Estonian army evacuated the people from the flooded areas. The defence forces provided vehicles and boats for evacuation. (Aamulehti 2005g) The ferry connection from the mainland to Saarenmaa Island was cut because the wharfs at both ends were underwater.

There were also electricity blackouts. According to estimates, it took at least three weeks to repair the flood damage to Saarenmaa's hotels. (Aamulehti 2005g) The Finnish Ministry for Foreign Affairs informed the RSU about the situation in Pärnu, Estonia, as well as in St Petersburg, Russia. People had been evacuated and one helicopter was in use in Pärnu. The situation seemed to be under control. Still the RSU prepared for the fact whether the Finnish Border Guard would loan one of its Augusta Bell 412 helicopters to Estonia, if requested.

7. Nuclear factor

At 05.00 on Sunday 9 January the nuclear power plant in Loviisa in southern coast of Finland, announced the Finnish Radiation and Nuclear Safety Authority (STUK) that it was on alert because of the sea level rise. (STUK 2005) At 09.00 it gave the same announcement to the RSU of the Ministry of the Interior. In the morning the sea level was 171 cm above normal and the energy company *Fortum* was preparing to close down the power plant if the sea level continued to rise. A 200 cm rise is the critical point after which the power plant needed to be secured and closed. Fortunately the sea level started to drop on the Sunday afternoon.[21]

The situation was monitored closely by STUK and the staff of the nuclear power plant. (STUK 2005) Closing down the nuclear power plant would have affected the distribution of electricity. There is a representative of STUK based in Loviisa and the STUK was prepared to establish a command centre there. STUK was responsible for communications, as is stated in the communications plan.[22] The RSU of the Ministry of the Interior informed the State Province Office of Southern Finland about the situation. Situation was also briefed to the Minister of the Interior, Kari Rajamäki, State Secretary Risto Volanen and to the other key officials. The alert in Loviisa was later cancelled (14:31).[23] Closing down a nuclear plant takes a few hours, depending on whether only the power is wound out or if the reactor itself is closed.

The sea level has never been so high in Loviisa before. It was also odd that there were few high waves near Loviisa, only the sea level was rising. The earlier record

[21] Duty record of the Rescue Service Unit of the Ministry of the Interior.

[22] Duty record of the Rescue Service Unit of the Ministry of the Interior.

[23] Duty record of the Rescue Service Unit of the Ministry of the Interior.

height was 1.6 meters. At the other nuclear power plant site in Olkiluoto there was no need for special measures. The sea level rose only 0.8 m and the danger limit is 2.3 m, according to Reijo Sundell, production manager of Olkiluoto nuclear power plant. (Aamulehti 2005h)

During Sunday 9 January STUK was in contact on several occasions with the Leningrad nuclear power plant, located in Sosnovyi Bor not far from St Petersburg. The nuclear power plant increased its preparedness for closing the power plant down if the rising sea level were to risk its safe functioning. According to information received from the Russian authorities, the sea level rise was estimated to be 240 cm above the average. This was still way under the risk limit of 325 cm in Sosnovyi Bor. Soon afterwards, safety cooperation between the STUK and the Sosnovyi Bor was focused on building an estimation system for water level in Sosnovyi Bor that would be linked to the Finnish forecasting network. (Helsingin Sanomat 2005u)

8. Floods in South and Southwest Finland

Large-scale flood and storm damage was avoided, but water cut off roads and traffic in the coastal areas. (MTV3 2005d) Traffic was cut off in many places in the Helsinki region. Routes that were partly cut off included the main circle roads Kehä I in Otaniemi and the intersection of Kehä III and Itäväylä. Traffic in the two of the main inner-city roads in Helsinki Pohjoisranta and Pohjois-Esplanad was also cut off. Water closed roads throughout the coastal region. (Helsingin Sanomat 2005k)

In the centre of Helsinki the sea rose to the main market place Kauppatori and in eastern Helsinki into the cellars and garages of private houses. (MTV3 2005d) Floods forced their way into dozens of houses in Helsinki. In Kauppatori, water was pumped from the sewer network to the sea so that its flow to the cellars could be prevented. In the port of Sörnäinen in Helsinki, about 400-500 imported new cars were damaged by floodwater when the sand wall protecting them broke down during the night. The wharf of the ferry to the island Suomenlinna outside the city centre was submerged as was one of the central parks of Helsinki (Kompassitori in the park of Kaivopuisto). (Helsingin Sanomat 2005k) Suomenlinna island was isolated because the ferry could not carry passengers from the submerged wharf. (MTV 2005d) The maintenance tunnel to Suomenlinna island was blocked with sandbags from the side of the mainland already on Saturday to prevent seawater from flooding it. (Helsingin Sanomat 2005l)

According to the City of Helsinki Rescue Department the massive paper bales proved to be necessary in preventing the flood peak, even though they did not totally prevent the sea from rising to main market place Kauppatori. (MTV3 2005d) According to fire chief Markku Lehmuskallio from the Helsinki Rescue Department, the paper bales made from newspapers were best in absorbing the water. Bales made from milk cartons or other such materials were not so effective. Rescue department got the massive paper bales from paper recycling company *Paperinkeräys Oy* in Helsinki. According to Lehmuskallio it would be good to have the paper bales in stock in case of future floods. (Aamulehti 2005h) During the night the rescue department had altogether 80 rescue and flood prevention assignments in Helsinki. The rescue department was still pumping the rainwater drains during Sunday afternoon near Kauppatori. The worst situation was in the area of Marjaniemi, where the floodwater entered cellars and garages and surrounded many of the private houses by the morning. The sea level rose as most of the snow melted, which in turn caused further flooding in ditches. (MTV 2005d)

The police estimated that traffic in the centre of Helsinki would become normal by Monday morning 10 January. The main market place Kauppatori was able to continue business as usual by the Monday. *Helsinki Water* asked for special attention from members of the public, especially in parking caves as well as in those buildings where there are many floors below street level. The pumping of floodwater from the sewers was to go on for days. It is possible but not likely that water would also get into the metro tunnels. (Helsingin Sanomat 2005m)

In Virolahti, on the coast of the Gulf of Finland, elderly people were evacuated from two terraces of houses and there were other evacuations in Pyhtää. Altogether some twenty people were evacuated. In the town Porvoo nearby Helsinki the water rose to the lower parts of the buildings along the shore. Residents from the houses near the railway station were carried by boat to the nearby road. (Helsingin Sanomat 2005n) A confirmation camp was evacuated from the Pelling island off Porvoo. (Helsingin Sanomat 2005o) Also, in Tammisaari, Loviisa and other east coast cities of the Gulf of Finland, sea flooded buildings along the shore. The rescue department pumped water from buildings in different parts of Uusimaa region until late Sunday afternoon. (MTV3 2005d) Some streets were closed off in towns nearby Helsinki, such as Espoo, Kotka, Kirkkonummi, Sipoo, Raisio and Porvoo (YLE 2005d).

The worst problems caused by the flood happened in Turku in Southwest Finland, where the whole passenger port of Turku was under water on Sunday morning. Passengers went to and from the ships on temporary bridges and even loader buckets. (Helsingin Sanomat 2005h) At the Hotel Seaport in Turku residents were evacuated to higher floors when the flood reached the hotel's entrance hall. (YLE 2005d)

On Monday 10 January the water level continued to be higher than normal even after the main storm was over. That was a relief for decision makers and allowed time to assess the damage of the weekend. But a new storm approached Sweden and Finland during the night between Thursday and Friday. However, the wind was not predicted to be as stormy as it was during the previous weekend and the water was not supposed to become a threat to houses it had been the week before. (MTV3 2005e; YLE 2005d) Yet, the local rescue services were again preparing for the sea level to rise along coastal areas, and banked up some of the areas with sand bags. (MTV3 2005f)

9. Aftermath

After the storm, it was the time to repair the damages and learn the lessons. According to the Finnish Road Administration's Traffic Management Centre, traffic was running smoothly already on the Monday morning 10 January. The morning traffic was not exceptional, contrary to what was expected on the Sunday. (Helsingin Sanomat 2005q) Also the pumping of the water out of the many private houses was mostly done by Monday noon. In many places dryers replaced pumps (drying work can take weeks). In many places in Helsinki flooding was due to sea water blocking up sewers. Sea level was so high that it got into the sewage systems. As a result of the overload of the sewer network, 63,000 cubic meters of untreated waste water was dumped into the sea. About 100 buildings in the Helsinki region were in need of rescue. In the town of Hamina, where the sea level rose 198 cm, more than 200 places needed help from the Rescue Department. (Helsingin Sanomat 2005o)

According to Rescue Commander Kari Lehtokangas, the prevention of the flood damage in Helsinki was successful: "Action was taken in time, when the weather forecasts were given." Private home owners called the Rescue Department and asked

what they should do, and the rescue department's crew went to advise them on the spot. Of course there was still some bad damage. The City of Helsinki Rescue Department was in the need for considering updating its preparedness plans. According to Lehtokangas, it was a good to question whether one should build on the waters' edge with the risk that the building's ground floor could be flooded once every 20-30 years. In Finland, the responsibility of the safety of the building sites belongs to the municipalities' city planning and construction license policy. (Aamulehti 2005i)

By contrast, in Estonia, where the damages were perhaps even bigger than in Finland, the storm showed clear failings in the preparedness of the authorities. The Estonian meteorological institute did not take the storm forecasts seriously on the Friday and the Estonian rescue department responded to the warnings of the meteorological institute only after a 26-hour delay. (Aamulehti 2005j) The Estonian media heavily criticized the storm damage prevention. Early warning about the storm of the century was spreading in Estonia on Saturday before the storm hit but no concrete instructions were given. The government press officer, Erki Peegel, admitted that there was a need for improved communications. People could have been informed what kind of consequences there would be from a two-metre water rise on certain streets. From the Estonian experience, we can see that the preparation for the flood was not accurate since it was too hard to imagine that such a situation would happen. It is not common to have these kinds of floods in Estonia and the last one of such a magnitude was in 1964. This made the forecasting of the flooding level also difficult and people were not prepared for the kind of flood that came. The timing was also a bit off since the flood began during night time so that people could not be warned accurately. Also, the problem was that people did not believe that the flood would be as big as it was. Therefore there were problems with the evacuation of the people, since there was no one to take care of evacuated people. As well the communication was difficult because of the power cuts and people were also present in dangerous areas because they wanted to see the extraordinary flood. As a consequence of this, securing drinking water to the inhabitants was challenging because of the salty water that flooded the city and its wells (especially in Pärnu). (Lipp and Rivo 2007)

In general, all sea level records were broken in the Gulf of Finland during the storm, especially the first one on 8-9 January. The sea level rose this much because of many simultaneous factors. The experts saw the cause of the storm as being due to increasing air pressure differences on the North Atlantic Ocean and alternation of the western currents. This phenomenon is called North Atlantic Oscillation (NAO). The air pressure difference between different parts of Atlantic Ocean has increased over the last 30 years. In addition, the wind blowing from west to east has gained in strength. According to specialists from the FMRI, it is not certain if this phenomenon is related to the greenhouse effect. (Helsingin Sanomat 2005k)

On 10 January four days after the first early warning signals, the Finnish Meteorological Institute (FMI) reported that the storm was not exceptional in its wind speed, which was in gusts around 30 m/s in Tulliniemi, Hanko. However, what did make the storm exceptional was the record rise in sea level. Of all the storms that Finland experienced in January from 1990-2004, 28 per cent were strong ones. The storm of 8-9 January 2005 was not exceptionally fierce. The dominant air flows had been from the Atlantic that winter and they brought with them above average temperatures and rainfall. During such winters the number and strength of storms are above average. (FMI 2005c)

10. Economic and legal factors

According to the estimates, the storm caused 20 million euros costs to the insurance company *Sampo* alone. *Sampo* estimates that in Finland its customers suffered damage worth 7 million euros. Bigger loses came in Sweden, where the loss was about 11-17 million euros. (Aamulehti 2005k). As often in a large scale disaster, the private and public sector had different policies for the compensation of the flood damage. In Finland, flood damage is usually covered by the state, but in case of a flood caused by a storm, broad home insurance policies are expected to cover most of the damage. The Counsellor for Water Administration at the Ministry of Agriculture and Forestry, Jaakko Sierla, pointed out that in this case it was the storm that caused the sea level rise and which led to the flooding. Damage is covered by the insurance, if storm is mentioned in the insurance conditions. (Aamulehti 2005i) Prime Minister Matti Vanhanen made an early promise on Monday (10.1.) that the state will cover the damage that the insurance companies would not. This was far higher promise than was made by his Estonian colleague Juhan Parts, who promised that the state would cover some of the damage.

The prevailing practice is that the insurance companies do not cover any flood damage. According to Jaakko Sierla, this is logical since large floods are rare and usually much localised. In the insurance sold to large groups, it would be difficult to consider also the special needs of some particular flood risk area. Since the 1980s about 800-900,000 euros have been enough annually for covering flood damage by the state's side. The only exception was 2004, when there were large floods in Ostrobothnia. The insurance companies have stated that they are in the process of developing better insurance policies to cover natural disasters. (Aamulehti 2005i)

Consequently, in this case the practice varied. Some of the insurance companies were not willing to cover the flood damage at all, and some of them considered the flooding caused by the storm an exception that they would cover. The insurance company *If* covered flood damage caused by storms in their home insurance, but in the real property insurance flood damage were not covered at all. The insurance companies *Fennia* and *Pohjola* were willing to cover the flood damage in both their types of insurance. (Helsingin Sanomat 2005p)

The flood damaged not only private property but also sewerage systems and harbour equipment. Some road foundations also collapsed. According to Preparedness Director Janne Koivukoski at the Ministry of the Interior, in a newspaper comment right after the storm, altogether the flood caused damage of millions of euros. As far as it is known the damage are only material. In neighbouring countries the floods and storm claimed lives, but in Finland no one died. (Helsingin Sanomat 2005p)

11. Environmental effects

According to different estimates, the sea level of the Baltic Sea is predicted to rise by about 20-40 cm during the next 100 years due to climate change. This would cause big problems to the areas such as Marjaniemi, the hardest hit residential area in Helsinki during the storm in January 2005. At least different kinds of cover structures should be built. Even if the sea level were to rise appreciably, there would not be need to abandon Helsinki, however, since it is relatively easy to build a flood barrier from soil. However, nothing of the sort has been officially planned. (Helsingin Sanomat 2005s)

According to leading Research Scientist Heikki Pitkänen at the Finnish Environment Institute, it is likely that the storms of the autumn and winter have improved the oxygen situation in the deepest parts of the Gulf of Finland. (Helsingin Sanomat 2005t) On the other hand, during the flooding the quality of the water deteriorated in Helsinki due to the fact that only partly purified waste water was released to the sea (in the Vanhankaupunginlahti). Due to the high sea level some waste water also ended up in the ponds of the conservation area. Also other sea areas were contaminated by dirty water from the overflows. (YLE 2005e)

The possibility of flooding has officially been taken into consideration in the town planning of Helsinki. The rise of the sea level of the Baltic Sea is not seen as a threat to the city. Still, the experiences that the flood caused will most probably affect future planning and building. There is no need for horror scenarios, but low build areas like Marjaniemi will face even more problems due to the rise in sea level. For new buildings the minimum building height is now 3 meters. In the old residential areas the building height is much lower. In the centre of Helsinki there are low areas in Töölönlahti and Rautatientori, that is, the areas nearby the main railway station. Theoretically, these areas could end up being underwater. (Helsingin Sanomat 2005s)

12. Conclusions

Following the events of the flash flooding in January 2005 in the Gulf of Finland, some important lessons can be learned since the systems for early warning and their response were put to the ultimate test. The analysis of the aftermath and the lessons to be learnt, focusing mainly on the Finnish experiences during this disaster, can be derived for four main themes: information flow between the different authorities; responsibilities; early warning systems; preparedness.

One of the key concepts of early warning regards the *information flows* and the possibilities to extend and transmit the information through the 'noise' of different actors and channels. In the case of the flash flooding in January 2005 in the Gulf of Finland the information flow from the RSU of the Finnish Ministry of the Interior worked along existing guidelines and there were no disruptions recorded. Furthermore the Finnish Institute of Marine Research FIMR was able to make successful forecasts of the rising sea level during working hours on Friday. The FIMR does not have 24/7 services, and if the forecast had been available for the first time during the weekend, the warning could not have been made in time. This kind of system still does not exist.[24]

Deriving from that notion we can conclude that the timing was a crucial factor for the success of early warning, since the information came to the Ministry of the Interior just before 16.00 on Friday afternoon, just before the end of office hours. There was information about the coming storm and bad weather, but not about the rising sea level already before the call from the FIMR.[25] Regarding the organisational scheme it can be observed that it was a good practice that the representatives of the FIMR and the FMI were present in the preparedness leaders meeting on the Saturday evening.[26] However the Finnish authorities did not have the information about the situation in Estonia and they were not aware that the Estonian authorities did not have the same kind of forecast information in use before the situation emerged. A week

[24] Interview with Taito Vainio 25.5.2007.

[25] Interview with Janne Koivukoski 29.5.2007.

[26] Interview with Taito Vainio 25.5.2007.

later, the situation authorities from Finland and Estonia started to negotiate about better information sharing between the countries in this kind of situations and as we know information sharing is essential and can reduce damage. Also, Geographical Information Systems can be used to make it easier to visualize information and this makes the possible threat more concrete and visible. (Koivukoski 2005) We can conclude that the early warning signals were taken seriously and furthermore it is rare that the rescue personnel will have information about coming damage already 1.5 days before it happens, so this time there was time enough for comprehensive preparedness. (Alenius 2005)

Looking more closely in to the issue *responsibility* in the case of the flash flooding in 2005 one of the main observations is that the legislation in Finland regarding early warning and response is regarded as being clear enough by the authorities. The action is taken in the field and the authorities are well aware of their responsibilities.[27] Furthermore the responsibilities between different agencies however depends on the flood situations – whether it is an inland water flood or a sea flood. In all cases the FMI should be responsible for the meteorological forecasts and when the incident is caused by the inland water flood, the Finnish Environment Institute will be central actor. The Ministry of Agriculture and Forestry has responsibility for dams. With sea flooding the FIMR has an important part for making the forecasts at about sea level. On field level the rescue departments and municipalities have their roles. In a large scale flooding, assistance from the Finnish Defence Forces and the Border Guard can be requested. The record shows that often this kind of cases are taken to the Ministries decision making level and even to the Government Council and media is feeding it by asking ministers what they are doing about the situation. Usually, there is no need for decision making at the government level during cases like this. The government will possibly make some decisions later about such things as compensation, but there is no need for government to head the operation during the situation.[28] Moreover the local actor and specifically the municipalities in Finland are responsible for the safety of the building sites, urban planning and construction licence policy. The possibility of flood and rising sea level should be taken into account even better in the municipalities as they posses the most crucial and vital tools for coping with emergency situations caused by flooding and extreme weathers. (Aamulehti 2005i) This also raises the issue of cross-sectoral cooperation and coordination between the different authority levels should be clearer and structured so that the issue of responsibility is made clear.

In the case of *early warning*, the technical aspects and dimensions must be acknowledged as different early warning system can prove to be crucial in order mobilise adequate resources for an active and suitable response. Such an example is that in case of a sea level rise, it should be tackled with an automatic system that would directly inform the environment and the rescue authorities on certain sea level rise values through the Emergency Response Centres. This already partly happens through the Weather Warning Service of the FMI. These early warning outlooks for severe weather go to all rescue authorities as well as other authorities. There are 150 recipients on the list.[29] The FMI has also started to build an early warning system for natural hazards, but there is no funding for it yet. Today it is already possible to foresee a bad weather scenario developing two weeks beforehand. The FMI gathers

[27] Interview with Taito Vainio 25.5.2007.

[28] Interview with Taito Vainio 25.5.2007.

[29] Interview with Taito Vainio 25.5.2007; Heikinheimo (2007).

the information about the coming risks and sends it to the authorities (early warning outlooks for severe weather system, rescue authorities are using the same email listing of 150 different actors that include also private actors like electricity companies). (Heikinheimo 2007) The present sea level forecast system in the FIMR is such that an operational system is up and running. Several models with different input data automatically run four times a day. Observations and model results are saved into a data base. Automatic graphs of data and model results for each sea level station separately four times a day. Foreign results can easily be used for comparisons within the BOOS (Baltic Operational Oceanographic System). Contacts to rescue authorities and services are good, but there are not enough human resources to make daily forecasts. The FIMR is not able to give daily forecasts to the public about sea level changes. This kind of service was working during the two years after the January 2005 flood case, but now they have run out of money again. 150,000 euros would be needed during one year to cover the overtime work in the cases if something happens. (Alenius 2007)

In the context of the flash flooding of 2005 the level of *preparedness* is another interesting observation because of the tsunami disaster which took place roughly a one week before this event, the preparedness of authorities was at a higher level than normal and co-operation with other authorities had been practiced. This might have been one of the reasons why the emergency response and the early warning system worked well. (Koivukoski 2007) Following this observation, the official viewpoint at the Ministry of the Interior is that there is not much to do when preparing for the flood. However it should be considered that there is no 24/7 service at the FIMR and no organisational arrangements for such events. During this flood, people at FIMR worked night and day and during the weekend but without proper organisation. This chronology also shows that sea level rise and sea flooding are probable on the coast of Finland during winter, not during summer. This also makes the 24/7 organisation of the FIMR more useful and more needed during winter time. The effects of winter storms to the sea are variable. Multiple natural conditions acting simultaneously in parallel are needed to generate a big flood – and this can happen although, theoretically, these kinds of floods only happen once in 200-240 years. Human interpretation of the numerical sea level forecasts can therefore give essential added value. Model results should be looked at routinely, but there are limited resources for that, especially at weekends. (Alenius 2007) Looking at this issue from a planning perspective it is of course possible to build flood barriers and evacuate people in terms of measures. However this depends heavily on how much time there is before the water rises. On the other hand construction is well regulated in Finland so that there are fewer residents living in flood-prone areas. Therefore flood prevention action should always be based on pre-planning, before the risks materialize. If there are areas that are known to be flooded from time to time, there should be plans about how to work on these areas when the flood warning comes (building barriers and planning of evacuations).[30] Flood risk must therefore be taken into account in the community planning.

[30] Interview with Taito Vainio 25.5.2007.

CHAPTER IV
Coping with Power Disturbances

Hannu Rantanen

Energy is a central area of European integration. The European Union (EU) has been active in the creation of a single market in the energy field and has promoted the connecting of energy networks (natural gas pipelines or electricity power links) between the Member States. This study focuses on the cross-border electric power supply and on those risks, whether human induced or natural, which have large scale implications and have the potential for harm to human health and safety, the economy, the environment, and the essential services of societies at large.

The European electric power system has evolved rapidly over the last ten years. The way in which the system now operates is often beyond the original design parameters, mainly due to market liberalisation. Originally the system was designed, built and operated under public ownership in a non-competitive environment. Market developments have substantially complicated the situation, because the grids now have to move power in ways they were not originally designed to do, which resulted in higher cross-border exchanges with short-term commercial objectives. All this has resulted in a huge multi-scale, distributed, highly interactive system, over which no single entity has complete control, or the ability to evaluate, monitor, and manage it in real time.

The system is highly efficient and economic at best but involves a number of vulnerabilities with the increased potential for the trans-border propagation of disturbances. Some say that the number of trans-border connections will not bring additional redundancy to the system but the reverse, and for instance the highest civil servant in the French energy administration D. Maillard has said that "one could assert […] that the Italian black-out can be traced to too many trans-border inter-connections" (European Parliament 2005).

Modern society is highly dependent on electricity, as are almost all other critical infrastructure elements. Loss of power would instantly affect a wide range of key infrastructure operations vital to a modern society. Well functioning technical infrastructure is important for every day life, economic welfare and national security. In an energy intensive society, better performance is continuously expected from the electric power distribution. Due to increasing energy dependence, a major blackout in urban areas would virtually paralyse the whole society.

We will study the life cycle and characteristics of power outages and focus on the early warning process, by starting from risk assessment and examining the different elements that need attention in order to manage an emergency. We include three case studies of different power disturbances to demonstrate the similarities and differences in coping with situations, and provide a short analysis of how these situations were handled from Early Warning Process perspective.

1. Cross-border electricity networks

The power system may be divided into three main components: the Physical Component, consisting of power generation, transmission and distribution; the Monitoring and Controlling Component, consisting of IT-based devices and

software; and the Management and Coordination Component, consisting of the operators and other actors as well as legislation, procedures and standards. The smooth functioning and interaction of all these components is essential for the efficient and economic supply of electricity.

1.1 Power generation, transmission and distribution

Generation is the means of converting other forms of energy into electrical power. These sources of energy include fossil fuels such as coal and natural gas, hydropower, geothermal power, nuclear power, solar power and wind power. Today, most electricity is generated in large central plants. The types of plants vary greatly between countries. For example, roughly 80% of the electricity generated in France comes from nuclear reactors, while over 90% of the electricity generated in Norway comes from hydroelectric plants. (International Energy Agency, 2007)

Transmission includes moving power from a power station to near where it is used. Once electricity is generated the voltage is increased so that it can be efficiently transmitted over long distances via high voltage transmission lines. These lines operate usually as an interconnected ('meshed') grid, often with multiple routes available for power to reach the same destination. Transmission also includes connecting together power systems owned by various companies, today also in different countries. The high voltage network is typically built by using aerial cables usually with steel pylons but also wooden poles can be used (e.g. in 110 kV lines). High voltage transmission lines are protected from fallen trees with a wide right of way.

Distribution involves taking power from the transmission system to end users. Transformers are used to lower the voltage as it enters the distribution system. While distribution systems in cities may also operate as an interconnected grid, most operate as tree ('radial') structures that feed power out to the customers. For instance, in Finland the primary distribution network voltage level is 20 kV or 10 kV. Domestic consumers voltage level in low voltage network is 400/230 V. The medium voltage network (70 kV – 0.5 kV) in rural areas is built using aerial cables atop wooden poles, but in cities and built-up areas underground cables are also commonly used. The right of way in the medium voltage network is considerably narrower than in the high voltage network right of way and therefore also more vulnerable to fallen trees. Even if the medium voltage network is built as a meshed network, it is normally used as a radial network, which is more economic. But in case of disturbance, the meshed network can be reconnected and the effects of disturbance can be reduced, because the electricity supply can be ensured from an alternative direction.

Europe is divided into a number of regions overseen by regional transmission organisations (RTOs). These RTOs coordinate the activities of a much larger number of national and sub-national transmission system operators (TSOs) that are responsible for the physical maintenance and ownership of the interconnected transmissions systems in each TSO control area. Each TSO area contains a densely meshed network of alternating current (AC) transmission lines interconnected by cross-border lines to neighbouring TSO networks. Within each RTO the TSOs must therefore cooperate closely to operate their individual networks as a single synchronised mechanism, because decisions made by one TSO will affect power flows on the AC network of all of its neighbours and indeed potentially the networks of TSOs thousands of kilometres away. (Bower 2003).

Electricity is transferred among regional RTO control areas by direct current (DC) lines. The characteristics of these lines mean that power flows along them can be more easily controlled than AC lines but still allow power transfer to occur between regions. The boundary of the European market is defined at its Eastern edge by the UPS system of Russia, under the control of RAO-UES. The TSOs of the UK and Ireland define the western limit, and the Nordel system of Scandinavia defines the northern limit. The TSOs of the Union for Coordination of Transmission of Electricity (UCTE) represent the core.

To give an example of a cross-boundary system, the following is a short description of the Nordel system. National transmission grids in Scandinavian countries are connected together as a Nordic Interconnected Grid, which enables power trading between countries and facilities the optimization of power generation within a country. In the north, the Finnish and Swedish transmission grid is connected by overhead cable. In the south, the Fennoskan marine cable (550 MW) close to the Rauma and Forsmark nuclear plant connects Finland and Sweden. In the near future, the new Fennoskan 2 marine cable (600-800 MW) will be ready for use. Estlink marine cable (350 MW) links Finnish and Estonian transmission network together. The main connection between Finnish and Russian transmission networks is the 400 kV double lines. There are also minor connections near Imatra and Inari in Lapland. In Utsjoki, Lappland, there is a connection line between Finland and Norway. Most of the electricity used in Åland archipelago comes through by marine cable from Sweden. (Nordel 2007a; see Figure 1)

1.2 Monitoring and controlling the power grid

Electricity cannot be stored in large quantities but must be constantly generated, transported and delivered to the customer. The continuous balancing of supply and demand within a grid is managed by control areas and reliability coordinators across the area, who forecast demand, monitor system conditions, and direct the operation of generation and transmission facilities. Without this coordination, individual equipment failures could affect other equipment and, if left unchecked, cause cascading interruptions.

A variety of measuring devices, both at generation plants and across the transmission grid, are connected to control centres where they allow operators to monitor the state of the system. By sending electronic commands back out, operators can control the settings of generator plants, reconfigure the grid, and, at least to some extent, affect its electrical properties.

The monitoring and controlling systems have gone according to Masera (2006) through the following stages during time: 1) 1950s-1960s: first electronics (relays, analogue simulators) for control and protection, growing demand; 2) 1970s: introduction of digital systems replacing electromechanical functions, first computing centres; 3) 1980s-mid 1990s: active protection, remote access, deployment of communication networks (fibre optics); 4) Recent years: increasing interconnection with business systems, gradual opening to open networks (Internet), online markets.

Figure IV—1 Nordic Transmission Grid. (Nordel 2007a)

Today, the systems are known as SCADA (Supervisory Control and Data Acquisition). SCADA systems are computer-based monitoring tools that are used to manage and control transmission and distribution of electricity. Look CSIA (2007) for more information on SCADA systems. Until recently, SCADA systems were often used in a reactive manner to identify system faults as they occurred, recording system data and events for later analysis. With demands on for increased efficiency, SCADA systems have today also the purpose of preventing problems, rather than recording them. There are some concerns that the security of SCADA systems is deficient, due to the arrow focus on using the systems for increased productivity, reliability and greater operating efficiencies. (CSIA 2007)

1.3 Management and coordination

In addition to the physical and technical solutions, the running of the electricity system also calls for coordinated efforts from all stakeholders. Recent European Union legislation means that, from July 2007, all consumers are free to shop around for electricity suppliers. At the same time, the European Union is working to ensure that infrastructure, such as electricity transmission networks, is improved, to transport energy as efficiently as possible to where it is needed. (Commission 2007)

Regulators have been established in each EU country in order to ensure that suppliers and network companies operate correctly and provide the services promised to their customers. The European Commission is monitoring closely the market identifying obstacles and shortcomings. All stakeholders meet regularly in the Electricity Regulatory Forum of Florence which was set up to discuss the creation of a true internal electricity market. The participants are national regulatory authorities, Member States, European Commission, transmission system operators, electricity traders, consumers, network users, and power exchanges. The Forum convenes once or twice a year, formerly in Florence but now in Rome. The first meeting was held in 1998.

The Electricity directive 2003/54/EC is the key European legislation to establish the Internal Market of Electricity. The directive had to be implemented by the Member States by 1 July 2004. The Regulation on cross-border trade in electricity 1228/2003/EEC sets rules for transmission of electricity between Member States. The regulation entered into force 1 July 2004. It is directly applicable to Community law. The Directive 2005/89/EC of the European Parliament and of the Council of 18 January 2006 concerns measures to safeguard security of electricity supply and infrastructure investment. The directive has to be implemented by the Member States by 24 February 2008. The Electricity directive and the Regulation on cross-border trade are based on a proposal made in March 2001 to revise the old Electricity Directive 96/92/EC, adopted in 1996. The EU level legal and regulatory institutions as well as policy provisions are still all market-focused. Reliability criteria are often traded-off against other important factors in liberalised markets. (IRGC 2006, p. 55)

Upon the emergence of the Internal Electricity Market (IEM) in the European Union, the leaders of the four regional transmission organisations recognised the need for an EU-wide harmonisation of network access and conditions for usage, especially for cross-border electricity trade. In 1999, ETSO (European Transmission System Operators) was created. ETSO is mainly active in harmonisation and establishment of rules in order to enhance network operation and maintain security of supply. (ETSO 2007)

While ETSO is still more concerned about smooth the flow of the electricity the actual operations coordination is within the RTOs and UCTE, the Union for the Co-ordination of Transmission of Electricity has the lead role. UCTE is the association of transmission system operators in continental Europe in 23 countries and has been over 50 years, coordinating the efforts and issuing technical standards in order to provide a reliable functioning of the high voltage grids.

The UCTE working group Operations & Security aims at ensuring a high standard of operability, reliability and security of the UCTE Synchronous Area based on standards which are compatible with grid access and market requirements. In detail, the working group defines and monitors technical and operational rules and recommendations to be implemented by individual TSOs as well as measures to be taken in case the requested standards and rules are not implemented as agreed. That implies the need: 1) to define and monitor technical standards and operational rules and recommendations to be implemented by individual TSOs; 2) to define and monitor measures to be taken by individual TSOs in case the requested standards and technical rules are not implemented as agreed; 3) to report about the quality-level of the synchronously interconnected UCTE Area; 4) and to define action plans with regard to coordinated intervention and mutual assistance in emergency situations.

As a key security standard, the N-1 criterion has been widely employed. The N-1 security criterion specifies that "any probable single event leading to a loss of a power system element should not endanger the security of the interconnected operation, that is, trigger a cascade of trippings or the loss of a significant amount of consumption. The remaining network elements, which are still in operation, should be able to accommodate the additional load or change of generation, voltage deviation or transient stability regime caused by the initial failure. It is acceptable that in some cases TSOs allow a loss of consumption in their own area on condition that this amount is compatible with a secure operation, predictable and locally limited".

TSOs monitor "the N-1 criterion for their own system through observation of the interconnected system (their own system and some defined parts of adjacent systems) and carry out security computations for risk analysis". After a contingency occurs, each TSO works to rapidly restore his power system to an N-1 compliant condition and, in case of any delay, immediately informs other TSOs affected.

UCTE has a number of publications and guidelines such as the *Operational Handbook and Emergency Operations Policy* (UCTE 2004). Within each individual TSO the standard operating procedures, calculation methods and standards still vary and there is a demand for more transparency and coordination. (Ergeg 2007, p. 3)

2. Power disturbances

Electricity networks form a complex, large-scale, extensive and vulnerable infrastructure with unavoidable failures or disturbances. A power failure (power outage) is the loss of the electricity supply to an area. In this study we are interested in total *blackout,* where power is lost completely, and in severe imbalances between supply and demand.

An extensive power failure resulting from any reason from purely technical causes to human errors can have serious consequences for activities that are important to modern societies and they cannot afford disruptions, at least not over a wide area and long period. The effects of a power failure are even more serious if

society were at the same time subjected to other pressures such as extreme weather conditions. (Svenska Kraftnät 2005; see Table 1)

A large scale blackout will have effects on almost all fields of a modern society. The most critical are those on the health sector and emergency services, as well as communications, transport and finance. Also the effects on economy are usually high. Following is a description of the problems in Canada during the 2003 blackout: when residents and consumers lost power on August 14, 2003, their ability to access banking and financial information in real time became compromised. Residents no longer had access to media devices (including television, radio and Internet). Telecommunications companies experienced difficulties receiving the enough fuel to power their backup generators, which had been brought in to provide electricity to the local area network cellular facilities. Without the emergency power, the coverage area of subscribers would have been severely compromised. Hospitals and emergency services struggled to maintain full operational capacity. Power to oil pipelines was cut, reducing the flow to refineries and limiting the amount of available refined oil available for purchase at the limited number gas station pumps that were still operating. Commuters discovered that traffic lights, railroad crossings and bridge toll booths were no longer functional. Similarly, commuters travelling by train or aircraft were confronted with significant delays or, in many cases, cancelled transportation. (Public Safety Canada 2006, p. 18)

The following are the main, partly overlapping different disturbances and their possible causes and characteristics, affecting either limited areas or in some cases several countries.

1) *Electricity generation shortage*, by which we mean problems that will cause any major power plant to be out of production temporarily for a longer time. There also exists political uncertainty on how to satisfy the growing demand of electricity in Europe in the future. Only a few countries, such as Finland, are building additional nuclear capacity whereas countries like Germany and Sweden which are now producing nearly half of their electricity with nuclear power have made political decision to abandon this production in the future. The question how to replace the nuclear energy has been left open so far.

2) *Imbalance between production and consumption* which may be caused by quite different reasons. *Extreme temperatures* in the north means subzero temperatures with the need to additional heating and in the south heat waves with the need for additional cooling. *Market gaming* is another reason, of which the most famous example is the California electricity crisis (also known as the Western Energy Crisis) of 2000 and 2001, which resulted from the gaming of a partially deregulated California energy system by energy companies such as Enron and Reliant Energy. The energy crisis was characterized by a combination of extremely high prices and rolling blackouts. Price instability and spikes lasted from May 2000 to September 2001. Rolling blackouts began in June 2000 and recurred several times over the following 12 months. (See Weare 2003).

Table IV—1 Illustration of possible consequences of two different blackouts. (Irgc 2006)

Infrastructure failure or service degradation	Spatial extent (radius)	Health and safety consequences	Economic consequences	Impacts to other infrastructures and/or socio-political systems	Resulting level of criticality
Local electric power outage of ~ 3 hours duration (e.g. from a local thunderstorm)	A few km	Little to none, unless local emergency services have no back-up and there are other contributing factors such as extreme cold or heat	Modest unless firms which have a high need for secure power have no back-up	Some disruption of ICT and other services which have no back-up. Few consequences to public or power company officials unless this is part of a recurring event, or happens at a critical time	Modest unless outage occurs in parallel with some other event (e.g. a terrorist bombing and traffic lights go out preventing emergency vehicle access)
Multi-national electric power outage of more than one week duration (e.g. from ice or wind storms or terror attacks on multiple substations)	100s of km	Potentially large as back-up fails, water and sewer systems that require pumps fail, food supplies run short and/or there are other contributing factors such as extreme heat or cold	Large, indeed catastrophic for some firms	Enormous	Extremely high

3) *Political pressure* has not been so common yet in the electricity arena[31] but a clear example of this as a general energy supply issue are the problems that were apparent between Russia and Ukraine in 2006.

4) *Outside cause* by which we mean any reason that cannot be controlled by the network operator although by better preparedness the effects could be alleviated.

5) *Physical damage* of the power line(s), due to for instance *natural phenomena* such as extreme weather, earthquakes etc. These often result in large scale destruction of huge portions of the network and the repair may take weeks or even months.

6) *Sabotage* is a deliberate action aimed at harming the system. It may be criminally or politically motivated. Especially a politically motivated terror type activity may result in long-lasting security problems in the network similar to those of the Iraqi oil pipeline problems since the invasion in March 2003.

7) *Accidents* are usually local but a fire in the cable tunnel, for instance, could lead to the blackout of an urban community like was case in Kista Sweden in 2001 with 50 000 inhabitants without power. (See Deverell 2003).

8) *Network inherent* cause, such as the degradation of power lines, transformers etc. These are usually local but may act as the starting point to cascading problems.

9) *Cascading system failure*. In an extremely complex and highly meshed system, disturbances may be propagated over a vast area within a short period of time. Whatever precautions, the short-term occurrence of insecure operating conditions can take place at any time due to a cascade of contingencies. Experience has shown that even a simple incident can degenerate rapidly into a large-scale breakdown. The triggering incident may be caused by anything from accidents to even geomagnetic storms due to increased solar activity or inherent network based problems. (UCTE 2006)

10) *Control system problems*. Most SCADA systems were originally built separately from other corporate networks and these could not be accessed through corporate networks or from remote access points. Today, the SCADA networks and corporate IT systems are often networked because of demand for SCADA engineers to monitor and control the system from points on the corporate network or even remotely. In addition, there are connections between corporate networks and SCADA networks in order to allow corporate decision makers to obtain instant access to critical data about the status of their operational systems. Often, these connections are implemented without a full understanding of the corresponding security risks. The use of commercial off-the-shelf Information Technology and Internet connections within SCADA systems provides the benefits of low implementation cost and ease of interoperability, but introduces the potential for new security vulnerabilities. SCADA systems, like all computer networks, are

[31] In September 2007, Israeli prime minister declared the Hamas-controlled Gaza Strip a 'hostile territory' and the Israeli security cabinet stated that additional sanctions will be placed on the Hamas regime to restrict the passage of various goods to the Gaza Strip and to reduce the supply of fuel and electricity. (ISN 2007)

vulnerable to hacking, intrusions, viruses, data loss, data alteration and the like. Because SCADA and other types of control systems regulate critical, real-world activities, their lack of security has worried experts for some time. (See e.g. Riptech Inc. 2001).

3. Aspects on risk management, warning and info sharing

The electrical power systems are multi-scaled in the time domain from microseconds to decades, as shown in Table 2. There is a need for quite different solutions for different contingencies, although there are also similarities in the event handling. The traditional approach to protecting critical infrastructure has been to identify specific physical assets of national importance and develop plans for detecting the possible problems and safeguarding the physical infrastructure at all times. As described earlier, the modern electricity system of systems cannot be guaranteed to function automatically. Despite all measures to make the electric power system more robust, major disruptions cannot be totally ruled out and will continue to happen.

While it is tempting to focus exclusively on the importance of critical infrastructures, one should remember that it is the social services they provide, not the systems themselves, that are most valued by society (IRGC 2006, p. 52). In order to cope with different power disturbances, society has to use all the stakeholders and see them and their assets as a unified system contributing to the resilience of the society. This calls for a Public-Private-Partnership between the electricity community and the governmental and local authorities as well as including the media and individual citizens as actors in securing the functioning of society.

Table IV—2 Examples of the time domain of electrical power systems. (Amin 2000)

Action/operation	Time frame
Wave effects (e.g. overvoltages caused by lightning)	Microseconds to milliseconds
Switching overvoltages	Milliseconds
Electromechanical effects of oscillations in motors & generators	Milliseconds to minutes
Tie line load frequency control	1 to 10 seconds; constant
Economic load dispatch	10 seconds to 1 hour; constant
System state measurement and estimation	Steady state; constant
System security monitoring	Steady state; constant
Load management, load forecasting, generation scheduling	1 hour/day or longer; constant
Maintenance scheduling	Months to 1 year; constant
Expansion planning	Years; constant
Power plant site selection, design, construction, environmental impact, etc.	10 years or longer
Power plant production life	40 years or longer
Power line equipment life span	40 years or longer

The life cycles of crisis and emergencies caused by power disturbances are of variable length and may be from a few hours to weeks and months. There are different phases to such emergencies and different stakeholders will be more actively

involved. This means that the following elements that need to be looked after in dealing with the situation will appear repeatedly but with varying characteristics, and different organisations and stakeholders need to examine them at different times.

Risk assessment is the key for preparedness planning. The risk assessment provides the platform on which to develop necessary measures needed to minimise the consequences of the power disturbances. It is obvious that within the electricity community the typical technological risks are well recognised and there are procedures to cope with them. But in the rest of the society it seems that the actual risks brought about by a long-lasting blackout are not clear. Without clear understanding of the risks the preparedness is not directed to right targets or will be undersized and insufficient. A key element for success is the ability to transfer of risk analysis into decision making processes.

As the electricity network keeps growing and becomes more complex, and there will be new types of risks. These emerging risks, which are distinguished from acute or current risks by the fact that there are already some indications of them that have not yet materialized into clearly definable or even quantifiable threats, are difficult for everybody. They tend to be dynamic, and the novelty of such risks means that there are no past experiences on which to base risk analysis and risk management. They are difficult to describe, measure, and quantify, and the further development of such risks is highly uncertain. Little information is available for assessing whether a specific risk will really develop into a concrete threat that must be managed actively, making it equally difficult to decide on the appropriate risk handling measures. Van Asselt suggests (CRN 2006, p. 10), borrowing from the methodologies of future studies, that it is useful for risk analysis professionals to be aware of approaches in this field.

Preventive measures are needed both in protecting the electricity system against various disturbances and in making society less vulnerable to blackouts. Protecting the system against power supply shortage calls for actions in the EU and at national level, and the measures should include planning legislation, agreements as well as partnership and transparency between the various actors running the system. In addition, there are initiatives towards increasing the use of distributed generation, which refers to the production of electricity at or near the place of consumption.

The protection against physical breaks, especially under severe weather conditions, can be enhanced, for instance, by using cables instead of aerial lines but they are naturally more expensive and on the other hand usually more difficult repair in case of failure. Then there is the issue of clearing the right-of way in order to prevent the problems with falling trees etc. and one may ask whether intervention by the authorities could reduce the risk by setting stronger rules and regulations. On the other hand, the external authority does not necessarily have the detailed knowledge to be able to intervene appropriately. (Eurelectric 2006, p. 48) .The same goes for the enhanced maintenance against the slow degradation of physical fixtures. The investments are not always adequate, and Svenska Kraftnät (2005, p. 55) states that the volume as well as the age and competence profiles of the personnel carrying out extensive repair work on electrical installations have developed in a negative direction over the past ten years.

The issue of prevention from system inherent problems with cascading effects is clearly within the transmission operators' community, and here all harmonisation efforts, better situation awareness are welcome. One positive trend is the shift from market values towards the secure running of the system, so that it is not running on the edge. The controls systems vulnerabilities should be analysed in all organisations, and the less they are linked directly to the Internet the better. One additional hazard is to use same software everywhere. The result could be that a severe problem in one

piece of software would cause long lasting problems for the whole system. There is also naturally the question of physical security needed for system's critical components.

When we consider at making society less vulnerable we bring all the stakeholders together in a joint effort. Once again, the need for thorough risk assessment is stressed. The work starts in each organisation but then we need to look together at the different value chains of the services and ask what is essential to us, how it can be guaranteed, who needs our services and what do we have to do in order to be able to provide them in all circumstances.

Monitoring and forecasting for possible power disturbances is manifold and has a varying time scale. Weather forecasts are the best examples of useful assessment and forecasting. The assessment for longer-lasting situations, such as market trends or political expectations, is demanding because in this domain even best models are somewhat vague. Even if monitoring and forecasting activities vary significantly, the basic task remains the same: to collect data, make analysis of it and forecast the following eventualities. Data collecting may involve special technical sensors, data mining techniques or simulation models.

With electricity operators systems, in particular, monitoring is often partly automatic but the use of human reasoning is often needed to get the best results. Above all, this is the case with weak signals. Although computers are usually needed to separate data from noise, it is the human mind who will comprehend the significance of it. With electricity power failures the weak signals are often indicators of system stress and indicate that some disturbance may occur. The problem is that it is difficult to determine exactly what will be the case. It is often only after the incident that the data analysis will reveal the events leading to the power failure. For instance, the disturbance timeline indicated that there were nearly 40 transmission line failures and power plant shutdowns in the United States approximately four hours before the grid collapsed in 2003 (Public Safety and Emergency Preparedness in Canada 2006, p. 10).

Information sharing and dissemination of warnings are needed throughout the process but are especially important when any actor has meaningful information about the situation. The information should be made available in a form that is accessible and useful for the recipient. Today's information technology tools help in this but many of the most difficult human computer interface issues are evident in the emergency response, which is characterized by the need to observe, understand and integrate a wide range of information sources often in a limited time and in adverse conditions. Human attention is a scarce resource during an emergency, and so every effort should be made to have the information accessible when needed and avoid the information overload. There are also potential hazards in the use of technology. Given too much information, the user may focus too heavily on the computer and lose touch with the physical word. Users may lose initiative, and let the computer take the lead and control the activities. (Rantanen 2003)

Information sharing will at best change the sequential order of actions into parallel actions that will enhance the use of resources and save time in critical moments. The transparency and mutual trust between all stakeholders is essential in information sharing during emergencies. This is clearly needed when we bring together actors from different countries with different working cultures. Transparency and trust could hopefully reduce the reluctance of private enterprises to share classified business information with competitors or even authorities especially when there are liability concerns.

Response activities in major accidents and especially in large scale emergencies, in which the coping mechanisms of the community is overwhelmed, will include different functions undertaken by different organisations. The responding organisations may themselves be affected by the disaster, so causing additional demands. As a consequence, according to Dowell (1997), a novel organisation can be seen to form adaptively to the exigencies of the emergency. Such an organisation is large, multi-level, multi-agency and distributed, and it will have important organic properties, in addition to their mechanistic ones

Decision-making based on correct information before the actual impact may help to prevent the emergency from happening or at least alleviate the consequences. After the impact decision making it is necessary to make appropriate responsive actions and help the necessary prioritization. The correct information in correct form is essential, as too much uncoordinated information will lead into similar decision making procedures as too little information namely reacting in an ad hoc manner.

When there are multiple stakeholders, often with various obligations and interests, the coordination of actions is necessary to optimize the response and to prevent unnecessary effects and further problems.

Communicating with the public and the media is a vital issue in effective emergency management. The cooperation of the public can be crucial during power outages. Therefore, communicating with the affected people is important. Within authorities as well as electricity companies, protocols should be drawn up to develop a common understanding of the situation as early as possible, thus avoiding contradicting or unclear statements. People need correct and responsible information about the extent of the damage to the network, the estimated date of reparation, instructions for dealing with the situation, to whom they should apply to solve practical problems, etc. Correct, timely and well-composed information can re-assure people and help them plan their own actions to cope with problems.

Due to a large number of enquiries, good intentions for informing people can easily be hampered by a shortage of available phone capacity, manpower and expertise. There is also often a lack of organized structure and well-established working methods for public information, since the people in charge may have never experienced such circumstances before and may not know how to react.

The media has an essential role in shaping the outcome of the crisis and it often has the ability to either make or break implicated actions. The media is still seen often as something that needs to be dealt with although it should be seen as an important actor in crisis management by working in favour of crisis mitigation. The media give the public insight into the crisis management process, and the stance taken by the media also influences the public's opinion of this management. The media may also shoulder part of the burden of the stakeholders by distributing correct and useful information.

Work with the media in a crisis situation is also often a novel experience for stakeholders and pressure from the media can make it tempting to issue firm statements and act decisively. The credibility is soon lost by creating gaps between words and deeds as well as expectation. (See e.g. Deverell 2003, p. 132).

Dealing with crises and emergencies bring together different stakeholders with different needs and working procedures, and if the contacts and information sharing between them before the emergency are minimal, it is sure to bring difficulties because there is no time for learning and training during the real thing.

4. Example cases

4.1 Storm Gudrun's impact on emergency services in January 2005 in Sweden

Gudrun was a powerful storm that battered northern Europe from Ireland to Russia, and most severely hit Denmark and Sweden on 8 January 2005. The name Erwin was chosen by the German Weather Service, while the storm was named Gudrun by the Norwegian Meteorological Institute. Sustained wind speeds of 126 km/h with wind gusts of 165 km/h were measured in Hanstholm, Denmark – the same strength as a Category 1 hurricane. At least 17 people died in the storm, and the emergency services in the affected area were busy (see Figure 2).

The storm caused much financial damage in Sweden, The power distribution and telecommunication networks, roads, railroads and buildings suffered major damage, with long-term consequences for the people living in the affected areas. Immediate repair efforts were compromised by blocked roads and the danger of falling trees.

Immediately after the storm, there were 663,000 network customers without electricity supply. There were significant differences in the damage and the ability to bring back the electricity between electricity companies. More than half of network customers had their electricity supply restored within 24 hours; 159,000 customers had to wait for between one and three days; 82,000 network customers got their electricity back 4 to 7 days after the storm; 56,000 customers were without electricity between 8 and 20 days; and finally 12,000 customers had to wait more than 20 days and the last customers of the company which had most difficulties were without supply for 34 days. (Eurelectric 2006, p. 20)

Meteorological forecast and warnings

The storm began as a perturbation on the polar front in a region just west of Ireland. On 7 January 2005 at 18:00 GMT, the centre of the forming storm was slightly below 995 mb and the system was barely visible on the meteorological maps. Around that time, the cold air masses from Greenland started to move southward colliding with mild and moist air masses located further south. (Carpenter 2005)

Over the subsequent twelve hours, the storm moved rapidly to the northeast, deepening by more than 25 mb indicating an extremely rapid intensification of the storm.

Thus the Swedish Meteorological and Hydrological Institute issued a weather warning at 23:18. The warning was passed to the fire departments by SOS Alarm, the Swedish emergency response centre. The majority of the departments immediately raised their states of alert. As the wind kept rising, the state of alert was further increased; additional personnel were called in. No further precautions were taken. However, during the night between Saturday and Sunday, many rescue units were pulled back due to the increasing risk of falling trees.

Impacts on the emergency services

The direct impacts on the emergency services due to power blackouts could have been significantly worse. The larger population centres (mostly cities) had functional power distribution during the storm and hence, larger command and coordination centres remained operational.

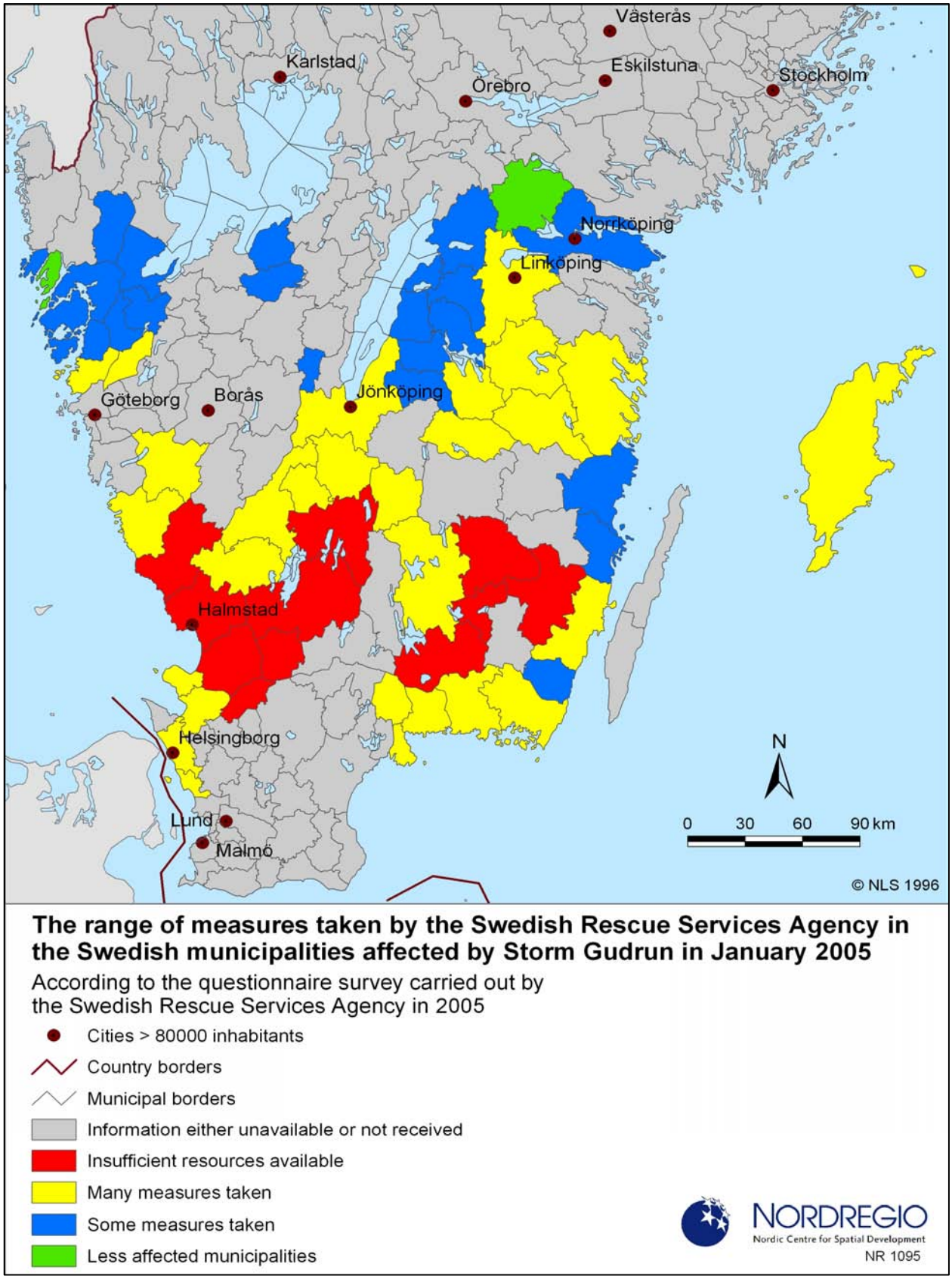

Figure IV—2 Actions of the Swedish Emergency Services during Gudrun. (Swedish Rescue Services Agency 2005)

Some fire stations with integrated command centres lacked backup power systems (such as generators). Fortunately, these stations were mostly located in cities and were therefore not affected during this particular event. However, this poses a severe threat to the overall robustness of society and will need to be addressed in the near future.

Many part-time fire stations in the countryside also lacked backup power systems and so were affected by the blackouts. This had a negative impact on the fire stations' role as communication and information centres when all other means of communication were out of order. At some fire stations, the only working communication systems were the vehicle radios. The recharging of portable radio devices was impossible.

The operational abilities of the stations were also affected due to loss of heating. Fortunately, the weather conditions after the storm were favourable; heavy snowfall and low temperatures would have rendered many fire stations completely use-less. The prioritizing of backup power equipment was handled by the county administration boards in some of the affected areas and by the municipalities themselves in others. The biggest impacts were due to communication problems, although the communication between units and command centres was working satisfactorily in most areas for most of the time. This aspect will be discussed in more detail in the following section.

Telecommunications

In many ways, lack of communications can be considered a far more serious problem than power blackouts. In the case of Gudrun, communication disruptions were mainly caused by either direct damage on phone lines and base stations (fallen trees, etc.) or by power shortage. Some critical base stations were equipped with backup power systems, but in many cases they were not equipped for a blackout of this extent. Batteries ran out of power and generators ran out of fuel. Refilling was impossible, as the affected stations could not be reached due to debris and danger of falling trees. Some stolen generators were also reported.

During the storm, authorities (such as fire services, ambulance and police) used 80 MHz analogue radio communications. The operational status of the system varied between areas; in some areas it was fully functional - in others completely out of order. Again, the primary reasons for communication failure were lack of power for communication base stations. (See Figure 3)

Both the mobile and the fixed telephone networks suffered from disturbances. At one point roughly 300,000 customers were without working telecommunication. Some of the radio communication stations used by the fire services and SOS Alarm were also damaged.

This disrupted the interoperability between rescue units and other actors, such as SOS Alarm and the power and telephone companies. It also caused problems for calling in additional personnel and alerting rescue units as well as problems for the general public to report emergencies to SOS Alarm. Because the emergency number 112 was unreachable in several areas, local fire departments had to set up custom solutions in order to alert rescue units. Many incidents were reported directly to the fire departments. Two days after the incident, more than 90% of the mobile network was operational. By comparison, several customers lacked fixed phone communications for several weeks. All fire departments who had planned for communication breakdowns, and had redundant and/or backup equipment in place, managed quite all right.

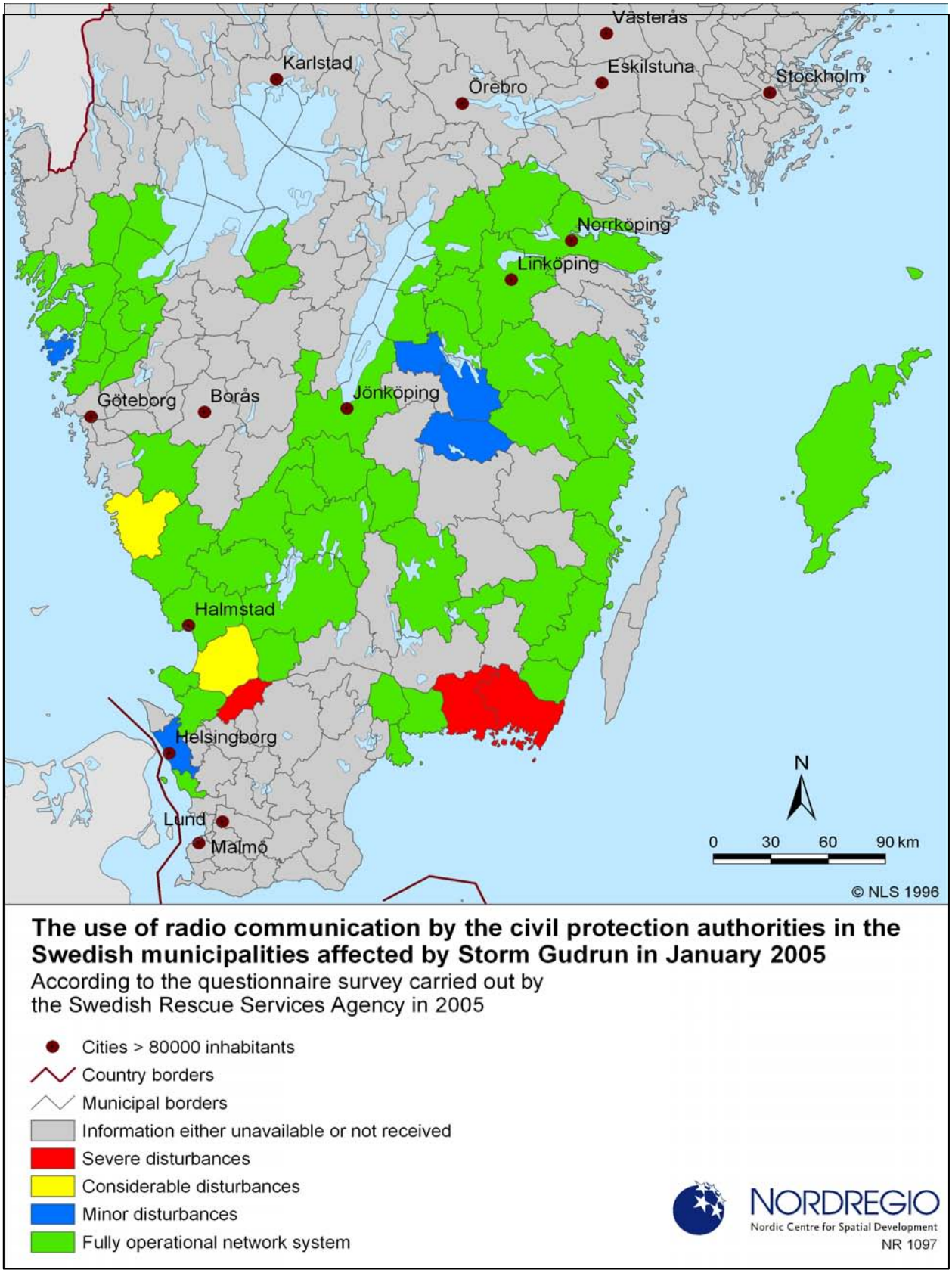

Figure IV—3 The radio communications during Gudrun. (Swedish Rescue Services Agency 2005)

Elderly or disabled people are especially vulnerable to blackouts. Several nursing homes were affected by the blackout and evacuations were considered but never executed. Some municipalities combined their inhabitant registries with Geographic Information Systems (GIS) in order to locate and reach elderly people living on their own. There are no accounts of whether the fire departments were directly involved with the evacuation of people, although it is highly likely.

Some fire stations equipped with backup power acted as 'warm cottages' for the public, i.e. a place where people could warm themselves and get the latest information about what is going on. Schools and community centres were also used for this purpose. Some areas experienced water distribution problems, which could have required measures from the emergency services, had they been prolonged.

The availability of fuel for vehicles and equipment was not affected, mainly due to the fact that larger population areas did not suffer from power blackout. However, there were problems with the distribution of fuel to backup power generators, as previously mentioned. These were due to lack of organisation and logistics and blocked roads.

Lessons learned

During Gudrun it was noted that the biggest need for improvement is the development of independent emergency supplies. When everything else fails, the emergency services should be prepared and equipped to continue their operations independently. The role of the part-time fire stations during exceptional situations turned out to be significant, and so many fire stations are now being equipped with backup power facilities. Most of the command centres are also resistant to power blackouts nowadays.

The radio communication problems between authorities is planned to be solved by the introduction of the digital TETRA-based RAKEL network. Important cooperation partners from the third sector (power and telephone companies) will also be part of this network, thus eliminating the interoperability problems. Additional resources have been allocated to make the base stations even more robust: all stations will have backup batteries and many will be equipped with automatic power generators designed for longer blackouts.

Emergency dispatching relies heavily on telephone communication networks, and so measures will be taken to improve the reliability of these. If the systems were to fail despite precautions, backup systems for reporting incidents and alerting rescue units should be ready to put into action with little or no delay.

Concerning the reliability of information systems, there were some problems due to the usage of centralized servers. To reduce vulnerability in situations like these, systems should be distributed in order to avoid single points of failure. In addition, the use of redundant communication links, such as fibre or satellite, is to improve the reliability even further.

During the storm, the emergency services did not only experience problems of a technical nature; some areas also experienced problems with coordination and organisation. On one occasion, the fire station was required to house the local municipality coordination group, which had a negative impact on the fire department's own coordination abilities. Basically all fire departments that had working command and coordination centres did not experience any management problems. An urgent need for GIS and Decision Support applications was discovered during the storm and are currently under development. (SRSA 2005)

It is obvious that risk assessment was inadequate in some parts of the emergency services. The services were not prepared to the extent of the storm and thus self-sufficiency was not ensured. The weather warning was taken seriously and more people were called in, but it seems that many of the departments did not perform additional risk assessment. If they had, there could still have been time for preventive actions by obtaining and distributing emergency provisions. During the actual emergency the work although professional was carried out mainly in an ad hoc manner without clear forecasting and coordination between actors due to the severe constraints in communications.

The response activities were hampered by the difficult circumstances, but the work for emergency services was somewhat straightforward. There was a lot to do but due to rather mild weather the situation was not in large scale life threatening. It can only be guessed how the prioritisation and coordination would have succeeded in cold weather.

4.2 Consumption peak period of January 2006 in Finland

The production and supply of electricity must correspond to the consumption of electricity at all times. In Finland, just as in other Nordic countries, peak consumption of electricity occurs during the coldest winter days and, more precisely, in the mornings and afternoons of such days. Consumption peaks correlating with the coldest days only occur a few times per winter and, in warmer winters, consumption remains clearly lower. In many industrialised countries, peak consumption occurs during the hot summer season, with cooling and air-conditioning increasing consumption.

At the end of January 2006, the temperature in Finland dropped suddenly and, correspondingly, electricity consumption increased rapidly. On the morning of 20 January 2006, electricity consumption reached its highest peak 14,776 MW in one-hour's average consumption. (See Figure 4) This consumption was close to what the main grid operator, *Fingrid*, had arrived at in calculations for the winter in question, during a cold spell occurring once every ten years (Energiateollisuus ry. 2006).

The weather forecast

The first implications of the coming cold came on Saturday the 14 January when the Finnish Meteorological Institute (FMI) issued a weather forecast for the next five days. The temperature, however, was forecasted higher than what in reality happened. In the forecast on 15 January the temperature was closer to reality but it was forecasted that in the next weekend the temperature will be higher. On 17 January the forecast gave quite correct estimate of the temperature development. In conclusion, it can be stated that the cold trend was estimated 5 days in advance and 2 days in advance the estimate was quite realistic.

On 6 and 7 February 2006, there was another cold spell, and maximum consumption rose clearly above the previous record from 2003 (14,040 MW), peaking at 14,434 MW.

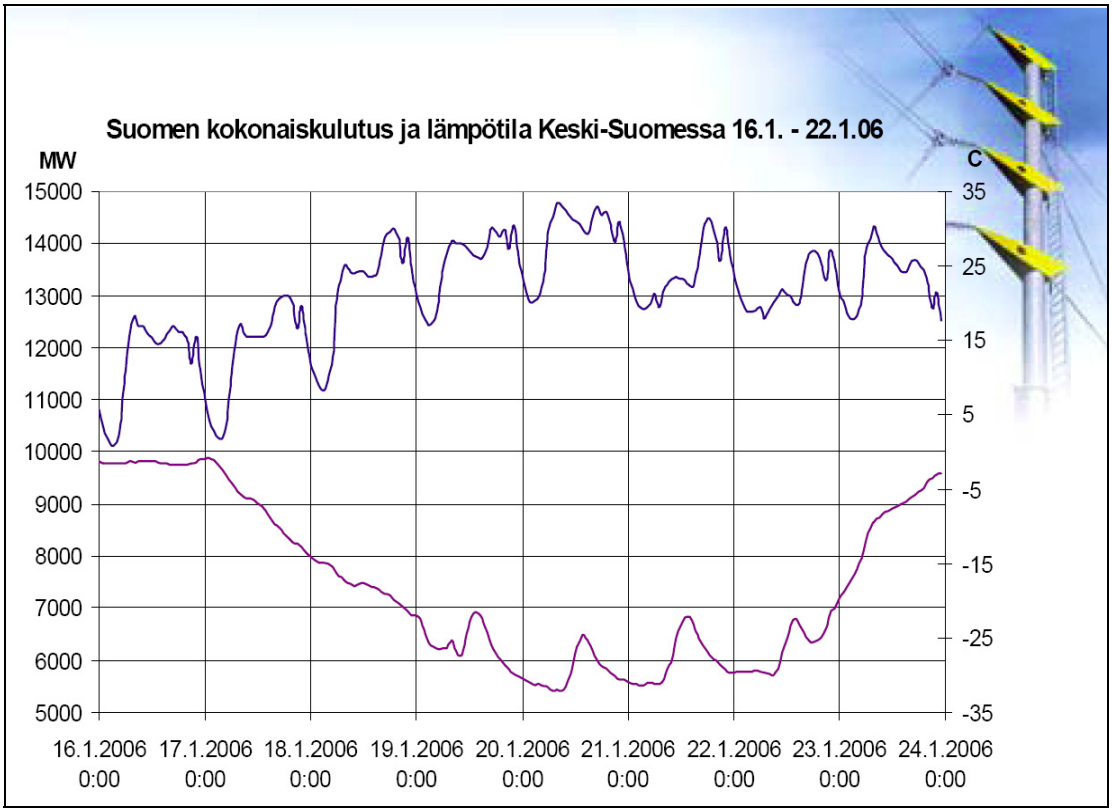

Figure IV—4 The Total Consumption in Finland and the Temperature in Central Finland. (Fingrid)

A three-step procedure to manage the peaks

The system could manage the described consumption peaks at less than full capacity. Some of the capacity – about 600 MW of condensation-based capacity – was not available for use fast enough. There were also some restrictions on the generation of hydropower due, for instance, to the ice situation. During the peak periods, the generation of hydropower was around 500 MW lower than the estimated maximum output capacity.

The tight electricity supply situation naturally interested the media. For the first time, the main grid operator *Fingrid Oyj* used a three-step procedure to be applied when the balance between electricity consumption and production is narrower:

If production and consumption forecasts show that, production and import may not cover the consumption in the Finnish power system during the next few hours, *Fingrid* will send a notice of *strained power balance* to balance providers. In such a situation, balance providers shall pay particular attention to the planning of their production and consumption and prepare to the situation.

A power shortage is deemed to have occurred when fast disturbance reserves have been activated for balance management purposes. Capability of power system to stand for failures is reduced.

A serious power shortage is deemed to have occurred when all the power reserves are in use and *Fingrid* has to restrict consumption to secure the function of power system. *Fingrid* will contact the local network operators to take necessary action to restrict loads according to the beforehand prepared plans. The aim is that the balance between power generation and consumption is maintained at all times, and if no more capacity is available, the reduction of consumption is planned to begin in a controlled manner. (Fingrid 2007)

Fingrid used the first-degree measure. The notification measures were originally intended for the parties involved in power generation and distribution, but became part of general reporting on the situation.

In addition to the authorities, electricity companies issued their own notifications on the situation. These companies have different practices for informing their customers and the public about power output peaks and the threat of a power shortage. A power shortage is a serious issue, but companies are often cautious not over-dramatise the situation.

Unexpected shortage in cross-border supplies of energy

During the peak consumption period of January 2006, both Sweden and Russia imposed restrictions on Finnish power imports, as a means of securing their own electricity balances. Sweden had done this earlier but for Russia these restrictions were the first of their kind and the notification came as a surprise and late on 19 January.

It is highly probable that restrictions may occur more often in the future when the electricity balance becomes weaker: exporting is restricted in order to secure each country's own electricity supply. During this cold period there were not any actual emergencies but the price of the electricity was high in Finland during peak days.

Lessons learned

The risk assessment on the *Fingrid* level is well conducted, and each year before the winter period *Nordel* assesses and publishes the power and energy balance of the Nordic system for the winter (Nordel 2007). One could ask, however, how well the risks of a severe power shortage during extreme cold are analysed in all levels of the society. Also, ETSO has noted in its winter review that the cooperation between *Fingrid* centre and operations people to manage power shortage situations is crucial and recommends therefore that they will be trained annually

In the consumption peak in question, the preventive measures (warnings) were taken early enough. Following this case a new preventive measure became available when a new Act came into force. This Power Reserve Act stipulates that in the winter period, the condensing power plants are kept at a starting readiness of a maximum of 12 hours, the plants can be started by *Fingrid* when the maintenance of power balance requires.

The monitoring and forecasting of the developing situation was in part adequate. The weather forecast was followed but the Russian restrictions came as a surprise. The dissemination of warnings started well but then it seems that further notifications to the public and media were quite variable and resulted in criticism about the lack of consistent information. There was not actual response needed and the preventive measures were enough this time.

During peak load, the Finnish power balance relies on imports from Russia, Estonia and Nordic countries. In the next few winters before the commissioning of the new nuclear unit in Olkiluoto the balance will become even tighter, if winters are cold. (ETSO 2007). It is clear that the Nordic electricity supply is not sufficient if there is a heavy frost in whole Scandinavia as well as in Russia. It is not likely that this will happen but, for instance in Finland, there have been quite recently long lasting cold spells even in the south. At the beginning of January 2003 the minimum temperature at Helsinki-Vantaa Airport was under -25 C for several days and in January 1987 not so long ago the temperature was around -35 C for a week. (FMI

2007). This extreme cold is still possible, although the overall trend might be towards milder winters as a whole.

4.3 The disruption in the European power grid in November 2006

On the night of 4 November 2006 at about 22:10, the UCTE interconnected grid was affected by a serious incident originating from the North German transmission grid that led to power supply disruptions for more than 15 millions European households and a splitting of the UCTE synchronously interconnected network into three areas. (UCTE 2007).

The course of events

The events leading into the incident started with a request for the disconnection of a double circuit 380 kV line. Such switching has been done several times in recent years. The TSO in charge carried out an analysis of the impact of switching off the line on the network situation using standard planning data. Since the analysis did not show the violation of the N-1 criterion in its network, the TSO provisionally approved the request on 27 October. At the same time the TSO informed neighbouring TSOs about the provisional agreement, so they could carry out an N-1 analysis on their network. The results of these analyses confirmed that the grid would be highly loaded but secure.

As a result of co-ordination among the TSOs for the disconnection of the line, the TSOs agreed to reduce the cross border transmission capacity between Germany and The Netherlands by 350 MW for 5 November from 00:00 to 06:00. On 4 November, it was decided to further reduce the capacity between Germany and The Netherlands for 5 November by additional 159 MW.

Meanwhile, on 3 November the request was made to advance the disconnection of the line by three hours, to 4 November at 22:00. A provisional agreement was given by the TSO in charge after a new analysis did not reveal a violation of the N-1 criterion in its network. At this point neighbouring TSOs were not informed about this procedure so no special security analyses were made to take into account the new timing in the neighbouring TSOs.

The late announcement made it impossible to reduce the exchange program between Germany and the Netherlands for the disconnection of the line in the same way as prepared for 5 November. In fact no exchange program reduction is possible after 08:00 for the day ahead due to the agreed auction rules (capacity is considered as firm, except in the case of ‘force majeure’). (UCTE 2007, p. 18)

Additionally, there was no indication of the switching of the line in the planning tools and Day Ahead Congestion Forecast data distributed by the TSO in charge to all UCTE TSOs on 3 November at about 18:00 with the forecast for 4 November at 22:00 and beyond.

At 19:00 on 4 November the neighbouring TSOs were informed about the new time for switching off the line. At about 21:30, the neighbouring TSOs confirmed that the flows between Germany and The Netherlands were high, however since the neighbouring TSO grid would be secure they agreed to the switching operation of the line. At 21:29, a load flow calculation made by the TSO in charge did not indicate any violation of limit values. Based on an empirical evaluation of the grid situation, the TSO staff assumed, without numerical computation, that after switching off the line the N-1 criterion would be met in the system. At 21:30, just before the opening of the

line, a neighbouring TSO made a load flow calculation and an N-1 analysis with the disconnection of the line. The results confirmed that the TSO grid would be highly loaded but secure.

At 21:39, after the switching operation, the TSO in charge received several warning messages about the high power flow on certain lines and at 21:41, a neighbouring TSO informed about a safety limit value on a connecting line. However, at this time the current on this line was still under the given limit, and the N-1 criterion was still met. The protection settings on both sides of this line are different. The dispatchers of the TSO in charge were not aware of the settings in the protection system in the neighbouring TSO substation. Therefore the dispatchers did not take into account the correct values for their evaluation of the situation.

There were several telephone calls between TSOs, at 21:46, 21:50 and 21:52, and the situation was considered to be tight. Between 22:05 and 22:07, the load on the 380 kV connection line increased by 100 MW exceeding the warning value of the neighbouring TSO. This triggered an immediate reaction in the TSO and they called the TSO in charge at 22:08 with the request for urgent intervention to restore safe grid operation. The TSO in charge made an empirical assessment of the corrective switching measures without any load flow calculations for checking the N-1 criterion. The would-be corrective manoeuvre was done at 22:10 without any further coordination with the neighbouring TSO due to necessary rush.

The later simulations have showed that this action led to a result which was contrary to what dispatchers expected; the current on the line increased instead of decreasing and the line was automatically tripped by the distance relays due to overloading. This tripping led to cascading line trippings throughout the UCTE area. All lines tripped due to overloading that triggered distance protection.

The UCTE system was split at 22:10:28 following the tripping in a short time of the interconnection lines between various TSOs as well as several internal lines. Finally, at 22:10:32, the interconnection lines between Morocco and Spain tripped due to low frequency. (UCTE 2007, p. 21.)

Corrective actions and resynchronization

In both under-frequency areas (West and South-East, see Figure 5), sufficient generation reserves and load shedding[32] allowed for the restoration of the normal frequency within about 20 minutes. The imbalance between supply and demand as a result of the splitting was further increased in the first moment due to a significant amount of tripped generation connected to the distribution grid.

In the over-frequency area (North-East), the lack of sufficient control over generation units contributed to the deterioration of system conditions in this area (long lasting over-frequency with severe overloading on high-voltage transmission lines). Generally, the uncontrolled operation of dispersed generation (mainly wind and combined-heat-and-power) during the disturbance complicated the process of re-establishing normal system conditions.

Full resynchronization of the UCTE system was completed 38 minutes after the splitting. The TSOs were able to re-establish a normal situation in all European countries in less than 2 hours. Due to the adequate performance of automatic countermeasures in each individual TSO control area and additional manual actions

[32] A rolling blackout (Load shedding) is a controlled way of rotating available generation capacity between various districts or customers, thus avoiding total wide area blackouts.

by TSOs a few minutes after the splitting, a further deterioration of the system conditions and a Europe-wide black-out was be avoided.

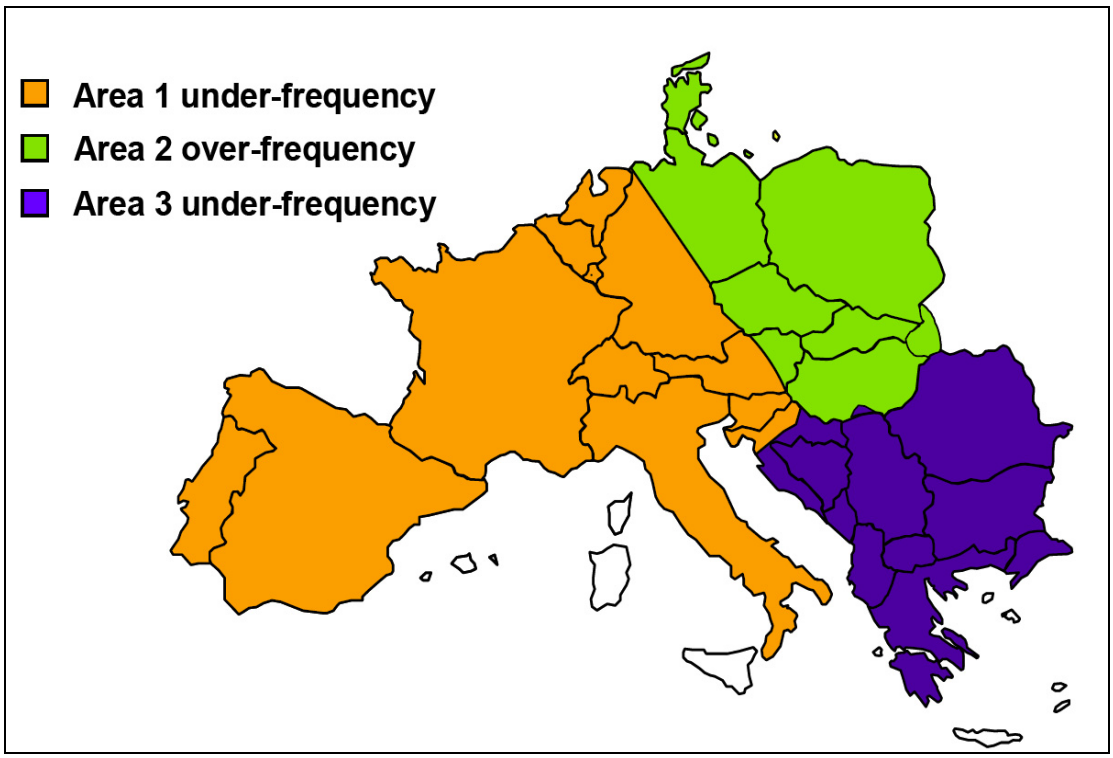

Figure IV—5 Schematic map of UCTE area split into three areas. (UCTE 2007)

Lessons learned

The investigations (UCTE 2007, p. 48) identified later two main causes of the disturbance as well as some critical factors which had significant influence on its course.

1) *Non fulfilment of the N-1 criterion.* After manual disconnection of the double-circuit 380 kV line the N-1 criterion was not fulfilled in the TSO in charge and on some of its connection lines to the neighbouring TSOs. Moreover, the resulting physical flow on the connection line was so close to the protection settings that even a relatively small power flow deviation triggered the cascade of line tripping. This occurred when the TSO in charge did not undertake proper countermeasures to reduce the flow on this line.

2) *Insufficient inter-TSO co-ordination.* The initial planning for switching-off the double-circuit 380 kV line scheduled for 5 November from 01:00 to 5:00 was duly prepared by the directly involved TSOs. However, the change of the time for this switching manoeuvre was communicated the other directly involved TSOs at a late moment; it was also not sufficiently prepared and checked in order to ensure the secure operation of the system in this area after the switching-off. No specific attention was given to the fact that the protection devices have different settings on both sides of the connection-line, although this information was critical due to the high flow on this line.

3) *Additional factors.* Most of the TSOs do not have access to the real-time data of the power units connected to the distribution grids. This did not allow them to perform a

better evaluation of the system conditions. Moreover, the overall situation awareness and coordination of action was not sufficient and resulted, for instance, in several unsuccessful attempts to put tie-lines back into operation and to resynchronize the three different areas with only a partial view of the status of the whole grid. Although training of dispatchers for situations related to TSOs internal control area conditions are often sufficient, incidents originating from external networks and affecting a TSO's own grid are not always trained. Joint simulation training with neighbouring TSOs is not yet a common practice. (UCTE 2007)

In general, one can say that the risk assessment for a normal situation was adequate. However, when the situation changed and the disconnection was advanced there was no joint risk assessment. Also the preventive measures for a normal situation were according to plan, but when difficulties started the preventive measures were counterproductive and resulted in the trippings. The monitoring of the system was technically working but the information was not recognised. The response activities were mostly professional and helped to solve the situation rather fast. The only flaw was the lack of situation awareness of the whole network which resulted in futile efforts of resynchronization. This demonstrates that timely response is not necessarily equal to immediate response.

This case is similar to that of the North-East USA Canada blackout in 2003 with fast cascading after the first trippings. There it resulted in a long lasting blackout in several areas with severe disruptions to normal life. (See Public Safety Canada 2006).

5. Conclusions

The demand for energy in modern societies will increase, and electricity is often the most convenient way of meeting this demand. Electricity dependency among the public and society at large is increasing and the electricity system will continue to grow and become more complex. If the driving force is mainly for market liberalization, the vulnerability will remain high or even grow. It is difficult for state and municipal actors to gain insight into the complex electricity system and monitor the status of power supply facilities. In addition, the interdependency between complex technical systems is intensifying. How the society responds depends on the ability to identify the risks, how well they and their consequences are understood, and the tools available to do something. This means that all the stakeholders are needed for a common endeavour.

Planning for a large scale blackout is difficult for a community that has never experienced one. Usually the necessary improvements in preparedness come only after the emergency. Therefore it is important to raise the overall awareness of communities and analyse the incidents that have occurred internationally and draw conclusion what a similar case would bring to own society. This requires also getting rid of the common attitude 'it can't happen here'. When the risks are mapped and the preparedness plans and procedures are done it is time for common training activities and exercises with the aim of achieving a sufficiently high level of co-operation proficiency among the main stakeholders.

CHAPTER V
Maritime safety: the North Adriatic Sea and the Gulf of Finland in comparative perspective

Emilio Cocco, Giulio Tarlao and Veli-Pekka Tynkkynen[33]

This chapter discusses maritime safety and early warning systems in two similar maritime areas of Europe, characterised by the need for cross-border cooperation: the North Adriatic and the Gulf of Finland. Starting with some general notions, the chapter goes on by presenting the basic physical features, traffic volumes and routes, types of risks, and characteristics of maritime safety actors in the North Adriatic. After that the same kind of data is offered with reference to the Gulf of Finland. Both case studies are largely based on interviews of the relevant maritime safety actors of the regions[34]. The concluding section summarises the findings in comparative perspective.

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[33] The division of labour in this chapter was the following. Emilio Cocco was responsible for the first section discussing the social science point of departure in relation to safety culture and to sea as a cooperation arena. In this volume this part is considerably shortened, whereas a longer version will later be available as a separate article. Giulio Tarlao has conducted empirical research among maritime and safety authorities in the North Adriatic Sea. Veli-Pekka Tynkkynen has done the same in the Gulf of Finland cooperation arena. The concluding section was written by Cocco, Tarlao and Tynkkynen.

[34] The authors thank the interviewees who were generous with their time, information and comments: Matti Aaltonen, Director, Finnish Maritime Authority, 6.6.2007 in Helsinki; Giuseppe Antonicelli, Assistant Manager of Italia Marittima shipping company, Trieste, Italy, 03.07.2007; Zvezdan Bozic, Head of Koper Branch Office of the Slovenian Administration for Civil Protection and Disaster Relief, Koper, 04.07.2007; Paolo Cacciari, MP for Venice, Italy, 26.07.2007; Paolo Castellani, Commander of the Coast Guard of Trieste, Italy, 23.03.2007; Mario Della Valle Di Pompei, Deputy Commander of the Coast Guard of Bari, Italy, Bari, 20.3.2007; Alberto Diamantini, Head of SAR Unit of the Coast Guard of Venice, Italy, 30.03.2007; Davor Fantulin, Head of the Guard Coast of Koper, Slovenia, 13.04.07; G. Felluga, Head of the Scuba Unit of the Civil Protection of Grado, Italy, 30.01.2007; Roberto Gandusio, Manager of Crismare company for sea ecological services, Trieste, Italy, 20.07.2007; Ivan Gotovich, Head of Regional Vessel Traffic Service, Ministry of Transport of the Russian Federation, State Enterprise "ROSMORPORT", St Petersburg's branch, answers to an e-mail questionnaire received 31.8.2007; Rein Haavel, VTS Project Office Manager, Cybernetica Ltd., 7.6.2007 in Tallinn, Estonia; Kari Kosonen, Vice Director, Finnish Maritime Authority, 6.6.2007 in Helsinki, and 25.9.2007 by telephone; Mladen Mandic, Head of Inspection District Office of the Harbour Master of Rijeka, Croatia, 27.06.2007; Are Piel, Head of Vessel Traffic Services Department, Estonian Maritime Authority, Tallinn, 7.6.2007; Zoran Rukavina, Captain of the Port Authority of Pula, Croatia, 27.03.2007; René Sirol, Deputy Director General, Head of Maritime Safety Division, Estonian Maritime Authority, Tallinn, 7.6.2007; Cristina Trocca, Responsible of the Operative Unit, Civil Protection of the

1. Security, safety and the sea

Security, safety and related issues represent functions usually performed by public institutions and are traditionally part of the public policy. The change of welfare and its growing costs, combined with the higher and more sensitive status of security and safety issues bring the civil protection and disaster reduction right to the centre of the political debate, often being the target of contrasting opinions. Moreover, the new faces of international terrorism, changing environmental conditions and the increased criminal activities connected with mobility patterns (illegal migrations, slavery and prostitution, smuggling, trafficking in human being, illegal weapons trade) progressively erase the border line between civil and military spheres of security and set the stage for a larger and all encompassing notion of safety. Moreover, considering the evolution of the political debate in the last two decades, both in Europe and overseas, one can notice that the topic of security abandoned its traditional military connotation to take a prominent position among the many political issues (Handmer et al. 2001). In this development, the subject of civil protection, despite its indefinite identity, maintains a cross-sectoral importance for the implementation of the main functions within government bodies.

Integrated coastal zone and river basin management systems are now being developed to answer urgent societal questions such as the sustainable development of coastal areas, the exploitation of coastal resources and the protection of the coastal environment. The sustainable development of the coastal areas depends on the quality of the marine environment, and it is timely to develop an assessment or forecasting system to enable policy decisions to be taken in a modern and efficient way. In this context, it appears clear that maritime safety should be included as a strategic issue in the perspective of sustainable development of coastal areas. The social implications of marine and coastal exploitations and environmental protection bring about a number of risks and safety issues that fall into the responsibility of the many local government bodies. Moreover, the complexity of the natural and geopolitical environment requires coordinated and innovative solutions, which are likely to be expensive.

The sea is certainly not one of the favourite research topics of sociology or history. As a crucial part of the ecosystem, waters have been largely investigated by natural sciences and they rarely got the attention of human and social scientists, with the exception of geographers and anthropologists. Actually, the maritime dimension is quite often excluded from social science and researchers rarely provide comparative studies of Eastern European maritime regions, like the Baltic or the Adriatic basins. Even in International Relations and Political Science, both open and closed maritime spaces have been approached mainly as part of larger processes of partitions, border disputes or defence strategy. Economic science looks at the sea as a source of goods (exploitation), in terms of infrastructures or along the contemporary concerns on sustainable development (Steinberg 2001). The analysis here is inspired by the need to focus on maritime spaces as a strategic field for integrated social science research, with special regard to the maritime spaces situated at the Eastern boundaries of Europe.

Region Friuli Venezia Giulia, Palmanova, Italy, 04.04.2007; Gaetano Vallefuoco, Head of the Fire Brigades of the province of Udine, Italy, 28.3.2007; Vladimir Vasilyev, Deputy Director/Associate Professor, Safety of Navigation and Radio Communication, Central Marine Research and Design Institute, answers to an e-mail questionnaire received 22.8.2007.

Indeed, the sea was one of the great protagonists of the historical processes that led to the development of modern society. From the period of the great explorations to the establishment of international maritime trade routes the ocean was the primary natural support for the social unification of the planet. Exactly as the Mediterranean was either the stage or the background to the main developments of the ancient European civilizations. The sea has set the stage for the globalization of society, providing a world encompassing systems of routes, connections and networks of social relations. However, the sea is also experiencing some of the problematic impacts of globalized society in terms of economic overexploitation, territorial partitions, developmental issues, security problems and cultural marginality.

In its origin the discourse about the sea – going back to the Bible and other classical texts – was one that pictured it as a locus of horror. Living by the sea represented constant danger, being exposed to the next flood while at the same time the people that dwelled by the sea bore the stamp of this horrible mass. Beside the fact that all kinds of monsters could come from the sea – pirates, savages, strangers, dragons – the shore dwelling populations and especially those who went out to sea could be lead into temptation by this element. Later on, during the age of Enlightenment and Romanticism, a different perception of the sea appeared and a more idyllic picture of populations that lived by the sea was presented.

On a theoretical level, looking at the notions of property on and in water helps us think more critically about issues of ownership and property of the sea. Property is often conceived of in terms of land and territory whereas the vast watery spaces of the seas figure as inimical to ownership. The notion of the high seas being free was developed and advocated historically by those maritime nations like Great Britain and Holland whose fortunes rode on their ability to cross vast expanses of watery space without having passage controlled or halted in key straits. The international principle that states have only a three mile limit of jurisdiction over the waters along their coasts – the so called territorial sea – dates to the 17th century; most states extended this limit to 12 nautical miles in the 1980s, although the United States continued to insist on the doctrine of the freedom of the seas.

2. The North Adriatic Sea

From the political point of view, the Adriatic Sea (Figure 1) coasts are divided among Italy, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro and Albania. Placed on islands within one of the lagoons of the North Adriatic, the city of Venice has its unique situation.[35] Looking at the North Adriatic Sea in particular (Figure 2), this study starts its analysis by presenting the basic physical data; a brief political background; data on maritime traffic and the most important ports of the area; and the record of maritime accidents that produced pollution of the Adriatic Sea in the last 30 years. Second, the focus will be put on most important actors for maritime safety in the North Adriatic, that is, the Coast Guards of Italy, Croatia and Slovenia.

[35] Other notable cities on the Italian coast are Trieste, Ravenna, Rimini, Ancona, Pescara, Bari and Brindisi. Major cities on the eastern coast include Izola, Koper, Piran and Portorož in Slovenia; Poreč, Rovinj, Pula, Opatija, Rijeka, Senj, Zadar, Šibenik, Trogir, Split, Makarska, Ploče and Dubrovnik in Croatia; Neum in Bosnia and Herzegovina; Herceg Novi, Kotor, Bar, Budva and Ulcinj in Montenegro; and Durrës in Albania.

Figure V—1 Map of the Adriatic Sea.

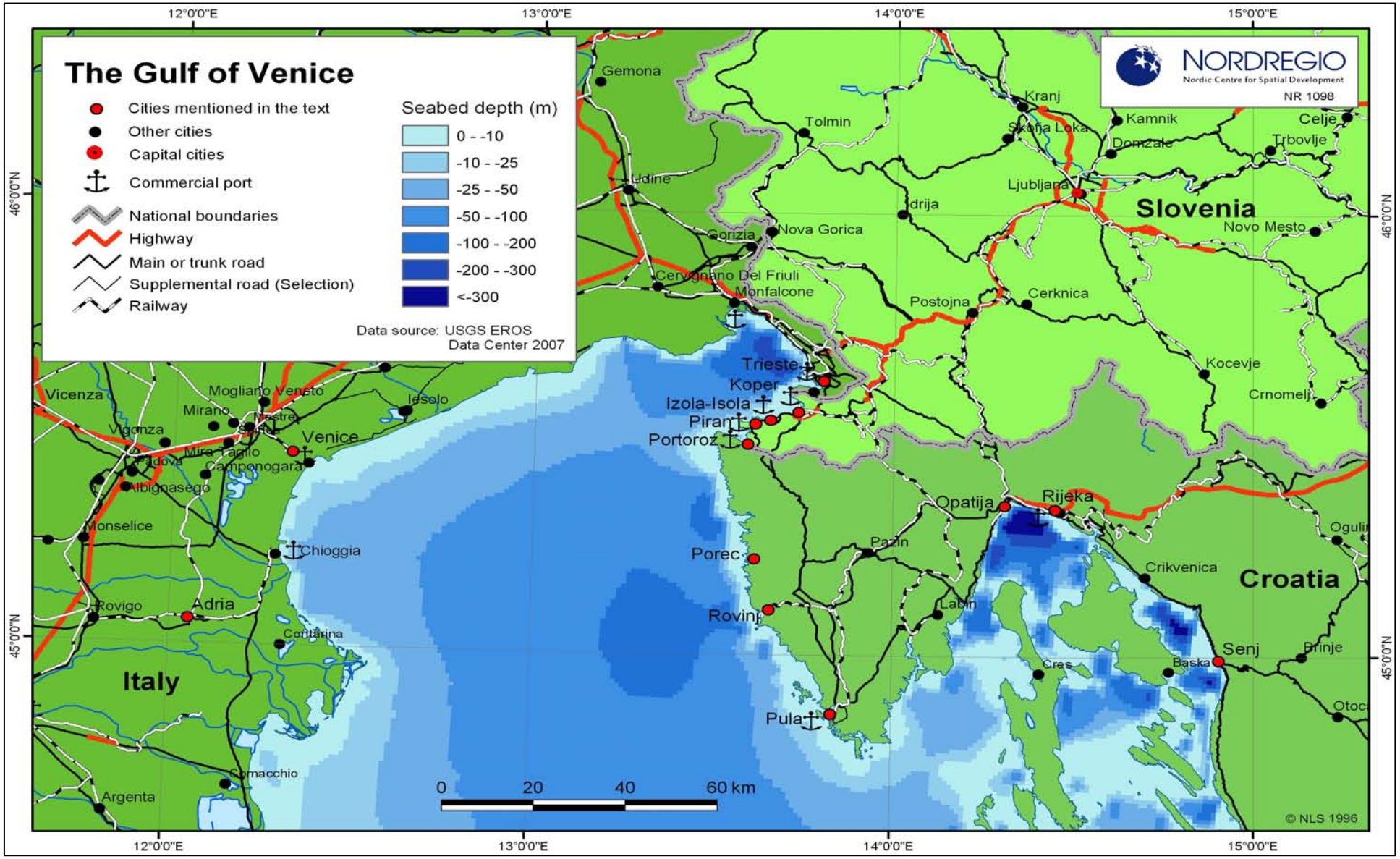

Figure V—2 Map of the North Adriatic Sea.

2.1 The physical setting

Taken as a whole, the Adriatic Sea has a total surface area of about 60,000 square miles (160.000 km^2). The Adriatic extends northwest from 40° to 45° 45' N., with an extreme length of about 770 km (415 nautical miles, 480 miles). It has a mean breadth of about 160 km (85 nautical miles, 100 miles), although the Strait of Otranto, which is connected with the Ionian Sea, is only 45-55 nautical miles wide (85-100 km). The west, Italian coast is generally low and sandy, rich of marshes and lagoons, whereas the east coast is bold and rocky, with many islands. Many rivers end their flow into the Adriatic Sea. The most important one is the Italian river Po (652 km). Its delta has historically pushed forward (and eastward) the coastline. Albeit the presence especially in winter of the strong northeast wind called Bora (Bura in Croatian), the tidal movement is slight. This is true especially for the North part of the Adriatic Sea, which is relatively shallow. Between Venice and the Croatian peninsula of Istria the depth rarely exceeds 46 m (25 fathoms), whereas in the Southern part of the sea, between Bari in Italy and Dubrovnik in Croatia, it reaches around 900 m (500 fathoms). The maximum depth is 1460 m (800 fathoms), and the mean depth is 240 m (133 fathoms).

2.2 Brief historical background

The Adriatic Sea has always played the role of channel to the East, putting in communication central Europe with the Eastern Mediterranean, Turkey and the Middle East. Nevertheless, in the eyes of Italian policy-makers the Adriatic has never been the 'Italian sea', but a second-rank space. The most important maritime area of Italy has always been the Tirreno Sea, on which is placed the biggest Italian port, the port of Genova. Paradoxically to many extents the Adriatic Sea has played a larger role in the history of Yugoslavia and before Austria than in the Italian one.

The defeat of Fascism at the end of the Second World War deprived Trieste of all its historical hinterland, and the entire east coast of the sea became part of the Socialist Republic of Yugoslavia. The situation changed with the war in the former Yugoslavia in the 1990s, which led to collapse of the Socialist Republic, and to the birth of a number of new political entities. The fall of Yugoslavia had a big impact on the life of the North Adriatic Sea, and one major consequence: where it used to be one border three emerged. The land border Italy-Yugoslavia was replaced by the land border Italy-Slovenia, a new land border Slovenia-Croatia was created, and also a maritime border Italy-Croatia originated. Slovenia is the only heir of Yugoslavia that has already joined the European Union (EU), also adopting the Euro and being part of the Schengen area. The disappearing of this border most probably will enhance the cooperation with Italy.

2.3 Maritime traffic

The nature and scope of maritime activities in the area are reflected in Tables 1-2, describing the turnover in the Italian ports of Venice and Trieste; in Figure 3 for the Slovenian port of Koper; and in Table 3 for the Croatian port of Rijeka. Table 1 shows that the activities of the port of Venice are experiencing a positive trend. Both the containers and passengers traffics have reached their historical maximum. In year 2006 around 5,000 vessels reached Venice: 1,377 passenger ships for a total of almost one and a half million tourists, and 3,655 commercial ships for a total of over 30 millions of tons of goods. Significant for the issue of safety is the datum about oil: in 2006 over 11 millions of tons of oil products have been treated in the port of this

historical and unique city, so breaching the Special Law for Venice 41 of 1973, that mandates to move the commercial maritime traffic out of the lagoon, and to place it in open sea, offshore. Such provision has never been enforced, and so the oil harbour of San Leonardo, situated right in the middle of the lagoon of Venice, is still in use.

Table V—1 Port traffic figures 2000- 2006. (Venice port authority 2007)

Goods (tons)	2006	2005	2004	2003	2002	2001	2000
Cereals	659 467	492 676	953 683	852 813	993 991	701 321	479 736
Raw flour prod.	751 354	654 899	686 699	700 513	878 295	1 025 979	670 542
Coal	907 804	696 951	685 456	714 330	648 225	690 096	590 945
Cast iron-scraps	1 476 903	1 240 529	1 360 029	1 304 251	1 182 089	1 304 555	1 287 292
Other dry bulk	2 052 172	2 417 709	2 479 355	2 627 248	2 127 382	1 783 395	1 639 907
Iron works	2 927 693	1 866 038	2 134 950	1 772 728	1 609 146	1 797 342	1 784 421
Other	406 095	303 054	455 962	398 670	525 177	508 868	527 274
Tot. conventional	9 181 488	7 671 856	8 756 134	8 370 553	7 964 605	7 811 556	6 980 117
Tot. specialized	5 360 473	5 050 187	4 260 129	4 345 190	4 510 862	4 366 203	4 082 873
Commercial port area	14 541 961	12 722 043	13 016 263	12 715 743	12 475 167	12 177 759	11 062 990
Tot. industrial port area	5 033 494	5 834 761	5 994 286	5 970 768	5 798 989	5 973 346	6 532 020
Tot. oil port area	11 361 476	10 542 237	10 745 587	11 440 487	11 274 386	10 658 118	10 581 193
Overall total	30 936 931	29 099 041	29 756 136	30 126 998	29 548 542	28 809 223	28 176 203
Container traffic (TEU's)	316 641	289 860	290 898	283 667	262 337	246 196	218 023
Passenger traffic	1 453 513	1 365 375	1 037 833	1 124 213	990 193	1 022 796	873 239
No. of vessels	4 998	4 871	4 906	4 883	4 857	4 826	4 764
of which commercial area	3 655	3 603	3 459	3 372	3 325	3 315	3 140
of which passengers	1 377	1 414	1 154	1 406	1 262	1 276	1 102

The port of Trieste in Italy is a smaller centre of traffic compared to the Venice case, especially in the passengers sectors. But if we focus on oil traffic, we see that in the recent years the port of Trieste has overcome the traditional position of Venice as the leading centre of the Mediterranean in this field, and this is due in particular to the oil pipeline to Germany that starts from the surroundings of the town. Table 2 indicates that Trieste is almost solely an oil port. To give an image, 37 millions tons of oil treated in the 2006 means having an oil tanker loaded with 100,000 tons that reaches the docks of Trieste every day of the year. And this huge traffic has obviously a bearing on the following discussion on the risks of oil spills.

Table V—2 Data about the traffic in the port of Trieste. (Trieste port authority 2006)

	Disembarked		Boarded		Together		Difference	
(Tons)	**2 006**	**2 005**	**2 006**	**2 005**	**2 006**	**2 005**	**Ton**	**%**
Cereals and oily seeds	99.458	37.006	182.494	158.271	281.952	195.277	86.675	44,38
Minerals	748.801	769.715	127.921	121.808	876.722	891.523	-14.801	-1,66
Coal	464.288	664.114	239.849	175.301	704.137	839.415	-135.278	-16,11
Lumber	15.512	13.922	29.360	22.713	44.872	36.635	8.237	22,48
Mineral oil	37.714.771	37.962.617	46.565	2.793	37.761.336	37.965.410	-204.074	-0,53
Other	4.213.070	3.759.424	4.285.629	4.030.647	8.498.699	7.790.071	708.628	9,09
Total	43.255.900	43.206.798	4.911.818	4.511.533	48.167.718	47.718.331	449.387	0,94
Refuelling and board provisions	0	0	150.325	149.018	150.325	149.018	1.307	0,87
Overall total	43.255.900	43.206.798	5.062.143	4.660.551	48.318.043	47.867.349	450.694	0,94

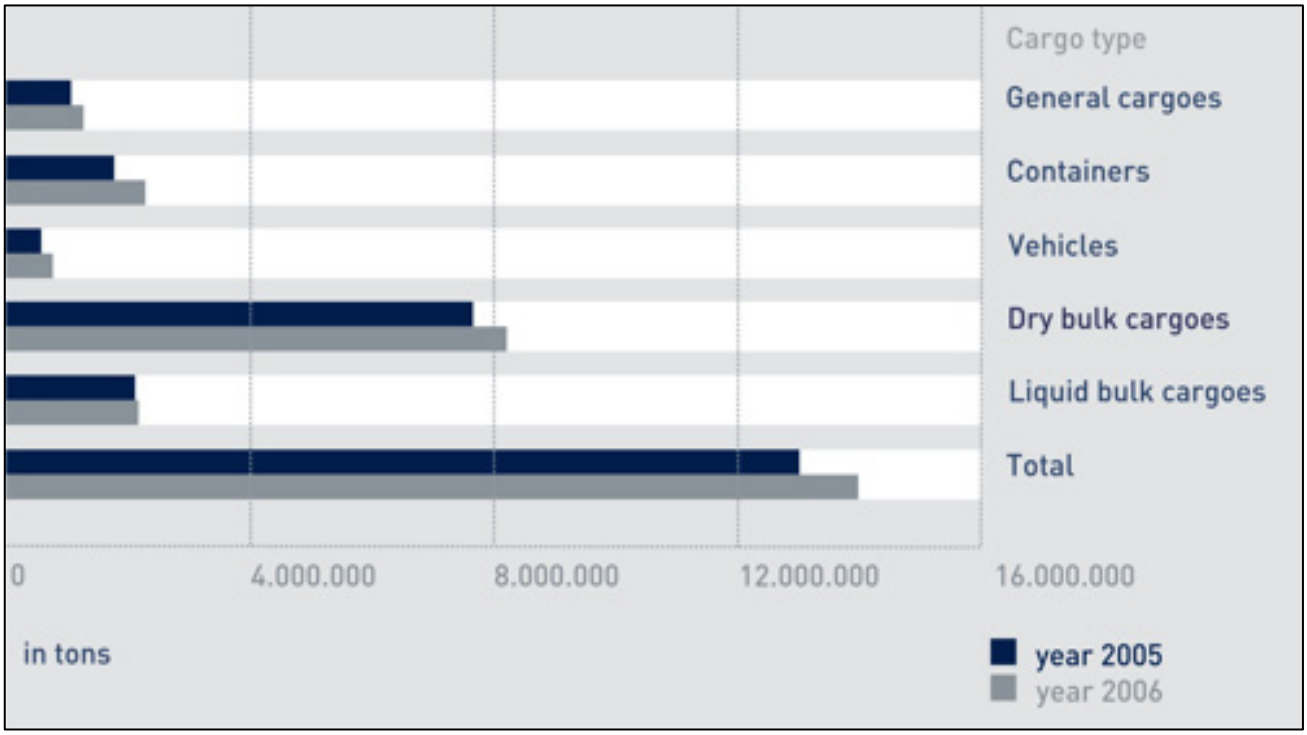

Figure V—3 Maritime traffic in the port of Koper, Slovenia.

The most important port in Slovenia is Koper. As Figure 3 shows that Koper is growing in importance, especially due to the traffic of goods to Germany. The amount of traffic activities developed in Croatia's largest port Rijeka, shown in Table 3, is of a lesser magnitude, but it is reaching the figures treated in the port of Koper.

Table V—3 Traffic in the largest port of Croatia, Rijeka. (Croatian Ministry of the sea, tourism, transport and development 2006)

In tons	**2 005**	**2 006**	**Difference (%)**
General cargo	1 435 225	1 572 997	10%
Dry bulk cargo	3 186 176	3 199 707	0%
Timber	219 580	236 438	8%
Liquid bulk cargo	7 022 789	5 877 906	-16%
Total	11 863 770	10 887 048	-8%
In TEU	**2 005**	**2 006**	**Difference (%)**
Containers	76 258	94 390	24%

2.4 The organisational setting

In each of the countries in question there are separate competent authorities devoted to maritime safety, basically Coast Guards. Their organisational structures and resources are shortly presented in the Fact boxes 1-3. They are usually national authorities with local branches. Thus, while being a national-level organisation, the Coast Guard in Italy, for instance, is organised according to three operative levels.[36] At the 'lowest' level the UCG (Coast Guard Unity) is in charge of the patrolling of around 30 miles; at the 'intermediate' level the Maritime Directorate is in charge of the coordination of all the UCGs present in their area (usually equivalent to the administrative borders of the region), and is better equipped; at the 'highest' level is the Central Directorate of Guard Coast in Rome, entering in action only in case of major crisis encompassing the single region.

Many other actors are also involved. For instance, In Italy, the patrolling of the sea to prevent illegal immigration (a frequent phenomenon from Albania in the 1990s) is officially delegated to the Italian Guardia di Finanza (the antifraud police headed by the Ministry of Treasure), but since such migration is dangerous for the life of immigrants, it is treated in the first run more as a Search and Rescue (SAR) activity, and so handled by the Coast Guard. Moreover, the arrival of boats loaded with illegal immigrants is detected not only thanks to the usual Vessel Traffic Service (VTS) radar system, but also thanks to the technological equipment employed by the Italian central intelligence, that is coordinated by the Home Affairs.[37]

[36] According to a representative of the Coast Guard of Bari (Italy, in the southern part of the Adriatic Sea).

[37] Such a flow of boats from the other side of the Adriatic has however stopped in the most recent years, because the political situation in Albania has overcome that turmoil, and so at the moment the Coast Guards are devoted to other tasks, including security and antiterrorism issues.

Fact box V—1 Italian Coast Guard.

Activities

- Search and rescue in sea (SAR)
- Safety of navigation
- Protection of the Marine Environment
- Control on maritime fishery
- Peripheral administration of State functions in the matters of training of the maritime personnel, of registration of the mercantile and fishing shipping, of pleasure shipping, and of the contentious for those maritime crimes that have been de-penalized
- Maritime Police

Organisation

- 14 Maritime Directions, which are at the head of as many Maritime Zone Operations' Commands
- 52 Capitanerie di Porto - 45 Maritime District Offices - 136 Local Maritime Offices - 46 Beach Delegations
- Marine – Environmental Division of the Capitanerie di Porto (by the Ministry for the Environment and Protection of the Territory)
- Group by the General Fishery Direction (of the Ministry of Agriculture.)
- 3 Underwater Operators Groups - 3 Aerial sections - 1 Helicopters section

Technical equipment

- COSPAS/SARSAT satellite station of Bari (in synergy with the Civil Protection Department);
- VTS service - AIS data base - 300 nautical means (patrol ships, high water unit, guard ships, light navy unit, rubber dinghy)
- 9 helicopters - 7 airplanes

Fact box V—2 Slovenian Maritime Administration.

Activities

- Safety of navigation
- Pollution prevention
- Seaways, ports and harbours management
- Ship surveys
- Issuing of certificates and documents required to be carried on board ships
- Port state control
- Registration of ships in a ship register
- Registration of pleasure boats
- Issue of seamen books and Certificates of Competence in the Merchant Marine
- Boat Leaders Certificates
- Search and rescue at sea

Organisation

- Harbour Master office
- Port State Control
- Sector for the investments, real estate and finance
- Sector for the maritime documents and general affairs

Technical equipment

- 1 Radar station - AIS data base - 3 nautical means (patrol ships, guard ships, rubber dinghy)

Fact box V—3 Croatian Maritime Rescue Coordination Centre.

Activities

- Provides a 24 hour watch service, and in terms of jurisdiction of the Centre, this includes the region of internal marine waters, territorial waters of the Republic of Croatia (marine belt wide 12 nautical miles from the shoreline towards the open sea) and the region of international waters as confirmed in treaties with neighbouring states and as reported to the International Maritime Organization (IMO)
- Provide maritime radio monitoring services on internationally confirmed frequencies and channels for emergencies and safety

Organisation

- 8 coast guard station

Technical equipment

- VHF radiotelephony
- VHF DSC digital selective calling
- MF/HF RT and MF/HF DSC (radiotelephony-mid/short-wave + digitally selective calling on short/long wave)
- Radiotelex
- Navtex
- SAR radar transponder and transmission VHF radiotelephony systems.
- COSPAS-SARSAT system as well as the satellite radio-location subsystem GMDSS and INMARSAT (the International Mobile Satellite Organization), as the communication section of the satellite subsystem GMDSS.
- Patrol ships - high water unit - guard ships - light navy unit - rubber dinghy

Perhaps even more important partner for the Coast Guard in Italy is the civil protection organisation, at least in some cases.[38] Thus, in the case of some SAR actions, especially in case of missing people after a sinking, the civil protection authority has offered its helicopters. A helicopter can obviously cover a much larger spectrum of water than the Coast Guard ships, a body can be better seen from the air, and above all, the helicopters of the civil protection have on board also an infrared detection system that gives the real added value in those circumstances. Another form of support in some areas is the system of maritime meteorological monitoring, constituted by a network of buoys placed by the civil protection and connected to its system of monitoring against floods. Furthermore, and with special regard of pollution, the civil protection authority has developed a satellite system of monitoring. The regional civil protection authorities have displaced sensors in different points of the sea, and those enable the Operative Unit to follow step by step the stream of any polluting material that might have been spilled by a vessel. In Venice, specific circumstances enhance the role of the civil protection authority in maritime safety because according to Italian laws, the lagoon is the only water space in which safety and environment protection is not appointed to the Coast Guard. The lagoon is considered internal water, and the public body responsible is the municipality. (See Figure 4 for the geographical picture of the lagoon) This means that in the event of a fire or grounding of boats in the lagoon, the order of intervention is reversed. It is most likely that the local authority (mayor) will rely on the municipal civil protection squad. If the crisis is bigger, the higher level of civil protection will

[38] According to a representative of the civil protection authority in Region Friuli Venezia Giulia, Italy.

react, since the ships of the Coast Guard are in general to large, slow and deep to enter in the lagoon.

The maritime safety organisation in Slovenia has been under reform in recent years.[39] While a proper Coast Guard does not exist in the military sense, there is a Slovenian Maritime Administration, In Ljubljana there is a task committee of all state institutions dealing with sea policies. Such committee is only two years old, and it was approved by the national parliament after strong discussion on whether it was to be put in the hands of the Navy or not. Eventually, it was decided to have a civil body, but with more consultative functions.

In Croatia, the Maritime Rescue Coordination Centre is the most important maritime safety actor. However, as a representative of the Croatian Coast Guard of Rijeka stated, in that country a kind of a dual system prevails as the Coast Guard deals basically with inspections and SAR, and the Navy takes care of antiterrorism at sea and also fight against smuggling.

From early warning and warning perspectives the somewhat unclear and overlapping organisational structures are reflected in the alarm systems, which are not integrated internationally in the region and not even domestically. The single European emergency number 112 seems not to have been established as to the maritime safety. Thus, for instance, in Italy the 115 is a special number to be called if a boat is experiencing the fire. In Croatia, while the normal alarm system is based on 112, the SAR actions, the SAR actions are based on the free telephone number 9155. This creates confusion and, as put by a representative of the Coast Guard of Rijeka, sometimes it happens that people call the 112 number of civil protection instead.

2.5 No major crisis on record

As analysed deeper later in this section, the loss of human lives in the Adriatic Sea is not a recurrent event. There has never been the sort of accident that happened involving the passenger ferry MV Estonia in 1994 in the Baltic Sea, when 852 human lives were lost. In fact, accidents that provoked damages to the natural environment has been the most important maritime safety issue. In Figure 5 the most significant polluting events, collected by the Rempec institution, are traced. Table 4 contains the relevant explanations.

Thus, the North Adriatic Sea has not experienced any single massive crisis and emergency in terms of huge loss of human lives. The closest event in modern time happened in 1997 in the Otranto channel joining the Adriatic and the Ionian seas. A highly unstable boat packed with illegal immigrants mostly from Albania capsized. The precise number of casualties (40 to 80) was never discovered, since the boat is still on the seabed of the Mediterranean. Because this shipwreck was linked to the hysterical flows of migrations from Albania to Italy of the late 1990s, it belongs to a part of contemporary history that Italian public opinion prefers not to recall.

[39] This part is based on information received from a representative of the civil protection authority in Koper, Slovenia.

Figure V—4 The lagoon of Venice.

Besides occasional drowning of fishermen due to storms, the small but dramatic instances of Italian fishermen who have been shot and killed in the past decades but also in recent years by Yugoslavian Coast Guard because they trespassed the maritime border to fish. These events are still vivid in the Italian memory. The issue is naturally reflected in the role of cross-border cooperation in improving the models of maritime security in the Adriatic.

The lack in the record of huge emergencies in terms of loss of human lives stands also in terms of damage of natural environment. As there are no tragedies comparable to the passenger ferry MV Estonia case, there are neither catastrophes of the scope of the oil tanker MV Prestige one, which sank off the coast of North West Spain in 2002. The only similar case occurred in 1998 in the port of Venice, when a tremendous fire

developed in a tanker coming from Bombay (India) and full of highly inflammable colza oil. The fire brigade had to struggle for days.

This general positive record is not only due to the efficient human action, but also favourable environmental conditions (shallow waters, no typhoons or the like), and some elements of economic and tourist backwardness that make the Adriatic Sea less busy than other seas.

However, especially the increasing oil tanker traffic is bound to increase the risks of a major oil spill. The preparedness, as testified by the practitioners, would not be enough to deal with a major emergency. Thus, the Director of the Sea Unit of Slovenian Civil Protection, Koper, has stated that "According to the experts of this office, in the event of spillage of oil carried by only one of the mammoth tankers (up to 100,000 tons) reaching every day the port of Trieste, not only the Italian or Slovenian sides, but the whole integrated system of civil protection of the North Adriatic would be unable to protect the environment and the cities". Similarly, his colleague representing an Italian company in Trieste responsible for ecological services puts it as follows: "If a collision between two tankers happens in the North Adriatic, with the complete spillage of their loads, which means from 80,000 to 100,000 tons of oil, then only a divine intervention can solve the problem."

2.6 Poor level of cross-border cooperation

The level of cross-border cooperation (Italy-Slovenia-Croatia) concerning maritime safety has not yet expressed its full potential. The key actors on the field are the respective Coast Guards, which are basically rather national than local actors. A higher level of cross-border cooperation can be detected regarding the other significant actor present on the field, that is, the civil protection system. For example, Italian and Slovenian bodies of civil protection have worked together in some recent occasions. Nevertheless, this bears little relevance to the maritime safety since the type of emergencies they handled together were fires on the Carso hills across the border.

In other words, cross-border cooperation is more developed for environmental crisis occurring on the land than for those occurring on the sea. The rationale beyond this has a legal basis: according to the Italian legal framework, civil protection is a competence of the regional government, and so it is much easier for the region of Friuli Venezia Giulia, for example, to enter in a closer cooperation with the system of civil protection of Slovenia (the latter is as large and as populated as an Italian region), than the national body of Coast Guard, centred in Rome, to do the same with Slovenian and Croatian Coast Guards.

Therefore, the most prominent form of cooperation in the maritime field remains the signing of key international charters, such as the International Convention for the Safety of Life at Sea (SOLAS) and its subsequent amendments. The neighbouring countries of Italy, Slovenia and Croatia have all ratified the main multilateral conventions on maritime safety. There also other agreements developed only by the three countries considered here. Among them are two memorandums signed in 2000: the Memorandum of Understanding on Mandatory Ship Reporting System in the Adriatic Sea (Adriatic traffic); and the Memorandum of Understanding on the Establishment of a Common Routing System and Traffic Separation Scheme in North Part of the North Adriatic.

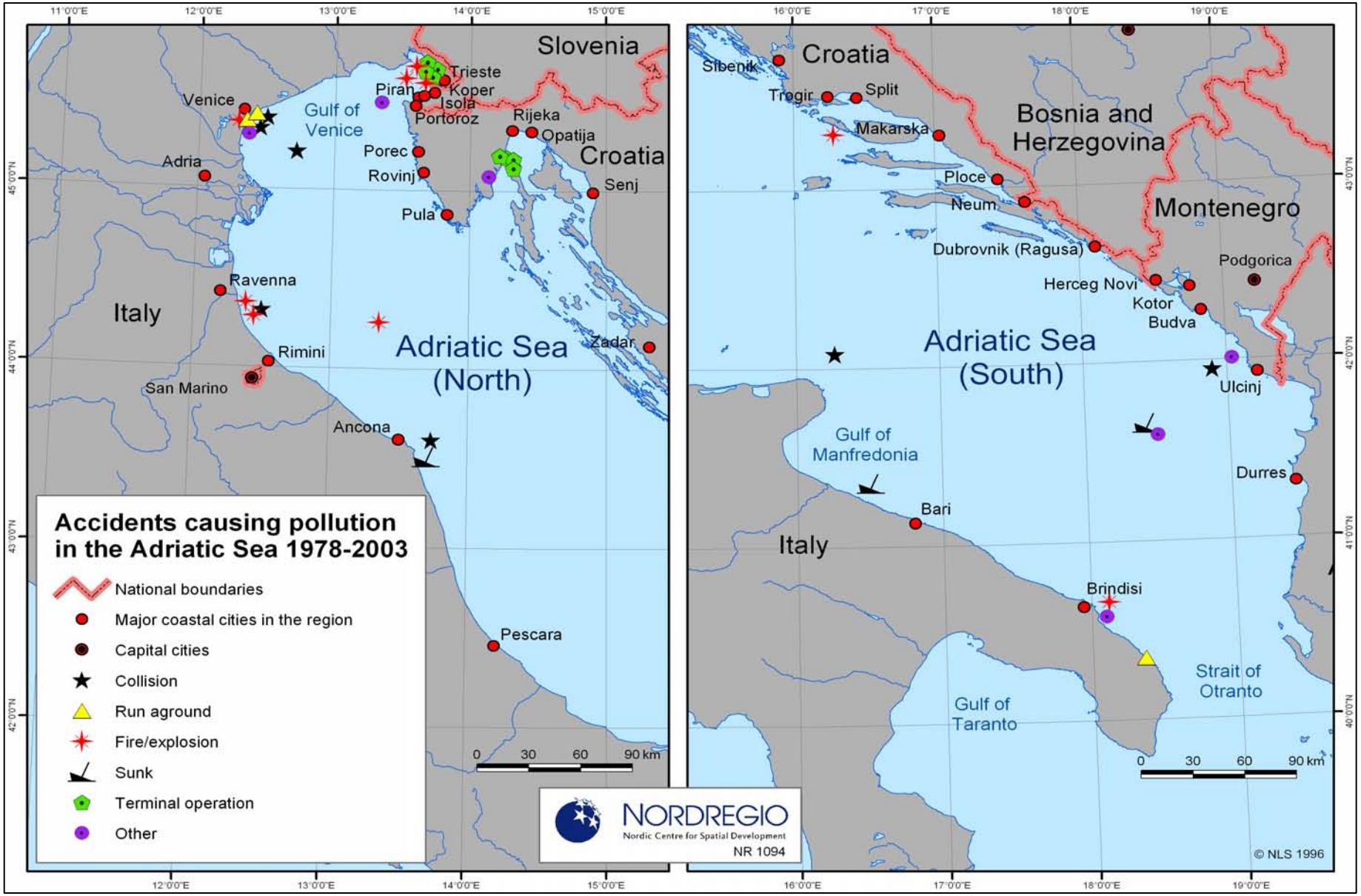

Figure V—5 Accidents in the Adriatic Sea that have resulted in major pollution, between 1978-2003.

Table V—4 Most significant polluting events 1978 – 2003 in the Adriatic Sea.

Year	Place	Ships Nationality	Accident type	Pollution type
1978	Trieste (I)	LBR Liberia	Oil pollution	Oil
1979	Venice (I)	GBR Great Britain	Collision	Oil
1983	Porto Marghera (I)	GBR Great Britain	Collision	Oil
1985	Porto Marghera (I)	LBR Liberia	Fire	Oil
1985	Trieste terminal(I)	CYP Cyprus	Oil pollution	Oil
1986	Urinj	GRC Greece	Oil pollution due to storm	Oil
1986	Malamocco (I)	ITA Italy	Run aground	Oil
1987	Bar (Serbia and MTG)	MTG Montenegro	Oil pollution	Oil
1989	Bakar (HR)	IRQ Iraq	Heavy oil pollution	Oil
1989	Bakar (HR)	IRQ Iraq	Oil pollution due to strong wind while discharging	Oil
1990	Koper (SLO)	HUN Hungary	Oil pollution due to faulty valve	Oil
1990	Brindisi (I)	ITA Italy	Propylene left to burn out	Hazardous substances
1991	Omisalj (HR)	IRN Iran	Oil dispersion due to strong wind (200kmH)	Oil
1991	Off Chioggia (I)	HND Honduras and SVN (Antilles)	Collision	Oil
1991	Off Ravenna (I)	PAN Panama	Explosion and fire	Oil
1992	Brindisi (I)	GRC Greece	Oil pollution due to wrong manoeuvre	Oil
1993	Brindisi (I)		Leakage from oil pipe terminal	Oil
1994	Off Ravenna (I)	CYP and VCT Saint Vincent	Collision	Hazardous substances
1994	Off Ancona (I)	ITA and HND	Collision	Hazardous substances
1994	Off Ravenna (I)	TUR Turkey	Explosion	Hazardous substances
1995	Off Vieste (I)	TUR and ITA	Collision, 2 members of crew missing	Oil
1995	Venice		Pipeline leakage	Oil
1995	Venice	ITA Italy	Run aground	Hazardous substances
1996	Bakar (HR)		Large leak from tank at the INA refinery	Oil
1996	Trieste	SYR Syria	Loss of part of cargo + pollution	Oil
1997	Split (HR)	HRV Croatia	Fire, 1 casualty	Oil
1998	Trieste	MLT Malta	Amna crude oil spilled	Oil
1999	Trieste	ITA Italy	Fire, 1 casualty	Oil
1999	Ravenna (I)	MLT Malta	Fire, 9 injured	Oil
2000	Trieste	HND	Fire at Siot pipeline terminal	Oil
2001	Izola (SLo)	ITA Italy	Fire	Oil
2001	South of Brestova (HR)	ITA Italy	Oil leakage from a wreck	Oil
2002	Bar (Serbia and MTG)	GRC Greece	Contact	Oil
2003	2 nm from Conero Cape (I)	BLZ Belize	Slick pushed back to sea by winds	Oil
2003	South Adriatic		Sinking, rescue of the crew	Hazardous substances

These two documents were signed after the collapse of the former Yugoslavia, and with the aim to renew the legal framework for maritime cooperation in the Adriatic. This effort of updating was necessary because the conventions ratified in the past and presented in the table were not signed by Slovenia or Croatia, but by Yugoslavia.

According to a representative of the Coast Guard in Trieste, the cooperation with Slovenia, for example in SAR actions, is daily and efficient, because Slovenian coasts are close and limited in extension (46 km). In the case of Croatia the cooperation is more occasional, because the Croatian maritime system in general is seen as 'backward' by many Italian actors. Moreover, Croatia is still involved in the negotiations for the access to the EU. However, progress has been made in the last years in the cross-border cooperation. For example, after years of negotiations, an agreement have been reached among Italy, Slovenia and Croatia on the delimitation of two corridors for vessels, one going northward and one southward. This satisfied especially Croatia, as the oil tankers heading to Trieste port (terminal of the pipeline to Germany) will pass less close to Croatian coasts, most important for a country in which summer tourism is a one of the fundamental sources of income.

Similarly, a representative of the civil protection authority in Koper, Slovenia, pointed out that there are almost daily relations with the Italian civil protection bodies, based on a protocol signed by both states, but mainly on the fields of prevention of fires and floods. Regarding to the sea the cooperation is reduced to the exchange of data coming from the oceanographic buoys placed in the North Adriatic, data eventually put on the internet. In the case of cooperation between Slovenia and Croatia, the situation seems worse. As one interviewee representing the civil protection authority in Koper put it, if any emergence occurs, "it is better to call Venice": on the Croatian side "there are no companies that could help us". In general the period after 2000 has not been fruitful for cooperation, especially among Slovenia and Croatia. Since these two parties do not agree even on their maritime border (see below), it is unlikely that they could develop extensive cross-border cooperation.

2.7 The burden of history

The current state of cross-border cooperation among the neighbouring countries of the North Adriatic can be summarised according to some key variables. The first element to consider is that the area is still suffering to some extent from the bad relations of the Cold War, even though the Berlin Wall came down almost 20 years ago. For example, we take the recent diplomatic crisis of February 2007 after a speech made by the President of Italian Republic, Giorgio Napolitano. On the day dedicated to the remembrance of the thousands of Italian-speaking inhabitants of now Croatian coast who had to leave their houses at the end of the Second World War because those shores had became Yugoslavian, the Italian President referred to "the Slav project of annexation" of those lands. The reaction of Croatian President Stjepan Mesic was a surprise for all Italian political milieus: he accused Italy of "clear racism, historical revisionism and political revanche". The diplomatic crisis ended after a couple of days, friendly attitudes were newly expressed, since on the way to the EU Croatia has every interest in counting on Italy as an ally and not an enemy. But the fact that such an argument developed even between two of the least nationalist political figures bears evidence that the past is still a hot token to handle in this part of Europe. Among the ordinary people prejudices and stereotypes are quite widespread on both sides of the borders, in the Italian political debate the issue of lost

property of those who had to leave is still open, being precious in terms of electoral consensus even 60 years after the signing of the Treaty of Paris.

To some extent the same can be said about Italy-Slovenia relations. The Italian citizens living along the border are still careful to protect town like Trieste from any presence of Slovenian language, retaining their children to learn any Slav term. The opposite does not hold because all Slovenian and Croats living close to Italy are bilingual. So the linguistic barrier to cooperation will hold for some years, unless the teaching of Slovenian tongue would become compulsory school curricula in the Italian side, but at the moment this does not seem the case.

2.8 Political geography and domestic political games

Geography does not greatly assist with cooperation on maritime matters. In fact, Slovenia is closer to Italy, is part of the EU, and enjoys more efficient institutions compared to Croatia, but it has only a small access to the sea. On the contrary Croatia is a real maritime country, but it is not yet a member of the EU. However, the closure of membership negotiations for all chapters of the *acquis communitaire* is expected by 2009, while signing the Accession treaty would happen in the year after.[40]

If we look instead to the relations Slovenia-Croatia, we face a different and more unpleasant picture. At the beginning of the 1990s the two Republics then parts of the Federative Republic of Yugoslavia were allied in dismantling their ties with Serbia and the rest of Yugoslavia. Due to its position Slovenia obtained independence in June 1991 almost without violence and blood, whereas it took years of war for Croatia to achieve the same goal. After one and a half decade the two independent republics are pretty jealous of the newly gained state status obtained, and the nature of their neighbouring relations are therefore highly problematic.

As a symbol of this is the issue of the sea border, already mentioned. As recently as August 2007 the two Prime Ministers met in Bled, in Slovenia, to settle the question after 16 years of unsuccessful negotiations. In the past both countries have formally declared the Gulf of Piran their own maritime space. After the Bled conference, the situation seems slightly closer to a solution. The Slovenian request was to appeal to the Court for Reconciliation and Arbitrate of Organisation for Security and Co-operation in Europe (OSCE), whereas Croatian position was aimed to appeal to the Hamburg Court of Maritime Law. In fact the two parts agreed to appeal to the International Court of Justice of the United Nations in The Hague. On the way back the Slovenian Prime Minister found political support in his country, whereas the Croatian political circles seem less united in the backing of their head of government. The fact is that the issue is more important for Slovenia than for Croatia, since due to the narrow coast of the former, at stake there is not only the control over a portion of sea, but almost the possibility of an access to the maritime space.

The problem is made worse by other border discussions, by domestic political games in both countries, and by the entrance of Slovenia into Schengen area from late 2007. In fact, from the Italian point of view, the entrance of Slovenia into Schengen area, after its joining of EU and Eurozone, means the full integration and so overcoming of the eastern border likewise the Italian northern border with Austria and western one with France. But what is good for Italy in terms of future cross-border cooperation, is bad for the cooperation Slovenia-Croatia.

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[40] In the autumn 2007 the situation is that out of the 33 chapters of the acquis comunitarie, 13 have been opened and are being negotiated in Brussels, only two have been closed, and 20 have not yet been opened.

Before the border Slovenia-Croatia became a Schengen border it was not so tight. In 1994 the two countries have signed the Agreement between the Republic of Slovenia and the Republic of Croatia on Border Traffic and Cooperation (SOPS), which is a framework to enable small traffic across the border, giving custom advantages and opening non-international checkpoints[41]. Obviously, such framework clashes with EU norms, and so after becoming a Schengen border everyday life and also economic development in some rural areas could suffer from a tightening of the now Schengen border between the two countries.

2.9 Uneasy economic cooperation

A further problem for cross-border cooperation in the North Adriatic has to do with the economic sphere. There are two issues here: port activities and tourism. At the moment in these two economic fields there seems to be more competition than cooperation, at least with Italy. Port activities are a matter of economic competition between Italy and Slovenia, whereas summer tourism flows put in competition more Italy and Croatia.

Venice is obviously the first Adriatic port for passenger routes. But if we deal with cross-border cooperation, we had better to focus on the ports of Trieste (Italy) and Koper (Slovenia). From the times of the Austrian empire, the port of Trieste was the channel of goods between the Adriatic Sea and the Central European areas. Koper was almost unknown on an international scale. But as the figures show, in the most recent years the Slovenian harbour took advantages from the EU memberships and from the historical ties with the German-speaking world. For example, some Italian entrepreneurs of the coffee market found it more convenient, in part for fiscal reasons, to store their goods in the harbour of Koper, and to send them to Germany through Slovenian infrastructures. In this scenario a momentous event happened in 2000, when Luka Koper, the company managing the port of Koper, took the running also of the seventh pier of the port of Trieste. Such a move was framed by the Italian side as a case of cross-border cooperation profitable for both sides, but the experiment ended quickly, and the Slovenians went back to Koper.

In the case of tourism, the situation is more straightforward. Italian tourist actors are afraid of offering joint summer packages with Croatian partners, because a holiday in Croatia is still cheaper than one in Italy, even if the gap is being bridged year after year. Slovenia is more a tourist competitor for wellness, spa and gambling, since the latter is illegal in Italy.

Thus, economic actors from the Italian side feel threatened by the once small neighbour, and this uneasiness does not constitute the best base for a deepening of the cooperation. Anyway it is worth to recall here the experience of the so-called North AdriaticPAN (Northern Adriatic Ports Area Network), which is an organisation established after the international conference “EU and Cross-border Regional Cooperation: the Northern Adriatic Ports of Trieste, Koper and Rijeka” (Portoroz, Slo - September 1998) with the aim to implement the cross-border economic cooperation in the North Adriatic region, with particular reference to the transport infrastructure development and the cooperation between North Adriatic ports.

[41] It is revealing that it took seven years to get the SOPS ratified by the two countries. This entered in force only in 2001.

2.10 Need for equipment and technological updating

In general, the Italian Coast Guard officials interviewed regard as satisfactory and even redundant the technological equipment they employ for their safety responsibilities. In fact, a representative of the Coast Guard in Trieste stated that in the last budget bill (2006) passed by the Italian Parliament, the Coast Guard, together with the historic *Carabinieri*, were the only two military bodies not suffering cuts in their funding. This is due to the high rank given to the fight against terrorism, with the goal to 'make ports like airports'. These investments on sea policies even in times of national economic austerity had a consequence also on the technological component. According to the same interviewee in the last five years huge technological investments made maritime safety turn 'upside down'. In particular, he referred to the VTS that in the case of Trieste is covering also the Slovenian maritime space, and the Automatic Identification System (AIS) database. In the case of vessels carrying dangerous goods, the ATAMAT message system is used, compelling any ship carrying such goods to clarify its position at every passage of a parallel. In the case of SAR actions, the Coast Guard can now employ the last generation of Augusta helicopter, and – for Coast Guards involved in the fight against illegal migration in the South – also boats of the class 200, which means with a length of 25 metres and a speed of 40 knots.

By contrary, when it comes to other actors such as the civil protection organisation, at least in Venice one can testify for the need for more resources and better equipment. In the recent years Venice has witnessed the occurrence of a number of strong fires in its premises: for example the Coin Palace close to Rialto, the mental disabled people house of San Marco, and probably the most infamous, the complete destruction of the marvellous 18th century Fenice Theatre in 1996. These fires were so devastating because many of the 176 canals of the city have a level of water too low for the fire brigade boats to use. So water must come from the air, but on the night of the Fenice Theatre burnt down, 29 January 1996, there was only one airplane available, an old Agusta Bell 204, that made 123 runs carrying one thousand litres each time[42]. Today, after more than 10 years, the fire-fighting equipment of the city of Venice was increased to two airplanes: an Agusta Bell Ab 412, able to carry 29 people and one thousand litres of water, and an Agusta A 109 for the emergency transport of injured people, but with no water supply.

There are several technical solutions offered by practitioners as to how to update the technological equipment. The most far-reaching update, proposed among others by the deputy Commander of the Coast Guard of Bari, would be that the two fundamental instruments used in patrolling the sea, the AIS and the VTS, would be integrated. The AIS is the Automatic (ship) Identification System, whereas the VTS, Vessel Traffic Service, is a radar. The latter is able to 'see' any ship entering maritime space, but gives no information about it. All the information is given by the AIS system. The same interviewee offered a further suggestion: that the VTS should be integrated also into the European satellite-based Galileo positioning system.

[42] According to the regulations, the night take-off of such an old aircraft was in itself an illegal action, but as sometimes happens in Italy an illegal action is the only possible reaction in an event of emergency. See Il Corriere della Sera, 16th May 2007, p. 40.

2.11 Training and education has a key role

As a representative of the Coast Guard in Trieste remarked, one of the most important things affecting maritime safety is professionalism of the ship crew. In the 1980s, the ship owners reacted to the economic crisis in the field by cutting the expenses for personnel training. In particular, they abolished from the crew of many vessels the crucial figure of the cadet (*allievo ufficiale*), crucial as he normally becomes the future captain. Such reduction provoked a number of risks, since – according to the interviewee – "the first source of maritime safety is the leadership ability of the captain". Now the situation has changed in many regards towards the better. Higher education schools have been opened in Italy for maritime training both on board and on the land. But also changes in the normative framework fostered such a process: today every seaman must have an international certificate to start his service. Also the Paris Memorandum (Paris Mou) authorises now a Coast Guard to stop a vessel in the case its crew is undermanned or not sufficiently trained. Trieste Coast Guard makes such controls on regular basis. The consequence of such tightening of rules on personnel had positive effects in so far as the ship owners realised that it is in their economic interest to sail vessels complying with all regulations, since the costs for training and manning of the personnel is lower – according to the interviewee – than the loss of having the ship stuck outside port.

Similarly, for the frequent small collisions or fires, that happen at sea, a representative of the Coast Guard of Venice, Italy, blames the bad weather, the intense traffic, the bad conditions of many vessels, and the "heterogeneous composition of the crews of many ships", in the majority made up of "non-EU citizens". However, according to him, one of the weak points related to training and education is also the poor proficiency in English by the average Coast Guard employee.

2.12 Moderate level of citizen participation in maritime safety

As stressed in the introductory chapter of this book, the widely shared early warning ideology emanating from contemporary debate is that an early warning system must be people-centred, and also that the authorities should work with the public and learn from the public. Effective early warning systems should be embedded in the communities which they serve. This factor has to do with the legal aspect, but also with the safety culture, which should entail a willingness to submit to outside inspection and the sharing of safety-related information with outside inspectors and with the public.

But if we look at the North Adriatic case from this perspective, the level of public involvement in shaping the maritime safety actions looks moderate. On the one hand, the guidelines about risks connected with life at sea seem to come down from above. As we have seen, the Coast Guard is the body responsible, and in fact each local *Capitaneria* of Port periodically produces a so-called 'mappatura' (mapping) of the most important risks present in the area. The performance of such task, appointed to the body by the law, apparently occurs without an open dialogue with the civil society and public opinion living in that region. It seems mainly an affair of technical expertise, with priorities set by the institution of the national 'centre'. This applies in particular to security more than to safety issues. The Coast Guard officials perform today their duties as the Port State Authority with special reference to the international terrorism threat. In essence such efforts are never fully brought to light, and are usually exempted from participatory processes.

On the other hand, security from terrorism as a priority is at least something that relevant actors have in common across the borders. The interview with the port authorities in the small port of Pula in Croatia was revealing: two targets have been set for them, fight against terrorism and smuggling, mainly of weapons. But the point is that the security of Italian citizens in the North Adriatic is probably more threatened by the ramification of Calabria crime organisation Ndrangheta in the port of Monfalcone (due to the policy of social irresponsibility of the State-owned ship building Fincantieri company), or by the business realised in the network of Slovenia casinos by Sicilian mafia, than by Al-Qaeda.

Indeed there is more room for social participation in the action of the civil protection system, but as was already mentioned, the civil protection authorities have much less to do with the sea and with maritime safety and security. In fact, civil protection in Italy is one of the largest public organisations. For this reason it prefers to call itself an integrated system, rather than the public body in charge of civil protection. Even in a small region like Friuli Venezia Giulia (1,000,000 inhabitants), according to an interviewee representing the local civil protection authority, it can count on tens of thousands of people, the majority of which acting on volunteer basis. In Venice, for instance, all volunteers employed by the civil protection are given 'individual protection devices', comprising a life jacket, high intensity light bulbs, GPS, radio, and for the team a special boat. The structure of the system is then capillary, and present in any village. For ordinary citizens it is probably more likely to join the civil protection in their leisure time than many other cultural and even sport clubs.

2.13 New infrastructures with a remarkable environmental impact

The North Adriatic is presently an area of new infrastructure projects. Probably the most discussed today not only on the Italian side are the two Liquefied Natural Gas (LNG) terminals, whose building the Italian government has recently authorised in the area of Trieste. Italy has a compelling need to find power supplies different from the oil it imports, and, having rejected the nuclear solution, the LNG facilities are heavily pushed by the national government[43]. Only one LNG terminal is now functioning in Italy, and 10 are under consideration. Of these five would be situated in the Adriatic Sea: Brindisi (close to Bari, Puglia region), Ravenna (Emilia Romagna), Rovigo (Veneto), Trieste industrial area, and the last one with the peculiarity of being offshore, in the middle of the Gulf of Trieste. Both the LNG of Trieste onshore and Grado offshore would be built by Spanish companies: the former by *Gas-Natural* and the latter by *Endesa*.

Having such terminals affects not only the facility itself but even more the tankers that it would bring into the small Gulf of Trieste. The local population and environmental non-governmental organisations oppose the projects. They have found backing from sections of local political elites, in a way recalling the well-known NIMBY ('not in my backyard') syndrome. Whatever the conclusion of this confrontation, it is convenient to underline that an essential precondition for the successful early warning is the high level of civil society self-organisations.

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[43] Italy imports power from nuclear plants in France. Slovenia too has a nuclear plant in Krsko. Italy is importing power from a number of countries, not only from France but also from Austria and Greece. In 2004 a huge power cut and black out occurred in Italy, darkening half of the country. It was due to the fall of a tree in Switzerland.

However, from our cross-border perspective there are two notable points. One is that the project for an offshore terminal has met with opposition from the Slovenian government. This facility would remain completely within Italian maritime space, so that Slovenian opposition would have no legal basis. It is difficult to foresee whether those parts of Italian civil society campaigning against the terminal would see in the Slovenian position a positive occasion to bridge gaps or a chance to nourish old anti-Slav feelings.

While Slovenia is against the Italian LNG offshore terminal, it is considering the construction of a similar infrastructure on its own territory. The Croatian government has also decided to build a LNG terminal, on the island of Krk, in the gulf of Rijeka.

In Italy, the opponents to these terminals seem politically stronger than those backing them. The opponents frame their grievance not only in terms of nature protection, but proved able to make advantage also of today's great 'discourse': terrorism. Though in 1972 Black September, the Palestinian group, attacked the oil pipeline to Germany in the vicinity of Trieste, those opposing the LNG terminal off-shore maintain that such new infrastructure would be a perfect candidate for an Al-Qaeda shock-and-awe action.

3. The Gulf of Finland

This section examines the marine traffic situation in the Gulf of Finland, but especially what was done in order to enhance safe navigation and to prevent accidents. Through an analysis of cross-border cooperation between Estonian, Finnish and Russian maritime authorities a picture is being drawn about the forming safety culture in the region.

3.1 The physical setting

The Gulf of Finland forms the 400 km long easternmost part of the world's largest area of brackish water, the Baltic Sea. The shores of the Gulf are occupied by a fine grain archipelago, especially in the Finnish side of the Gulf. There is also an extensive archipelago in Russian territorial waters, adjacent to the Karelian Isthmus. The Estonian shores lack an extensive archipelago, which is the consequence of sand and lime stone bed rock found in the area. However, in the westernmost part of Gulf of Finland there are two large islands, Saaremaa and Hiiumaa, belonging to Estonia, whereas the Northern shores of Gulf of Finland are formed of granite and other old bed rock minerals, making the area rich in small islands.

The criss-crossing traffic of oil transports and passenger traffic in the Gulf of Finland constitutes a major challenge for the surrounding countries. The volume of oil transport is especially heavy in the Gulf, and the volume of transported oil will increase in the future. In case of an oil accident the most affected countries would be Finland, Estonia and Russia. If an oil accident should take place in the Gulf, the areas occupied with extensive archipelago are the most sensitive. Collecting oil in a fragmented archipelago is much more difficult than on a straight shore line. Fact box 4 covers facts about the Gulf, whereas Figure 6 shows the geographical peculiarities of the area.

Fact box V—4 Facts about the Gulf of Finland. (Merentutkimuslaitos 2006 and Sonninen et al. 2006)

Physical dimensions:

- Approximate length 400 km
- Width 60-135 km
- Maximum depth 60 m
- Average depth 37m (Neva Bay only 5-10 m)

Environmental indicators:

- Brackish water, salinity ranging from 0,4 % in the Neva Bay to 1,1 % in the Western part of the Gulf of Finland (in the Atlantic Ocean 3,5 %)
- Bottom layers of water are oxygen free (lifeless layer) and surface waters occupied yearly by algae blooms due to excessive nutrient load
- Partly ice-covered from December till April

Furthermore, the Baltic Sea is highly vulnerable and was identified as the Particularly Sensitive Sea Area (PSSA) by the International Maritime Organization (IMO) in 2005. All Baltic Sea states are included in this agreement with the exception of Russia (IMO 2007). This nomination means that special protection measures should be taken in order to guarantee that the vulnerable ecological or socio-economic situation in the area, and to protect it against damage by international maritime activities. Due to the land-locked character of the Baltic Sea, it is easily polluted for long time periods.

3.2 Increasing oil transportation

The EU's external dependence on energy is increasing in which the Russian oil transported by sea plays an important role. Many estimates say that the overall traffic and the transportation of potentially hazardous cargo, especially oil, have more than doubled since the late 1990s. This has increased the volume of traffic and made the traffic routes increasingly congested, especially during winter. Furthermore, the role of the Gulf has increased since Russia wants to transport oil through its own ports, thus diminishing the importance of Baltic States as oil transit countries. This will most probably be the trend in the future (Ministry of Transport and Communications of Finland 2005).

In addition to its increasing oil transportation traffic, the Gulf of Finland was burdened by heavy passenger traffic, especially between Helsinki, Finland, and Tallinn, Estonia. In 2005 this traffic comprised of 40,000 vessels (HELCOM 2006a), both passenger and freight transport. The narrow and shallow geographical conditions of the Gulf of Finland makes the Gulf a high level risk zone. This means that in case of an accident the consequences would overrun the so-called first-order consequences of environmental degradation and might have economic and even political ramifications. (See Figures 7-8)

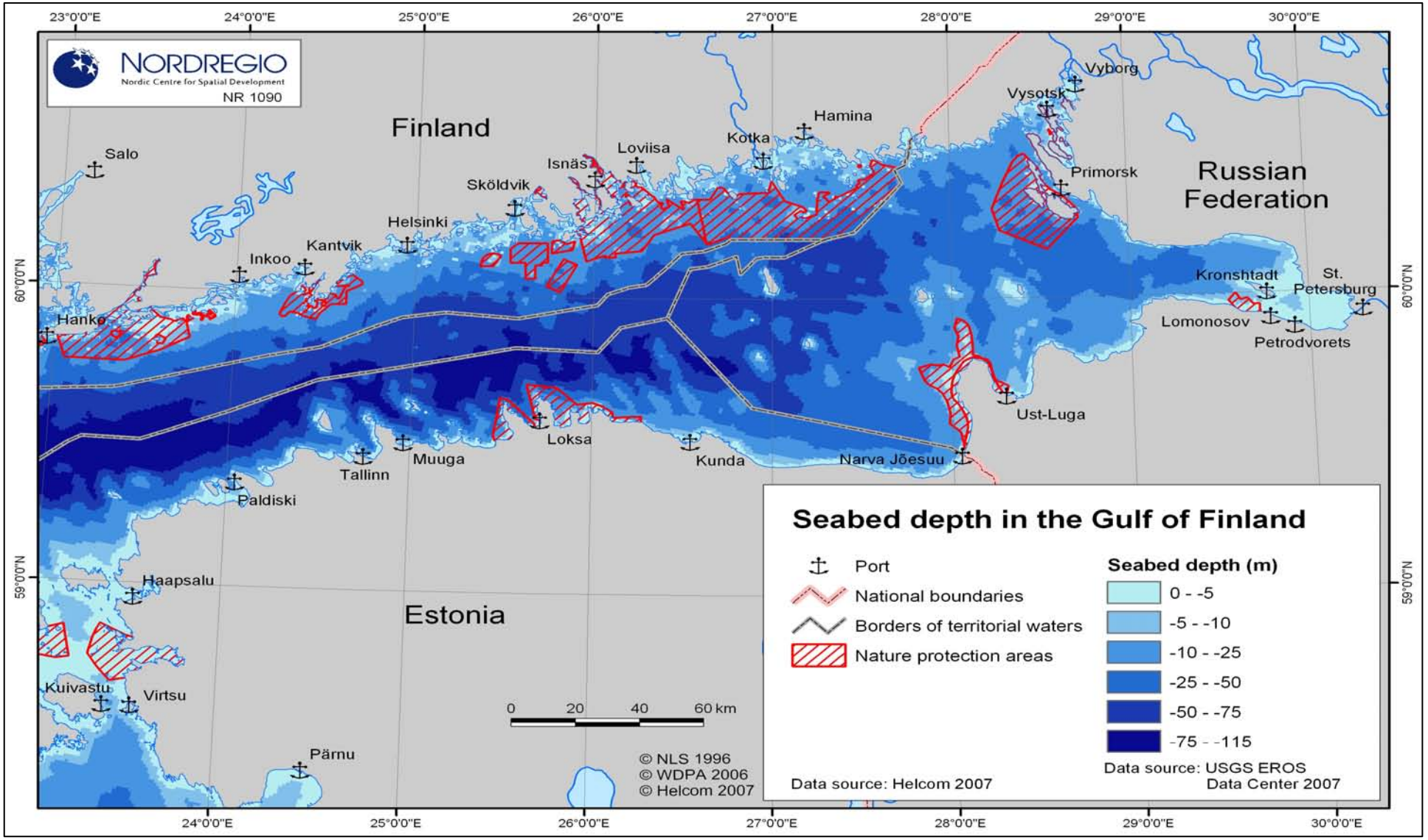

Figure V—6 The contour, nature protection areas and the most risk-prone areas of the Gulf of Finland.

The oil transportation by tanker within the Gulf of Finland is seven times greater than it was ten years ago. Among the 11 largest oil terminals in the East Baltic five are situated along the shores of Gulf of Finland. They are Muuga, Primorsk, Porvoo, Naantali and St Petersburg (HELCOM 2006a). Oil exportation via the Gulf of Finland has increased drastically with the opening of the new oil terminals.

Both the number and size of oil tankers have been growing steadily in the recent years. According to HELCOM (2006b), by 2015 an increase of 40% is expected in the volume of oil shipped yearly on the Baltic Sea. Other estimates are even greater than this, and they are related to the fate of the *Druzhba* oil pipeline that runs through Byelorussia to Central and Western Europe. If this is closed, as was mooted in Russia, the volume of oil transports in the Gulf will step to a totally new level. Currently the figure is 160 million tonnes of oil per year. In addition, the use of bigger tankers, carrying 100,000-150,000 tonnes of oil, is expected to rise (Vainshtok 2007). The consequence is a lower risk probability due to the reduction in traffic volumes, but higher risk of a major scale accident, because of the vast amount of oil transported in one vessel. (Figure 9)

The Gulf of Finland has not been faced with a large scale oil accident yet. However with the average figure of shipping accidents annually being around 140 and increasing every year (Vainshtok 2007), the odds are that a serious accident will happen. This would naturally be a great shock in view of the ecological fragility of the Baltic Sea.

3.3 The present safety systems in vessel traffic control

Maritime traffic safety-enhancing legislation comes from the EU and eventually the IMO, but the working procedures (traffic surveillance and control) adopted by marine safety authorities of all three countries have been gained through cooperation on a professional practitioners' level. Thus, the role of regional cooperation is accentuated in enhancing the Baltic Sea energy transportations safety. It seems that this type of informal cooperation, in the sense that the cooperative steps taken are not in any way bound or dictated by the law, and are more a case of 'harmonizing by doing', may be the best way to deal with an international shipping fleet that operates according to different environmental, technical and social standards.

One example of effectiveness of this kind of professional level cooperation is the working out of a Document of Joint Procedures (DJP) in relation to the adoption of the Gulf of Finland Mandatory Ship Reporting (GOFREP) system. GOFREP was developed to match the safety needs in a sea that has experienced rapid growth in vessel traffic, and DJP is the handbook on how to make operational and put forward the GOFREP system (e.g. synchronisation of tasks, responsibilities, procedures in relation to the technical system). The central idea with GOFREP is to gather information on ships, their cargo and routes, so that the authorities responsible of vessel traffic control (Estonian, Finnish and Russian maritime authorities) will have information on ships navigating the Gulf of Finland. In addition, the ships that are about to enter the GOFREP area have to report via radio to the operator centre, and the operators have the possibility to warn and give advise to the ships about various situations (weather, ice, other vessels, manoeuvrable routes etc.) in the Gulf.

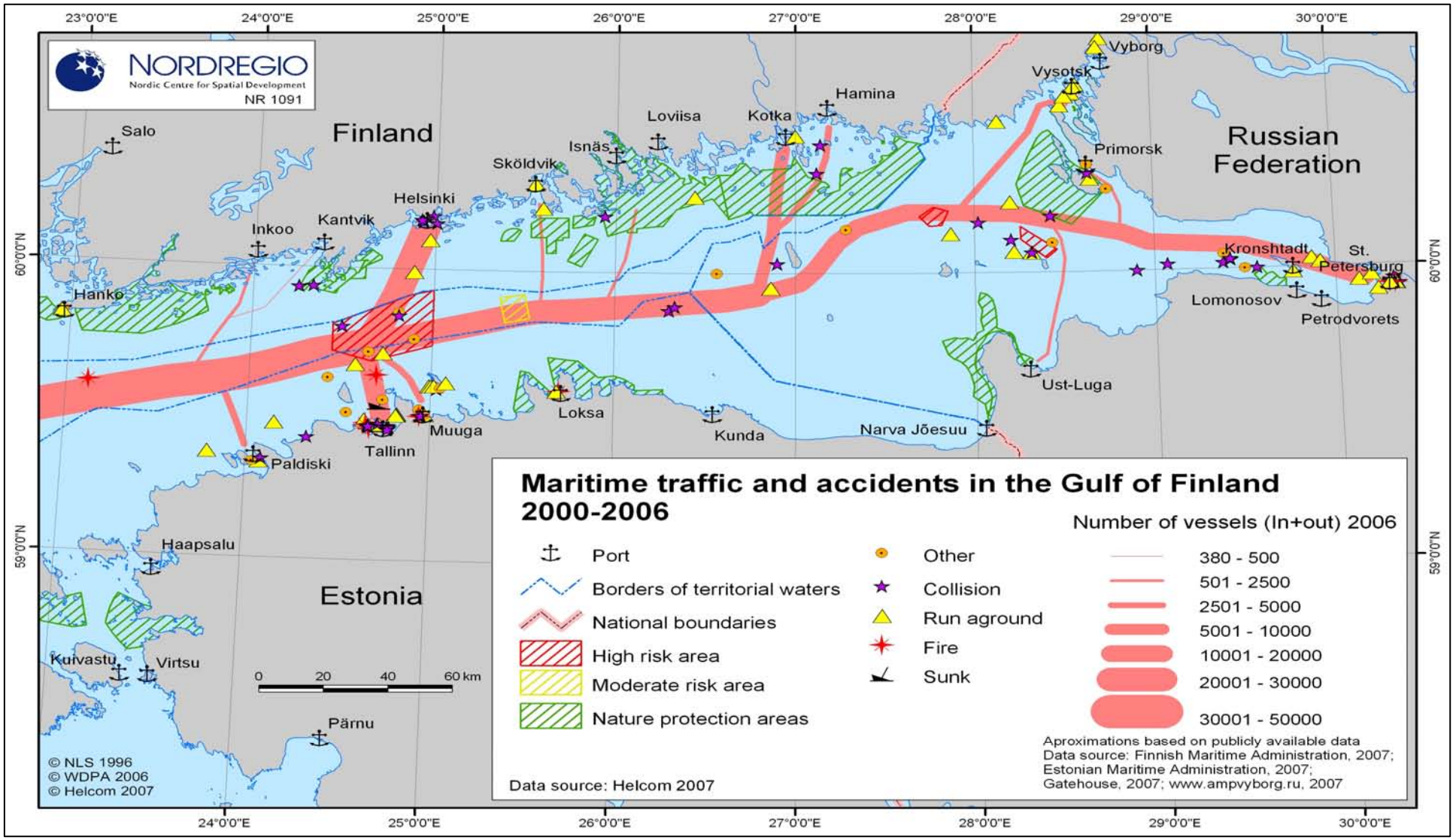

Figure V–7 Traffic volumes and routes in the Gulf of Finland.

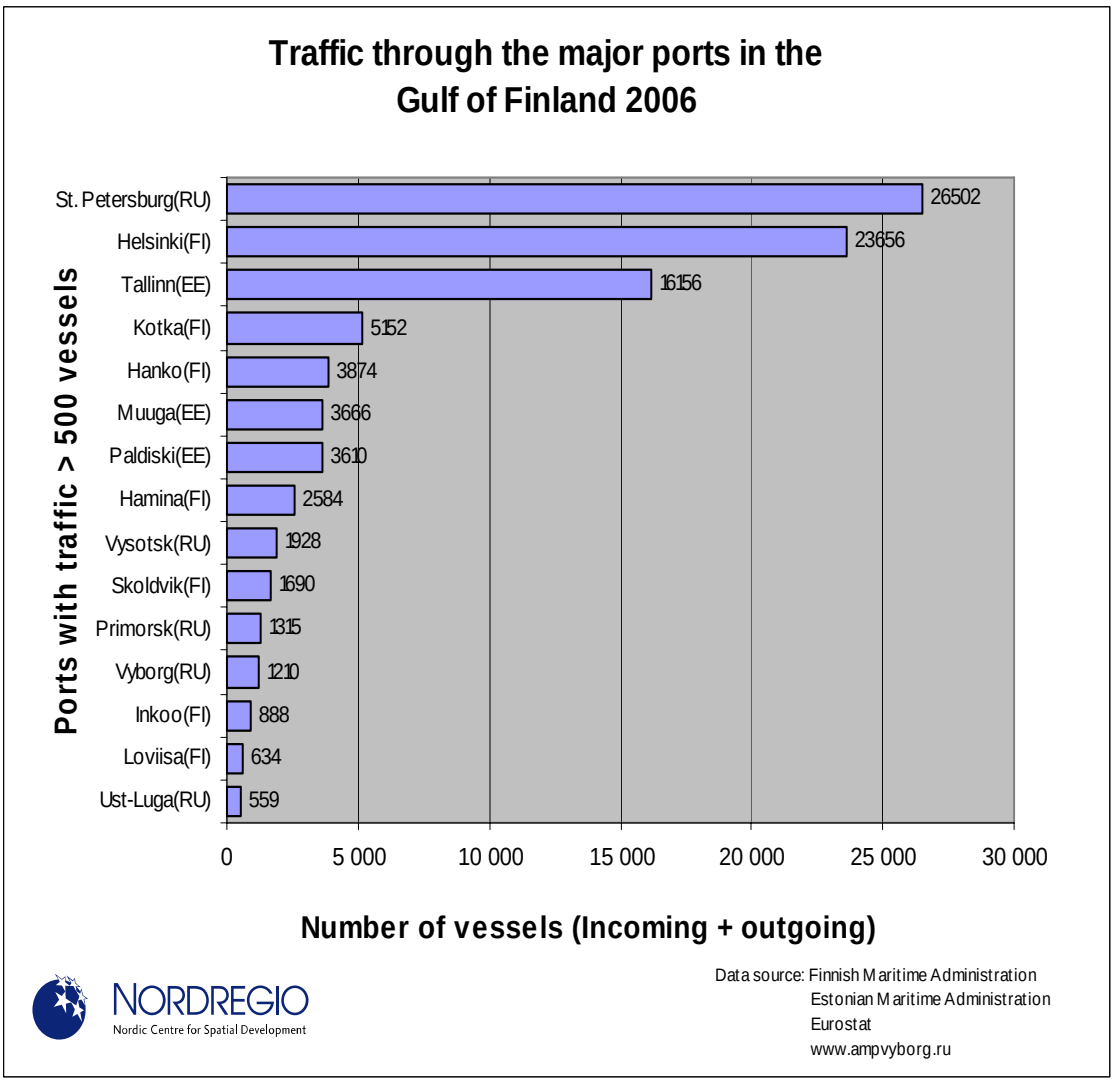

Figure V—8 Major ports in the Gulf of Finland area measured by the amount of entering / leaving ships.

The international water of Gulf of Finland, which equals now to GOFREP area, was divided into three areas of responsibility (see Figure 10). Southern part and east-bound route (ships entering the Gulf of Finland from the West) is controlled by the Estonian operator centre, the Northern route is controlled by the Finnish and the easternmost strip of international water is controlled by the Russian operation centre. This easternmost strip was annexed into the GOFREP system on 1 July 2007. A major part of the eastern Gulf of Finland is under the jurisdiction of the Russian national vessel traffic service system. The Northern route of the Gulf is crucial when it comes to the safety of oil traffic. Fully-loaded oil tankers, which have started their voyage from the Russian oil ports on the Karelian Isthmus or St Petersburg, travel along the coast of Finland, including during winter, in difficult ice conditions. In addition to the Russian part of the route, this lane of the maritime highway is the most risky.

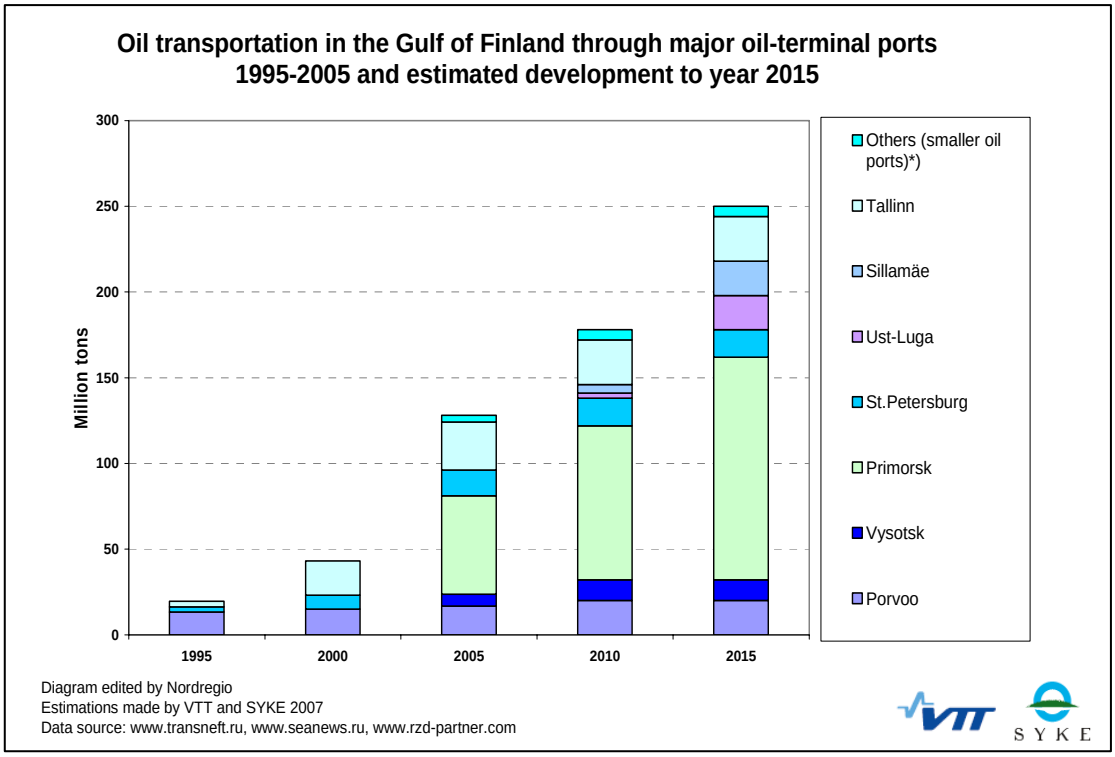

Figure V–9 Oil transportation volumes in the Gulf of Finland, and estimates for years 2010 and 2015.

The hard core of the safety-enhancing system was agreed between marine authorities, by consolidating the DJP, although the adoption of the GOFREP system itself is mandated through IMO. That is, most procedures that guarantee safety in the Gulf are based on agreed procedures. In this light, the most important feature in safety cooperation is the day-to-day joint work between the professional maritime safety authorities of the three countries, concentrating on the fine definition of work procedures and not the political decisions of a higher administrative level. As a result, the duties agreed in the DJP go much further than the IMO GOFREP obligation demands. Success in this field levels criticism at IMO policy, which excessively concentrates on ship safety and not on traffic control systems. There is an increasing need for such systems globally.

As a result, when considering the proportion of different types of risks in maritime transport in the Gulf of Finland, modernisation of technical and navigation technology is not by far the only thing to emphasise. Even more important would be to put weight on the administrative (and political) decisions, which enhance sea traffic safety much better. For example, decisions widening the GOFREP system into a demanding one, that is, practically making the Vessel Traffic Service (VTS) an obligatory procedure in the whole area would increase sea traffic safety considerably in the Gulf of Finland. The Estonian, Finnish and Russian VTS systems, which are in use in their national waters, is not at all wide spread in EU Member States' waters.

Estonian, Finnish and Russian maritime authorities are trying to put forward, through national ministries of transport and eventually the IMO, a developed version of GOFREP and a common VTS for the entire Gulf of Finland. High hopes exist that this would be operational in the Gulf of Finland in 2008. At present the VTS system is functioning only in national waters, which means that ships entering the national waters are more profoundly under a direct control of the operational centres than the

ones navigating in international, GOFREP mandated water. The GOFREP system was adopted in 2004, and its development was a result of intense cooperation between the maritime authorities of these countries.
The above-mentioned technical and system-based solutions can avoid only a part, albeit a big share, of the risks in marine traffic in the Gulf of Finland. The specific winter time conditions (Figure 11), especially the difficult ice conditions from January until April, form a central part of risks for traffic in this area. Navigation in ice is difficult, which accentuates the role of the human factor in vessel traffic safety. For example, when vessels manoeuvring in the Gulf of Finland are given the coordinates of icebreaker routes this information always refers to a situation that has already passed, and thus the open route on the ice might have changed. Heavy vessel traffic also forms queues of ships that line up after ice breakers, which multiplies the risk for rear-end collisions. The risk of collision is the greatest when smaller and bigger ships form these queues. Vessels and tankers of greater tonnage cannot stop at short distances, whereas smaller ones can. All these risks are part of the 20% of risks induced by human factors, which cannot be erased at the moment by technical solutions and systems. However, the cooperation around safety issues and the establishment of the GOFREP system between Estonian, Finnish and Russian maritime authorities has enhanced also this ice manoeuvring safety, despite its above mentioned deficits.

3.4 Development of a specific safety culture

Preconditions for cooperation

Finnish maritime authorities have been by far the main forerunners in developing safety-enhancing agreements and procedures in the Gulf of Finland, since most development proposals that have eventually led to upgrading of safety enhancing systems have come from the Finnish authorities. This is confirmed by all three parties in this cooperation. Despite similar staff resources and similar levels of expertise among marine authorities in these countries, Finland seems to have the strongest interest in developing maritime safety in the Gulf of Finland area. This Finnish interest has resulted in a professional working culture where the limitations and advantages in the field are well known. This safety cooperation would have stagnated without Finnish initiatives, but once the discussions about a specific topic are under way the cooperation was supported by all parties and thus successful.

Naturally, all that is agreed in safety cooperation does not guarantee similar safety practices in each country, especially when one considers the areas outside the GOFREP area, that is, national waters of each country. A ‘good‘ example is the running aground of the oil tanker M/T Propontis, discussed below.

Preconditions for Estonian-Finnish cooperation are, however, on a much better level than cooperation with Russia. This is a result of, firstly, long traditions in common education and development projects funded by these two states and the EU (e.g. common education for vessel traffic operators, the coast guard and ice breaker personnel). Secondly, Finland and Estonia have a common sea border, with only a narrow strip of international water between these countries. Most of the cargo and tanker traffic travel along both the Estonian and Finnish coasts and passenger and cargo vessel traffic is exceptionally busy between Helsinki and Tallinn.

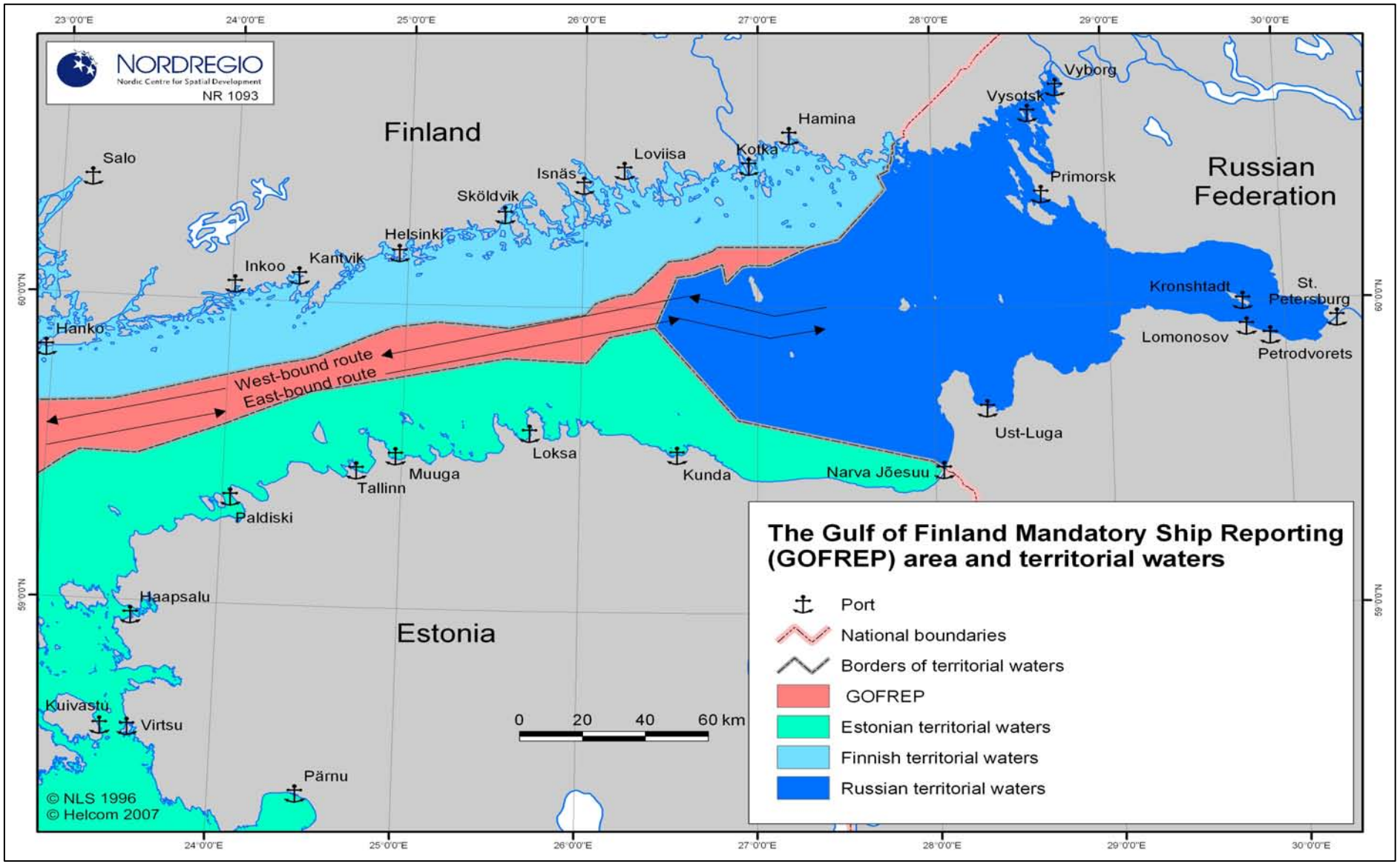

Figure V–10 Division of territorial waters and the GOFREP mandated international water in the Gulf of Finland.

Consequently, the maritime authorities of these countries share information on vessel traffic on an hourly basis. Also the administrative structure in Estonia and Finland in maritime administration is almost the same, whereas the Russian cooperative bodies include representatives from the Ministry of Transport (Moscow) and its regional departments (Rosmorport in St Petersburg), but also experts from Marine Research Institute (St Petersburg). The latter body has a formal role in the Russian structure, despite its academic position.

Russian maritime authorities have been quite passive what comes to new ideas about the development of safety in the Gulf of Finland and about how to enhance cooperation. This fact can be partly explained by the fast rate of changes among Russian authorities with whom the Estonians and the Finns are trying to cooperate. However, the Russian side has *not* been reluctant to proceed with the cooperation, once an initiative was raised on the agenda. Lately the Russian side has also been keen to develop their safety enhancing procedures and the whole safe navigation system. Unfortunately, boost for this came only after the M/T Propontis accident.

The lessons of M/T Propontis

The running aground accident of the 100,000-ton oil tanker M/T Propontis took place in the Russian territorial waters, near the Suursaari Island, in February 2007 (e.g. Schönberg 2007; Helsingin Sanomat 2007). This accident should have been avoided if marine transport surveillance would had been on the same level as was agreed in the framework of GOFREP cooperation. The Russian VTS operators should have warned the crew of M/T Propontis, since for an half an hour she was travelling on a shipping lane too shallow for her draught. All the information needed to trace the conflicting situation was available. According to the Finnish maritime authorities this should have been spotted by the Russian VTS and GOFREP operators. However, in addition to the ship's crew, the safety securing function was in the hands of the operators and no automatic warnings were produced.

The aftermath of the accident saw extensive activity, despite the fact that at the official level there was no maritime declaration from the Russian side. On the professional, hands-on cooperation level, however, the accident has produced a range of technical and procedural specifications, which are now leading to new policy recommendations towards national ministries of transport and IMO. The Finnish maritime authority has even started to use the concept 'Propontis-generated measures' to describe the many innovations that are being put forward after the accident. Some are related to operators hands-on work and, for example, to the watertight use of computer software capable of producing automatic warnings, but others range all the way to international marine legislation concerning Gulf of Finland shipping.

First, the Russian vessel traffic operational centre has increased its manpower. One reason for the accident was that one operator had too large a water area and too many routes to follow. The St Petersburg-based centre has now two persons covering and surveying the same area, which was previously covered by one. In addition to reducing risks in the human factor sphere, the technical systems have been upgraded: the software that gives automatic warnings in conflicting vessel/route situations was made obligatory in all Gulf of Finland vessel traffic centres, including the St Petersburg centre. This software was available in the St Petersburg centre, but not in use when the accident occurred.

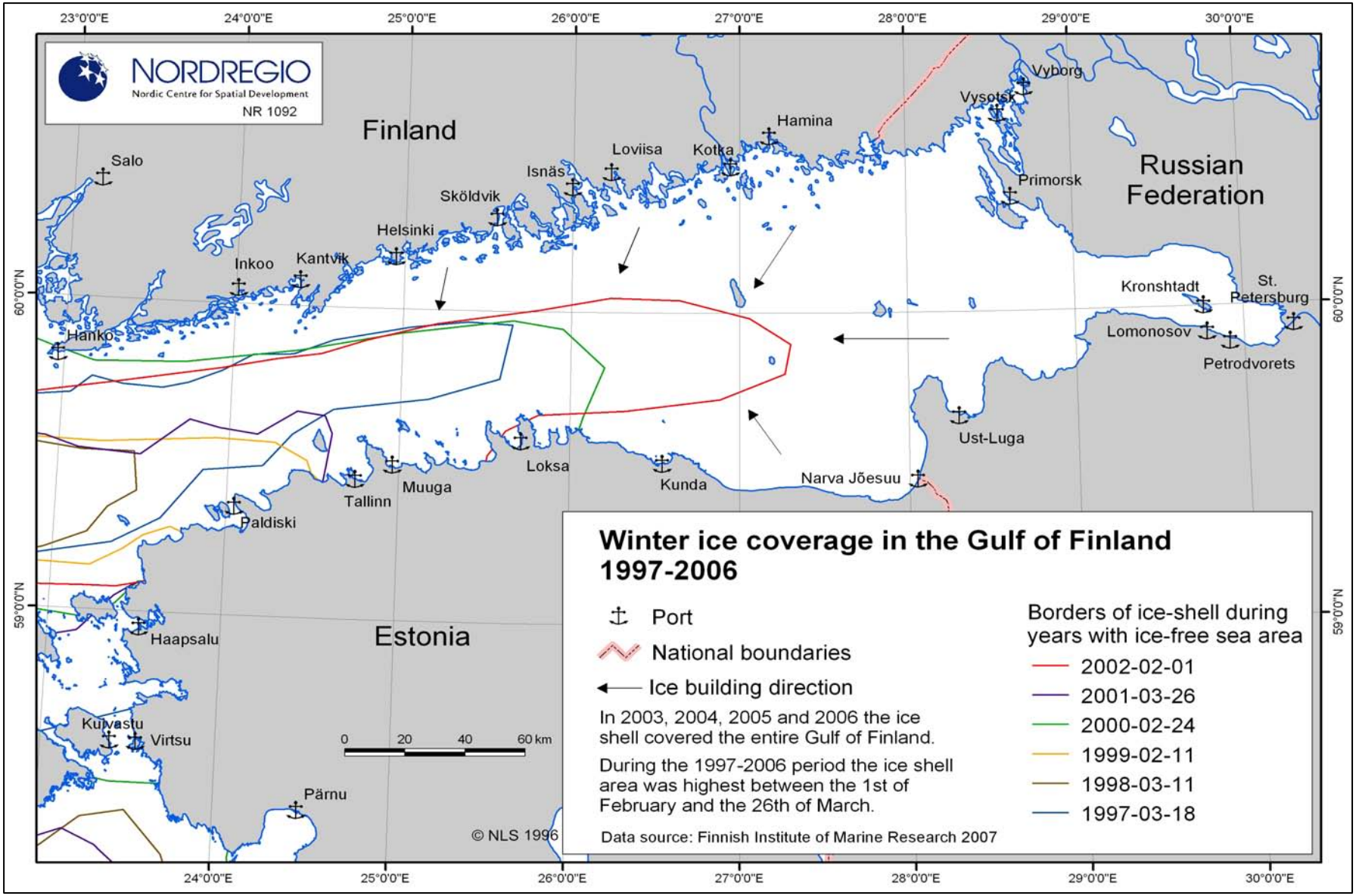

Figure V—11 Ice conditions in the Gulf of Finland.

Also, the objectives, more related to political decisions to develop the GOFREP and territorial VTS systems further, have popped up on the maritime safety cooperation agenda with a more profound force than before. The Propontis affair is exemplary, and the objectives of the maritime authorities to develop GOFREP into an intelligent system now have a strong tailwind. The Finnish maritime authority has proposed significant procedural and technical innovations to be taken into use in the GOFREP framework, which has several positive impacts for marine safety in the Gulf of Finland.

The main novelty in the new system proposed by the Finnish maritime authority is the obligation of ships to feed an exact route plan into the GOFREP system. Navigation on this route will be bind to time and space, i.e. a ship must be on an announced geographical location at an announced time. The control system will be automatic, so that the system will constantly compare the announced route plan of the ship and its real-time location. If a ship is not following the announced route plan, the system will give an automatic warning, which will be forwarded from vessel traffic operator to a ship. Another plus of this kind of automatic surveillance system is its predictive ability. The routes of all ships manoeuvring in the Gulf of Finland are placed in the system, and in a near future projection of ships' locations the system will give a warning, if the routes (vectors) of the ships are conflicting with each other, i.e. ships are on a collision trajectory.

Overcoming political differences

Despite the shortcomings, the Estonian and Finnish maritime authorities have been successful in building a reliable platform with the Russian party on which the safety of marine traffic greatly relies on today. This cooperation has managed to build a culture of reliability, at least on the collegial level. Therefore, Estonian and Finnish maritime authorities see that on a professional level the cooperation with Russia was fruitful. All cooperating parties have a pragmatic and professional attitude on the matters they are trying to enhance. Unfortunately, on wider and more profound questions these parties often have a totally different viewpoint, that is, when national ministries are involved in agenda formulation. This can probably be explained by the great power position of Russia, when it refuses to go forward with the cooperation having a EU based agenda as a point of departure. In practical cooperation this can be seen in the way the same maritime authorities in the three countries have a markedly different authority to decide over matters discussed. Estonian and Finnish maritime authorities have a far wider authority to decide over agenda formulation in the cooperation than the Russian counterpart, Rosmorport.

Despite the convergence of many vital objectives in marine safety promotion, it seems that Russian safety culture is still quite different from those of Estonia and Finland. This view is hard to prove, but is relatively conspicuous, for example, when one compares the amount of ships an ice breaker takes in her convoy. A Finnish ice breaker takes a maximum of three ships in its convoy, which is through professional practice defined as a safe amount, whereas a Russian ice breaker can take up to seven ships in its convoy. The more ships you have in a convoy, the greater the risk of a rear-end collision.

The Estonian maritime authorities consider that the Finnish maritime authorities and the safety system they have produced are transparent. Estonians, representing a relatively new state among European nations, have used the Finnish administrative structure and traffic control as a model.

The Russian system is quite different. Russia is politically and administratively more centralised, and there is a great uncertainty about the role and decision-making power of maritime authorities. This concerns authorities on different levels, too. The Estonian view is that the Russian authorities interpret jointly-agreed regulations in a too rigid manner, which makes it difficult to keep the system transparent and functioning. The only practical way to diminish the risks brought along by the different interpretations of regulations would be to have a constant dialogue among maritime authorities of these three countries, a practice that was sustained especially by the initiative of Finnish maritime authorities.

However, the Russian maritime authorities are as professional as their colleagues in Estonia and Finland. The quality of the Russian personnel is easily overshadowed by the political level decisions that have been taken several times on not following EU-initiated safety procedures. On the other hand, the maritime safety system Russia has developed is based on strict sanctions dating from the Soviet times. It has approved so far more or less successful to battle sea safety risks. What has to be bore in mind is that not even Russia or its predecessor Soviet Union have had such vast oil tanker traffic intensity in such a small geographical area, if the projected volume of oil is to be transported from Karelian Isthmus through the Gulf of Finland.

All in all, the close cooperation between Estonian, Finnish and Russian maritime authorities has proved to be fruitful and innovative in character. A proof of this is the great interest of Swedish and Danish maritime authorities towards the DJP in relation to GOFREP that was agreed between these three countries. Denmark and Sweden are building up a similar reporting system, mainly the Danish Straits in mind. In this sense the DJP, the 'marching order' how to operationalise GOFREP procedures, is a product that has a good possibility to be copied and transferred to other sea areas, in the EU and even globally.

This cooperation based traffic control is unique in the world, since elsewhere costal states are taking care of their own territorial waters, but not extending the traffic control beyond national waters. In this sense there is a unique regional culture of reliability in the Gulf of Finland, especially taking into account the different political contexts these countries are positioned in and the historically troublesome relations between these states.

4. Conclusions

The Adriatic and the Baltic regions are excellent comparative case studies because an ambivalent condition of inclusion and exclusion from the European dimension can be observed. On the one hand, they are border seas situated by EU's external frontiers while on the other they are truly European, inner, maritime spaces that both divide and connect European countries. The Baltic and the Adriatic regions reveal a set of common socio-cultural and political-economic issues that are extremely significant in the European perspective for the coexisting dynamics of European integration and post-communist transition constantly interact and overlap.

In comparing the North Adriatic Sea and the Gulf of Finland from maritime safety and early warning perspective, we may discuss both similarities and differences. The obvious similarities are well known to us before embarking in this study, and so those that made worthwhile to compare the North Adriatic and the Gulf of Finland. These similarities refer to the physical characteristics of the maritime spaces – both the North Adriatic and Gulf of Finland are internal waters rather than open sea – but even more they refer to the political features of the lands overlooking those maritime

spaces. In fact, in both cases the lands belong to different countries – making thus cross-border cooperation a key issue in the view of enhancing maritime safety – and, more important, in both cases these countries belong to different political systems. In the North Adriatic case, we have a founder of the EU (Italy), plus a new member (Slovenia), and a non-member (Croatia). In the Gulf of Finland case, we have an older member of the EU (Finland), a newer member (Estonia) and a non-member (Russia)[44]. A further point in common is that in both cases we have countries that up to the recent past used to be united: Slovenia and Croatia were part of Yugoslavia, and Russia and Estonia were part of Soviet Union. The latter point is significant from the cross-border cooperation perspective.

If we compare risks coming from the natural features of the two maritime spaces, we probably have to begin with a difference. While the situation in the Gulf of Finland is characterised by difficult winter-time ice conditions, it is no surprise that ice conditions are not an actual risk to the navigation in the North Adriatic (albeit the lagoon spaces present in the Gulf of Venice have been exposed to this natural event a couple of times in the record).

In terms of the fundamental human action in the maritime traffic, we find a remarkable similarity. On the one hand, the port of Trieste (Italy) has become the first port of Mediterranean for the amount of oil traffic, and this due to the presence behind the city of the terminal of the pipeline to Germany[45]. On the other hand, the Gulf of Finland study begins precisely with a focus on the Gulf as a context for oil transportation that has increased greatly in the last period due to the opening of new terminals in Russia. Thus, the most threatening risk to maritime safety in both areas is the increasing risk of major oil spills.

Regarding the human actions to guarantee maritime safety in both areas, the factor of cross-border cooperation becomes important. Apparently a higher level of cooperation does *not* exist between the countries once united, that is, in the North Adriatic case between Slovenia and Croatia, and in the Baltic Sea case between Estonia and Russia, but amongst countries separated up to recent past by 'systemic' cleavages: Italy and Slovenia, Finland and Estonia.

Here again, we must distinguish the three Gulf of Finland parties from the three North Adriatic ones. In fact, the relations between Russia and Estonia during the era of the Soviet Union were pretty different from the relations between Slovenia and Croatia at the times of Yugoslavia. The former was very much a case of master-servant relation (centre-periphery, empire and dominion), and so it is no surprise that such a past could leave in Estonian people little desire of cooperation. But the relations between Slovenia and Croatia were quite different, almost a case of brotherhood in the common fight for freedom from the centre. Actually Slovenia and Croatia, in historical perspective, are like Estonia and Latvia, or Lithuania. Therefore the poor level of cross-border cooperation between them (whose symbol is the never-ending negotiations on their maritime border) is a peculiarity of the North Adriatic situation that undermines the possibility of cooperation also with Italy. A number of reasons can be given to explain the persistence of such a situation. Among them, the inter-Yugoslav war of the 1990s and its contested institutional effects, the historical impact of the 20th century's dictatorships and their expansionist strategies, the weakness of democratic institutions certainly represent the most important variables

[44] Evidently we cannot compare Croatia and Russia because Croatia is willing to join the EU. This is the reason we refer here to similarity and not identity.

[45] Moreover, the port of Venice (Marghera) used to be, up to few years ago, the largest petrochemical pole in Europe, and this is again linked to oil traffic.

to understand the 'politicised' nature of cross-border cooperation in the North Adriatic. On the contrary, cross-border cooperation in the Gulf of Finland seems more oriented to functionality, or 'professionalism', for social and historical reasons but also for the urgent need to cooperate strictly on environmental issues in a sensitive area for traffic transportation and pollution risks. In other words, the good historical record of the Nordic cooperative culture (from Hansa to the present institutionalised Nordic cooperation) only partly explains the differences between the contexts of the Gulf of Finland and North Adriatic. There are concrete and contemporary reasons to pursue the maritime safety as a common good in the Gulf of Finland, mostly depending on the centrality of this area for energy flows and maritime traffic.

Thus, the level of cooperation seems higher in the case of the Gulf of Finland than in the North Adriatic one. As evidence we report the example the fate of the tripartite agreement on environmental protection: it was signed by three ministries of the environment (Italy, Slovenia, Croatia), but so far the signing has not been followed by regular meetings of the committee envisaged by the agreement. The only turning point for cross-border cooperation in the North Adriatic would be the entrance of Croatia into the EU, which is expected to occur in a couple of years. As known in the field of risks and civil protection, the only other event that could significantly boost the cross-border cooperation in the North Adriatic would be the happening of a major and dramatic accident involving loss of human lives and/or severe damages to the environment. The sinking of MV Estonia in 1994 produced a tightening of safety regulations in maritime traffic (as it was recalled also during the fieldwork in Italy). However, we have no elements to support the likelihood of such an event in the North Adriatic, which is more exposed to the risk of oil pollution.

Another factor in the area of human actions is the role of technologic equipment. We have detected overall similarities in the technological devices employed both in the North Adriatic and Gulf of Finland: we refer mainly to VTS (Vessel Traffic Service) and AIS (Automatic Identification System). Actually, in the case of the North Adriatic, this equipment is not yet fully operational, and still needs to be integrated: this holds true for Italy, but especially for Croatia. Anyway, the political will to invest even more in the technological updating of this type is clear on the part of the Italian government. In the case of the countries of the Gulf of Finland they have developed a more advanced ship reporting system (GOFREP). But, as is made clear above, not even the GOFREP is a smart system, and in terms of prevention it could be upgraded.

All in all, the most striking difference, between these two cross-border cooperation and sea areas, seems to be the depth of cooperation. Despite the totally different historical trajectories of the three Gulf of Finland countries, and the political tensions arising from this fact, Estonia, Finland and Russia have managed to develop a common maritime safety system, the GOFREP, which is quite unique in the world. Through cross-border cooperation the Gulf of Finland countries have also managed to build a safety culture amongst the cooperative parties, which is a compromise between quite different national safety cultures. A strategy to avoid a clash of national safety cultures and the ultimate key to success in the Gulf of Finland was the strictly professional or functional level (maritime administrations and vessel traffic operators) of the parties leading the cooperation, thus avoiding the 'high politics' disagreements. In the Northern Adriatic safety cooperation has not been this deep, but the common political future, inside the EU, of all three parties makes this area better equipped with possibilities for cooperation on both political and professional levels to enhance the safety of maritime transportations.

Seen from a theoretical point of view, in both areas the sea has played an important historical role as a mean of communication and transport; thus, despite the national

differences in the contemporary approach there are good possibilities to implement and further develop cross-border cooperation. Apparently, in the North Adriatic an institutional representation of the sea as a territorial, national asset (prohibiting or hindering cooperation) is stronger than an interpretation of the sea in terms of 'cultural melting pot', which sustains trans-national common space of development (giving a possibility to cooperation). However, even in the Gulf of Finland there are social and cultural factors hindering cooperation as well as in the North Adriatic there are important examples of cooperation. In other words, the empirical findings in relation to the dichotomy expressed in the theoretical discussion suggests that in both areas, the North Adriatic and Gulf of Finland, the sea is clearly still considered a territorial asset, but that in the Gulf of Finland this barrier was successfully conquered, of which the well established vessel traffic safety cooperation and all its technical and procedural innovations, bare witness. This barrier still waits to be overcome in the North Adriatic.

Both in the Baltic Sea Region and in the Adriatic Basin the patterns of local, ethnic-national and multicultural (imperial) identity are ambivalently intermingled and express a reciprocal tension that affect the notions of safety cultures. As a result, while in the Baltic the maritime safety actors have achieved a high degree of professional cooperation, in the Adriatic case it is still difficult to reach a macro-regional unification. However, even in the Adriatic region an original framework for complex and multi-level regional interactions is emerging and, in this regard, a Baltic-Adriatic partnership on maritime safety might increase the chances to achieve a better European integration of the Western Balkans. This would happen through the transfer of good practices and strategic know-how in the field of regional maritime safety. Considering that there is a lacking connection between the European Nordic and the Southern dimensions, the establishment of a scientific and professional cooperative networks on maritime safety culture could certainly enhance such a dialogue.

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Early Warning and Civil Protection

When does it work and why does it fail?

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This book is about early warning in the context of civil protection. The concept of civil protection refers to the protection of people, the environment and property in the event of man-made, technological and natural risks or emergencies. Early warning is an essential element of any functioning civil protection system.

The study defends a wide understanding of the concept, consisting of five 'phases' of an 'early warning system'. Early warning starts with risk assessment, followed by prevention, which in a way should prove that the early warning system works. The third phase is that of monitoring the risks in order to detect possible signals with respect to a potential forthcoming or occurring emergency. The fourth phase is the dissemination of warnings. Finally, early warning includes also response, in the sense that response can be more or less timely.

The main puzzle discussed in this study is that when does early warning work in relation to civil protection and, more significantly perhaps, when does it fail, and for what reasons. While providing a general framework for analyzing these questions, the book also includes some detailed case studies in fields such as climate change related floods and spatial planning, sudden sea water rise, electricity blackouts, and maritime safety in cross-border context.

NORDREGIO
Nordic Centre for Spatial Development

Nordregio
P.O. Box 1658
SE–111 86 Stockholm, Sweden
nordregio@nordregio.se
www.nordregio.se
www.norden.org

norden
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