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## Aggregation of information as a basis for risk and vulnerability assessments - challenges and opportunities (PHD-research paper)

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**Abstract:** In Sweden, municipalities, County Administrative Boards and the Government are obliged by regulations to carry out analyses which depict the risks and vulnerabilities within their geographic areas. The quality of these analyses hinges upon that these actors succeed in attaining information from a variety of players (both private and public organizations and companies) within their geographic areas and manages to communicate their findings across administrative borders (i.e. horizontal as well as vertical aggregation of data). One challenge while making synthesis of several different risk and vulnerability assessments (RVA) is that data must be processed and cannot retain the same level of detail as the individual analyses do. At the same time, there must be a link between the higher-level analysis and those of the lower level. Another interconnected challenge is the production of comparable data.

Municipalities and County Administrative Boards currently use different methods to gather, analyze and present the necessary information, resulting in fragmented and disjoint data, which creates difficulties while trying to attain a complete picture of risks and vulnerabilities at different levels of the society. In accordance with a request from the Swedish Civil Contingencies Agency (MSB), the Lund University Centre for Risk Assessment and Management, LUCRAM (and I particularly) will look into the possibility of developing processes and methods that will facilitate the production of structured and comparable data to support the synthesis of different risk and vulnerability assessments within and across administrative borders.

During my studies I will try to pinpoint factors that hinder as well as facilitate effective exchange and aggregation of information, describe the current pitfalls of the Swedish RVA-system vis-á-vis these findings and propose solutions to ameliorate the situation. My studies will be based on surveys and interviews with civil servants that work with RVA at all administrative levels in Sweden. I also foresee conducting comparative studies on how other countries deal with the challenge of aggregation. I look forward to developing my ideas by exchanging experiences with other participants at the conference in Potchefsroom.

#### **Introduction**

Today's society is vulnerable. Accidents or deliberate actions that causes harm to people, environment, property and economy occurs sooner or later in every community. Although it is impossible to foresee the exact type of events that will occur, it is possible to prepare oneself by imagining possible scenarios and try to identify what actions and capabilities that needs to be in place in order to prevent, respond and recover from such disturbances. As one relates this to existing capabilities, one may discover gaps and identify additional measures to mend the gap and, hence, reduce risk. Such an exercise is a normally called a risk- and vulnerability analysis (RVA), which is a very important planning tool in the Swedish emergency management system.

#### **Background**

According to Swedish legislation (SFS, 2006:544, 2006:637) all municipalities (290 entities), County Administrative Boards (21 entities, henceforward abbreviated to County Boards) and a number of selected national authorities (32 bodies) have to carry out RVAs in order to reduce the risks to their own operations as well as to societal functionality at large<sup>1</sup>. The second of these objectives entails that results from RVAs that are carried out by individual entities (e.g. municipalities, County Boards) will be used as input to a situational picture of the risks and vulnerabilities in the country as a whole. In this sense, municipal RVAs are collected and function as a basis for the RVAs carried out by the County Boards, which in turn will be collected and function as a basis for executing RVAs at the national level. The Swedish Civil Contingencies Agency (MSB) is supposed to enact a national picture of the risks and vulnerabilities that exist in Sweden. Aside from the RVAs of County Boards, MSB collects, interprets and tries to consolidate RVAs that are composed by the 32 national agencies as well as County Councils. Conversely, MSB and County Boards should provide feedback on the analyses they collect as well as convey the results of their own analyses downwards in the system. This process is illustrated by figure 1.

<sup>&</sup>lt;sup>1</sup> The Swedish administrative levels consist of three different layers: the national or central government, the regional governments ("County Administrative Boards") and the local governments ("municipalities"). A County Administrative Board is appointed by the government and responsible for coordinating the development of the county in line with goals set in national politics. This embraces a vast and varied number of policy areas, including disaster risk management. In each county there is also a County Council which principally is responsible for the public health care system. In each county there are also several municipalities, which care for the local government and administration. Municipalities are, inter alia, responsible for childcare, schools, elderly care, urban planning, sanitation (waste, sewage) and emergency services (not policing, which is the responsibility of the central government).





The process requires vertical as well as horizontal aggregation of information (i.e. municipals and County Boards have to collect The Swedish emergency management system is essentially based the perception that transboundary risks necessitates transboundary cooperation (across sectors, administrative levels and geographical borders). Regarding disaster risk management (DRM), the 32 authorities and County Councils carry a so called sectoral responsibility, which compel them to coordinate all the pertinent players within a certain societal sector (e.g. transport, finance, health care). In addition, municipalities, County Boards and the government carry a geographical area of responsibility that obliges them to coordinate all the actors within their geographical areas (i.e. the municipality, the district and the country) which may be affected by or involved in the handling of a disaster. This responsibility is transsectorial and encompasses all phases of disaster management - before, during and after potential disturbances to societal functionality (Prop. 2007/08: 92).

information from relevant public and private actors within their geographical areas as well as collect and convey information across administrative levels). Such a process naturally requires that the results of individual RVAs can be communicated to and understood by external actors. Moreover, the ultimate goal - to get an overview of the risks and vulnerabilities that exist at different levels in the administrative system – requires that the information attained from different actors can be compared to one another.

When the government issued the aforementioned regulations, they did not simultaneously supply the actors with any unified tools or methods on how to abide to these regulations. Amongst those who were liable to the new regulations, it was mainly municipalities (more specifically the fire brigades within the municipalities) that had experience from performing risk analyses<sup>2</sup>. These analysis, however, are typically confined to frequent accidents that may lead to a response from fire brigades (e.g. traffic accidents, fires, floods).

In contrast, the act 2006:544 and regulation 2006:637 focus on so called "extraordinary events", which *diverge from what is normal, means a serious disturbance or an evident risk* 

<sup>&</sup>lt;sup>2</sup> A preceding regulation stipulates that municipalities have to enact an action program for dealing with accidents that may motivate emergency responses from the state or the municipalities. The program should be based on a risk analysis (SFS, 2003:778).

for a serious disturbance in critical societal functions and calls for prompt action by a *municipality or County Council* (SFS, 2006:637). Such a definition covers a broad range of risks for which also fire brigades lacked experience from analyzing (e.g. financial instabilities, pandemics, cyber-attacks, disruptions to the supply of electricity, telecommunication, water and waste management and more). Unlike more common hazards (as mentioned above), such events had not been analyzed before. Neither was there any methods developed to do so. The government mainly left it up to the municipalities and the County Boards to solve the issue, albeit it funded research and projects aimed at developing tools for this purpose (MSB, 2011). Some municipalities also chose to hire consultants to undertake the RVAs for them. This has resulted in a number of varied approaches and methods that produce heterogeneous data which are hard to compare and aggregate.

The core problem is that it is impossible to attain a clear overview of the risks and vulnerabilities in the country at large in so far that various actors use different parameters and scales to assess e.g. capabilities, consequences and probabilities as well as questions to guide them in this process. This does not only cause a problem for attaining a sound basis for decision making concerning what risks to address - and how - in Sweden. The European Council has now initiated a process in which all member countries must develop national risk assessments with the aim of creating a comprehensive assessment of risks within the union<sup>3</sup>. This of course presumes that each country is able to create this image for their own geographical areas.

#### Purpose and objective

Adhering to a request from the Swedish Civil Contingencies Agency (MSB), the Lund University Centre for Risk Assessment and Management, LUCRAM (and I particularly) will look into the possibility of developing processes and methods that will facilitate the production of structured and comparable data to allow syntheses of different risk and vulnerability assessments within and across administrative borders. To produce such a methodology is hence the objective of my research.

The purpose of such a methodology is manifold. Structured, unified and comparable data is needed to enable clear overviews of risks and vulnerabilities at different administrative levels in Sweden. This in turn is required in order to support prioritization between risks and cost-efficient decisions on risk reducing measures. A unified way of conducting RVAs within and

<sup>&</sup>lt;sup>3</sup> The task is commissioned in accordance with Council conclusions on Further Developing Risk Assessment for Disaster Management within the European Union, 11–12.4.2011. (8068/11)

across administrative levels will also facilitate communication and sharing of experiences on how to best address various risks, which purportedly will enhance overall preparedness amongst the actors in the Swedish emergence management system. A structured way of conducting RVAs will also make it possible for one and the same actor to validate the progress of its own preparedness from one analysis to the next (i.e. comparisons over time).

The research will be carried out as one part of a larger research program called PRIVAD (Program for Risk and Vulnerability Analysis Development) that LUCRAM will implement between the years 2012-2017, with financial support from MSB. PRIVAD builds upon the accomplishments of a previous program, FRIVA (Framework Program for Risk and Vulnerability Analysis) which LUCRAM carried out between the years 2004-2011<sup>4</sup>. FRIVA resulted in a number of useful tools, which mainly were designed to encourage organizations to start thinking about the risks and vulnerabilities and to increase awareness and knowledge about them. These methods can be said to represent the first generation of risk and vulnerability methods and interest is now focused on developing the next generation, where the focus shifts from designing methods that are useful for individual players to also enhance the usability of the system as a whole (Petersen, 2011).

#### Possible research questions and papers

Given that I only started my PHD-studies in February this year, it is premature to render account for specific ideas and research questions that will form basis of papers that I will produce. I know the overall purpose and objective of my research and have some ideas of the challenges that I have to explore, but one obviously have to recognize that the research process itself is likely to induce questions and areas of concern as one goes along. Nonetheless, a general research question of my study could be phrased: *how can we design a method that would answer to the needs of organizations of various kinds to analyze the vulnerability of their own operations and yet at the same time ensure the possibility of generating information that can be aggregated to enable clear overviews of the risks and vulnerabilities adhering to extraordinary events in different parts of Sweden?* 

<sup>&</sup>lt;sup>4</sup> FRIVA was originally funded by the Swedish Emergency Management Agency (SEMA) and later by the MSB, which was established on the 1 January 2009 and simultaneously replaced the Swedish Emergency Management Agency (SEMA), the Swedish Rescue Services Agency (SRSA) and the Swedish National Board of Psychological Defence.

As explained in the methodology section, the development process will be guided by a set of design criteria. A major part of the research is thus to identify and explore these design criteria, wherefore a sub-question to the general research question outlined above would be: *which are the set of design criteria that would answer to the research objective and how should the methodology be designed in order to satisfy these criteria?* 

Before exploring ways to improve RVA-methodology (a prescriptive part), it is necessary to study existing methods and methodologies and try to identify their potential weaknesses (which may need to be addressed) and strengths (which could be retained) with regards to fulfilling the objective of my research. For one thing there is no compilation of the strategies used and the factors that complicate and sometimes hinder effective information exchange (e.g. differences in terminology, power, prestige, accountability, confidentiality laws etc.). During my studies I will try to pinpoint factors that hinder as well as facilitate effective exchange and aggregation of information pertaining to RVAs, describe the current pitfalls of the Swedish RVA-system vis-á-vis these findings and hopefully be able to propose solutions to ameliorate the situation. Research questions connected to such a study would be: How are risk and vulnerability analyses carried out in Swedish municipalities and at County Boards and in what way are utilized processes and methods conducive or obstructive to the exchange and aggregation of data? What design criteria for the development of the forthcoming methodology could be derived from the identification of factors that are decisive for vertical and horizontal aggregation of information in the context of risk and vulnerability analyses?

Given that aggregation of information is a focal area of concern, I aim to produce a paper on the essence of information aggregation as well as try to define the notions of vertical and horizontal aggregation in the context of risk and vulnerability analyses (and possibly try to model the interconnectedness regarding RVA-information between various actors in the Swedish system). Subsequent to such a paper, it would be logical to produce a paper that renders account for factors that may be decisive to the possibilities of aggregating data in general and in the realms of risk and vulnerability analysis in particular. Such studies would most likely be conducive to the identification of relevant design criteria and thus form part of the basis for the method development.

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#### Research process and methods

The study and development of a new method for RVAs will most likely be based on design science. As opposed to explanatory science, where one strives to understand and depict some aspects of the world with stringent methods of investigation (frequently applied within the natural and social sciences), design science is concerned with how things *ought* to be in order to attain some predefined purpose or function (Simon, 1996). Design science is most often applied in the context of designing and constructing physical artefacts and systems. Nonetheless, Checkland (1993) argues that it also could be used in the process of developing methods, since methods per se can be viewed as an abstract system of interrelated thoughts and concepts aimed at solving a particular problem.

Design science underscores the necessity of defining the purpose of the artefact (here method) a priori to its development as well as establishing a set of design criteria (i.e. required functions) that correlate to the purpose and will guide the development process. The purpose, design criteria and the construction of the method can be elaborated and established through an iterative process and mediation between the needs of potential users, existing "knowledge base" (e.g. previous research and existing methods related to the problem at hand) as well as potential constraints inherent to the socio-political environment wherein the method will be used (e.g. legislation and policies).

The two main research activities involved in this process are to *build* and *evaluate*, where "building is the process of constructing an artefact for a specific purpose and evaluation is the process of determining how well the artefact performs" (March and Smith, 1995: 254). In design science one commonly starts by examining the knowledge base in order to enhance ones understanding and subsequently build a first prototype of a solution. An important part of the process is to test the method in its intended context. According to Jönsson (2007) this is analogue to experiments or observations while trying to validate hypotheses in natural sciences, whilst the subsequent evaluation of the method corresponds to interpreting experimental results. The evaluation may induce amendments to the method, whereupon the modified method will be tested and evaluated. This iterative process will continue until the researcher finds that the outcomes are satisfactory in relation to the given design criteria (or runs out of time or money to continue the quest for the optimal solution)<sup>5</sup>.

<sup>&</sup>lt;sup>5</sup> Aside from the input and constraints stemming from potential users, the knowledge base and sociopolitical environment, it should be noted that the researcher's own judgment plays a role in the process of elaborating the purpose, formulating design criteria and constructing the method. Such an influence is unavoidable and even required since it is the researcher (designer) that ultimately is responsible for safeguarding that the outcomes of the research process fulfil its intended purpose (Abrahamsson, 2009).



**Figure 2**. A conceptual framework for design science applied to the development of risk- and vulnerability analyses. Based on a figure by Hevner et al (2004).

In line with the approach outlined above, this study will start with examining the knowledge base related to the problem of aggregating results from risk and vulnerability analyses. As yet, I am uncertain about the extent to which research has been produced on the accumulation and synthesis of security information in general, not to say on the aggregation of societal risk and vulnerability analyses. According to International Risk Governance Council "Assessing the impact of systemic interactions is one of the most important but least understood aspects of modern risk assessment." (IRGC, 2009: 25). On the other hand, a lot of research has been conducted on methods for risk and vulnerability analyses and its individual components (e.g. risk, vulnerability, quantitative and qualitative assessments) as well as on notions like resilience and systemic risks, which will be used for shaping design criteria. Not least the predecessor to the current research program, Framework Program for Risk and Vulnerability Analysis (FRIVA), produced valuable insights on the application of risk and vulnerability analysis at local, district and national levels in Sweden.

Part of the knowledge base is comprised of studying existing methods for executing RVAs. One such method, Municipal Vulnerability Analysis (MVA), was developed by LUCRAM during the FRIVA program and is currently used by various municipalities (most notably in the Counties of Skåne and Västra Götaland). A number of more or less profound methodologies have also been elaborated by actors that are accountable to the act 2006:544 and regulation 2006:637. Two of these methods became (and still are) quite widespread and utilized by various actors in the Swedish emergency management system, ROSA and IBERO<sup>6</sup>. ROSA was developed by the County Board of Kronoberg and IBERO by the County Board of Stockholm. All three methods were developed in conjunction with municipalities with financial support from the Swedish Emergency Management Agency (MSB, 2011).

IBERO was invented after the development of ROSA and MVA and built on many of the successful features of the precedent methods<sup>7</sup>. However, whereas MVA and ROSA both focus on the development of emergency preparedness of individual actors (e.g. departments, municipalities, County Boards), IBERO was designed to allow comparisons between different actors' assessments of their ability to deal with extraordinary events as well as their assessments about the consequences of these events. This means that the results from the analysis of a single actor (e.g. a sub-division within a municipality) can be used for analysis at higher levels of the organization (e.g. a whole municipality) or a compilation of several actors' analyzes (e.g. several municipalities within a county).

IBERO thus creates favorable conditions for uniformity, comparability, exchange of knowledge and the built up of personal networks, which is why I will choose to focus on this method as a point of departure for my research. IBERO nevertheless have some drawbacks that I aim to explore and lacks a couple of features that are required or would enhance the possibilities of creating feasible overviews of risks and vulnerabilities at regional and national levels (e.g. a comprehensive section on operational continuity management and the possibility to manage and present geospatial information).

Conducted research and the study of existing methods for RVAs will thus form part of the "knowledge base". Another part will most likely be comprised of comparative studies to understand how other countries, with similarly decentralized emergency management systems, deal with the challenge of aggregating information on risks and vulnerabilities.

The design criteria will also draw upon interviews with safety- and security coordinators in municipalities that have applied one of the three most commonly used tools for the realization of RVAs in the Swedish emergency management system (IBERO, MVA and ROSA). An emphasis may be put on examining the impressions of people that have used IBERO as this is the only tool that has the explicit purpose of aggregating information from a

<sup>&</sup>lt;sup>6</sup> "ROSA" is a Swedish abbreviation for risk and vulnerability analysis. "IBERO" too is a Swedish abbreviation (Instrument för beredskapsvärdering av områdesansvar), which in English would correspond to "tool for assessing preparedness within geographical areas".

<sup>&</sup>lt;sup>7</sup> MVA, ROSA and IBERO are all scenario-based and exercised in seminar settings, meaning that a scenario is selected and developed on the foundations of previous risk analyses and subsequently used as a basis for group discussions which lead up to joint assessments of capabilities, consequences and possible measures to reduce risks (MSB, 2011).

variety of actors, which supposedly renders substantial input to the establishment of design criteria for the same purpose. These interviews will be complemented by interviews (and/or surveys) with actors that have applied ROSA and MVA and ask them about the strengths of these methods with the prospect of integrating such aspects in the forthcoming method.

In-depth document studies of risk and vulnerability analyzes based on IBERO will also be undertaken to gain insight into how the various actors' risk and vulnerability analyses are carried out in practice and whether the outcomes of these analyses indeed has met its intended purpose (i.e. that it is possible to use the substance for comparisons between different actors and as a basis for regional and national overviews of risks, vulnerabilities, proposals on capacity enhancing measures and more<sup>8</sup>). Allegedly IBERO has been used by close to a hundred municipalities in Sweden, five County Boards, 19 (out of 21) County Councils as well as the National Board on Health and Welfare, so there should be enough empirical data to make a thorough analysis. Most likely, the document analysis will begin at the municipal level (for example, by analyzing the municipal analyses in two or three selected counties) and then scrutinize the analyses of County Boards, County Councils and finally the analyses enacted by the National Board on Health and Welfare.

Concerning socio-political requirements, the act and regulation (SFS, 2006:544; 2006:637) stipulate that the RVAs should be a planning tool to reduce risks to one's own operations as well as to the society as a whole. To this end, it is imperative that the method will be able to support operational continuity management (information that will mostly be used for internal purposes) as well as produce results that are communicable to external actors and function as an input to their RVAs.

Secondly, the legislation stipulate that the RVAs should focus on extraordinary events, which has bearing on the process (e.g. which participators that should be involved) as well as the method (e.g. the dimensions and indicators for assessing capabilities, consequences and probability). Extraordinary events typically have a low probability but could generate substantial consequences in a national perspective. In essence, they correspond to what Renn and others label as "systemic risks". Systemic risks are not liable to be assessed with quantitative methods. Given the poor statistical basis and the multitude of possible indirect consequences (due to the complex web of interconnected sectors and critical functions), consequences and probabilities simply cannot be framed and assessed with the help of mathematical formulas (Renn et al, 2011). Rather one is left with qualitative assessments,

<sup>&</sup>lt;sup>8</sup> Although different actors use the same method, they may apply it differently (e.g. if they make joint assessments in inter-departmental working groups or try to synthesize input from individual departments) or in various ways diverges from the intended manner of using it.

whose quality will be dependent on the collective experience and knowledge possessed by the set of individuals who perform them. Since extraordinary events typically transcend sectorial and geographical borders, they foster a holistic approach where information from numerous stakeholders is needed in the quest of grasping their complexities (IRGC, 2009). The participators' competence in different fields (e.g. on the nature of hazards, interdependencies between sectors, available resources, the social vulnerability of the geographical area in question) can hopefully be combined to a successful synthesis that exceeds the sum of their individual understanding. Accordingly, RVAs carried out by municipalities and regional County Boards require a qualitative method and a holistic process that encompasses players from public as well as private sectors as well as an interchange of information between all levels of public administration.

Aside from the input of potential users, research and a probing socio-political context, the design of the method will be guided by typical scientific criteria such as transparency, traceability and verifiability. The tools and methodologies will continuously be tested and evaluated by practitioners through case studies and action science, in order to ensure their feasibility and that they meet the demands of foreseen users<sup>9</sup>. The input from such "reality checks" will be used as basis for adjustments.

#### **Delimitations**

Apart from heterogeneous methods and processes, there are a number of areas that may inflict upon the aggregation of information as basis for functional RVAs (e.g. unified terminologies, the willingness and possibilities to share data adhering to aspects such as prestige, power, accountability, classified material; differences in organizational cultures and lack public-private partnerships and more)<sup>10</sup>. Although my study probably will encompass reflections on the issue of attaining valid information, the PHD-period will likely not suffice to make thorough studies on ways to address such challenges. The objective will be to construct a method that would be able to produce sound overviews on risk and vulnerabilities at different administrative levels in Sweden, given that all the actors use it and provide the requested information without (intended) distortions.

<sup>&</sup>lt;sup>9</sup> The main difference between case studies and action science is that the researcher only acts as an observer during case studies, whereas he or she takes a more active part (perhaps as a facilitator of the workshops) in action science and even may try to effect a change or improvement in the object of the study (Robson, 2002).

<sup>&</sup>lt;sup>10</sup> In order to keep this paper brief, I refrain from elaborating on these issues in this paper, but may do so in connection to my presentation at the conference.

My period as PHD-student will neither be sufficient to investigate all existing RVAmethodologies in Sweden or abroad. I will therefore limit my study to the three most pertinent methodologies used in Sweden (IBERO, ROSA and MVA) as well as do comparative studies in a selected number of countries with decentralized emergency management systems, coupled with judicial requirements on the realization of RVAs by actors on different administrative levels. With regards to analysis of RVA-documents and collection of data through interviews or surveys, I will also have to be selective as to the amount of municipalities, County Boards and national authorities that will partake in the study. As mentioned in the methodology section, the focus will be directed at those counties where the municipalities and County Boards have used IBERO and supplement this with studies of some counties where the municipalities and County Boards extensively (exhaustively if possible) have used either ROSA or MVA as basis for their analyses.

#### **Final remarks**

The purpose of my presentation is to get tips from the audience concerning, inter alia:

- Knowledge of similar studies

- Knowledge of other *countries* trying to cope with problems of aggregating RVAs/information concerning risks and vulnerabilities across administrative levels

- Knowledge of *methods* for RVA that are designed to deal with the problem of aggregating information from various stakeholders

- Feedback on the choice of methodology to conduct research

- Feedback and suggestions on suitable concepts and theories to use in understanding the problem.

I want to thank for the opportunity to share and hopefully get feedback on these ideas. I look forward to a fruitful conference!

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