



Swedish Civil
Contingencies
Agency

A summary version of the report

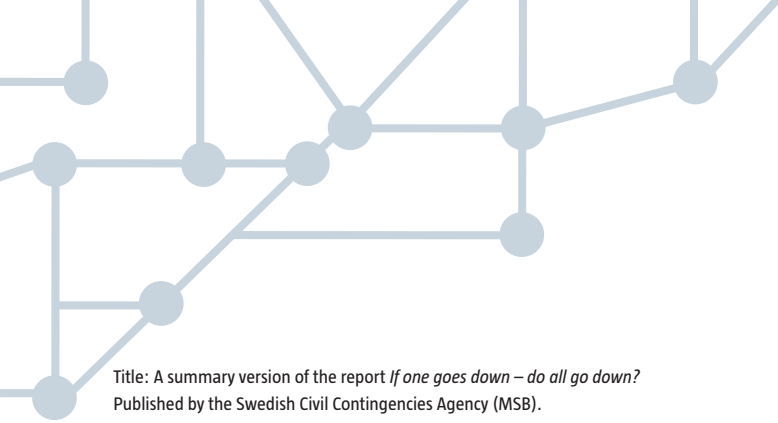
If one goes down – do all go down?

A final report from SEMA's assignment
on Critical Societal Dependencies



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Title: A summary version of the report *If one goes down – do all go down?*
Published by the Swedish Civil Contingencies Agency (MSB).
The summary report is a part of a Government assignment the objective of which has been to identify and analyse Critical Societal Dependencies.
The results have been published by both the Swedish Emergency Management Agency (SEMA) and the Swedish Civil Contingencies Agency (MSB).
A graphic element, the net pattern above, reappears in all the publications.

Edition: 3 000
ISBN: 978-91-7383-001-0
MSB Publication number: MSB 0002-09

This report can be downloaded from:
www.msbmyndigheten.se

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Introduction

This is a summary version of the Swedish Civil Contingencies Agency (MSB) report, *If one goes down – do all go down?*. The objective of the report is to present the agency's Government assignment to identify and analyse critical dependencies in society and to distribute the results to the actors that have a need and an interest in studying them. Clear target groups comprise central authorities, county administrative boards and municipalities as well as private actors. Knowledge about dependencies is the first step towards stopping propagation effects that could lead to serious crises for society in a worst case scenario.

Today, society consists of a fine weave of more and stronger dependencies than ever before. This is largely due to a number of concurrent social changes, of which technical development is the one that has created the most dependencies between various functions. The growing degree of specialisation has also created many dependencies. Today, an increasing proportion of functions are outsourced to third parties at the same time that the “just-in-time” principle is increasingly applied to production. This generates new dependencies. A third social change is the fact that most functions have reduced their workforce in recent decades, resulting in a decrease in staffing redundancy.

Internationalisation and globalisation entail a fourth, fundamental social change that affects the dependencies. The states of dependence no longer stop at national borders, but rather most functions are in one way or other dependent on goods and services produced in other countries. Integration within the EU is another dimension that makes functions more dependent on the world around them. Lastly, private actors have gained a role of growing significance in what is known as critical societal functions.

Altogether, these social changes mean that we can work more efficiently today. Moreover, we can produce better products, hopefully at a lower price. At the same time, these social changes also mean that we have become more vulnerable. This entails new challenges to how the responsibility for emergency preparedness and emergency management should be divided between different actors.

Dependencies can be viewed as a special type of vulnerability that every function should be aware of and be able to handle. A function must know what dependencies it has towards external actors and how these should be managed. For society, however, it is a matter of creating a comprehensive picture of the social system based on how various critical societal functions are dependent on each other and on other actors. This way, a better basis for decisions at the central level is achieved and it becomes easier to analyse risks, vulnerabilities and capacities in society. The dependency analysis can form the basis for decisions regarding the prioritisation of measures, resource distribution, the focus of studies and research, etc. It can also be a part of functional decision support during a crisis.

This is the first overall, cohesive analysis of dependencies in society conducted in Sweden. However, elements of the knowledge presented in the report were previously known since continuous work is conducted within and across sectors, where dependency-related issues are touched upon in various ways. On the other hand, this is the first time we see a comprehensive picture of dependencies between a large number of critical societal functions. One could say that the puzzle pieces were already known, but that the puzzle has now been put together.

Work on identifying and analysing critical dependencies in society has taken place in cooperation with a large number of organisation representatives– from both the private and public sectors. More than 120 organisations have participated. Many participated in interviews as well as various workshops and games. In this context, the conclusive request for comments on the final report should be mentioned as a process that involved many and thereby contributed to quality assurance

of the report. The final report has also been separately reviewed by Dr. Kurt Petersen, Professor of Risk Analysis and Management at Lund University.

SEMA's assignment

The Swedish Emergency Management Agency (SEMA) has analysed dependencies between various critical societal functions based on a Government assignment the agency received in 2006. The assignment was formulated as follows:

SEMA shall, in cooperation with the societal actors concerned, conduct work to identify and analyse critical dependencies in society. This work shall identify and provide knowledge about critical dependencies in society. The international dimension shall also be taken into consideration.¹

This work was conducted in project form together with a large number of concerned actors. The objective of the project, Critical Societal Dependencies, was to strengthen society's emergency preparedness in the following ways:

1. Amass knowledge regarding the dependencies in society that could cause serious crises.
2. Propose measures that can mitigate the effects of the dependencies that could cause societal crises.
3. Support other processes in civil safety and preparedness by offering a basis for planning and investigation work and resource prioritisation.
4. Develop a functioning method to conduct dependency analyses.
5. Increase awareness in society about how various functions are dependent on each other.

¹ The Swedish Government. Regeringen: *Regleringsbrev för budgetåret 2006 avseende Krisberedskapsmyndigheten*, (Government's regulation letter to SEMA regarding the budget year 2005), 2005-12-15.

The project will be concluded and the final report will be issued in December 2008. Large components of the results will be taken care of by the Swedish Civil Contingencies Agency (MSB) and used to support the future work on risk and vulnerability analyses, capacity assessments and basic security levels as well as the functional work in MSB's status reporting function.

Results from the assignment are reported in several different ways

MSB wants the results from the assignment to be available and to function as an aid for all of the actors in society that have use of working with dependency issues. The results will therefore be presented in a number of different ways (both in the form of knowledge documentation and concrete aids) and will be available through various channels. All publications are available on the website and some of them are also published in print form.

Knowledge bank

- ▶ The report *If one goes down – do all go down?* – main report and final report of the Government assignment in which methods and results are presented (to be published in January 2009).
- ▶ Summary version of the main report *If one goes down – do all go down?*
- ▶ *Sector reports* (9) – dependency and impact analyses for all studied sectors and functions.
- ▶ The report *Cross-border dependencies* – a study of the dependencies of critical societal functions across national borders.
- ▶ *Glossary* – an explanation of terms associated with dependency analysis.
- ▶ *Dependency, propagation and focus chains* – the assignment's results illustrated in three ways based on each sector.
- ▶ *Scenario-based narratives* (2) – illustrative descriptions of the impact on individuals based on a pandemic flu and a large-scale power outage.

Toolbox

- ▶ *User guide for dependency analysis.*
- ▶ *The Dependency Wheel* – an interactive computer tool with support for analysing a function's dependencies.
- ▶ *The Matrix* – an aid for creating an overview of the dependencies of many functions.
- ▶ *Presentation material: Dependencies between critical societal functions, an introduction* – PowerPoint presentation including text manuscript.
- ▶ *Scenario-based dependency game* – documentation and guidance for carrying out scenario-based games. This is a platform that the actors can use as a starting point for their joint discussions surrounding dependencies and measures.

Concepts associated with critical dependencies

The assignment has largely concerned concepts such as critical societal functions, critical dependencies, buffers and endurance. These expressions are described below.

Critical societal functions mean such functions that meet one or both of the following conditions²:

1. A shutdown or severe disruption in the function, single-handedly or in combination with other similar events, that can rapidly lead to a serious emergency in society.
2. The societal function is important or essential for responding to an existing serious emergency and minimising the damage.

A critical dependency is a dependency that is essential for critical societal functions to be able to work. It is characterised by a disruption in a supply function leading to a rapid and lasting degradation in the function of the dependent function.

² A factsheet from SEMA. Krisberedskapsmyndigheten: *Samhällsviktigt! Förslag till definition av samhällsviktig verksamhet ur ett beredskapsperspektiv* (Critical Societal Functions – Suggested definitions of essential functions from an emergency management perspective), (0253/2005).




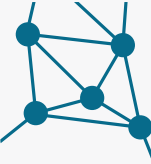
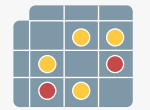
Such functional degradations can occur if the dependent function lacks buffers and, with them, endurance.

A function that has *buffers* can meet the need for a certain good or service in an alternative manner if the ordinary supply function is affected by a disruption. There are various types of buffers. One example is redundancy, which means that there is a sufficient amount of the affected resource at the disposal of the organisation to be able to handle a shortage. Another example is a substitute, which means that the organisation has the possibility of replacing one important resource with another. A third example is adaptability, which means that an organisation has the ability to adapt its function or manner of production in such a way that it can manage without the disrupted resource.

Endurance means that the function can manage for a certain period of time even though the supply function does not function as it should.

Method

An important part of SEMA's assignment has been to develop a method for conducting dependency analyses. Some parts of the method address users in individual functions while others are directed at actors that need to conduct aggregate analyses, such as municipalities, counties, central authorities and companies. Because the dependencies change over time, it is also important that they can be continuously analysed. The work on developing a methodology and distributing knowledge regarding it has therefore been accorded a prominent role in the scope of the Government assignment.

| Dependency analysis | Users | Tools |
|---|---|---|
|  <p>1. Selection and description</p> <ul style="list-style-type: none"> – Functions which are most important for the municipality, the county, the agency or the company to be able to adequately function in a crisis, are selected. – The functions selected are described based on what they should supply, to what extent and to whom. | Municipalities Counties Agencies Companies | Criteria for selection of critical societal functions |
|  <p>2. Identification and evaluation of external dependencies</p> <ul style="list-style-type: none"> – Identification of needs that entail a dependency on an external, supply function or an external resource. – Evaluation of the strength of external dependencies based on an analysis of consequences, buffers and endurance. | Critical functions | Dependency wheel  |
|  <p>3. Aggregate analysis</p> <ul style="list-style-type: none"> – Structuring the collected material in the form of a matrix. – Dependencies between all the functions identified are visualized by propagation chains, dependency chains and focus chains. | Municipalities Counties Agencies Companies | Matrix  |

The method consists of three stages: selecting and describing the functions, identifying and evaluating the individual functions' dependencies, and ultimately analysing the dependencies between the chosen functions on an aggregate level. There are a number of aids for each stage of the method that will be available to users on the website.

Stage 1

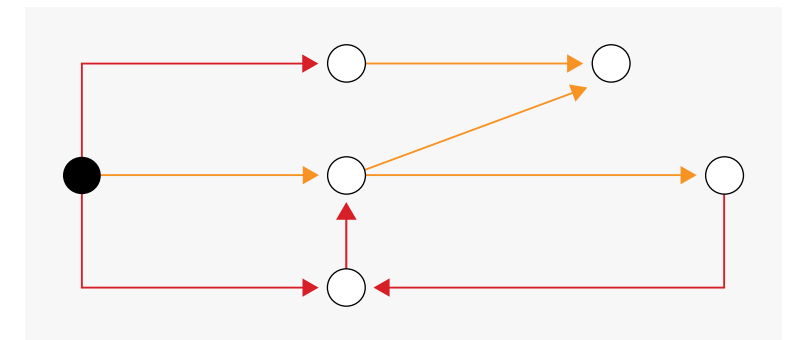
In the first stage, a *selection* is made of the functions that are to be examined. For a municipality or a county, it is important to choose the critical societal functions that are judged to be the most important for the municipality or the county to be able to adequately function in a crisis. A private actor can instead choose the business-critical functions and processes that must function even during a crisis. The functions selected are then also *described* based on what they should supply, to what extent and to whom.

Stage 2

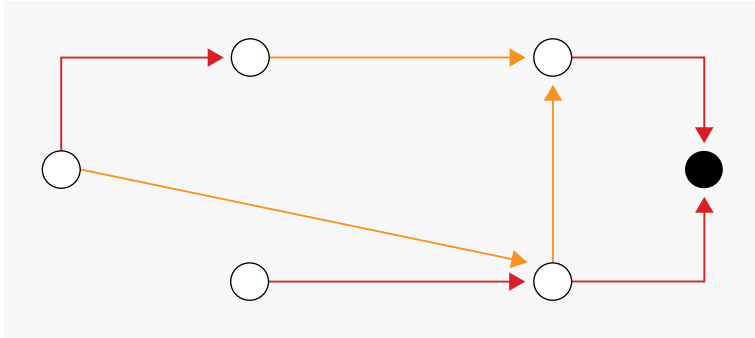
When the selection is complete, each function's external dependencies are *identified* and *evaluated*. The functions can do so themselves or engage an external party for the task. SEMA has developed an aid called the "Dependency Wheel" that will facilitate this step. The Dependency Wheel is in the form of an interactive computer tool on the website, but can also be used without the computer tool. In brief, the wheel's working method can be described as follows: First, one describes what a function needs in order to function as described in the first stage of the method "selection and description". Then one identifies the needs that entail a dependency on an external, supply function or an external resource. These external dependencies are evaluated based on the dependent function's ability to handle a disruption in the supply function. The functions can also have different kinds of buffers that can compensate for a loss of a supply function for a certain period of time. The degree of dependency is evaluated as per the following scale: *critical* dependence (no buffer, no endurance), *clear* dependence (some buffer and some endurance) and *weak* dependence.

Stage 3

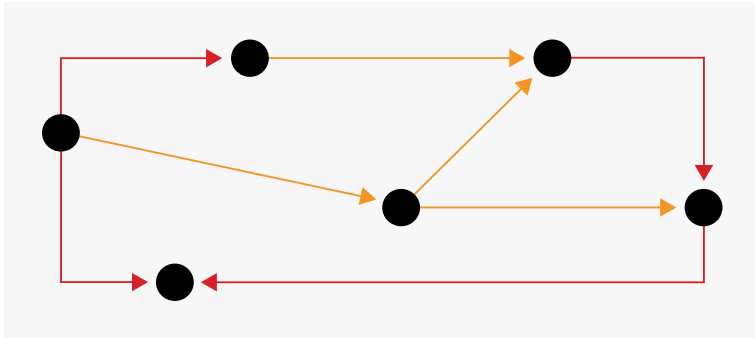
Lastly, the knowledge surrounding each function is put together in an *aggregate analysis*. This analysis provides a comprehensive illustration of how the studied functions affect each other, both directly and indirectly. The first step in an aggregate analysis is structuring the collected material from stages 1 and 2. This can be done with the help of a matrix where all dependencies and their strength are noted. The matrix can then be used to paint a comprehensive picture of all dependencies and roughly show how different functions affect one another. Then, one can create sub-diagrams to focus on various components and conduct a more concrete discussion on them. Such sub-diagrams, or chains, are called propagation chains, dependency chains and focus chains in the method. These subsets are easier to take in and they are consequently suited as a basis for in-depth analyses.



Propagation chains describe how a disruption in a certain function propagates to other functions in several stages. When the dependencies are visualised this way, the combined effect a specific disruption has on society becomes clearer.



Dependency chains describe which other functions a certain function relies on in several stages. This way, a clearer illustration is provided of how a function is dependent on the dependencies and vulnerabilities of others.



Focus chains describe dependencies between certain functions based on a particular aspect. This can for example be applied to functions that have broad points of contact with each other.

The knowledge gained from such a dependency analysis provides a good basis for discussing how society can become more secure and for improving and giving more detail to planning for a crisis. This information can also be used as decision support during a crisis. For dependency work at the societal level to have any effect, it is absolutely crucial that the method is well rooted and that the information is then fed back to the actors concerned.



Results

As previously mentioned, a large number of organisation representatives participated in the work on identifying and analysing critical dependencies in the Swedish society. This summary report provides a highly condensed account of the results. The report *If one goes down – do all go down?* provides a more complete account of the results. For further detailed information, please refer to the sector studies conducted for each sector, which are available on the website.

SEMA's dependency analysis is based on a selection of nine critical societal sectors and 36 functions. This selection is a comprehensive, but not complete collection of critical societal sectors and functions. The sectors and functions analysed are the following:

- ▶ electronic communication (fixed and wireless telephony, data communication)
- ▶ energy supply (electricity supply, fuel supply)
- ▶ financial services (cash supply, card payments, fundamental sourcing, transfers, credit transfers and settlement, securities trade)
- ▶ protection and security (police, rescue services, emergency alert services, guard services)
- ▶ municipal services (waste, sewage, drinking water supply, district heating)
- ▶ food supply (food production, food stocks, convenience goods trade, restaurants and institutional catering)
- ▶ mass media (TV, radio, newspapers, Internet publishing)
- ▶ healthcare and nursing (healthcare counselling, emergency medical care, primary care, elderly care, pharmaceutical distribution, regional management and information, infectious disease prevention)
- ▶ transports (road transports, rail transports, maritime transports).

In the presentation of results, the electricity supply and the fuel supply are reported separately for practical reasons.

Functions have different dependency profiles

The results show that different functions have different profiles based on their dependencies. No function is completely independent of others and no function completely lacks an impact on other functions. However, there is a relative difference in the degree of dependency between different functions. These relative differences have given rise to the following dependency profiles:

1. *Propagators* – functions on which many other functions are dependent, but which themselves are not dependent on very many other functions to any significant degree. Examples of clearly propagating functions include the electricity supply and electronic communications.
2. *Hubs* – functions on which many other functions are dependent and which themselves are dependent on many others. Examples of functions with a hub profile include transports, fuel supplies and municipal utilities.
3. *Targets* – functions on which few other functions are dependent, but which themselves are dependent on many others. This includes functions within the food supply and healthcare and nursing.
4. *Solitaires* – functions on which relatively few other functions are dependent and which themselves are also not dependent on very many others. Solitaire functions exist within the mass media sector, the financial sector and the protection and security sector.

Propagation chains

The results of SEMA's dependency analysis are reported here in the form of the propagation chains described at the end of the method section. For each sector, there is a description of what chain effects a disruption to the functions within the sector can have on the other critical societal functions.

A disruption in a critical societal function naturally also affects the society and its residents in a clearly negative manner, but this is implicit and is not specifically discussed for each sector.

Municipal utilities

(waste, sewage, drinking water supply, district heating)

Disruptions in the drinking water supply affect sewage systems and district heating plants, both of which need a constant supply of water. Disruptions in waste management affect the district heating plants that use waste as fuel as well as sewage systems that need sludge removal to be able to rapidly dissolve line stoppages.

Municipal utilities as a whole are of major importance to healthcare and nursing as well as the food supply to be able to maintain an adequate level of hygiene and an acceptable living environment in emergency medical care and elderly care. The situation in healthcare and nursing is directly affected by such disruptions, but is also indirectly affected by the food supply chain having problems in delivering food to patients and residents through institutional catering services. Rescue services also need water to extinguish fires, but also have some buffers since they can also use water that does not meet the quality standards set on drinking water.

Otherwise, disruptions in municipal utilities affect other critical societal functions by people having greater difficulty in maintaining their hygiene and finding access to suitable drinking water and food. Such difficulties apply both to homes and workplaces.

Financial services

(cash supply, card payments, fundamental sourcing, transfers, credit transfers and settlement, securities trade)

Within the financial sector, all functions are dependent on transfers, credit transfers and settlements. This function is the hub in the financial system that must work for all other financial functions to be able to work.

The majority of functions need to be able to pay wages, receive payment for their goods and services through invoices, card payments or cash payments and various forms of credit. Most critical societal functions that were studied in this work should be able to continue to conduct functions on condition that the disruption in the financial services is relatively short term. The food and fuel sales can, however, have such large problems that functions are forced to close for a period of time. If grocers and petrol stations are forced to close, it could also cause extensive problems for healthcare, elderly care, waste management, the police, rescue services, security firms and road transports. If the disruption in financial services were to become more lasting, more extensive consequences could arise.

Protection and security

(police, rescue services, emergency alert services, guard services)

The functions within protection and security cooperate with each other, and if any of them does not fully function, the others may experience a higher workload. If, for example, the security firms cannot function as usual, their tasks will instead be placed on the police. The police and rescue services would also have more difficulty in performing their duties if the other party was not fully functioning. Despite the potential problems, each function should, however, be able to perform its duties – although it would involve more work for the employees and probably lower levels of service. Emergency alert services (SOS Alarm) are an exception, however. Because they are clearly the spider in the web, a disruption in their function would make the situation difficult for the other functions within their own sector as well as the healthcare and nursing sector.

Food supply

(food production, food stocks, convenience goods trade, restaurants and institutional catering)

Food production, food stocks, the convenience goods trade, restaurants and institutional catering are links in the food supply chain, and all have to function so that people will have access to food. The critical societal functions affected by

disruptions in the food sector are emergency medical care and elderly care. Disruptions in the food supply chain could lead to the shops not being able to maintain their regular assortment. This could cause problems for people, especially the elderly, disabled and ill, to gain access to food.

Healthcare and nursing

(healthcare counselling, emergency medical care, primary care, elderly care, pharmaceutical distribution, regional management and information, infectious disease prevention)

Healthcare and nursing is a sector that is strongly dependent on other functions working, both within the sector and outside it. However, no other critical societal function is assessed to be directly affected by disruptions within healthcare and nursing. The sector does, however, have a significant impact on people's life and health, and critical societal functions could consequently be indirectly affected by personnel being ill or at home to take care of family members.

Electronic communication

(land-line and wireless telephony, data communication)

No function would be unaffected if electronic communications were disrupted. The functions primarily affected include financial systems, security firms, the food supply, the electricity supply, media and transports. Disruptions in electronic communications mean that people will have more difficulty in communicating with their surroundings as well as gathering information, which can further worsen a crisis.

Electricity supply

Disruptions in the electricity supply affect all critical societal functions. Critically dependent functions include the cash supply, card processing, the food supply, sewage systems, the transport sector, the fuel supply, primary care, elderly care, newspapers and Internet publishing. The other functions are critically dependent only in certain instances since several of them are equipped with auxiliary power. Because auxiliary power solutions have a limited duration, these functions can also be affected by an extended power outage. Extended power outages also have a major impact on private persons. Electricity

is needed to be able to heat homes, listen to radio and operate computers and cordless phones. After a while, mobile phones will also stop working.

Fuel supply

Fuel such as petrol and diesel is needed for both vehicles and auxiliary power stations. However, the functions that need fuel for auxiliary power stations do not become dependent until a power outage occurs, and their endurance depends on how much fuel they have stocked. In addition to the transport sector, the following functions are also critically dependent on fuel for their vehicles: the police, rescue services, guard services, valuables transports within cash management, waste management, emergency medical care and elderly care. Under certain conditions, the electricity supply and electronic communications are also dependent on fuel, and together with the transport sector's critical dependence, an insufficient fuel supply could have a major impact on critical societal functions and could thereby cause many problems.

For private persons, problems with the fuel supply mean that there will be a shortage of petrol, and that the available petrol would become more expensive. People will also be affected by various critical societal functions not working. Refuse may not be collected, grocers may be empty due to fewer or delayed transports, and the elderly cared for at home may wait longer for assistance because the home-help service cannot use their vehicles, but must use other means of transport instead.

Mass media

(TV, radio, newspapers, Internet publishing)

If a crisis occurs, many functions and people are likely to experience a great need for information, particularly all of the command functions that use mass media as a source and communication channel. However, there are no indications that any critical societal functions would directly shut down if the mass media did not function and their dependence cannot therefore be called critical.

Transports

(road transports, rail transports, maritime transports).

The transport sector has strong internal dependencies both between the types of transport and between the infrastructure and the vehicles in each type of transport. A transport chain from supplier to customer can include all types of transport, and the vast majority of transports by rail and sea also include some road transport.

Disruptions in the transport sector would have an extensive impact on other critical societal functions. The sector is by nature very much a supply sector and potential disruptions can consequently spread far. The critically dependent functions are district heating, the food supply, emergency medical care, elderly care, pharmaceutical distribution and newspapers. Other functions that are clearly dependent on transports include the rescue services, electronic communications, the electricity supply and primary care.

In addition to this, functions with their own vehicles are clearly dependent on the transport infrastructure working, in other words that the roadways are passable. This applies to valuables transports, the police, rescue services, security firms, emergency medical care, elderly care, the mass media and repair services within the electricity supply, electronic communications and district heating.

Dependency chains

A dependency chain shows how a function is dependent on other functions. It is often relatively easy to say the functions on which one is directly dependent. An example of such an analysis is a risk and vulnerability analysis. The dependency chains analysed in the scope of this assignment also indicate the functions on which one is indirectly dependent. Altogether, this provides a more realistic picture of, for example, how a disruption in electronic communications affects a function.

In the main report, only one dependency chain is presented to indicate the kind of benefit that can be gained from them.

The dependency chains are judged to be of particular interest to representatives of individual functions, which is why they are presented in their entirety on the website and not in the main report or this summary.

The dependency chain presented in the main report is based on functions in municipal utilities. In this dependency chain, one can see, for example, that district heating plants are critically dependent on electronic communications and electricity through their dependence on the transport sector. In an analysis not taking indirect dependencies into consideration, this particular link to electronic communications and electricity would certainly not have been brought up.

Focus chains

We have chosen to delve into three questions to clarify the indirect dependencies, that is to say how functions can be affected by their dependence on each others' dependencies. This has not only been done to present results important for the Government assignment, but also to illustrate the significance and importance of conducting aggregate dependency analyses. The first in-depth question regards how secure a function is during a power outage when there is access to auxiliary power. The second investigates if society can function without transports and electronic communications, and the third question regards how important the workforce is today, if the country were to be afflicted by a pandemic flu.

Are functions with auxiliary power secure?

It is not always enough to equip oneself with auxiliary power to avoid being affected by a power outage. Although auxiliary power eases the situation considerably, it is necessary to in turn be aware of how the functions one is dependent on manage a power outage.

Some functions that are equipped with reserve power stations are emergency medical care and the drinking water supply³. Both of these functions can nonetheless be affected by a

³ The access to auxiliary power within these functions varies throughout the country.

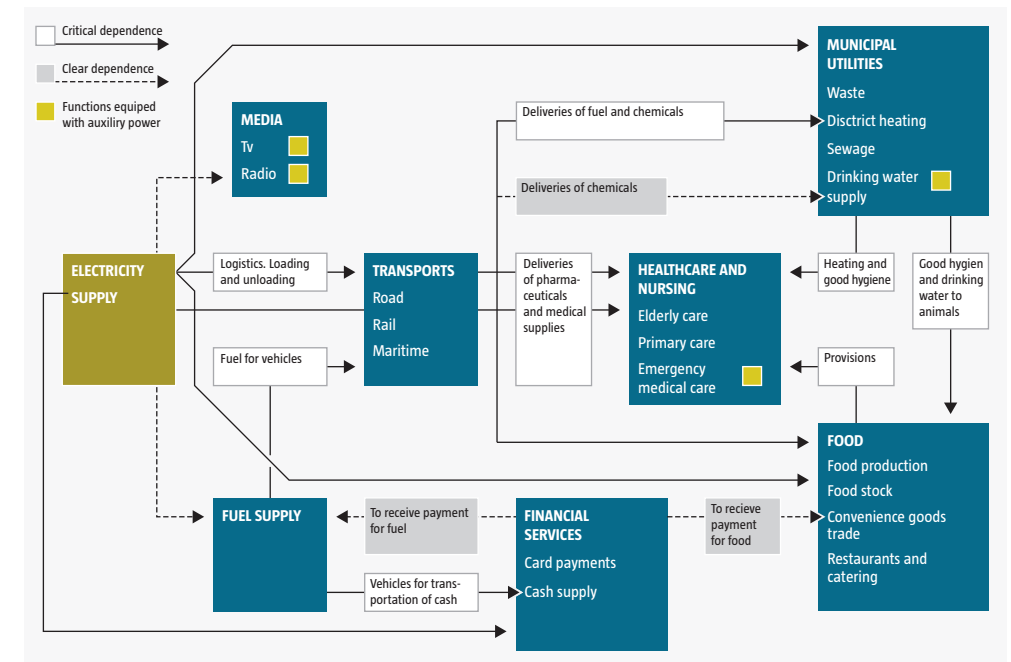


Figure 1. Focus chain:
Are functions with auxiliary power secure?

power outage. The foremost reason for this is that the need for transports cannot be met with certainty. Road transports can be affected by a power outage if the haulage contractor's centre for order management and traffic planning is located within the area of the outage or if access to petrol is closed off by petrol station pumps not working.

The drinking water supply is affected by deficiencies in the transport sector by the need for regular chemical deliveries for water purification not being able to be met. Emergency medical care is affected by failures in the daily deliveries of pharmaceuticals and medical supplies. Other functions affected by disruptions in the transport sector include district heating plants through the need for fuel deliveries, and the food supply, which has difficulty in maintaining good hygiene and providing drinking water to animals.

Another interesting relationship is the one between the electricity supply, fuel, payment systems and transports.

Card and cash management need electricity for card terminals and cash points to work. Cash management is also dependent on fuel for the vehicles that take care of the valuables transports. If payment systems do not work, there is a risk that grocers and petrol stations close during the period of time that the crisis lasts because they cannot take payment for their goods. The petrol stations also already have problems in the power outage in that the pumps are electrically powered. Problems of obtaining access to fuel affect road transports as well as passability on the roads because the National Road Administration's vehicles have difficulty in operating. Deficiencies in transport capacity and passability can make repairs to resolve the power outage difficult.

Does a society function without electronic communications and transports?

The technical development of the past century has made it possible to use telecommunication and data communication to enhance the efficiency of increasing numbers of functions in a function. This has facilitated daily life for many people. This has also led to the possibility of making many functions less dependent on personnel, which is why workforces have been reduced in many cases. What is perceived as positive changes in daily life can, in the event of a crisis, show another side. If computers, telephones and various kinds of signalling systems do not work, there are not always alternative auxiliary methods. Manual procedures that existed previously are not always known by new personnel. Nor does the same redundancy in the workforce exist because it has been reduced in pace with work efficiency enhancements. Internationalisation has meant that functions and monitoring of certain critical societal functions are currently conducted outside Sweden. This sets even higher demands on well-functioning electronic, cross-border communication possibilities.⁴

The transport sector suffers a major impact from disruptions in telecom and data traffic in that order management, logistics planning and traffic command are largely based on electronic

⁴ Report from SEMA. Krisberedskapsmyndigheten: *Gränsöverskridande beroenden – En studie om samhällsviktiga verksamheters beroenden över nationsgränserna*. (Crossborder dependencies – a study of Critical Societal Functions dependencies) (0021/2007).

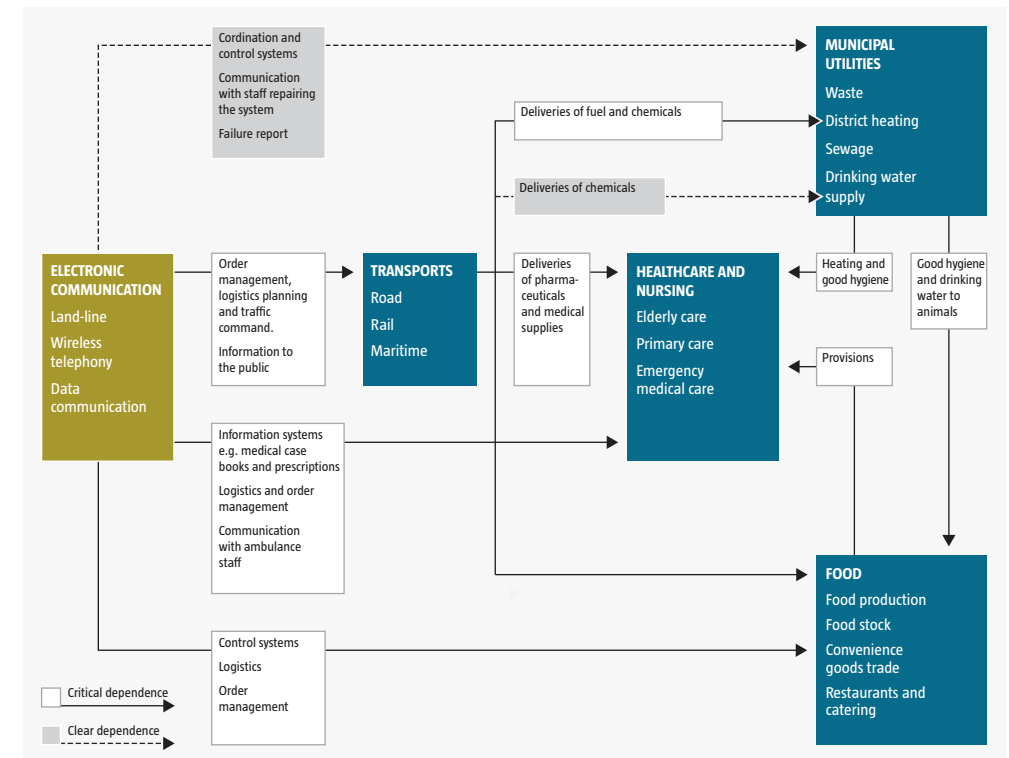


Figure 2. Focus chain:

Does a society function without electronic communications and transports?

communications. Disruptions in the transport sector affect many sectors, primarily municipal utilities, healthcare and nursing, and the food supply.

Municipal utilities have a certain degree of endurance for managing telecom and data communication disruptions. But in extended processes, problems arise with waste management, sewage systems and the drinking water supply, which in turn affect healthcare, nursing and food production.

Both the food supply and healthcare and nursing are affected in multiple ways by a disruption in electronic communications. Besides the direct disruption, they are also affected by the ensuing disruptions in transports and municipal utilities. Healthcare and nursing experiences the worst impact in the form of problems with records and lab results, failures of crucial deliveries, a lack of drinking water and difficulties in taking care of hygiene and the heating of the premises.

How important is the workforce?

All functions, critical to society or not, are generally in need of labour. Some functions have very large needs while others manage with a few people. Here, we have proceeded from a scenario involving a pandemic influenza to see the impact of many people becoming ill at the same time.

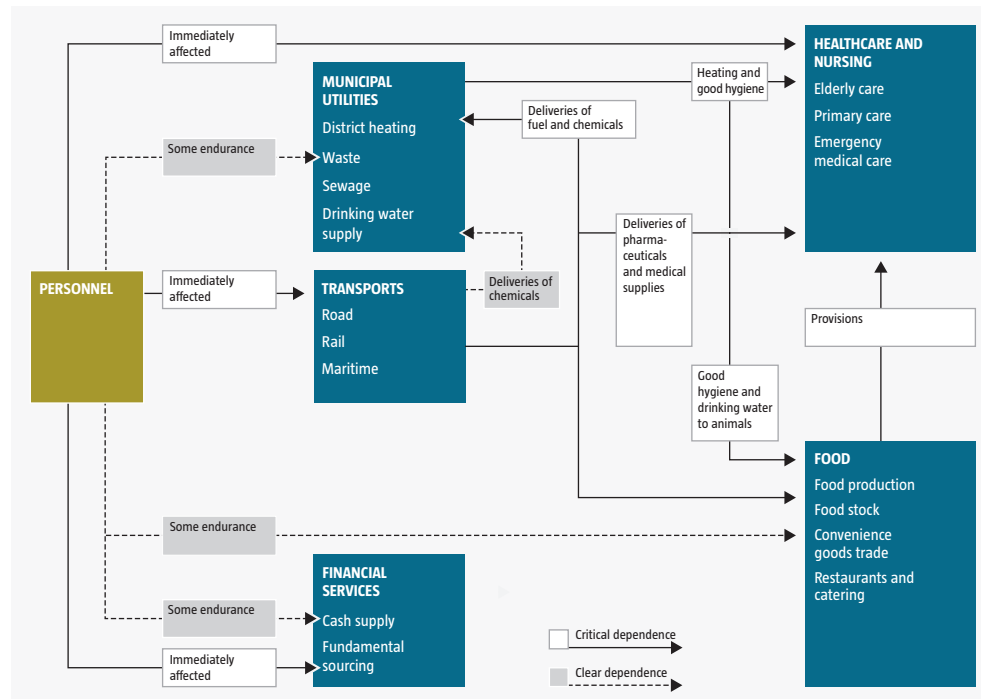


Figure 3, Focus chain:
How important is the workforce?

A widespread shortage of personnel primarily affects healthcare and nursing, transports, municipal utilities, the convenience goods trade and institutional catering as well as some financial services. The transport sector cannot maintain its usual capacity, which means that the other functions are not only affected directly by the loss of personnel, but also indirectly as a result of the decreased transports.

A personnel shortage in municipal utilities can, for example, affect small waterworks that are not staffed around the clock. Larger facilities manage better, and sewage treatment is

inherently a less sensitive function than e.g. drinking water production, which handles a foodstuff. District heating production is judged to be able to function even during a pandemic despite a strained situation. However, waste management is a labour-intensive function and can be hit harder. When the transport sector loses capacity, the drinking water supply and district heating production are also affected because they need deliveries of chemicals and fuel.

A personnel shortage in the financial services sector, including social insurance, would have direct consequences: The valuable transports are the component of the cash supply that is most dependent on personnel. Moreover, the social insurance system would rapidly be heavily loaded.

The food supply would also be affected by the reduced transport capacity so that the assortment of food in shops would decrease and some foods would rapidly run out. In addition to this, they are also affected by the shortages in municipal utilities because it becomes difficult to maintain hygiene levels in production.

All of these disruptions in turn affect the sector that is the most vulnerable of all during a pandemic – healthcare and nursing. Healthcare and nursing is a labour-intensive function and an influenza pandemic increases the load on the functions at the same time that the workforce decreases. The personnel would be confronted with some duties that would be different than in a normal situation and relatives would have to bear a larger part of the burden.

A personnel shortage in the energy supply will probably not affect electricity production. However, it may be more difficult to carry out repairs to the grid during a pandemic. The situation becomes significantly more serious if a pandemic were to coincide with a major power outage.

Electronic communications and the functions in protection and security should work without any major problems despite a reduction in the workforce.



Conclusions

The following provides a number of important conclusions from SEMA's work with critical societal dependencies. In light of their summary and thereby brief nature, they should be considered as an overview. Please refer to the final report for a more thorough presentation of the conclusions from the Government assignment.

Dependency analyses are needed for individual functions and at the cross-sectoral societal level.

A dependency analysis increases understanding of how a function is dependent on other functions, both directly and indirectly. Such an analysis therefore provides better and more realistic assessments of the function's vulnerabilities.

Actors with overall responsibility (such as municipalities and county administrative boards) need to be able to obtain a comprehensive picture of dependencies between the functions in their area of responsibility. This type of aggregate analysis provides a good illustration of society's collective vulnerabilities. A corresponding analysis is of course also needed at a national level.

It is necessary to analyse both direct and indirect impacts to obtain an accurate view of strain during a crisis.

To analyse how a function is affected during a crisis, it is not enough to take into consideration the direct consequences. It is necessary to also investigate the indirect consequences and undertake measures to be able to handle them. There are several examples of the combined strain becoming much larger than one would think based only on the direct consequences. Some of these examples have been presented in the results chapter.

Verification of anticipated dependencies – electricity and electronic communications.

All functions and society in general are dependent on the electricity supply and electronic communications. This is hardly news, but known dependencies must also be continuously reviewed because they are not static, but change over time. New technology, changed business logic, specialisation, etc. contribute to changing the nature of the dependencies. Consequently, it is also important to monitor known dependencies to see how their impacts and the need for measures change.

A clear majority of the studied critical societal functions are critically dependent on functioning electronic communications.

A majority of the critical societal functions included in the analysis are critically dependent on functioning electronic communications, either directly or indirectly in that they are critically dependent on a function that is in turn critically dependent on electronic communications.

Auxiliary power is no guarantee to not be affected by a power outage.

A function can be affected by the consequences of a power outage even though it has auxiliary power. These functions can namely be affected by other supply functions being affected because they in turn lack auxiliary power. Emergency medical care and the drinking water supply are examples of such functions that can be affected by a power outage although auxiliary power works well. In this case, it is the functions' distinct need for functioning transports that causes problems.

Besides the electricity supply and electronic communications, the transport sector is the sector that results in the greatest impact on other critical societal functions if it is affected by a disruption.

A large proportion of critical societal functions depend on functioning transports. Many rely on regular, in some cases daily, deliveries and have no or strongly limited stockpiles of their own. An involuntary reduction in capacity in the transport sector must be able to be managed, for example, by prioritising deliveries to the most important functions in society.

The transport sector is in turn critically dependent on electricity and electronic communications, primarily due to the functions' need for being able to manage logistics flows. Lorry transports are also indirectly dependent on petrol station dependence on electricity to be able to have access to fuel.

It is important that the fuel supply functions all the way out to the user through the petrol stations.

The fuel supply has proven to be a very important component and a strong propagator if it does not function. A power outage or a shutdown in the payment system not only affects petrol stations that may need to close, but also affects critical societal functions such as the rescue services, police, emergency medical care, security firms and waste management. Many functions are also indirectly affected through their dependence on a functioning transport sector.

Dependencies tied to strategic goods and services need to be managed in a special way.

Many functions, perhaps mainly those associated with the electricity supply and electronic communications, have a distinct dependence on qualified personnel that can take care of functions and repairs. They comprise a strategic resource that is under-dimensioned relative to the needs that may arise in a crisis situation.

There are also strategically important goods, such as vaccines, that are produced outside Sweden. If the demand for these goods were to become greater than the supply, it could be difficult to obtain sufficient amounts to cover demand.

Strong intra-sector dependencies are a potential source of concern in the event of a crisis.

Several of the sectors studied in the scope of SEMA's assignment regarding critical societal dependencies show clear intra-sector dependencies. Examples of such sectors include healthcare and nursing, internal protection and security, and the financial sector. One interesting conclusion can be drawn in light of the supporting evidence that came forth is that there is a clear risk that the strain within the sector would

shift to other functions in a crisis, which then have problems fulfilling their function. Altogether, the entire sector can as such have problems as a result of this type of shift, which can both further worsen the crisis as well as limit the possibility of managing the crisis in an adequate manner. Some relevant examples of dependencies that can result in shifts between functions within a sector include:

- ▶ security firms and police functions
- ▶ primary care, elderly care and emergency medical care
- ▶ the cash supply and card payments

End users are affected (more) often.

One general conclusion is that private persons are often affected in a crisis even if critical societal functions manage to maintain their capacity. For example, banking customers cannot use the Internet bank in a power outage because there is no power for the computer even though electronic communications and financial services may have succeeded in withstanding the electricity disruption. Another example concerns radio and TV stations that are equipped with auxiliary power to function during a power outage, but where people nonetheless cannot use the service if they lack access to electricity.

The dependency profile of the functions can be associated with a strategic discussion regarding measures.

Functions can be divided into four different dependency profiles based on the degree to which they are supply or dependent functions. The dependency profiles are described in the results section and classify functions as propagators, hubs, targets or solitaires. Based on the different dependency profiles, one can see which measures may need to be undertaken.

Measures that should make propagator and hub functions more robust also provide beneficial effects for many other functions. This applies, for example, to electronic communications, the electricity supply, the fuel supply, transports and municipal utilities.

However, measures that make target functions, such as health-care and nursing and the food supply, more robust, stop within the function and provide limited effects for other critical societal functions. On the other hand, they naturally provide beneficial effects for society in general.



What needs to be done? Proposed measures and action plan

There is a standing ambition and on-going work to increase society's ability to withstand disruptions and its functional and emergency management capacity. The study regarding dependencies between critical societal functions should be seen as a part of this work, and its results contribute to creating better conditions for a strategic discussion concerning capacity-improvement measures. Against the backdrop of the results presented in this report, it is possible to discuss the effect of various measures undertaken in the scope of a critical societal function in the light of the cross-sector propagation chain resulting from a shutdown of the individual function. Similarly, it is possible to see how the effect of another measure may "stop" within the function and not benefit the security of other functions. The picture generated of dependencies can accordingly comprise a basis – a support – for reasoning and deciding on the prioritisation and allocation of resources based on the perspective of focusing on the functions in the weave of society, where resources have the greatest impact.

A number of proposals are presented below regarding overall measures and a proposal for a plan of action for the MSB with regard to dependency-related issues.

Proposal of overall measures

Appoint one actor to be responsible for the aggregate, society-wide dependency analysis.

An appointed party is needed as the designated responsible party for a continuous, society-wide dependency analysis at the national level. This must be an analysis that is based on the dependency analyses by the individual organisation representatives, but which does not constitute an integrated part of the work with risk and vulnerability analyses. The analysis

instead aims to aggregate the supporting documentation to a national level based on a cross-sector perspective. Today, there is no appointed actor in charge of this specific analysis.

The MSB is proposed to be charged with this assignment, which in terms of content has close ties to the agency's work on risk and vulnerability analyses and the work on capacity assessments. Like the dependency analysis, the capacity assessment is also aggregate in nature. It is important to ensure a business perspective in this context and not only base the analysis on the supporting evidence received from the actors covered by the regulatory methods in the risk and vulnerability assessment area. In terms of this, considerable demands are placed on the agency's ability to conduct private-public partnerships.

Create a comprehensive view of the supplementary resources (goods and services) that are available in Sweden.

Today, work is being conducted in various places to map different supplementary resources. However, the perception is that this work is fragmented and that there is currently no comprehensive view of available supplementary resources that can be used when necessary. Creating such a view can be considered to be important in light of the need to be able to bring resources to bear in strategic locations (read functions) in the event of a crisis. To achieve this, the information needs to be compiled and the conditions need to be created to be able to make the information available to the actors concerned when required. Where are the greatest needs? What resources are needed? What is available and where do they do the most good (with the aim of preventing further propagation of the impact to the societal level)?

Create clarity with regard to the division of responsibility for special measures in a crisis.

Although the principle of responsibility applies – both in everyday situations as well as in crises – some uncertainty exists regarding the division of responsibility for special measures in a crisis. This is something that was emphasized in the discussions with the organisation representatives in both the private and the public sector. This often concerns issues

regarding prioritisation, such as who decides what should be transported in the event of a reduction in transport capacity, but also concerns issues regarding areas for which there are currently no actors appointed to be in charge. In the latter case, it is usually mentioned that there is currently no responsible actor for there being consumer goods (food) in the shops (although there is an authority, the National Food Administration, responsible for ensuring that the food that is in shops is safe from a quality point of view). Similar conditions apply to ensuring the quantity of drinking water.

Work on creating clarity with regard to the division of responsibility for special measures in a crisis should take place in cooperation between the MSB and all central authorities. Authorities that have areas in which ambiguities have been identified in connection with the responsibility issue, such as the National Food Administration, have a particular responsibility to this regard. In this context, it should be noted that the National Food Administration has conducted work for several years to ensure the drinking water supply in crisis situations, despite ambiguity in the issue of responsibility.

Prepare special crisis agreements with the private suppliers that fulfil critical societal functions.

SEMA proposes that a basis for special crisis agreements with private suppliers of critical societal functions (such as the electricity supply, telecommunications and other critical societal infrastructure) be developed. It is important to set clear requirements on functionality in connection with the procurement of these types of functions, which would be facilitated if standardised agreements existed that the parties concerned could use.

The need to be able to sign suitable agreements with private suppliers is neither something new nor an area in which no work has been conducted. In spite of this fact, the subject is mentioned again because results from the work on critical societal dependencies clearly indicate that problems continue to exist in association with existing agreements. This is because the lack of implemented dependency analyses automatically

means that they have weaknesses that can entail problems for the actor in the event of a crisis. It is not uncommon that there is no clear stipulation that also takes into consideration the supplying party's own ability to meet the contractual objectives expressed in the agreement. In this context, it is of interest to emphasize the need for basic levels of security associated with critical societal functions. The above proposal can be seen as a part of this work. The work needs to be conducted by the parties concerned, such as the MSB, the National Post and Telecom Agency (PTS) and the Swedish Energy Agency, in close cooperation with private actors such as the industry associations.

Investigate the possibility of developing a code of rules that permits the prioritisation of transports critical to society.

All functions are dependent on transports. In terms of road transports of goods, the project's results indicate that a loss or reduction of delivery capacity would have major propagation effects in society. Functions that are critically dependent on road transports can, for example, be found in the food supply, healthcare and nursing, and the fuel supply.

In a situation where the transport capacity has been degraded for some reason, the issue of who should receive deliveries and what should be delivered comes to the fore. Is it the highest paying customers that are guaranteed deliveries? Is it critical societal functions in general? If it were not for the knowledge about critical societal dependencies and the insight of what a reduced transport capacity can entail for society as a whole, it would be easy to shift the entire set of problems to the domains of the principle of responsibility. All functions are responsible for their own activities – both in a normal situation and in a crisis. The agreements signed before the crisis also apply during the crisis (naturally with exception for force majeure clauses). From a societal perspective – where the objective includes ensuring the life and health of individuals, the functioning of society and democratic rights – there may, however, be reason to discuss the need of deviating from market forces in a crisis as a sole control mechanism.

There are mainly two national strategies to handle the problems that can arise as a result of reduced transport capacity. Either a strategic effort concerning the stockpiling of identified goods (such as pharmaceuticals, fuel and perhaps food as well) to ensure a degree of robustness even without ordinary transports is necessary, or a code of rules must be worked out for the prioritisation of critical societal transports in a situation of reduced capacity. Which strategy is chosen is very much a choice of cost as well as political ideology. In many respects, stockpiling of products important to society has been abandoned to the benefit of market forces. Arguments for prioritisation – and thereby control – of resources as a complement to “letting the market decide” may only be seen as appropriate where the cost-benefit effect weighs over to the benefit of society's objectives.

In light of the above, it is proposed that the possibility of developing a code of rules allowing for prioritisation of transports critical to society be investigated, particularly with regard to fuel, pharmaceuticals and medical supplies as well as food. This work should be begun in the activities already initiated in the transporters' co-ordination area (SO TP). In the scope of SO TP's work, efforts have been conducted to identify and analyse which transports can be considered to be critical to society. Natural parties to this work include all traffic authorities with the support of the MSB and in cooperation with private actors.

Work for the possibility of being able to prioritise critical societal functions' needs for electricity and electronic communication.

It is also important to be able to prioritise critical societal functions so that they have an electricity supply and can use electronic communications even if access is limited. PTS and the Swedish Energy Agency have actively worked with these issues and SEMA can only point out how important it is to continue this work.

⁴ See for instance the reports from the Swedish Post and Telecom Agency, (Post – och telestyrelsen: *Samhällsviktiga användares behov av prioriteringsfunktioner i elektroniska kommunikationer*, PTS-ER-2008:7) and the Swedish Energy Agency (Energimyndigheten: *Prioritering av elvanvändare vid elbrist*, ER 2007:38).

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Investigate the possibility of exceptions from specific legislation in crises (such as working hours restriction legislation).

In society, there are a large number of regulations that control how functions may be conducted. The objective is to protect people's life and health, the functioning of society, financial assets or environmental assets. In a crisis situation, certain functions may need to deviate from current regulations so that the situation will have as mild an impact as possible. In some cases, this may be a question of changes to legislation, in others of applying the existing legislation in a better way. Many emergency measures require investments or large organisational changes, and by comparison, this is a simple measure that can nonetheless be very important to managing crises.

Proposed plan of action for the MSB

The following are the proposed measures, in heading format and the form of an action plan, that have been worked out for the future agency.

- ▶ Include dependency analyses in the MSB regulations in the area of risk and vulnerability analysis.
- ▶ Integrate dependency analyses into MSB's internal work on risk and vulnerability analyses and the work on capacity assessments.
- ▶ Work for dependency analysis to become an integrated part of the actors' work on risk and vulnerability analyses.
- ▶ Use the results from the aggregate dependency analysis to develop supporting documentation and concrete measure proposals for functional work.
- ▶ Work for the observation of the cross-border dimension of dependency problems within the scope of MSB's intermediation for the European Programme for Critical Infrastructure Protection (EPCIP).
- ▶ Ensure that the system's actors are made aware of the problem with dependencies.
- ▶ Make it possible for the dependent and supplying actors (both public and private) to cooperate across sector boundaries.
- ▶ Invest in research in the dependency area.

The Swedish Emergency Management Agency concluded a Government assignment in December 2008, which analysed critical dependencies between critical societal functions. The Swedish Civil Contingencies Agency (MSB) presents the results from the assignment in the report *If one goes down – do all go down?* This brochure is a summary of that report.

The extensive collection of material that the project has resulted in can be found on www.msbmyndigheten.se (in Swedish). The material includes specific descriptions of critical dependencies between various critical societal functions, as well as concrete aids and tools for conducting a dependency analysis.