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Cross border crisis management concept: Establishing cooperation measures between Dutch and German veterinary authorities in animal disease control

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Abstract

Cross border crisis management concept: Establishing cooperation measures between Dutch and German veterinary authorities in animal disease control

The objective of this thesis consisted in the development of cross border cooperation management in animal disease control. Particularly, the experiences and intentions of public and private stakeholders have been identified and inluded in this research in order to find out to what degree cross border cooperation can be regarded as a benefit to national animal disease control strategies. By means of a case study, the research activities were focussed on Dutch and German experts on Classical Swine Fever control. Based on the results, a Cross border cooperation concept has been developed that provides veterinary authorities with a standardization of all steps that have to be taken for the preparation and evaluation of cross border cooperation measures.

This study was provided with a multi-disciplinary approach. Elements from different scientific disciplines have been combined to an integrated concept. Initially, expert elicitation methods have been used to collect data and information on the subject of interest. Relevant stakeholders have been interviewed before an expert survey was made to validate the results.

In the following section of the thesis the prosperity of cross border animal disease control was illustrated by means of quantitative simulation. The aim of this study was to compare the epidemiological and the economic effects of recent strategies against livestock diseases with cross border cooperation strategies. The main findings of this chapter give insight in the basic differences in CSF control in the Dutch German border area.

The aim of the next chapter was to contribute to a standardization of data and information transfer in cross border crisis management. The guidelines presented in this section were developed in order to improve the identification of data or information gaps while preparing cross border cooperation plans for crisis management. In a second step these gaps had to be repaired before cross border cooperation could be implemented into national animal disease regulation. The concept combines decision theory, information theory, quality management and innovation theory to an integrated approach. A central result is the definition of fact sheets for all stakeholders concerned in information transfer activities. These instructions refer to the tasks and benefits each actor has in order to make information transfer possible.

In the final section of this study a Cross border crisis management concept was developed as a supporting tool for veterinary authorities. The design of this concept has been described in several sequences and its capabilities have been illustrated in a single case study. As a core result, the evaluation of this crisis management concept made clear how benefits of cross border cooperation can be implemented and, at the same time, how to deal with a variety of limiting factors that are standing in the way of a successful implementation.

Finally, the standardization of cross border crisis management by means of an integrated concept is highly recommended, but stakeholders have to participate and decide for official agreements in normal times. As soon as a crisis is at hand, there is no more room for debate about cross border cooperation. The majority of Dutch and German stakeholders support the principle of cross border cooperation in animal disease control. But, the findings of this research show that in every single cooperation plan the benefits always depend on the perspective a stakeholder has on this very subject. Thus, crisis management cooperation is a dynamic process that needs systematic innovation.

KURZFASSUNG

Die Zielsetzung der Dissertation bestand in der Bewertung von grenzüberschreitenden Maßnahmen zur Tierseuchenbeherrschung. Insbesondere die Einbeziehung von Erfahrungen und Absichten der verantwortlichen Entscheidungsträger aus Behörde und Privatwirtschaft waren von Bedeutung wenn es um die Beurteilung des Nutzens von grenzüberschreitenden Kooperationsmaßnahmen im Vergleich zu rein nationalen Strategien ging. Im Rahmen einer Fallstudie an den deutschen und niederländischen Vorkehrungen zur Beherrschung der Klassischen Schweinepest wurden exemplarisch Erkenntnisse zum Aufbau von grenzüberschreitenden Kooperationsmaßnahmen gewonnen. Auf der Grundlage dieser Ergebnisse wurde abschließend ein grenzüberschreitendes Kooperationskonzept entwickelt, das die Veterinärbehörden zur standardisierten Vorbereitung und Validierung von gemeinsamen Beherrschungsmaßnahmen verwenden sollen. Diese Studie basiert auf einem multi-disziplinären Ansatz. Elemente aus verschiedenen akademischen Diszipline wurden vereinbart zu einem integrierten Konzept. Einleitend wurden zunächst Methoden zur qualitativen Datenerhebung verwendet. Alle relevanten Entscheidungsträger wurden befragt, bevor zur Validierung der erhobenen Daten eine breite Expertenumfrage lanciert wurde.

Im folgenden Arbeitsschritt der Dissertation wurden die Erfolgsaussichten von grenzüberschreitender Kooperation in der Tierseuchenbeherrschung anhand quantitativer Simulationsmodelle untersucht. Zielsetzung dieser Untersuchung war es, die epidemiologischen und wirtschaftlichen Effekte aus aktuellen Tierseuchenbeherrschungsstrategien zu vergleichen mit den Auswirkungen grenzüberschreitender Maßnahmen. Die Erkenntisse aus diesem Abschnitt geben einen differenzierten Eindruck, welche Vor- und Nachteile grenzüberschreitende Maßnahmen für die beteiligten Entscheidungsträger bieten.

Die Zielsetzung des nächsten Kapitels war die Entwicklung eines Leitfadens zur standardisierten Erfassung von entscheidungsrelevanten Daten und Informationstransfers im grenzüberschreitenden Krisenmanagement. Vor dem Hintergrund der Annahme, dass der Mangel an Daten und Informationen eine prominente Ursache für das Scheitern von Entscheidungsprozessen ist, wurde ein Konzept erstellt, mit dessen Hilfe sich die Identifikation und Behebung von Datenlücken verbessern lässt. Das Konzept vereint Elemente aus der Entscheidungstheorie, des Qualitätsmanagements und der Innovationstheorie. Zu den zentralen Ergebnissen zählte die Bereitstellung von Handlungsinstruktionen für alle am Entscheidungsprozess beteiligten Akteure. Auf dieser Grundlage wurden den Entscheidungstägern konkrete Aufgaben zugeteilt, die zur Überbrückung der Informationsdefizite und somit zur Umsetzung des Kooperationsprozesses erforderlich waren.

Im Schlußkapitel dieser Studie wurde das grenzüberschreitende Kooperationskonzept vorgestellt. In mehreren Stufen wurden die zu ergreifenden Maßnahmen bei der Vorbereitung von Kooperationsmaßnahmen anhand eines Fallbeispiels erläutert. Die Auswertung des Konzeptes zeigte, in welcher Weise sich Vorteile aus grenzüberschreitender Zusammenarbeit erzielen lassen ohne gleichzeitig bei der Implementierung der entwickelten Maßnahme an vorhersehbaren limitierenden Faktoren zu scheitern.

Abschließend konnte festgehalten werden, dass ein standardisiertes Konzept zur Vorbereitung grenzüberschreitender Kooperationsmaßnahmen in der Tierseuchenbeherrschung unter den in dieser Studie genannten Bedingungen zu empfehlen ist. Von wesentlicher Bedeutung ist dabei die Beteilgung von Entscheidungsträgern, da diese in krisenfreien Zeiten verbindliche Absprachen zur Kooperation treffen müssen. Erfolgt dies nicht, sind die Kooperationsmöglichkeiten im Krisenfall gering. In dieser Dissertation wurde zudem bewiesen, dass deutsche und niederländische Experten das Prinzip der grenzüberschreitenden Zusammenarbeit stark befürworten. Es zeigte sich allerdings auch, dass jede neue Kooperationsmaßnahme jeweils aus den unterschiedlichen Perspektiven der verschiedenen Akteure bewertet wird. Grenzüberschreitende Kooperation im Krisenmanagemtn ist nicht zuletzt daher ein dynamischer Prozess, der von systemischer Innovation begleitet werden muss.

CONTENT

List of abbreviations

AID	Algemene Inspectiedienst
BMELV	Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz
CIDC	Centraal Instituut voor Dierziektecontrole
CL	Capability level
CMD	Centraal Meldpunt Dierziekten
CSF	Classical Swine Fever
DGIQ	Deutsche Gesellschaft für Informationsqualität
DR	Dienst Regelingen
EEM	Engage and exchange model
EL&I	Ministerie van Economische Zaken, Landbouw en Innovatie
EU	European Union
FAO	Food and Agriculture Organisation
FLI	Friedrich Löffler Institut
FMD	Foot and Mouth Disease
FMEA	Failure Mode and Effects Analysis
GD	Gezondheidsdienst voor dieren
HPAI	Highly Pathogenic Avian Influenza
HRP	High Risk Period
I&R	Identification and Recording
ISO	International Organization for Standardization
KOB	Kreisordnungsbehörde (local administration unit)
LANUV	Landesamt für Natur, Umwelt und Verbraucherschutz
LaTiKo	Landes-Tierseuchenkontrollzentrum
LWK NRW	Landwirtschaftskammer Nordrhein Westfalen
MinLNV	Ministerie van Landbouw, Natuur en Voedselveiligheid (out of use)
MKULNV	Ministeriums für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes Nordrhein Westfalen
MUNLV	Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein Westfalen (out of use)
NL	the Netherlands

NRW	North Rhine Westphalia
OIE	World Animal Health Organisation
PRM	Process reference model
pTÄ	Praktizierende Tierärzte (Practising veterinarians)
TH	Tierhalter (Livestock owner)
TKBA	Tierkörperbeseitigungsanlage (rendering plant)
TSK	Tierseuchenkasse (Animal Health funds)
UK	United Kingdom
VIC	Incident en crisiscentrum
VWA	Voedsel en warenautoriteit

1 General introduction

1.1 Introduction

In a globalized world consumers can easily get access to products from all over the planet. This is to the same extent valid for the international food market which is continuously changing and evolving as food suppliers, manufacturers, and retailers adjust to meet the needs of consumers who are increasingly demanding a wider variety of higher quality products [USDA ERS, 2009]. As a consequence of these global markets the complexity of trade patterns, the volume of daily traffic, and the extent of contacts within production chains are continuously increasing. Hence, it is only logical that the global food production chains are getting more susceptible for threats and risks. While they can easily be confronted with agents and contaminants from all over the world at any time, the time for decision making in crisis management is shrinking because of the high speed that is necessary to deliver exclusive products in perfect quality from one end of the planet to another. Time is more and more becoming a crucial factor in food production and retail.

Compared to other branches the stakeholders of food supply chains are often dealing with significantly sensitive products that underlie a cascade of specific risks, e.g. endurance limits, contamination or pathogens that can have a severe impact on trade flows, animal health and in some cases even on human health. The European regulation for example is very strict about this issue: even the slightest suspicion of a pathogen or contaminant can set food and livestock production on hold for some time. In a Single European Market with free trade between European countries the highest priority remains the need for effective prevention and control measures against threats to the food and feed industry in order to prevent a crisis or, in case of an outbreak, bring life back to normal as soon as possible [EU, 2010].

Highly pathogenic livestock diseases are commonly counted among the most important threats to the production of and trade with livestock, feed and food [MOENNIG, 2000; LADDOMADA, 2000; STEGEMAN et al., 2004; KREIENBROCK et al., 2010]. Since the early 1990s a steadily growing number of European countries made direct experiences with different epidemics followed by large effects to the local economic sectors. The rankings of incidents are dominated by the following crises: Classical Swine Fever (CSF) in the Netherlands in 1997; Foot and Mouth Disease (FMD) in the UK and the Netherlands in 2001 and High Pathogenic Avian Influenza (HPAI) in Italy, the Netherlands, Belgium and Germany in 2001. The 2001 FMD outbreak in the UK costs the UK economy around 13 billion €, while the 2003 Avian Influenza outbreak in the Netherlands costs the EU budget 650 million. The expenses of the CSF outbreaks on Dutch premises in 1997 were estimated between 2 ½ and 5 billion € [EU, 2007].

According to practical experiences the nature of a crisis due to highly pathogenic livestock diseases can be very complex. A study by LONGWORTH and SAATKAMP [2007] displays five major categories of impact: epidemiological, economic, social-ethical, environmental and human health. From the perspective of the majority of stakeholders the economic issues have the largest direct and indirect impact on a region that has been struck by a highly pathogenic disease [VAN ASSELDONCK et al., 2005]. Approximately one-third of global meat exports, or 6 million tons, is presently being affected by animal disease outbreaks. With the value of global meat and live animal trade estimated at $ 33 billion (excluding EU intra-trade) this could amount to world trade losses of up to $ 10 billion, if import bans extend throughout 2004 [FAO, 2004]. Not included are costs of public disease control measures, losses to producers and consumers through destabilized markets, fluctuating prices and the general costs to the industry. Hence, highly pathogenic animal disease outbreaks are first and foremost a crisis for the food supply chain, particularly with regard to zoonoses.

While the consequences of livestock diseases are first of all a concern of the private sector, it is the public veterinary administration that is traditionally in charge of crisis management measures [Breuer et al., 2008]. The origins of European animal disease control, as we understand it nowadays refer to the challenges of the post war reconstruction area where first objective was to guarantee the food supply for all citizens. Therefore, it has been a traditional task of veterinary authorities to find measures against animal diseases, even if they are no direct threat to public health. The veterinary administration knows different layers of responsibility. Therefore, in this research approach we will distinguish between four different dimensions of responsibility. In animal disease control every dimension knows a specific set of authorities and tasks (see Table 1.1).

Table 1.1: Dimensions of veterinary crisis management authorities

Dimension	Authority	Tasks
Global dimension	FAO, OIE	Global standards of animal disease control
Supranational dimension	European Union	European regulation of animal disease control (based on global standards)
National dimension	National ministries	National regulation of animal disease control (based on European strategy)
Local dimension	Veterinary authorities	Execution of national regulations

As already mentioned the preparation and performance of animal disease prevention and control measures are in the hands of national veterinary authorities. Based upon recent crisis management experiences the European Commission decided to tighten all measures for prevention and control of animal epidemics in a new Animal Health Strategy. Hereby, a central issue is the improvement of interregional cooperation [EU, 2007]. While the ongoing harmonization of animal disease regulation in Europe is first of all aiming at more efficiency in crisis prevention and management, it might cause serious obstacles for cooperation while the implementation of European law is still a purely national task. The status quo deriving from this EU regulation settings can be best described in a few words: national governments are in charge of animal disease prevention and control, but only on their own territory. Actually the practical experience with disease outbreaks shows that most epidemics do not develop within national borders though. Cross border jumps of pathogens can roughly be arranged in two categories: international jumps and cross border regional jumps. Some popular examples are the following: FMD in 2001 affected the Netherlands and the UK; HPAI in 2001 started in Italy and spread to the Netherlands, Germany and Belgium [OIE, 2010]. Particularly, the outbreak of an animal disease shows a so called cross-border dimension like the CSF outbreak in 2006 in the border area of Germany, Belgium and the Netherlands [BREUER and PETERSEN, 2008].

Hence, one of the future core challenges of national veterinary authorities is that compared to the Single European Market with no trade barriers the governmental structure of European member states is still issuing crisis management tasks along traditional bodies of national veterinary administration. As a consequence, cross border developing epidemics have to be managed by a number of national crisis management teams that are acting under different instructions.

Thus, there is a large likelihood that during a crisis this lack of cross border interfaces can lead to inefficient crisis management procedures. This hypothesis is supported by evaluation of animal disease control where it has been richly illustrated that governmental administration has to take their decisions in crisis situations as fast as possible in order to limit the possible spread of the epidemic [DEN BOER et al., 2004]. Two aspects are crucial for a fast decision making in crisis: high routine of staff and availability of relevant and exact information by time. Dealing with bilateral developing epidemics in most cases the importance of building interfaces between different veterinary systems becomes even more obvious.

1.2 Cross border dimension

As already referred to, cross-border issues are part of European animal disease control. The responsibility of crisis management actors becomes even higher if it comes to cross border areas where the amount of people, livestock and transport is extraordinary high. In so called epidemiological units the intensity and the complexity of contact structures within single parts of the local production chains becomes quite difficult to retrace if a large quantity of livestock and related products is traded across border lines [BREUER et al., 2008]. Hence, in addition to the four dimensions of veterinary authorities in crisis management (see Table 1.1) it seems to be appropriate to add a fifth level: the cross border dimension.

In the attempt of framing a case study for further research a whole bunch of aspects sets the Dutch-German border area and their veterinary administration in the picture when it comes to the analysis of strategic challenges and the effects that cross border cooperation measures can have: within the territory of the European Union there is clearly no other area where the density of livestock and population as well as the amount of animal related transport is comparably high [VEAUTHIER and WINDHORST, 2007; BITTER et al., 2007; BÄURLE et al., 2007; VEAUTHIER and WINDHORST, 2008]. Looking at the local production chains, e.g. the pork chain or the poultry chain, a highly cross border linked production is very significant for this area [BREUER and PETERSEN, 2008]. Having an important local economy in the background the national crisis management is of course aware of the fact that an animal disease outbreak on one side of the border has always direct or indirect consequences for the other side of the border. Neither the flow of goods, livestock and products nor the spread of pathogens or consumer activities is held back by a national border. As already mentioned both countries have made their negative experiences with animal disease outbreaks during the last two decades. The risk awareness – even for cross border challenges – is significantly high [MUNLV, 2007]. But still, the national contingency planning is not equipped with pre-defined cross border aspects.

1.3 Aim of this study

The following hypothesis underlies this study: Without pre-defined cross border interfaces in animal disease control, the national crisis management administration will be less effective and thus more expensive. Therefore, one of the core challenges of cross border cooperation will be finding official agreements that facilitate cross border cooperation of public bodies without increasing any risks that derive from highly pathogenic epizootics. According to this hypothesis, cross border trade in the Single European Market has to be attended by cross border measures in prevention and control of animal disease outbreaks.

Thus, the objective of this research is to find out how cross border cooperation in animal disease control can be established into Dutch and German veterinary authorities. Therefore, in a first step it is important to analyze if cross border cooperation is a relevant issue for veterinary authorities. In case, the next question would be what priorities veterinary authorities have for the implementation of cross border cooperation measures. Do differences between national veterinary systems play an important role or is the cross border potential reduced to specific subjects of animal disease control?

After having consulted the intentions of relevant stakeholders, the following question will be if cross border cooperation would have a significant impact on the quality of animal disease management in a border area. The prosperity of cross border cooperation depends on the following aspects: Do cross border measures help in reducing economic losses or in shortening the time that is necessary to put a stopper on an outbreak or is there no significant benefit compared to the recent procedures in European border regions?

Assuming that a positive impact of cross border cooperation can be demonstrated in this study, the next task will be to concentrate on possible limiting factors that do arise during the implementation of cross border measures. Therefore, in this study it will be analyzed to what extent a lack of decision relevant information is a barrier for cross border cooperation. Here, one of the core issues will be how it can be guaranteed that in crisis relevant information is provided across the border in a proper quality.

Finally, the question arises how cross border cooperation measures have to be prepared and implemented into national contingency plans. What has to be considered in terms of decision making processes, organizational structures and information transfer activities before a cross border strategy is worth coming into praxis?

Therefore, a cross border cooperation concept will be presented in this study that addresses the veterinary authorities in the Dutch-German border area and provides them with a qualitative procedure considering all research findings of this study.

1.4 Research scope and outline of the thesis

The research design of this study is organized in a four level approach. In Figure 1.1 the conceptual architecture of the thesis is presented highlighting the empirical and methodological steps that will be implemented to achieve the results.

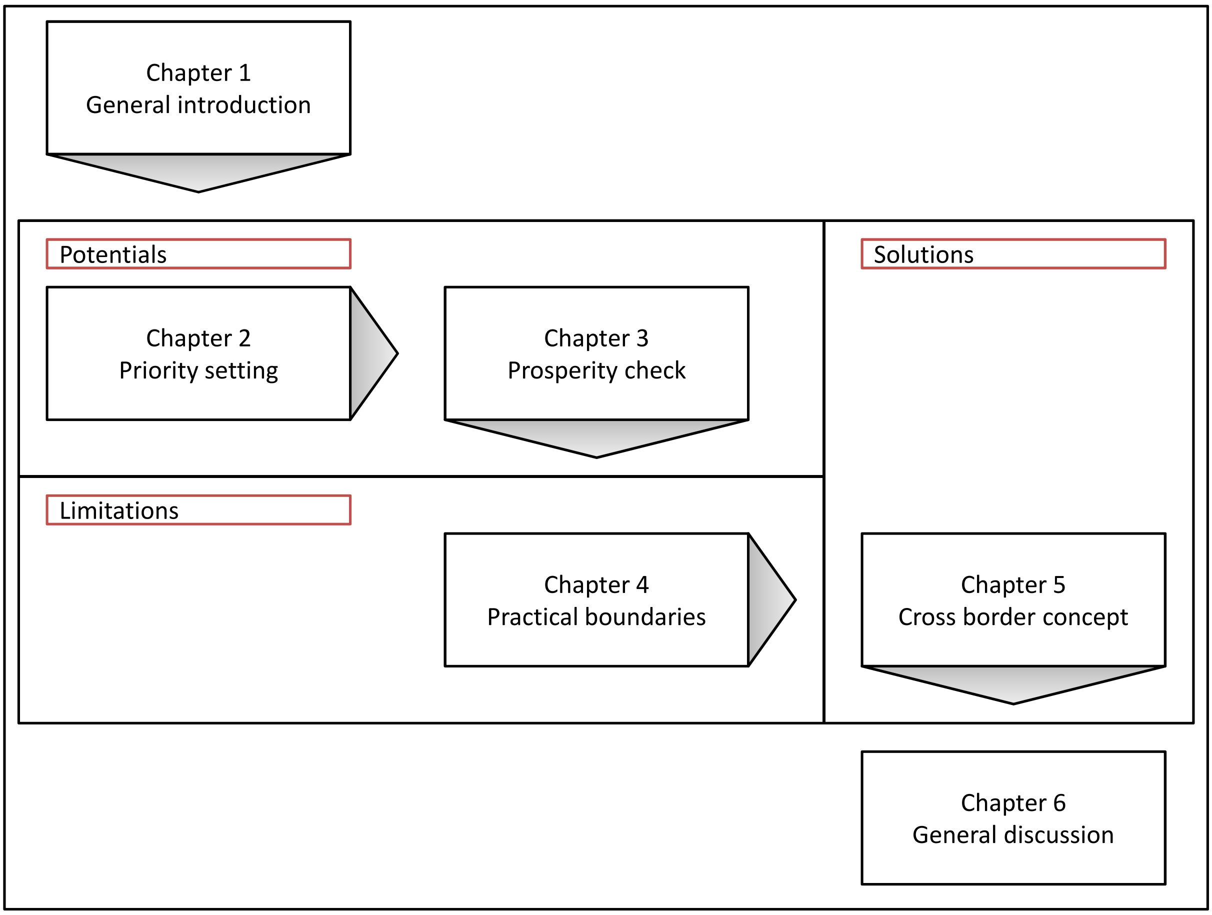

Figure 1.1: Conceptual architecture of the thesis

In Chapter 2 it will be analyzed how the veterinary administration in both countries is set up. For this study it is basically important to address any differences in the national implementation of EU strategies and to assess if these differences have any relevance for the quality of animal disease control in the border area. With this empirical analysis the identification of relevant actors and their responsibilities within the veterinary systems will be indicated. Based on results from the comparison of the veterinary hierarchy it will be important to figure out how the identified actors think about cross border cooperation options in CSF control. By this qualitative approach it will be found out where and how cross border crisis management can take place. Compared to quantitative approaches which allow the illustration of cross border cooperation effects along normative parameters this expert elicitation method has the benefit of taking practical experiences into account. A second step will be taken in order to find out more about the priorities that experts see in cross border solutions for crisis management problems. Two questions will be answered so far: (1) Are there any differences between the veterinary systems of both countries that have an effect on the quality of CSF-control and (2) where do the identified experts would emphasis to set up specific cross border solutions for CSF-control measures in order to overcome differences or intensify measures that already correspond?

As already mentioned for the majority of livestock disease outbreaks it is common opinion that their largest impact is on the economic sectors concerned by the threat. Therefore, in Chapter 3 the prosperity of cross border cooperation measures will be analysed compared to basic control strategies. Therefore, the nature of certain economic impacts that can arise from different CSF control strategies is illustrated in a quantitative simulation. To what extent can cross border cooperation reduce negative impacts on local economies and at the same time are certain measures strong enough to enhance the epidemiological power without raising the cost level above a degree of effectiveness? Finally, this chapter contains a quantitative verification of the qualitative results of Chapter 2.

Beside the potential of cross border cooperation it is crucially important to think about the nature of possible limitations to this attempt. Therefore, in Chapter 4 it will be analyzed and described how to deal with practical boundaries to cross border cooperation. The availability of relevant information is a core example for practical problems in CSF control. In this chapter a methodological protocol will be provided that shows how to deal with this limiting factor in order to make certain cross border solutions convertible for veterinary authorities. Hereby, a central aspect will be the definition of fact sheets for all actors concerned by information transfer activities. These instructions refer to the tasks and benefits each actor has in order to make information transfer possible. A very significant issue is the quality of information that is necessary to succeed in crisis management. In this chapter a categorization of information quality is made in order to enable crisis managers to make a sufficient data collection.

Thanks to the intelligence of the first three chapters it will be clear to what extent cross border cooperation has a potential for the prevention and control of epidemiological and economic impacts. Besides, it will be cleared out how to deal with practical boundaries like availability of decision relevant information. As a final task Chapter 5 sets out to describe the full cross border crisis management procedure that allows the development and implementation of cooperation options into national contingency plans.

Therefore, elements of two different methods have to be considered:

1. Qualitative scenario and simulation methodology: they allow an effective construction and evaluation of cross border crisis management measures.
2. Information and communication methodology: the closed loop model is inevitable to organize the administration of information relevant for decision making in crisis management.

Finally, the study provides the identified experts with specific cross border cooperation approaches. The set up of scenario based cooperation plans is ready made for training activities or direct implementation in national contingency plans.

In Chapter 6 of this study the attention will be devoted to the general conclusions, the practical usage of the results and the need for further research. The results of this study will be placed in the network of recent scientific activities that do contribute to a successful implementation of cross border cooperation efforts in animal disease control. Moreover, an outlook will be given on future research activities on this very topic.

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2 Cross border Classical Swine Fever control: Improving Dutch and German crisis management systems by an integrated public-private approach[1]

Abstract

The objective of this research approach is to analyse in which ways crisis management measures against Classical Swine Fever (CSF) can be improved by a public private cross border model. A core activity contains the analysis of information and communication systems: In a case study it has been empirically analysed if a sufficient supply of public and private information enables crisis managers at both sides of the Dutch-German border area to take decisions about CSF control more efficient. At the end of this approach a new crisis management model had been developed. One of the most important aspects thereby is the assessment of data: (1) within private quality management systems in normal times according to the benefit for public management tasks in times of crisis and (2) within public crisis management systems according to the benefit for cross-border CSF-control activities. To this effect two different methodological approaches have been combined within the model: (1) a method to identify and illustrate public actors and their options in crisis management decision making and (2) a system of communication and information exchange between public and private as well as Dutch and German actors (engage & exchange model) which permit to collect and to evaluate data in addition for a predefined time period are activated.

2.1 Introduction

Classical swine fever is a highly contagious disease of pigs and wild boar with a widespread worldwide distribution [MARSH, 1999; MOENNIG, 2000; MANGEN et al., 2003] and a particularly impact on high pig density areas like the border area between the Netherlands and Germany [FRITZEMEIER et al., 2000; STEGEMAN et al., 2000; DE VOS et al., 2003]. The outbreak of CSF in North Rhine Westphalia in March 2006 has underlined the perception, that the control of CSF outbreaks within Europe is still an unfinished task. Hence a certain potential of improvement at the level of control measures within a state and between states is detected. The events in 2006 conveyed the impression that a lack of harmonization in public European contingency planning and an insufficient further development of public and private information systems took valuable time in controlling the outbreak. Losing time has a direct impact on the High Risk Period (HRP): the longer it is the more money is spend and the more losses in trade and animals are not avoided. Particularly the use of different data formats in documentation or in passing on of information as well as the fact that personnel resources were even more added for bureaucratic activities than for concrete control measures made the German crisis management less effective [UHLENBERG, 2006; ZWINGMANN, 2006; BLAHA et al., 2006]. Another crucial point for the low efficiency of some preventive and control measures was the degree of cooperation between the authorities of

[1] Published in: BREUER, O.; SAATKAMP, H.; SCHÜTZ, V.; BRINKMANN, D. and B. PETERSEN (2008): Cross border Classical Swine Fever control: Improving Dutch and German crisis management systems by an integrated public-private approach, Journal für Verbraucherschutz und Lebensmittelsicherheit, Volume 3, Number 4, November 2008, pp. 455-465.

Germany, North Rhine Westphalia and the Netherlands. In 2006 both countries recognized that their information and communication structure concerning CSF-control needed specific updates to run more efficient in future crises. Relating to these empirical experiences it is the focus of this study, whether organizational and technical innovations should gain more importance according to the expansion of existing control systems on public and private levels – particularly in regions with a high animal density, like in the so-called North-West-German-Belt [SCHULZE ALTHOFF et al., 2007; THEUVSEN et al., 2007].

Thus, the objective of this interdisciplinary project is to analyse, in which ways a cross border crisis management model can enhance the cooperation between (1) public and private actors and (2) Dutch and German authorities in order to improve the quality and efficiency of CSF-control measures in the border area during the Post-HRP. In a first step empirical work has been done to identify different areas for cross border cooperation. Afterwards the model is conceptualised out of two different methods: It is focussed on the hypothesis that a sufficient and punctual supply of information enables different protagonists in crisis management to be faster and more efficient in decision making. By testing the model in interdisciplinary research projects a contribution to the enhancement of Dutch and German crisis management in CSF control will be given.

2.2 Empirical work

Empirical work was necessary to identify the areas for cross border improvement of CSF control. During the phases of analysis the following steps had to be taken:

- Identification of Dutch and German public and private actors and their responsibilities in CSF control,
- Illustration of analogies and differences between public CSF control systems,
- Understanding the priorities of relevant public and private actors for cross border cooperation,
- Construction of ambition levels for different degrees of cooperation.

2.2.1 Overview public CSF control

In Figure 2.1 schematic view on the course and control of CSF has been given in order to understand the different periods CSF is cycling through. The HRP is subdivided into phases: During the Pre-HRP is no virus present. The HRP1 starts with the introduction of the virus in an area that was previously CSF free and ends with the suspicion of the first case. In HRP 1 there is a suspicion of a CSF outbreak while in HRP 2 the suspicion has been officially confirmed. The Post-HRP begins with the notification of the first case and ends when all control measures are considered effective [HORST et al., 1998]. The events that are necessary to achieve an advanced CSF-period are illustrated in the second line of Figure 2.1 containing four different arrows. After eradication of a CSF outbreak is completed the first period is in force again. Furthermore Figure 2.1 contains the course of action that is based on EU-regulation and core examples for the cross border need of information which is fully based on the results coming out of expert interviews and a cross border survey that will be presented later in this chapter (2.2.4).

The new crisis management model that has been developed within this research approach is focussed on the Post-HRP. As one can draw from Figure 2.1 the control strategy begins after the notification of CSF has been accomplished. From the moment of notification on crisis management operation begins. Afterwards the need of information transfer and efficient crisis management is rather crucial and overwhelming. During the Post-HRP one can reduce the damage to animal health and economy by stopping the spread of virus as fast as possible. Therefore a clear management approach for a cross border crisis management model is inevitable.

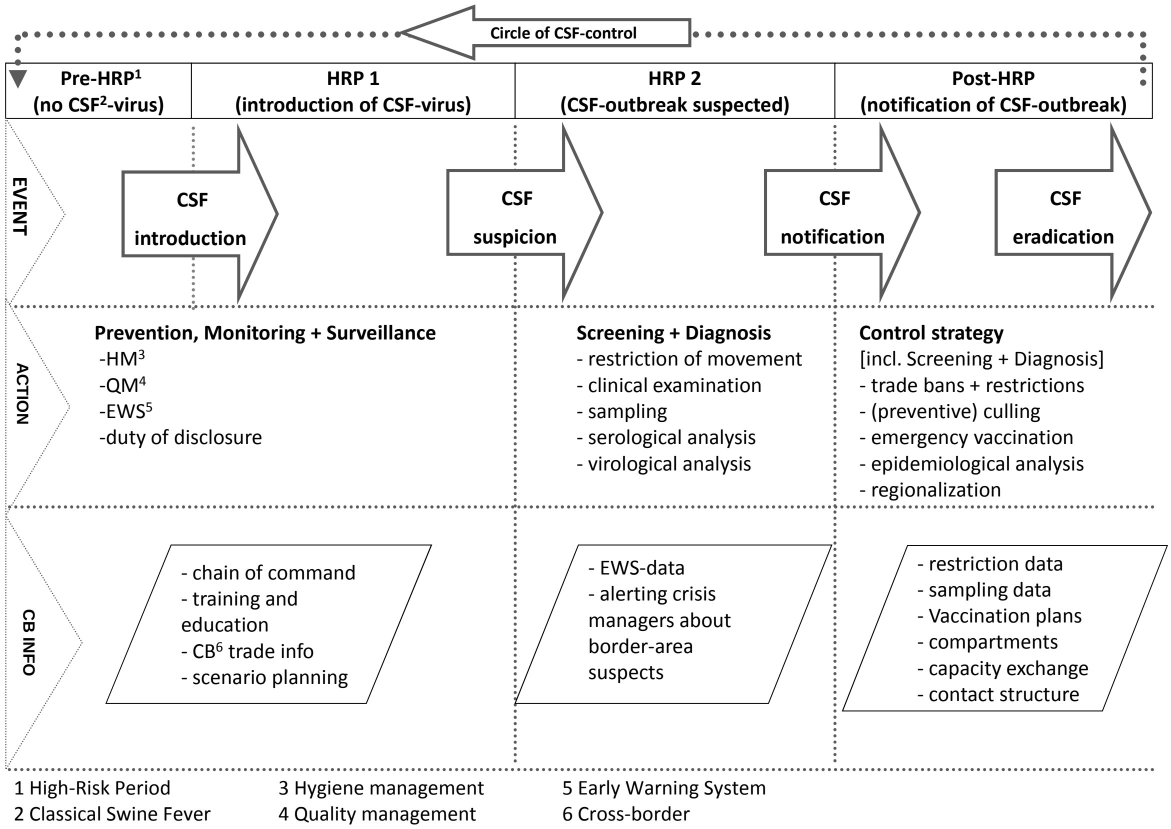


Figure 2.1: Schematic view on CSF control

2.2.2 *Identification of public and private actors and their responsibilities*

All relevant actors of animal health crisis management can be divided into different categories. Besides the concerned public and research institutions all levels of the private production chain have been taken into account (see also Figure 2.2).

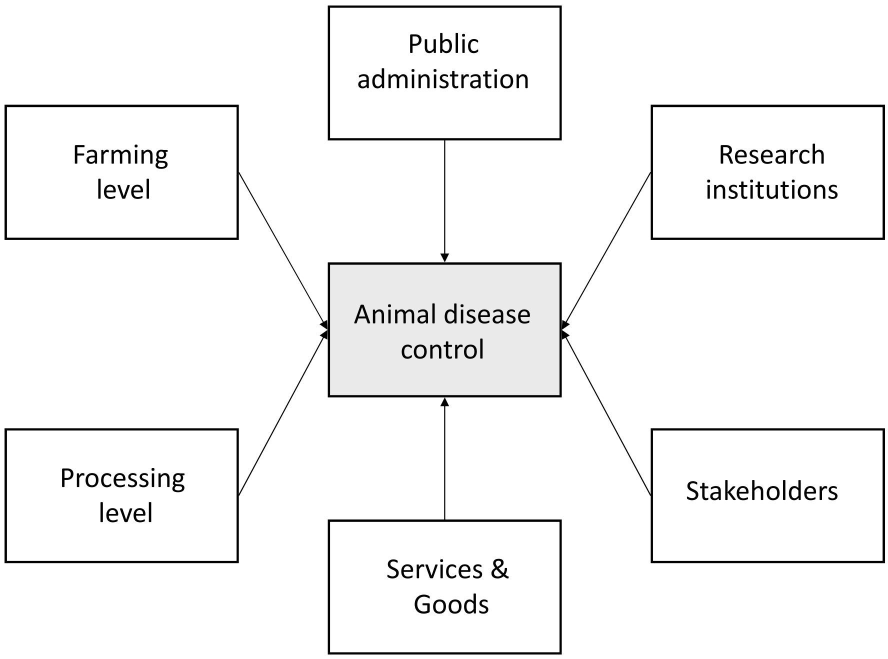


Figure 2.2: Identified crisis management actors in different categories

The identification of actors led to a code chart containing all public players and their crisis management tasks within the four phases of HRP (see Table 2.1). First of all the collected data has been filed into three columns: Due to the federal organisation of Germany animal disease control management is divided into national and federal-state tasks. In the Netherlands the entire system is organized under national responsibility which explains why there is only one column.

Established on the European basic strategy deriving from the European Council directive 2001/89/EC of 23 October 2001 on Community measures for the control of CSF the left ordinate contains all relevant measures during the HRP in order to compare responsibilities at each side of the border.

Table 2.1: Overview outline public actor crisis management code chart

Measures = directive 2001/89/EC \ responsibilities of actors		Germany		Netherlands
		National level	Federal state level	National level
Pre-High Risk Period (no CSF-virus)				
Legis-lation	Directives + regulation	BMELV (P)	MUNLV	MinLNV
[…]	[…]	[…]	[…]	[…]
High Risk Period 1 (no suspicion of CSF-outbreak)				
High Risk Period 2 (suspicion of CSF-outbreak)				
Art. 3	Duty of disclosure	TH + pTÄ	TH + pTÄ	TH + pTÄ
[…]	[…]	[…]	[…]	[…]
Post-High Risk Period (notification of CSF-outbreak) [*for full section see tab. 2.2*]				
	Decree of Standstill	*- in progress -*	*- in progress -*	MinLNV-VD
[…]	[…]	[…]	[…]	[…]

Legend: BMELV= Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz; KOB = Kreisordnungsbehörde; LANUV = Landesamt für Natur, Umwelt und Verbraucherschutz; MinLNV-VD = Ministerie van landbouw, natuur en voedselveiligheid – directie voedselkwaliteit en diergezondheid; MUNLV = Ministerium für Umwelt und Natur, Landwirtschaft und Verbraucherschutz des Landes NRW; P = Preparation, pTÄ = practising veterinaries; TH = livestock owners

This code chart enables to identify differences and analogies between the organisation of CSF control systems in the Netherlands and Germany. Having the function of a basic tool it allows identifying all actors concerned on both sides of the border. Regarding the high amount of data only the Post-HRP is presented in this paper (see Table 2.2). The following aspects belong to the most striking differences in tasks that have been found during the analysis:

- Common tasks are differently arranged: the veterinary system in the Netherlands is completely centralized while the chain of command in Germany is federal.
- Different level of strategy above the EU-regulation: The Netherlands e.g. are so far not using carcass data for Early Warning Systems; in Germany they miss a 72 hour standstill regulation in case of a first confirmed animal disease outbreak.

Having all public actors and their national responsibilities identified and listed completes the first step in analysing crisis management systems of both countries in order to find areas for cross border improvement.

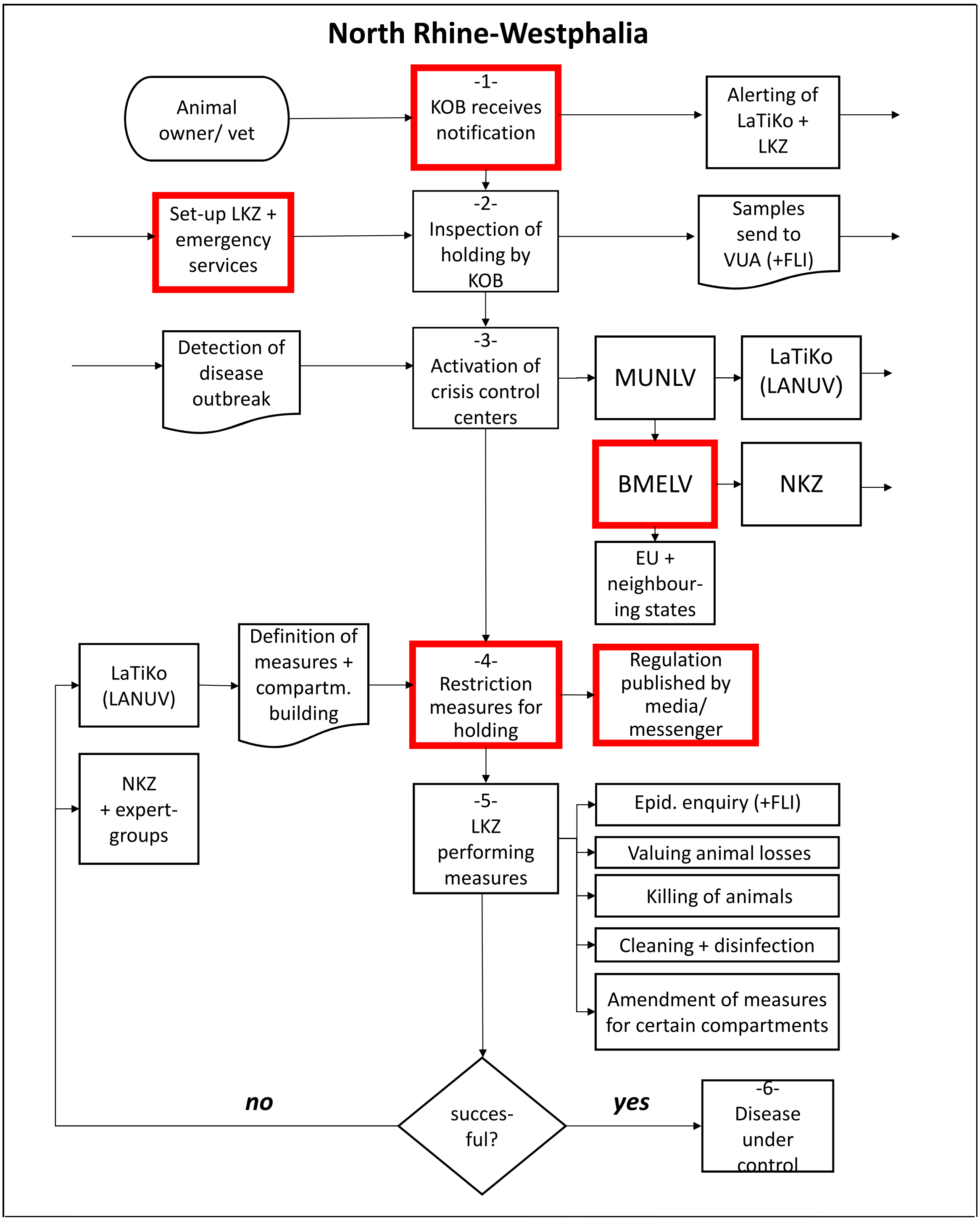
Table 2.2: Section from public actors crisis management code chart: Post-HRP

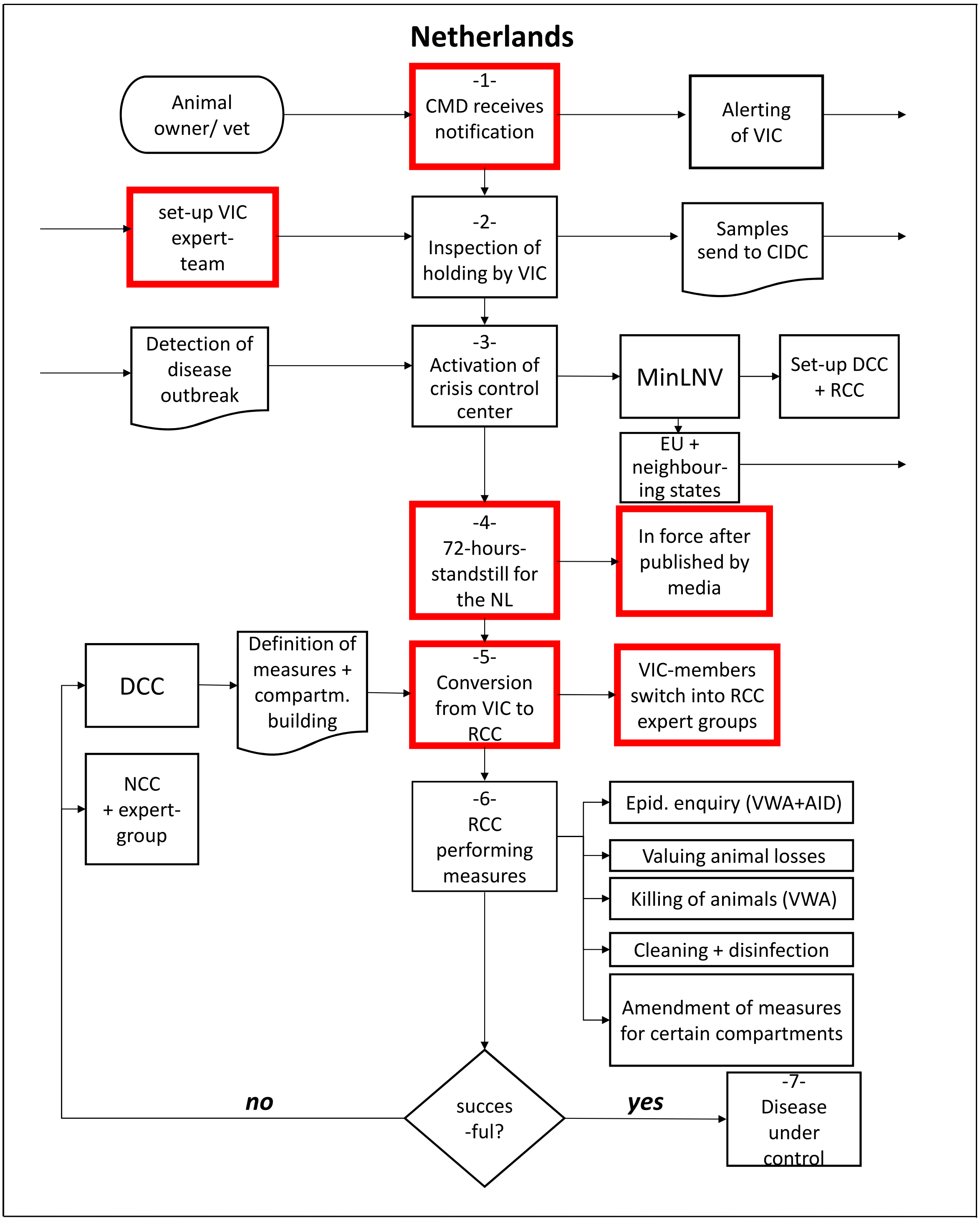
Measures = directive 2001/89/EC \ responsibilities of actors		Germany		Netherlands
		National level	Federal state level	National level
Post-High Risk Period (notification of CSF-outbreak)				
	Decree of Standstill	*- in progress -*	*- in progress -*	MinLNV-VD
Art. 23	Disease control center	BMELV	MUNLV + LANUV + KOB	MinLNV (VD+DRZ)
	Compartment building	-	MUNLV + LANUV	MinLNV-VD + VWA
Art. 9	Protection + surveillance zones	-	MUNLV + LANUV	MinLNV-VD + VWA
Art. 5	Killing of confirmed holdings	-	KOB + LWK (O)	VWA
Art. 5	Taking samples	FLI (O)	KOB	VWA
Art. 5	Processing of carcasses	-	KOB + TKBA	Rendac
Art. 5	Destruction of contam. Products	-	KOB	VWA
Art. 12	Cleaning & desinfection	-	KOB	VWA
Art. 8	Epidemiological enquiry	FLI (O)	KOB	CIDC
Art. 10	Definition measures protection-zone	BMELV	MUNLV	MinLNV-VD
Art. 11	Definition measures surveillance-zone	BMELV	MUNLV	MinLNV-VD
Art. 18, 19	Planning + performing emergency vaccination	FLI (A) + BMELV	MUNLV + LANUV	MinLNV-VD + VWA + GD
Art. 13	Repopulation holdings	-	LANUV + KOB	MinLNV-VD
	Evaluation	BMELV	MUNLV + LANUV + KOB	MinLNV + VWA + CIDC
	Compen-sation	-	TSK	MinLNV-DR

Legend: A=Advisory tasks; BMELV=Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz; CIDC=Centraal Instituut voor Dierziektecontrole; FLI=Friedrich Löffler Institut; GD = Gezondheidsdienst voor dieren; KOB = Kreisordnungsbehörde; LANUV = Landesamt für Natur, Umwelt und Verbraucherschutz; LWK = Landwirtschaftskammer; MinLNV-DRZ = Ministerie van landbouw, natuur en voedselveiligheid – directie regionale zaken; MinLNV-VD = Ministerie van landbouw, natuur en voedselveiligheid – directie voedselkwaliteit en diergezondheid; MUNLV=Ministerium für Umwelt und Natur, Landwirtschaft und Verbraucherschutz des Landes NRW; O = Optional; Rendac B.V. = Dutch rendering company; TKBA = German rendering company [e.g. SARIA]; VWA = Voedsel en warenautoriteit

2.2.3 *Analogies and differences between crisis management processes*

To be able to analyse the differences between both systems a little more in detail one can use flow charts to illustrate how information and communication transfer is embodied in the Netherlands and in Germany during the Post-HRP.





Legend: AID = Algemene Inspectiedienst; BMELV = Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz; CIDC = Centraal Instituut voor Dierziektecontrole; CMD = Centraal Meldpunt Dierziekten; DCC = Departementaal Crisis Centrum; DR = Dienst Regelingen; EU = European Union; FLI = Friedrich-Löffler-Institut; KOB = Kreisordnungsbehörden; LANUV = Landesamt für Natur, Umwelt und Verbraucherschutz; LaTiKo = Landes-Tierseuchenkontrollzentrum; LKZ = Lokales Krisenzentrum; MinLNV = Ministerie van landbouw, natuur en voedselkwaliteit; MUNLV = Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz NRW; NCC = Nationaal Crisis Centrum; NKZ = National crisis centrum; R&D = Cleaning and desinfection; RCC = Regionaal Crisis Centrum; TKB = Tierkörperbeseitigung; VIC = VWA Incident- en Crisiscentrum; VWA = Voedsel- en Warenautoriteit; VUA = Veterinary services

Figure 2.3: Flow charts of animal disease contingency planning in Germany [NRW] and the Netherlands

In Figure 2.3 the contingency plans of both countries are translated into flow charts in order to underline major differences within the national information transfer. These two flow charts have been used to identify the strategy most likely to reach the ending of a CSF-outbreak. Differences between the two models are pointed out by broad black edgings. Stating that differences between systems that need to cooperate are a handicap that has to be removed the following aspects are most relevant for further analysis. Figure 2.3 shows that the main difference in transfer of information during a crisis is settled right in the beginning of the contingency process (boxes nr. 1): While the Dutch system claims a direct notification to a central institution (CMD – Centraal Meldpunt Dierziekten) the German system decrees that notifications about disease suspense are first given to the local (KOB – Kreisordnungsbehörde) and then passed on to the federal and national authorities. Speaking about harmonisation of information and communication transfer means that on the German side even more existing data bases have to be considered for designing interfaces. Furthermore Figure 2.3 illustrates that publishing relevant information like decisions about total standstills and restriction measures and schedules (boxes nr. 4) is organised differently as well. Therefore a technical integration into harmonized information and communication system or at least a development of interfaces between different systems in order to save time and communicate properly could be rather helpful. This aspect is of particularly importance for our research activities as it contains both the combination of public and private information systems (e.g. transfer of schedules) as well the cooperation between Dutch and German entities (e.g. transfer of restrictions).

2.2.4 Priorities for cross border communication

Based on the comparative data collection analysis interviews have been led out with experts of the veterinary administration in the Netherlands and in Germany in order to analyse the initial situation and to be able to estimate the future development of CSF control. The assessment of the collected information has been carried out via an opinion poll in both public and private expert circles [MAYRING, 2002; FLICK, 2005].

During the guided interviews with 54 actors [35 public actors: 21 German, 14 Dutch; 19 private actors: 9 German, 10 Dutch] questions have been asked to accomplish the understanding of animal health control systems – and here specifically of CSF control – in both countries, define differences and analogies and to get a first impression of the extent to which Dutch and German actors see a benefit in cross border cooperation concerning CSF control.

In a second step a cross border opinion poll has been launched. The actors were confronted with three questions about the CSF crisis management system in order to prioritize the demand for further research activities: To start with an expert was presented to a code chart that contained major differences between the current CSF-control systems in the Netherlands and in the federal state of North Rhine Westphalia. The rating of the single categories within the chart had to express the impact these differences might have on crisis management structures of the country he belongs to. In order to regulate the statements a 5 point Likert scale [LIKERT, 1931; BABBIE, 2005] has been applied to this questionnaire. A Likert scale is a type of psychometric response scale often used in questionnaires, and is the most widely used scale in survey research.

Subsequently the expert has been asked to value the practicability of cross-border-cooperation-approaches within the different categories as there could be a mismatch between the demand for a change and the practicability of a political reform. Finally the expert had to ascertain his priorities for (more) cooperation between the Netherlands and North Rhine Westphalia on the range of CSF control.

After evaluation of the questionnaires several expert rated rankings for the Netherlands and for North Rhine Westphalia had been on hand: Finally the average top 5 categories (out of 24 categories) for the extension of cross border cooperation have been chosen for processing within this research approach. Based on the results of this empirical survey in Figure 2.4 the most important categories for the intensification of Dutch-German cross border cooperation have been listed. With an average value of 4.2 out of maximum 5 points the Dutch and German experts voted for a consultation about the feasibility of vaccination as a CSF-control measure as their highest priority for cross border cooperation. On second place we find the category Restriction areas + Compartment building (4.1) followed by Exercises (4.0), Communication + information transfer (4.0) and Early warning (3.8). Three out of these top five categories (2; 4; 5) contain major organisational differences between the Netherlands and Germany. Finding the category communication and information transfer on fourth place underlines that the knowledge about each other is particularly scarce. For all five categories different decision scenarios will be modelled in order to find ways to integrate available data. In addition the figure shows the Dutch and the German votes for each of the top categories. Especially about vaccination and exercises the distribution of votes has been quite diverse.

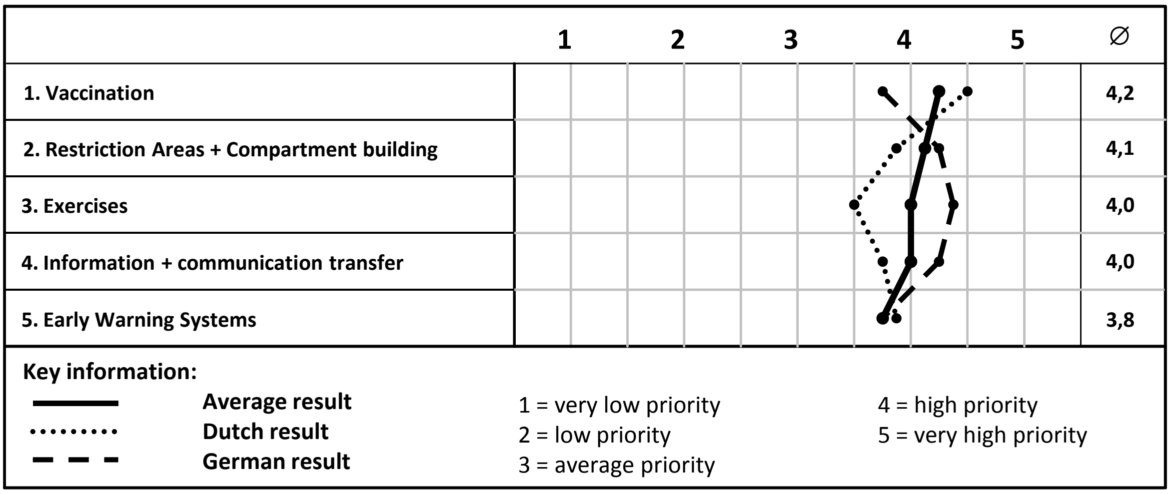


Figure 2.4: Expert survey regarding prioritisation of demand for cross-border cooperation between the Netherlands and Germany [NRW] in CSF-control

2.2.5 Crisis scenario construction

For each elected category several ambition levels can be defined. In this paper the scenario construction concept is exemplified in illustrating different ambition levels for category 4 information and communication transfer as it suits both parts of the research objective:

combination of public and private systems and the cooperation between Dutch and German actors.

Speaking about ambition levels we first of all have to define the concrete ambition. In this case the ambition of all players concerned is the willingness to cooperate with each other. Then it is necessary to settle a minimum and a maximum level of ambition. In between them a freely chosen amount of levels is possible. The minimum ambition level has already been defined within the expert survey: Clarification of communication channels between all relevant actors in times of crisis. In this case the maximum level of cooperation can be announced as a fully integrated cross border information and communication system. To illustrate only some medium examples of further strategies one can learn from Table 2.3.

Table 2.3: Ambition level category 4: information transfer and communication

Maximum ambition level	Integrated cross border information + communication system
Level 5	Harmonization of data basis in times of crisis
Level 4	Harmonization of data format to allow cross border assessment
Level 3	Defining interfaces for data exchange
Level 2	Exchange of liaison officers to support crisis communication
Level 1	Organisation of Dutch-German hotlines in times of crisis
Minimum ambition level	Clarification of communication channels in times of crisis

Creating ambition level flow charts has several advantages. First off all the minimum level can be regarded as the lowest common denominator between all relevant actors. In this case all private and public players from the Netherlands and Germany can definitely support this approach. Assuming that the minimum ambition level is soon and easily translated into practice the flow chart can already offer following scenarios that have already been analysed. This bottom up approach can be in some ways compared with the political theory of Neofunctionalism, where the effect of regional integration is called spill over [MITRANY, 1976; MC CORMICK, 1999]. Subsequently for each ambition level a scenario can be constructed. This initially requires the development of a closed loop model (see chapter 2.3.1) in order to illustrate the starting situation of the scenarios that have to be constructed.

During the construction of a crisis management scenario for the minimum ambition level the concerned players can altogether make their decision with full information at hand. For reasons of better understanding crisis scenarios an example is given out of the recent scenario building process (see Figure 2.5). In chapter 2.3.2 the Scenario bundle method is explained as a part of the newly defined crisis management model.

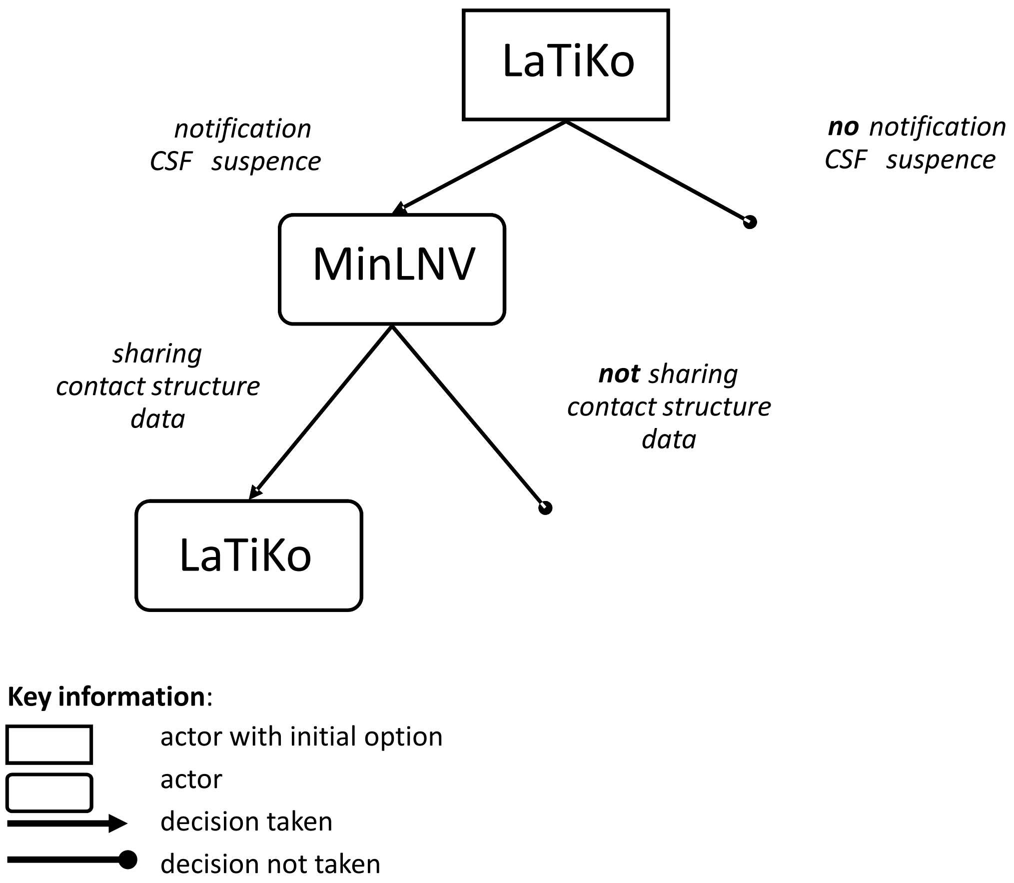


Figure 2.5: Abstract of a Scenario bundle

2.3 New Model for Cross Border Crisis Management

One of the most important aspects in crisis management decision making is the assessment of the optimal use of data and communication channels [ROSENTHAL et al., 2001; BOIN et al., 2005; RODRIGUEZ et. al., 2007; MCCONNELL and DRENNAN, 2007; KOUZMIN and ROSENTHAL, 1997]. As we already stated this is of crucial relevance for the crisis management actors responsible for private quality management systems in pork production chains [PETERSEN et al., 2002 and 2003; KNURA et. al., 2005] and public authorities responsible for CSF control. Both sides are currently developing data warehouses according to their scope of duty on both sides of the border.

In order to be able to share more important information in times of crisis it was necessary to find out more about the priorities for cross border cooperation in CSF control. At the same time one has to be aware of the respective courses of action each actor has [EC, 2007]. Therefore the concept for a cross border crisis management model has to contain two different aspects: (1) a model of actors and their options in crisis management decision making and (2) a model of communication and information exchange between actors.

2.3.1 Closed loop model

In order to understand the concerned actors and their tasks in crisis management they are represented as regulators in a socio-technological closed loop model (see Figure 2.6). The ambition of regulation processes is to stabilize a system against the impact of unforeseen disorder. Regulators need four information categories for decision making in this model defined by PETERSEN [1985]: Information can be descriptive, diagnostic, predictive and prescriptive [HARSH et al., 1981]. PETERSEN [1985] describes a closed loop model as the role of actors as controlling units in complex systems. In this paper the model has been adapted to parts of the crisis management systems in the Netherlands and Germany. As already stated veterinarians, farmers as well as public crisis managers have to take their decisions fast and efficient. Every necessary decision process contains the production and edition of information. If decision makers or policy makers aim to regulate certain processes they need to have full information at their free disposal. Hence the following data assessment tools are irreplaceable for an efficient crisis management: substantial monitoring, regular outlines and systematic evaluation [PETERSEN, 1985]. Diagnostic information is particularly important as it enables decision makers to identify and analyse certain problems [BERG, 1985]. As soon as a problem is detected the actors concerned are in need of information about the causes of the disorder in order to draw necessary conclusions for optimal response measures. At this time they are depending on the different categories of information. Descriptive information means regulations, contingency plans or any kind of data coming from the husbandries. Predictive information is an answer to the question: What, if…? It contains prospective scenarios that can come from a general trend or a risk assessment or a simulation. Finally prescriptive information is given to be the right course of action in decision making. It is directed towards answering the question: what should be done [HARSH et al., 1981].

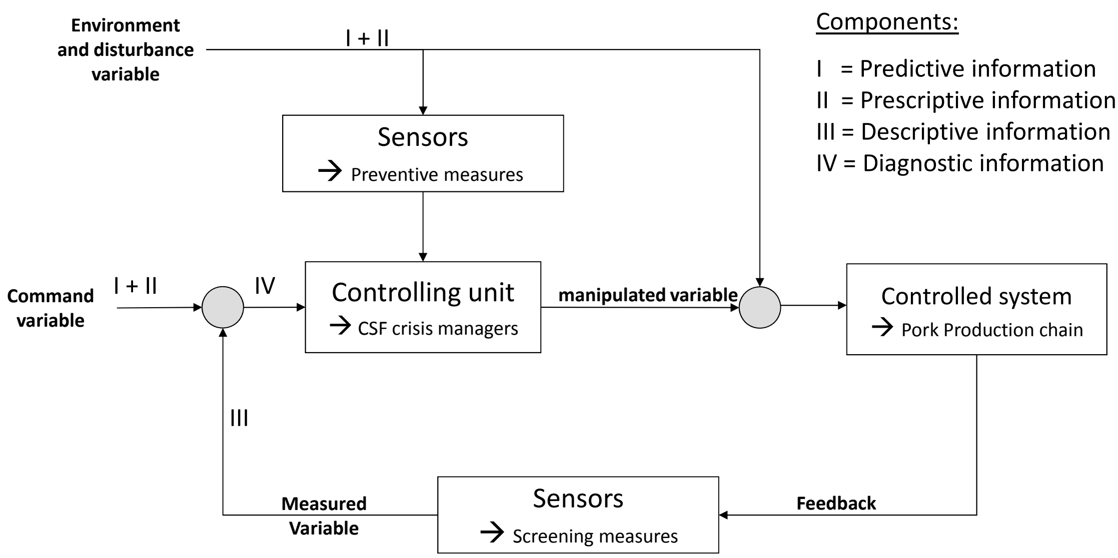


Figure 2.6: Closed loop model

To assign this basic model to decision making in crisis management a certain amount of aspects has to be considered:

1. Action alternatives described in a decision tree model;
2. Concrete decision problems that are going to be evaluated by the model;
3. Ambition levels of communication between farmer, veterinarian and public crisis managers.

2.3.2 Scenario bundle method

The Scenario bundle method is a component of the classical games theory [Selten, 1999; Reiter and Selten, 2003]. It is a systematic method to the collection of expert verdicts from which simple game theoretical models can be drawn. In this case study information at hand is installed into prospective crisis management scenarios in order to find prescriptive courses of action for cross border CSF control. By use of the Scenario bundle method the options for action each actor has within a crisis become represented and valuated.

This method enables researchers to illustrate the different alternatives decision makers have in concrete crisis situations. The construction of scenarios is based upon expert information that contains answers to the following questions:

- Who are the relevant players?
- What are the motivating factors which determine the players' preferences?
- What are tactical possibilities of the players?
- What are the consequences of various combinations of tactical choices?

Scenario bundles indicate possible future developments (prospective information). Selten [1999] compares the benefit of information coming from scenario bundles with decisions taking in a chess game: Predictive reliability cannot be promised. Human decision making in chess seems to be analogous to the construction and evaluation of scenario bundles. Generally, a chess player who tries to plan ahead cannot really predict the future course of a game. Nevertheless, he will approach his decision problem in a predictive spirit. It will be his aim to explore the likely consequences of a selection of plausible moves. Finally they will provide decision makers with the answers to the following questions:

- Which initial options are likely to be taken?
- Which initial options are not likely to be taken?
- What are the likely consequences of internal events?

Implementing the preliminary findings into scenario bundles is an optimal way to evaluate their possible benefit for CSF control in forms of concrete courses of action: According to the closed loop model one can state that the Scenario bundle method helps gathering predictive information in order to define prescriptive information [Breuer et al., 2007].

2.3.3 Combination of methods

Combining the Closed loop model approach and the Scenario bundle method the organizational part of a concept for a new crisis management model is presented for the construction of crisis scenarios regarding the necessary information transfer. The complementarity of both methods is most striking and made it possible to develop one new model: According to the Closed loop model we need four types of information to take safe and sound decisions: While the diagnostic information comes from monitoring and surveillance activities of all kinds and the descriptive information can be gathered from analysing any available and relevant source the Scenario bundle method enables decision makers to gain predictive information in order to find prescriptive information. Thus we have the tools to find out when a certain information is relevant (Closed loop model) and how we achieve predictive information in order to realize what we have to do next in crisis management (Scenario bundle method).

The second part of the crisis management model is a technical one. The Engage and exchange model illustrates how information can be technically gathered and shared in order to optimize crisis management.

2.3.4 Engage and exchange model

The communication model is based upon two different communication channels (Figure 2.7): (1) the communication takes place between the data warehouses of public crisis management actors and the concerned sector orientated production chain (e.g. pork production chain). (2) This channel organises the exchange of information between public crisis management actors of the Netherlands and of Germany.

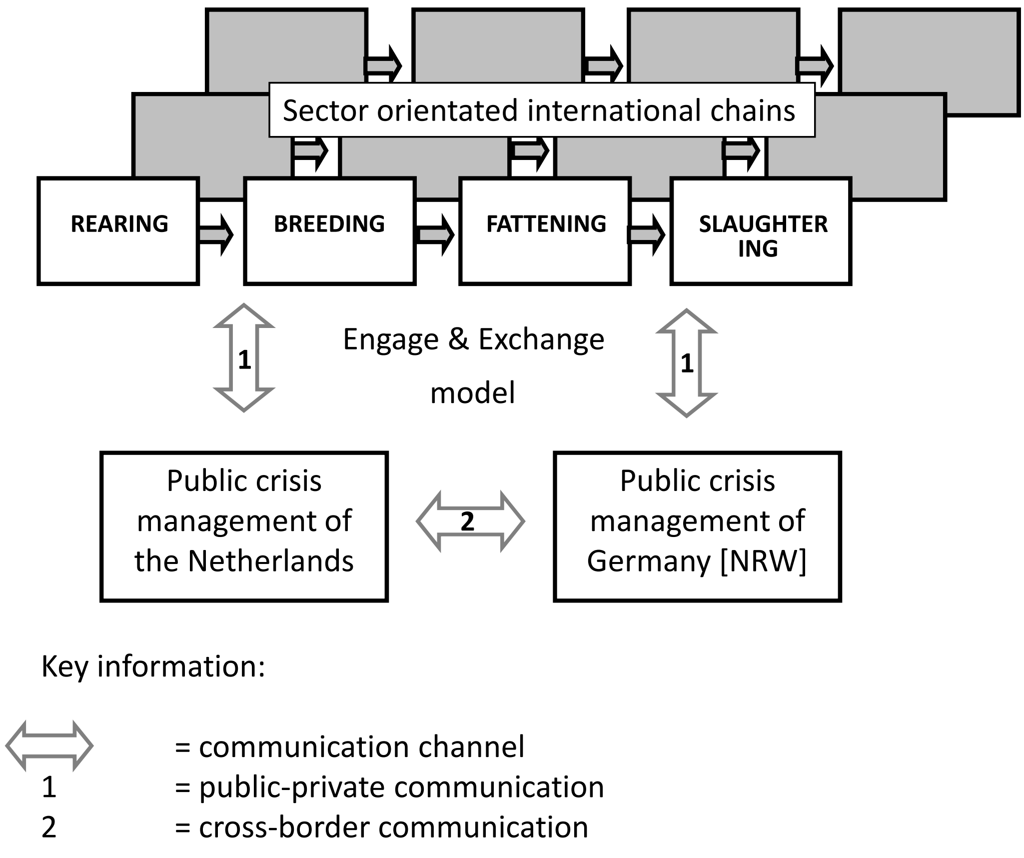


Figure 2.7: Communication model

The model presented in Figure 2.8 [SCHÜTZ and PETERSEN, 2007; Hoffmann et al., 2008] is developed to simplify the information and communication transfer between public authorities and farmers via certain network-coordinators in times of crisis. It is chiefly based on a two-step-approach: The first step contains the amplification of information transfer in normal times within inter-enterprise systems of private authorities. In a second step the exchange of certain information between public and private authorities in times of crisis is defined. The underlying idea of this concept – exemplified for pork production chains – is the definition of certain information that is part of public or private internet based data warehouse systems for an exchange in times of crisis. In Figure 2.8 the systems set-up in normal times is illustrated. Basically the data assessment that is compulsive in every private quality management system is involved. Any relevant information coming from the data warehouses, e.g. about the animal health status, is edited by integrated software tools into certain parameter. Between every link in the chain information about transport is gathered.

So called network coordinators – like slaughterhouses or farming coordinators – are in their position as an information broker along the whole chain and towards the state authorities particularly suitable for the organisation of these databases. As soon as an official limiting value is exceeded (e.g. loss of animals is certain in observation period; prevalence for diseases) all animal husbandries and their supervising veterinarians will receive a warning message through the system. At the same time the official information management system is in a phase of reorganization. The German federal state North Rhine Westphalia is presently busy implementing a countrywide server that is said to be a central data base for all veterinary authorities in national, regional and local entities [MÄTZSCHKER, 2004]. With this integrated approach the harmonization of several different applications (Hamlet, Traces, Balvi, etc.) that are currently running in NRW is intended. Any data concerning feed and food surveillance, animal health and animal disease prevention coming from animal husbandries is going to be collected unitarily in the near future. Specific software solutions are made for food control measures like food traceability in farms. Furthermore the structure of this central data server gives way to the use of control applications in times of crisis via a website. Ongoing an animal disease outbreak this involves a continuous data assessment of public and private authorities as well as a risk based assessment of specific data for certain and well defined time periods. It includes that e.g. transport permission documents will be provided on the common website. Hence the passive segments of the database are activated in a second step. This means that the edited data coming from husbandries, farming cooperation and slaughterhouses on the one hand and from public authorities on the other hand is ready for public and private exchange in order to optimize the national crisis management. The network coordinators are dealing with the proper course of action concerning the engage of the system and the exchange of data.

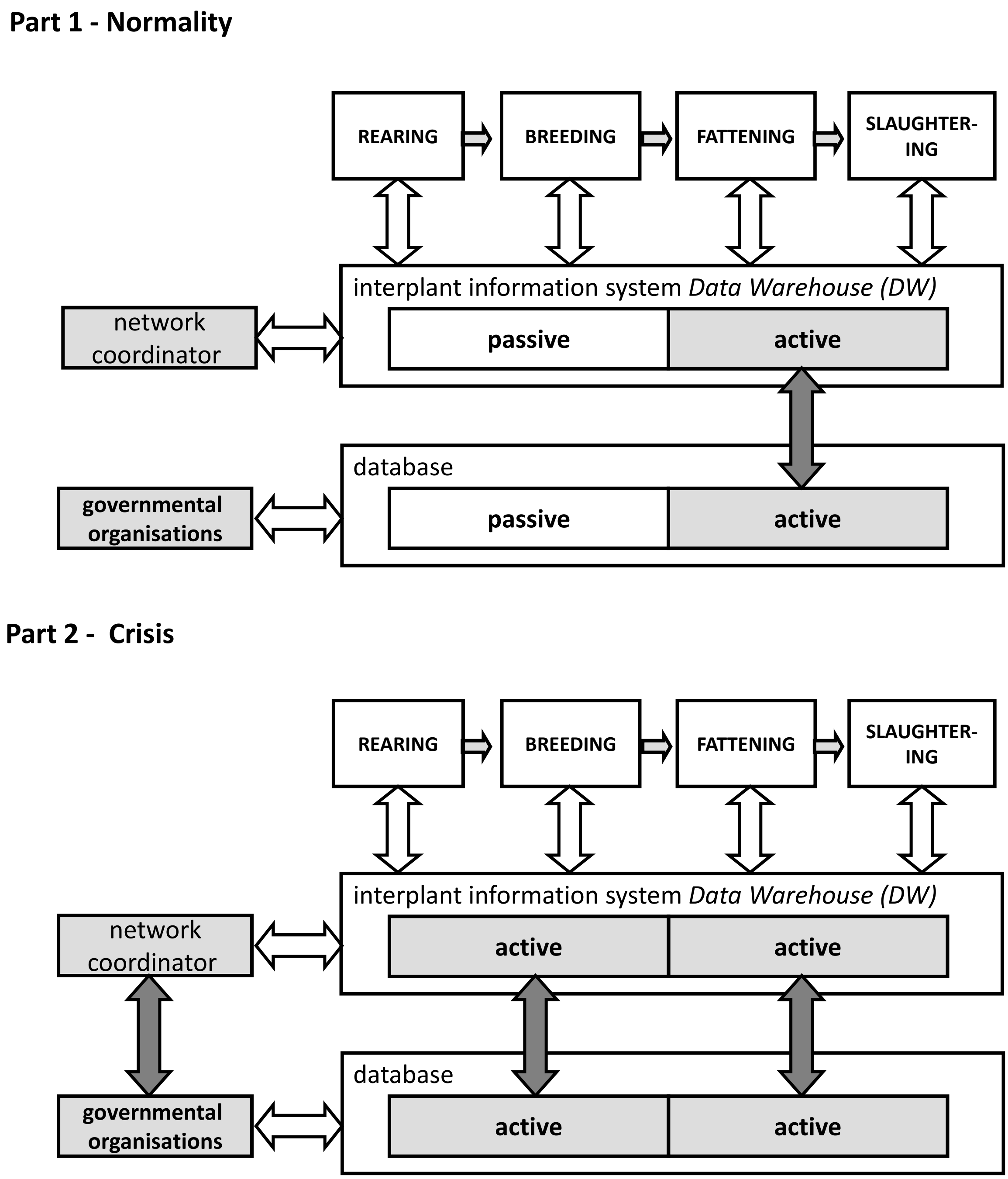


Figure 2.8: Engage and exchange model

2.4 Conclusions

Concepts for both organisational and technical innovations in cross border CSF crisis management are presented in this paper. They have been integrated to a new cross border crisis management model that contains possible approaches to solutions for cooperation between

1) Public and private authorities and;

2) Public authorities in the Netherlands and in Germany.

Using methods from game theory and quality management in order to structure the experiences that experts already have made about crisis management before predictive information is gathered from scenario bundles has turned out to be a solid approach in supporting critical decision making during a crisis.

Illustrating first experiences with scenario bundle construction by analysing further cooperation within the category information and communication transfer showed that gaining relevant information at the right moment is a crucial task for an efficient crisis management. As all top 5 minimum strategies underline, are Dutch and German experts sharing the opinion that starting cooperation means gathering more information about each other. This statement takes private and public actors into account.

By connecting the Closed loop model to the Scenario bundle method a model is generated that can contribute to the improvement process of CSF crisis management in the Netherlands and Germany. While the organisational part of the model enables public and private crisis managers to understand the cross border need of information in times of crisis and to gain and spread the relevant information at the right moment, the technical part is focussed on the ideal distribution of the cumulated knowledge. It has been illustrated how the implementation of this model can help to reduce the Post-HRP. A higher degree of efficiency in information and communication transfer between public and private actors in the Netherlands and Germany can save the lives of pigs, the pork production economy of the border area and not least ready money that is spend on CSF control in every day of a crisis.

Regarding the technical innovation a final concept for the customization of the information systems chiefly consists of two columns:

1) Continuous elevation and safeguarding of data in normality;

2) Risk oriented connection of data collection modules in crisis.

In normality data are processed into Data Warehouse systems according to the uniform criteria of quality management [PETERSEN et al., 2007]. In times of crisis auxiliary modules of databases which permit to collect and to evaluate data in addition for a predefined time period are activated. At the same time interfaces, data and information that have been agreed on before are exchanged between private and official Data Warehouse systems for a restricted time period. The inclusion of network coordinators [SCHÜTZ and PETERSEN, 2007] is particularly important.

The crisis management model has been developed and tested in the INTERREG IIIA project Managing Risks (http://www.giqs.org/projects/risiken/). The final report containing all results is available since July 2008. The degree of added value this model can achieve is mainly depending on the ambition of public and private actors to continue in cooperating about CSF control. Therefore further elaboration and implementation of this model in upcoming research projects is highly intended.

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3 Harmonization of control of Classical Swine Fever between North Rhine Westphalia and the Netherlands: a simulation study

Abstract

In this study the prosperity of cross border animal disease control measures has been illustrated by means of quantitative simulation. The aim of this study was to compare the epidemiological and the economic effects of recent control strategies against livestock diseases with specific cross border cooperation strategies. The main findings of this research give insight in the potential of certain combinations of cross border animal disease control between veterinary authorities of North Rhine Westphalia and the Netherlands. At the same time, the results are pointing out what kind of challenges both countries have to face while proceeding in cross border harmonization.

3.1 Introduction

In the aftermath of Classical Swine Fever (CSF) outbreaks in 2006 in the German North Rhine Westphalia (NRW) the economic issue of animal disease control strategies became highly classified on the political agenda. The evaluation of crisis management activities illustrated that the veterinary measures were not completely prepared on taking into account what options could have made life for pig holdings e.g. in restriction areas easier and this way go easy on the resources of all stakeholders concerned. In the first place there has been a critical debate about the conditions allowing pig holdings to make dead end transport to slaughter houses, even if they are within an area where no transport is permitted. This example illustrates that besides veterinary aspects in CSF control measures there could be a certain potential for the consideration of economic aspects that helps reducing the market damage and consequential losses of CSF outbreaks without taking a higher risk for veterinary crisis management [MEUWISSEN et al., 2000; HUIRNE, et al., 2002; MEUWISSEN et al., 2004]. Thus, the prosperity of veterinary animal disease control measures is strongly depending on the economic impact.

The evaluation of CSF outbreaks in NRW showed that there is a second issue worth thinking about: if veterinary measures can take economic side effects into account in order to reduce the economic impact of CSF outbreaks, why then not directly analyze their potential for cross border animal disease outbreaks? The CSF outbreak in 2006 made absolutely clear that effective cross border actions are missing [BREUER et al., 2008]. Even if the virus did not jump to the Netherlands in 2006, it has been obvious that both administrations were eager to share more knowledge and to have more specific crisis management options e.g. in canalizing livestock, products and services.

The cross border solution approaches that have been presented in an earlier study are until now completely targeted on the optimization of veterinary measures [BREUER et al., 2008]. On the background of recent discussion that the private sector should take more responsibilities on animal disease prevention and control, the question arises if there are possibilities to reduce economic impact of CSF control measures without weakening the veterinary effect. As earlier research pointed out, economic issues in animal disease control can be described from two different points of view: economic issues can be found as limiting factors to veterinary disease control measures or they can be regarded as an economic add-on to established veterinary prevention and control measures. In both cases working on these issues means more cooperation between public and private actors what is even more challenging if this setting is put in a cross border area.

Hence, in this study it will be analyzed if cross border cooperation on an epidemiological level can reduce economic impacts of CSF outbreaks in NRW and the Netherlands and how this cooperation has to be implemented. The main issues of this study are:

- Possibilities for cross border cooperation for the reduction of CSF impacts on animal health.
- Possibilities for cross border cooperation for the reduction of CSF impacts on animal production.
- Cross border consequences on animal health and production through a reduction of the High Risk Period (HRP).
- Possibilities for cross border cooperation through an enhancement of animal destruction capacities.

3.2 Methodology and theoretical framework

The aim of this research is to simulate the epidemiological potential of cross border cooperation between the Netherlands and North Rhine Westphalia in CSF control. The main questions are how these cooperation approaches can be implemented and what economic implications these veterinary measures would have.

In order to measure the importance of economic factors for the quality of Dutch-German CSF control options quantitative simulation is brought into this study. Based on qualitative scenarios from earlier research the economic effects of several basic veterinary strategies can be illustrated according to the following aspects:

1. What kind of effects do specific veterinary strategies have on CSF-outbreaks in the border area between the Netherlands and NRW?
2. What kind of economic consequences does a CSF-outbreak initiate in this area?
3. How can these economic consequences be reduced by cross border cooperation without weakening the epidemiological effect?

The quantitative research has been made based on simulation methodology in order to illustrate the economic effects of the following veterinary strategies:

- EU basic strategy.
- Culling: the EU-basic strategy, enhanced by preventive culling in a radius of 1 km around an infected holding.
- Recent: the control strategy that is recently valid in the Netherlands and North Rhine Westphalia; for NRW this is the EU-basis strategy, for the Netherlands the following

parameters are valid: EU basis + 72 hours stand still + culling 1 km (< 8 days) + vaccination area 2 km > 7 days (excl. sows).

- Harmonized: one control strategy for the Netherlands and NRW, what would be the Dutch strategy in this case.

The quantitative simulation proceeds with four different index-regions: Boekel and Groenlo (NL) and Borken and Viersen (NRW).

In this study two different types of computer models have been integrated:

- a generic-epidemiological simulation model that illustrates the spread of CSF under certain circumstances (e.g. livestock density, contact structures)
- an economic model that allows the calculation of direct and indirect costs that arise from CSF outbreaks. The results of the epidemiological simulation are the input data for the calculation of costs.

3.2.1 The epidemiologic simulation model

The simulation of a CSF outbreak in the Dutch German border area has been made possible with the Inter-Spread-Plus Model [STEPHENSON et al., 2006]. This model allows the simulation of spread by the day. The paths of infection are illustrated in local spread and contact structure. As soon as a holding is infected different control measures are activated: they include culling of infected farms, transport restrictions, preventive culling of neighboring farms and vaccination of neighboring farms. The model shows the development of an epidemic based on the activated packages of control measures [JALVINGH et al., 1999, MANGEN, 2002; MOURITS et al., 2002; VELTHUIS and MOURITS, 2007, BOKLUND, 2008]. The model contains the geographical information of every single livestock holding. Hence, the position of a farm is determinant for the fact that a holding is infected or not and underlies movement restrictions or not. The model is dynamic, what allows the consideration of time effects: Spread and control parameters can be altered during a CSF epidemic (e.g. by enhancement of culling capacities). At the same time the model is stochastic, which includes that the different spread and control mechanisms can be set up with variations. For example, the interval from infection until detection is according to research results between 21 and 100 days [MANGEN, 2002]. In this simulation model a range of probability has been calculated on the possible results. The model determines a probable point of detection for every single farm. This realistic procedure includes that the model has to be exercised several times under the same starting point in order to show the variability of possible developments. The results are therefore not only interesting in terms of probability but also in terms of variations [MANGEN, 2002; BOKLUND, 2008].

The final findings can be described in epidemiological parameters, like e.g. the amount of holdings under movement restrictions. They are the input for calculation of economic consequences.

Input data from pig holdings

Based on data from the Dutch Veterinary Services (Gezondheidsdienst voor Dieren – GD) and the North Rhine Westphalian veterinary services (Landwirtschaftskammer NRW) the relevant input data has been introduced into the simulation model. The data includes information about the type of a holding, the pig categories (sows, piglets, and fatteners), the amount of livestock and the geographical position of 17.958 farms in NRW and 15.430 farms in the Netherlands.

In Figure 3.1 an overview is given about the GIS data base and the density of holdings in the border area. On both sides of the border the livestock density is quite heterogeneous. The total amount of livestock in this area is outstanding. The type of farm is very important to the contact structure within the pig production chain. The Dutch farms have been sorted in 2.079 multiplier farms, 8.235 fattener farms, 1184 mixed farms, 619 breeding farms and 3.313 hobby farms (< 6 pigs). On the German side no such information is available for research. Therefore the sorting is based on an expert assessment: 19 % multiplier farms, 20 % mixed farms and 61 % are fatteners. This leads to the following assumption for the population of NRW: 2.767 multiplier farms, 9.089 fattener farms, 2.953 mixed farms and 3.149 hobby farms.

In Table 3.1 a statistic overview is produced for the amount of livestock in pig holdings of both countries. In average the farms in NRW are a bit smaller than in the Netherlands. The size of farms is important when it comes to the calculation of production capacities and direct costs. The relation between the number of fatteners and sows can give a first hint to the potential problems with piglet surplus during crisis management. The average relation in the Netherlands is 5.77 [GD_BRBS, 2005] what certainly highlights the Dutch role in piglet export. A system that is not focused on export would have an average relation of 7.1 fatteners to 1 sow unit. In NRW the average relation is 8.63 [LDS-NRW, 2007].

Table 3.1: Farm size of pig holdings in NRW and NL

		Farm size (amount of livestock)					
Country	Farms	Average	5%	25%	50%	75%	95%
NL	15430	480	5	81	309	557	1693
NRW	17958	379	2	16	176	615	1312

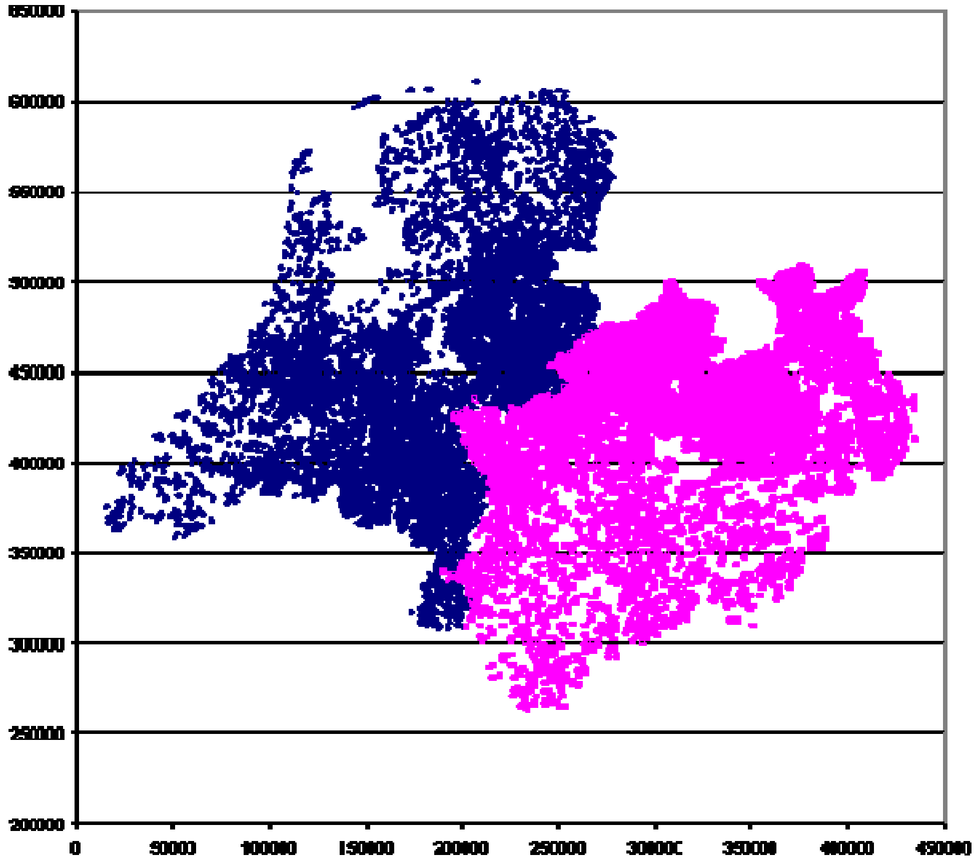

Figure 3.1: Geographical distribution of pig holdings in NRW and the Netherlands. On the X- and Y-coordinate the geographical location of farms is nominated in national coordinates

Definition of index farms

First of all, an index farm has to be determined before the model calculation can be started. The index farm is the starting point of an infectious disease outbreak. The simulation calculates the spread of a certain virus as from this farm. The location of an index farm is very important for the development of a disease outbreak: e.g. in Figure 3.1 the animal density in the border area as one of the core issue for virus spread is illustrated. Another aspect is the relevance of cross border cooperation issues: the closer an index farm is located to the national border, the more likely are cross border aspects in animal disease control measures. Hence, in this study four different index farms have been determined (see Table 3.2):

- Landkreis Borken (NRW): considering the farm density a modal area with an average capacity of 492 pigs per farm in a 10 km radius around the index farm. The closest Dutch farm is in the radius of 10 km.
- Landkreis Viersen (NRW): an area with a lower farm density and an average capacity of 367 pigs per farm in a 10 km radius around the index farm. The closest Dutch pig holding is located within a 15 km radius.

- Boekel (NL): this region has a high farm density with a pig capacity of 788 animals per farm in the 10 km radius around the index farm. The closest NRW pig farm is located in a radius of 30 km.
- Groenlo (NL): an area with a high farm density. The average capacity of pigs around the index farm is 460 per farm in a 10 km radius. The next NRW pig holding is located in a surrounding of 10 km.

Table 3.2: Number of pig farms and pigs per farm in a radius of 1,3 and 10 km around the four determined index farms [BRBS-NL, 2005; LWK-NRW, 2007]

	Number of farms			Number of pigs		
	1 km	3 km	10 km	1 km	3 km	10 km
Borken	12	49	473	6.767	26.649	233.118
Viersen	4	18	89	2.746	10.115	32.976
Boekel	25	87	579	21.401	64.900	456.997
Groenlo	22	91	508	10.682	40.702	233.980

The relationship between fatteners and sows in Boekel and Groenlo are below the Dutch total average. In a 10 km radius around the index farms the relationship is 4.81 and 5.30. For NRW there is no information about the fattener-sow relationship available as there is no official statistic per type of pig holding.

Input of spread mechanisms

The model is built on specific preconditions, e.g. that a farm becomes infectious after a period of 5 - 10 days after virus introduction [JALVINGH et al., 1999]. Afterwards the virus spreads from the index farm into the immediate surroundings or via direct contacts to other farms. The spread via neighbouring farms has been introduced to this model as a daily process that puts all farms within a 2 km radius under risk of infection. The risk for infection has been assumed as follows: 0,0122/day per farm in a radius of 0,5 km, 0,004/day for farms in a radius between 0,5 and 1 km and 0,00003/day per farm in a distance of 1 between 2 km [MANGEN, 2002].

For the simulation of spread via direct contacts certain distinctions in categories have been made: cross border trade (regional transport compared to export), type of transport (delivery or collection) and the assumed risk of spread in high risk (animal transport), medium risk (transport lorries) and low risk (professional contacts).

Finally, there are 13 different spread mechanisms. All of them are escorted by the following probabilities:

- the incidence of a contact that comes from an infectious farm;
- the distance that a contact has passed;
- the target farm;
- the probability of introduction.

In order to receive parameters out of these probability issues the illustration of regional transport (not cross border) has been based on an analysis of Dutch I&R data from 2001 [MOURITS et al., 2002]. The analysis resulted in an average contact structure per farm type in the Netherlands. For NRW estimation has been made based on the Dutch results. In Table 3.3 an overview is given about the frequencies per transport introduced in this model. The table contains information about the number of direct contacts (=livestock) and the number of indirect contact (=transport lorries). For example, a Dutch breeding unit has an average number of 32 piglet deliveries a year to Dutch fatteners. These transport contacts are not a continuously process. Some day the farm organizes the transport, the other day this is not the case. Therefore, in order to address this probability process correctly, it is resembled with the Poisson-distribution: a parameter λ has the average frequency (probability) per day (0,0877). In case of transport all piglets are brought to a target farm (constant and direct contact). If the transporter is not disinfected properly after delivering the piglets, it can easily infect another holding. According to piglet transport it is assumed that there are two different ways of indirect contacts structures that have been introduced into the model via the settings of the Poisson distribution. Considering the spread risk it is evident to distinguish between direct and indirect contacts. Compared to indirect contacts a direct contact has a higher risk potential. The probability of infection is 0,277 compared to 0,048 [MANGEN, 2002].

Table 3.3: Average amount of regional transport per year and number of connecting transport (in types of transport and farm)

Region	Type of transport	Number of transports per year and type of farm					Number contacts per transport	
		MUL	FAT	MIX	BR	HoB	direct	indirect
NL	Piglet collection	32	0	2	20	0	constant (1)	Poisson(2)
NL	Hog collection	0	0	0	20	0	BetaPERT (1,2,3)	Poisson(2)
NRW	Piglet and hog collection	35	0	3	0	0	constant (1)	Poisson(2)
NL&NRW	Piglet and hog delivery	5	9	3	2	0	constant (0)	Poisson(2)
NL&NRW	Fattener collection	10	17	26	17	0	constant (0)	Poisson(1)
NL&NRW	Sow collection	13	0	10	13	0	constant (0)	Poisson(3)

Legend: NL = Nederland, NRW = North Rhine-Westphalia; BR = Breeding, FAT = Fattening, MIX = mixed farm, MUL = Multiplier, HoB = hobby owner

Based from the same I&R analysis the distribution of regional transport categories has been defined (see Table 3.4). According to this distribution the majority of regional transport (73 %) passes a distance of <20 km.

Table 3.4: Probability of distance category for simulated regional transport

Distance category (km)	0-10	10-20	20-30	30-60	60-100	100-150
Probability	0,511	0,22	0,101	0,115	0,041	0,012

In a highly specialized pig production market the transport activities are not running by pure chance. Around 95 % of all piglet transports coming from Dutch breeding units are going to be delivered to fattener units. The remaining 5% are brought to mixed units or other breeding units [MANGEN, 2002]. The simulation model is modified for the consideration of these specific aspects while determining the index farm. In Table 3.5 the categorization of transport target has been illustrated.

Table 3.5: Probability of transport targets for different regional transports

Region	Type of transport	Origin	Target			
			MUL	FAT	MIX	BR
NL	Piglet loading	MUL	1	95	4	0
		MIX	12	75	10	3
		BR	31	34	21	14
	Hog loading	BR	31	34	21	14
	Other	Unspecific	17	68	10	5
NRW	Piglet and hog loading	MUL	2	95	3	n.a.
		MIX	2	95	3	n.a.
	Other	Unspecific	19	61	20	n.a.

Legend: NL = Nederland, NRW = North Rhine-Westphalia; MUL = Multiplier, FAT = Fattening units, MIX = Combinated farms, BR = Breeding farms; Unspecific = all professional farms, n.a. = not applicable, in NRW breeding units do not exist.

Referring to import and export statistics of 2005 [LDS-NRW, 2007] the amount of cross border transport from the Netherlands to NRW has been assumed as follows:

- Breeding pigs: 1.987 animals/ year, in total 40 transports/ year;
- Piglets: 1.493.006 animals/ year, in total 7.500 transports/ year;
- Fatteners: 1.780.956 animals/ year, in total 20.000 transports/ year.

These data has been divided by the total amount of possible origin farms in the Netherlands. As a result, in Table 3.6 the average transport frequencies have been indicated. For example, an average Dutch multiplier unit has a transport of piglets to NRW 3,65 times a year. These piglets go directly to a fattening unit in NRW so there is a direct threat of virus introduction either via transport lorries (cross border, indirect) or further spread of virus when returning to the Netherlands (regional, indirect).

Table 3.6: Overview of characteristics of cross border transport from the Netherland into NRW according to the simulation

Type of transport	Origin	Frequency per year	Type of target			Number of contacts per transport		
						Cross border		Regional
			MUL	FAT	MIX	direct	indirect	indirect
Hog	BR	0,07	100	0	0	BetaPERT (1,2,3)	Poisson(1)	Poisson(1)
Piglet	MUL	3,65	0	100	0	Constant(1)	Poisson(1)	Poisson(1)
Sow	MUL	0,44	19	61	20	Constant(0)	Poisson(1)	Poisson(1)
	MIX	0,44	19	61	20	Constant(0)	Poisson(1)	Poisson(1)
Fatteners	FAT	2,01	19	61	20	Constant(0)	Poisson(1)	Poisson(1)
	MIX	2,01	19	61	20	Constant(0)	Poisson(1)	Poisson(1)

Legend: MUL = Multiplier; FAT = Fattening; MIX = Combinated farms; BR = Breeding units

The predefinition of a distance category takes place by chance. Therefore, the probability that a farm is chosen as index farm is equal for all farms in NRW. The probability of an infection through import of piglets or hogs is high (0,277), other transport contacts do have a medium probability of infection (0,048). The statistics of cross border transports from NRW into the Netherlands contain the following information:

- Breeding pigs: no transport;
- Piglets: 25.197 animals / year, 125 transports / year;
- Fatteners: 45.845 animals / year, 510 transports/ year.

Based on this relatively small amount of data the definition of a common cross border transport of a professional pig farm in NRW resulted in a frequency of 0,04 transports per year and farm, the choice of a Dutch target farm by chance (no hobby owners), an average amount of direct contacts by 0,4, an average amount of direct contacts by 1 and a medium probability of infection (0,048). Next to contact via transport the spread probability via professional contacts has been taken into account in this study. They have (without considering the region) an average frequency of 0,2 contacts a day in professional holdings and 0,02 contacts in hobby farms. This contact pattern results in a low spread probability (0,03). Taking the probability distribution on distances into consideration [MANGEN, 2002; see Table 3.7], it is obvious that professional contacts can occur cross the border.

Table 3.7: Probability in distance categories where professional contact takes place

Distance category (km)	0-5	5-10	10-15	15-30	30-100
Probability	0,65	0,15	0,15	0,025	0,025

Probability of detection

After virus introduction the spread is developing along the defined mechanisms until the detection of virus takes place (High Risk Period). During a running simulation infected farms can be detected on a daily basis. This probability process is based on the High Risk Period definition illustrated in Table 3.8.

Table 3.8: Cumulative probability of detection

Days after infection	21	28	35	42	49	56	63	70	77	98
Probability of detection	0	0,02	0,121	0,337	0,583	0,776	0,893	0,953	0,981	1,00

After the first virus detection national surveillance measures will be intensified. As a consequence, the next detection occurs in average 14 days earlier (the interval between infection and detection varies between 8 and 70 days). All control measures that start with the first detection do have an influence on an earlier detection of farms within the restriction zones (medium interval = 21 days) and in tracing back measures of direct contacts (medium interval= 14 days).

Simulated control strategies

In this model different animal disease control strategies can be simulated (see Table 3.9). This study is based on the EU control strategy that contains the culling of infected and suspected farms and restriction areas in a radius of 3 and 10 km. Every EU member state can decide to enhance the EU basic strategy by national measures, e.g. national/ regional trade bans, preventive culling or emergency vaccination. In this study the effects of four different control strategies have been simulated and analyzed:

1. EU basic strategy: This set of control measures contains the minimal demands of the EU veterinary regulation. By activating restriction areas (protection and surveillance zone) the spread via animal transport is more or less impossible (assumingly 2 % illegal transport). Under this regulation professional contacts can only occur within the restricted areas. Problems can only occur if an infected livestock holding outside the restriction zones is not yet detected.

2. Culling of farms: This strategy is build upon the EU basic strategy. The only difference is that livestock in neighbouring farms in a 1 km radius around the infected farm are going to be culled on a preventive basis. This is an effective measure that reduces the impact of spread via contacts in close surroundings.
3. Recent: The Dutch and German animal control measures that recently legal bindings are simulated in this strategy. At the time of the simulation in NRW the animal disease regulation was principally identical with the EU basic strategy. For the Netherlands the following additions have been made: 72 hour transport restriction for the whole country at the time of the first detection, preventive culling of pigs in a 1 km radius around the infected farm within the first 7 days, after that emergency vaccination of all pigs within a 2 km radius around freshly infected farms (excl. sows). The vaccination is effective against spread via contacts in close surroundings and direct contacts.
4. Harmonization: This strategy implicates that for both the Netherlands and NRW identical control measures are used.

Table 3.9: Overview of control strategies considered in this study

Strategy	Region	Control measures
EU Basic	NRW	EU Basic
	Nederland	EU Basic
Culling	NRW	EU Basic+culling_1km
	Nederland	EU Basic+culling_1km
Recent	NRW	EU Basic
	Nederland	EU Basic+72 hour+culling_1km<8days+vacc_2km>7Tage_(excl.sows)
Harmonized	NRW	EU Basis+72 hour+culling_1km<8days+vacc_2km>7Tage_(excl.sows)
	Nederland	EU Basis+72 hour+culling_1km<8days+vacc_2km>7Tage_(excl.sows)

In order to simulate the effects of early warning systems based on the recent strategy the importance of the High Risk Period has been evaluated. Therefore, the length of the HRP has been once reduced for 10 days and once extended for 10 days. Besides, the effect of a combination strategy of culling and vaccination based on the strategies Recent and Harmonized has been analyzed. In this model the culling capacity for both countries has been determined as 5 farms/ day in the first week, 10 farms/ day in the second week and beginning with the third week 15 farms/ day. The vaccination capacity is determined as 150 farms a day. There is a chance that the culling capacity is too limited what would make the detected farms a risk for infection for a longer period. The combination of capacities makes a more effective control of the virus spread possible.

Specifications, repetitions and length of simulation time

Because of all probability processes that are relevant for spread and control of an infectious disease outbreak all calculations of index situations (choice of index farm and control of strategy) are repeated a hundred times. Based on these repetitions one receives a pattern of dispersion during an epidemic. The variation potential is enormous: once there is only a contact in the infectious period, next time there is no contact to other farms at all. Hence, there are 100 different results from calculation activities, e.g. on the number of infected livestock holdings. Bringing these data into a ranking it is clear how much variability there is in the possible development of a crisis. In this study the concentration lies on the 95 % value and the median value. The length of the simulation time has been determined on a maximum of 500 days. Thus, the simulation ends after 500 days or after the epidemic is under control.

3.2.2 Model on economic impacts

Based on the results from the epidemiological study the economic model is focused on the calculation of losses that arises from an epidemic. Every epidemiological simulation gives a certain amount of information:

- the length of an epidemic (beginning with the detection of the first infection and ending with the last week a fresh infection has been found)
- the number of detected farms and the amount of farms that have been culled for preventive reasons (point of time for all events)
- the number of vaccinated farms and the time of vaccination
- the number of farms that are under transport regulation and the length of these restrictions

General aspects and assumptions

In Table 3.10 the key assumptions that have been introduced to this study concerning costs and general aspects are listed up. There are three main categories of economic impacts: direct costs of control measures, consequential losses in the affected area, damage to the market inflicted by vaccination. Pig farms in the affected area do not only suffer from consequential losses but also from market damage.

Table 3.10: Categories of economic impact due to animal disease outbreak

Direct costs of animal disease control	- Buying up animals - Buying up feed - Vaccination costs - Execution costs
Consequential losses in the area affected	- Losses due to vacancy - Losses due to transport restrictions
Market damage due to vaccination	- Damage to vaccinated farms - Damage to other livestock holdings in the protection zone and in the whole country

The direct costs of control measures are costs that have relevance for culling and vaccination activities. They contain diagnostics, valuation, culling, disinfection and vaccination. In Table 3.11 the key issues and input data concerning the direct control costs have been listed up. Next to the cost location for the veterinaries there is a cost location for more or less solid costs in times of an outbreak, e.g. for screening, equipment, payment of services, etc. These average fix costs are based on the evaluation of FMD outbreak in 2001 (where vaccinated animals have been slaughtered) and of the HPAI outbreak in 2003. In both cases the costs were estimated on 55 Mio. € or rather 30 Mio.€ [MinLNV]. Not included are costs that arise during the execution of control measures on the side of other administrative bodies (e.g. police). Besides, the costs have not been recalculated based on the EU compensations. Another important aspect is the variability of cost for the examination of livestock holdings, e.g. clinical or serological examinations.

Table 3.11: Direct control costs in cost categories [MEUWISSEN et al., 2004; KWIN 2007/ 2008]

Cost categories	Value	Unit
Buying up sows (infected or preventive)	522,00	Euro/Sow
Buying up fatteners (infected or preventive)	77,00	Euro/Fattener
Buying up sow fodder	33,00	Euro/Sow
Buying up fattener fodder	3,70	Euro/Fattener
Vaccination of sows	7,20	Euro/Sow
Vaccination of fatteners	1,80	Euro/Fattener
Variable administrative costs	400	Euro/Sow
Variable administrative costs	150	Euro/Fattener
Fixed administrative costs	35.000.000,00	Euro/Outbreak/Country

In Table 3.12 an overview is provided of the consequential damages at primary farm level. In long time epidemics the vacancy of production capacities can cause enormous losses. It has been assumed that pig farmers do not have any alternatives for their work. A farm that has been confronted with transport restrictions suffers from additional costs due to feed and vacancy.

Table 3.12: Consequential losses per cost categorie [MEUWISSEN et al., 2000; HUIRNE et al., 2002; MEUWISSEN et al., 2004; KWIN 2007/ 2008]

Cost categories	Value	Unit
Vacancy sows	1,02	Euro/sow/day
Vacancy fatteners	0,18	Euro/fattener/day
Costs for transport restrictions	0,42	Euro/Sow/day
Costs for transport restrictions	0,05	Euro/fattener/day
Launching costs sows	87	Euro/sow
Launching costs fatteners	11	Euro/fattener

The market damage is calculated for all pig farms in a country with an epidemic. The livestock holdings are sorted into categories: vaccinated farms, other farms in the restriction area and pig farms in the rest of the country. For the animal husbandries that have been culled is assumed that the production will be start again in short time.

Table 3.13: Market damage per cost category at vaccination [Meuwissen et al., 2004; Bergevoet et al., 2007]

Cost categories	Value	Unit
Vaccinated piglets	-75	%
Vaccinated fatteners	-35	%
Logistic costs for slaughtering of vacc. fatteners	9	Euro/ fatteners
Other piglets	-20	%
Warehouse charges for pork	154	Euro/ton/6 months
Warehouse time	6	Month

Delimination

This study is first of all concentrated on the consequences of an outbreak for the primary sector, meaning the pig farms. Eventual consequences for others, e.g. connected sectors like feed industries, manufacturing industries or veterinary services are not included in this study. The damage for other stakeholders in the production chain is difficult to illustrate: reasons are possible catching up effects (e.g. for breeding organizations or feed industry) or transport corridors (e.g. for slaughterhouses). This study does not include animal welfare issues and therefore no costs are considered that arise in buying up activities for animal health reasons. The effect of animal health issues concerning the additional capacities of piglet holdings are not analyzed in this study.

3.3 Results

3.3.1 Control strategies

Epidemiological comparison

In Tables 3.14 and 3.15 the median and the 95 % results of the simulation have been illustrated for the control strategies considered in this study (see Table 3.9). The simulations have been executed for four different index regions: Boekel and Groenlo in the Netherlands and Borken and Viersen in NRW.

Table 3.14: Results of epidemiological simulations of control strategies against CSF (median)

Index	Strategy	Detected farms (number)	Frequency jumps (%)	Length HRP (days)	Length epidemic (days)	Pre-empt. farms (number)	Culled farms (number)	Vacc. farms (number)	Surveill. zone farms (number)
Boekel	EU Basic	108	31	45	238	0	108	0	3,244
	Culling	21	24	45	112	148	171	0	2,758
	Recent	35	27	45	141	35	72	338	2,771
	Harmonized	34	27	45	140	35	70	341	2,810
Borken	EU Basic	25	14	45	151	0	0	0	1,452
	Culling	6	6	45	85	39	39	0	1,111
	Recent	25	13	45	151	0	0	2	1,458
	Harmonized	10	9	45	97	14	14	83	1,157
Groenlo	EU Basic	73	35	46	184	0	0	0	2,186
	Culling	13	25	46	110	87	87	0	1,684
	Recent	23	27	46	121	35	35	182	1,804
	Harmonized	23	27	46	117	35	35	188	1,795
Viersen	EU Basic	8	5	47	91	0	0	0	294
	Culling	5	6	47	79	10	10	0	288
	Recent	8	5	47	91	0	0	2	294
	Harmonized	6	5	47	83	4	4	17	276

The results listed in Table 3.14 make clear that the EU basic strategy is not capable for an effective control of a CSF epidemic in Boekel: the number of detected infections is 108 and the epidemic is active for 238 days. In a worst-case scenario (95 % percentile, see Table 3.15) the results are 592 detected farms and 499 days. Moreover, a strategy that contains pre-emptive culling is still very efficient from an epidemiological point of view: 21 detected farms and 112 days in a median run and 41 detected farms in 227 days with a 95 % percentile. Further, the amount of farms in the surveillance zone is declining from 3,244 with the EU basic strategy to 2,758 in a median run. The strategy that is currently practiced (Recent and Harmonized) shows, compared to the culling strategy, a higher number of detected farms and a longer epidemic time, while the number of farms in the surveillance zone is almost identical. Though, the results of 95 % percentile of both strategies have a greater impact compared to the culling strategy. And, of course, less farms have to be culled than in the culling strategy (171 compared to 70 or 72).

Table 3.15: Results of epidemiological simulations of control strategies against CSF (95% percentile)

Index	Strategy	Detected farms (number)	Frequency jumps (%)	Length HRP (days)	Length epidemic (days)	Pre-empt. farms (number)	Culled farms (number)	Vacc. farms (number)	Surveill. zone farms (number)
Boekel	EU Basic	592	31	58	499	0	592	0	8,667
	Culling	41	24	58	227	235	320	0	4,792
	Recent	100	27	58	228	56	153	849	5,896
	Harmonized	90	27	58	218	56	161	856	5,896
Borken	EU Basic	124	14	61	366	0	124	0	3,707
	Culling	23	6	61	159	108	157	0	3,040
	Recent	125	13	61	367	0	125	44	3,739
	Harmonized	58	9	61	200	25	74	381	3,460
Groenlo	EU Basic	324	35	62	460	0	324	0	5,769
	Culling	33	25	62	184	179	256	0	4,468
	Recent	69	27	62	230	54	115	508	4,367
	Harmonized	58	27	62	208	56	107	557	4,099
Viersen	EU Basic	36	5	65	196	0	36	0	1,447
	Culling	15	6	65	160	34	60	0	1,554
	Recent	36	5	65	196	0	36	21	1,447
	Harmonized	21	5	65	179	10	34	86	1,202

For Groenlo the same trends are obviously true, even if the impact of the CSF epidemic is less. The number of farms affected and the length of the epidemic is much lower. The culling strategy is still the most effective one and the EU basic strategy shows the longest epidemic time and detected farms. The application of current strategies in Borken (EU basic/ Recent) resulted in 25 detected farms and 151 days in the median run (Table 3.14). The culling and the harmonized strategy can both reduce the CSF impact significantly. The culling strategy knows 6 detected farms and has an epidemic length of 45 days. Using the harmonized strategy the impact is stronger: 10 detected farms in 97 days; 25 farms have been culled and 83 have been vaccinated. In a worst-case scenario (Table 3.14) the impact rises considerably while the comparativeness between the different strategies is almost identical. Finally, it is most obvious that an index outbreak in Borken leads to a number of vaccinated farms (2 in median, 44 in 95 % percentile). This is the consequence of a CSF spread to the Netherlands where the strategy Recent contains vaccination (this phenomenon counts as well for Viersen).

The Viersen simulation shows almost no differences between the four strategies. But in the worst-case scenario (Table 3.15) the strategies Culling and Harmonized are much more efficient: 15 or 21 detected farms compared to 36 while the length of the epidemic is rising as well. What can be extracted from the Tables 3.13 and 3.14 is that significant differences between the frequency jumps take place. In this study this is the percentage of simulation runs where the CSF epidemic does not stay in the index region but develops in a cross border way. First of all, epidemics that start in the Netherlands have a higher probability of jumping across the border than the other way around. This is a consequence of the contact structure, e.g. the export of piglets and fatteners from the Netherlands to NRW. The probability depends on several factors: one of the most important is the length of an epidemic. Using more effective strategies like Culling the chance of cross border jumps is declining compared to the EU basic strategy. A second issue is the variability within NRW: having a CSF epidemic in Borken brings about a higher probability for cross border jumps than in Viersen. These results do have to go with the remark that it is based on 100 different simulations. A real outbreak can have very different influences on the chances of cross border jumps. Nevertheless, the probability is higher in the Netherlands than in NRW.

Economic comparison

The general description of the categories direct costs, consequential losses and market damage is posted in this section. Nevertheless, to understand the results properly it is important to explain the market damage potential. In this cost category there is only the market damage included that is arising from vaccination. For strategies with vaccination it is assumingly the real market damage. But, for strategies that do not contain vaccination the market damage is not included. This is due to the method of calculation in which the devaluation of meat and piglets are the most important components. The calculation of the full market effects can only be made by complex models [MANGEN, 2002]. At the same time it can be assumed that this market damage would have first of all impacts on the strategies Culling and EU basic for Boekel and Groenlo as they are regions with a high animal density, even if these strategies are not in usage any more for these regions. One can deduce from different studies [MANGEN, 2002] that at a private sector level these strategies do have economic advantages: looking at the market damages it is assumed that national borders stay completely closed for export of meat and piglets. The calculation of the market damage can succeed as follows: Meat from vaccinated pigs is declining in price at about 35 % (see Table 3.13). Any surplus on the national market at meat from non vaccinated pigs will lead to storage for a maximum period of 6 months. This leads to extra costs of 154 Euro/ ton/ 6 months. Selling vaccinated piglets is getting difficult. There will be a drop off in prices for 75% while not-vaccinated piglets will decline in price at around 20 %. More detailed information about market damages can be found in earlier studies [MEUWISSEN et al., 2002]. In the Netherlands market damages are in most cases the consequence of sales problems with fatteners and piglets while in NRW the market damage has an impact on fatteners as they are depended on the import of piglets from the Netherlands. In Table 3.16 the most important economic results out of the simulation studies are illustrated. It has to be added that these data are results for total epidemics: if there is a cross border jump, the results contain costs from both countries.

Table 3.16: Results from economic calculations (median and 95%-percentile)

Index	Strategy	Median				95% percentile			
		Direct costs (mEuro)	Consequ. costs (mEuro)	Market damage (mEuro)	Total costs (mEuro)	Direct costs (mEuro)	Consequ. costs (mEuro)	Market damage (mEuro)	Total costs (mEuro)
Boekel	EU Basic	77.4	56.1	0.0	133.5	158.1	121.8	0.0	279.7
	Culling	87.4	28.1	0.0	116.1	139.9	50.4	0.0	185.8
	Recent	58.3	30.0	123.4	225.8	103.7	64.6	190.0	332.0
	Harmonized	58.3	30.1	138.2	229.6	104.6	62.3	294.1	439.1
Borken	EU Basic	39.2	5.8	0.0	45.3	80.2	20.7	0.0	92.6
	Culling	41.7	3.1	0.0	45.2	89.2	10.5	0.0	97.3
	Recent	39.2	5.8	0.0	45.4	82.9	20.7	182.1	291.0
	Harmonized	39.2	3.7	68.3	114.0	76.2	13.1	198.5	279.1
Groenlo	EU Basic	52.1	17.4	0.0	81.3	100.9	52.5	0.0	152.1
	Culling	54.0	10.8	0.0	66.2	106.3	27.1	0.0	129.4
	Recent	45.8	11.4	100.7	168.9	88.0	28.4	183.3	278.6
	Harmonized	45.8	11.3	112.4	175.4	85.9	25.8	241.7	344.3
Viersen	EU Basic	36.1	0.8	0.0	36.9	71.0	5.7	0.0	76.3
	Culling	36.8	0.7	0.0	37.5	76.8	5.3	0.0	80.7
	Recent	36.1	0.8	0.0	36.9	71.0	5.7	122.0	170.6
	Harmonized	36.6	0.7	59.5	96.8	70.9	5.0	175.5	242.8

For Boekel it can be said that the Culling strategy is the most efficient one: even if the direct costs are 87.4 million € and the consequential costs 28.1 million Euro the total costs are relatively small (Table 3.16, median). In the worst-case scenario the total costs rise at 185,8 million € but still are significantly lower than in other strategies. Both strategies which contain vaccination (Recent / Harmonized) are significantly expensive (225.8 and 229.6 million €). This is first off all a consequence of high market damages (123.4 and 138.2 million €). This total damage is much higher than in the EU basic strategy (133.5 million €). The Groenlo simulation shows a more or less identical tendency but the costs are significantly lower. Again, the Culling strategy is most efficient while as a consequence from the market damage the strategies Recent and Harmonized lead to a higher amount of total costs.

In case of a CSF epidemic in Borken the median results show that there is not much difference between the economic impact of the strategies EU basic, Culling and Recent. All of these strategies lead to a total damage of around 45 million €. Nevertheless, the strategy Harmonized leads to a significant rise of the total costs to 114,0 million €. Furthermore, for the 95 % percentile the total damage of the strategies Recent and Harmonized is almost identical with 291.0 million € and 279.1 million €. The rise of total costs (for the strategy Recent) has first of all to do with the market damage, which is, under recent conditions, completely the problem of the Dutch pig sector. In case of a Harmonized strategy half of the market damage would be addressed to Borken itself as a consequence of sales problems for fatteners.

3.3.2 Effects of alteration of High-Risk Period

In Table 3.17 there are the results of the epidemiological simulations concerning the HRP (median).

Table 3.17: The epidemiological effects of an alteration of the High-Risk Period (median)

Index	Strategy	Detected farms (number)	Frequency jumps (%)	Length HRP (days)	Length epidemic (days)	Pre-empt. farms (number)	Culled farms (number)	Vacc. farms (number)	Surveill. zone farms (number)
Boekel	Recent	35	27	45	141	35	72	338	2.771
	HRPmin10	21	19	35	119	29	52	187	1.940
	HRPplus10	56	43	55	159	46	101	494	3.448
Borken	Recent	25	13	45	151	0	25	2	1.458
	HRPmin10	18	9	37	135	0	18	2	1.208
	HRPplus10	34	20	54	163	1	34	2	1.645
Groenlo	Recent	23	27	46	121	35	57	182	1.804
	HRPmin10	12	17	35	93	25	39	93	1.132
	HRPplus10	38	43	55	143	45	83	221	2.419
Viersen	Recent	8	5	47	91	0	8	2	294
	HRPmin10	5	4	37	72	0	5	2	209
	HRPplus10	10	6	57	107	3	10	2	355

As a basis for the comparison the strategy Recent has been elected (NB: This strategy contains differences between the Netherlands and NRW). A shortening of the HRP for a period of 10 days has positive effects on all cases: the length of the CSF epidemic becomes shorter and the number of detected farms is declining. For Boekel and Groenlo the reduction of epidemic length is four weeks; for Borken and Viersen it is 16 and 19 days. A comparable trend is obvious for the number of detected farms, which is again higher for Boekel and Groenlo than for Borken and Viersen. Curious as well is the fact that for all regions but Viersen the difference in numbers of detected farms between Recent and HRPmin10 is greater than between Recent and HRPplus10, although this is exactly the opposite case for the length of the epidemic. Furthermore, the shortening of the HRP has a positive effect on the frequency of cross border jumps. This is especially true for the regions Boekel and Groenlo, but also for Borken. This reduction is a consequence of the smaller epidemiological impact.

In Table 3.18 there are familiar results like in Table 3.17, but this time for the 95 % percentile. In this worst-case scenario there is a significant effect by the shortening of the HRP on the number of detected farms, the decline is substantial. But for the length of the epidemic there is almost no change at hand. For all regions but Viersen there are just small differences between the Recent strategy and the HRPmin10. On the opposite, comparing the HRPplus10 with the Recent strategy there are greater effects. In Table 3.19 the economic results are listed up. Concerning the median-values it is obvious that a shortening of the HRP for index farms in Borken and Viersen does not lead to a reduction of the total costs. This is chiefly a consequence of the great deal of direct costs, especially of the fixed costs. Outbreaks in Boekel and Groenlo show that a reduction of the

HRP can lead to a significant decline of total costs: from 225.8 million € to 194.3 million € in Boekel and from 168.9 million € to 139.6 million € in Groenlo. This is mainly motivated in the decline of market damages as well as in the reduction of consequential costs. A final aspect is, compared to the Recent strategy that the HRPmin10 in a 95 % percentile results in an enormous uprising of both total damage and market damage for Borken. This is actually a chance be caused in the stochastic character of the simulation. In this specific case the epidemic time was extremely long making the costs rise high. This result is far from being representative.

Table 3.18: The epidemiological effects of an alteration of the High-Risk Period (95%-percentile)

Index	Strategy	Detected farms (number)	Frequency jumps (%)	Length HRP (days)	Length epidemic (days)	Pre-empt. farms (number)	Culled farms (number)	Vacc. farms (number)	Surveill. zone farms (number)
Boekel	Recent	100	27	58	228	56	153	849	5.896
	HRPmin10	70	19	49	214	45	101	629	4.627
	HRPplus10	141	43	69	250	66	190	1.118	7.127
Borken	Recent	125	13	61	367	0	125	44	3.739
	HRPmin10	92	9	51	360	0	92	24	3.273
	HRPplus10	144	20	69	284	1	144	62	4.976
Groenlo	Recent	69	27	62	230	54	115	508	4.367
	HRPmin10	47	17	49	218	43	87	414	4.288
	HRPplus10	93	43	65	281	62	160	675	6.371
Viersen	Recent	36	5	65	196	0	36	21	1.447
	HRPmin10	29	4	53	165	0	29	7	1.324
	HRPplus10	36	6	74	212	3	36	23	1.575

Table 3.19: The economic effects of an alteration of the High-Risk Period (median and 95%-percentile)

Index	Strategy	Median				95% percentile			
		Direct costs (mEuro)	Consequ. costs (mEuro)	Market damage (mEuro)	Total costs (mEuro)	Direct costs (mEuro)	Consequ. costs (mEuro)	Market damage (mEuro)	Total costs (mEuro)
Boekel	Recent	58.3	30.0	123.4	225.8	103.7	64.6	190.0	332.0
	HRPmin10	52.8	21.3	108.5	194.3	95.8	52.2	183.2	304.3
	HRPplus10	77.1	38.8	132.6	252.7	117.8	74.4	212.1	409.7
Borken	Recent	39.2	5.8	0.0	45.4	82.9	20.7	182.1	291.0
	HRPmin10	37.8	4.4	0.0	42.4	77.8	17.3	258.9	340.2
	HRPplus10	40.2	6.9	0.0	49.3	89.9	27.0	181.8	278.8
Groenlo	Recent	45.8	11.4	100.7	168.9	88.0	28.4	183.3	278.6
	HRPmin10	42.1	7.4	88.4	139.6	82.0	26.8	166.4	266.4
	HRPplus10	52.9	15.6	115.0	195.0	99.3	37.1	209.0	338.8
Viersen	Recent	36.1	0.8	0.0	36.9	71.0	5.7	122.0	170.6
	HRPmin10	35.8	0.6	0.0	36.5	46.6	4.0	85.5	143.2
	HRPplus10	36.5	1.0	0.0	37.5	73.7	6.8	98.4	170.6

3.3.3 Effects of a joint use of destruction capacity

In Table 3.20 the epidemiological results (median) are presented considering the possible effects of Dutch German cooperation in destruction capacities. This means for practical execution that in times of crisis on both sides of the border the total capacity can be distributed across the border. Two strategies for comparison have been taken into account: Recent and Harmonized. For both strategies the effects of a distribution of capacities have been calculated. Com-Recent and Com-Harmonized. It is curious that for all strategies and index-regions the distribution of destruction capacities does not lead to a decline of impact in CSF outbreaks. Other studies [MANGEN, 2002] show that a shortage of destruction capacity in times of crisis is one of the crucial problems in a CSF epidemic. The explanation for these results is that both strategies do not contain buying up measures for animal health reasons, the amount of pig farms is compared to 1997/ 1998 heavily declined and that these strategies are more effective than in 1997/ 1998. Hence, for the strategies Recent and Harmonized there is no shortage of destruction capacity. The most important reason for this is that the virus spread in CSF outbreaks is relatively slow which leaves enough time for the destruction of infected farms.

Table 3.20: Effects of alteration of destruction capacity on the epidemiological results (median)

Index	Strategy	Detected farms (number)	Frequency jumps (%)	Length HRP (days)	Length epidemic (days)	Pre-empt. farms (number)	Culled farms (number)	Vacc. farms (number)	Surveill. zone farms (number)
Boekel	Recent	35	27	45	141	35	72	338	2.771
	Com-Recent	36	27	45	134	33	69	350	2.828
	Harmonized	34	27	45	140	35	70	341	2.810
	Com-Harm.	36	26	45	133	33	69	362	2.827
Borken	Recent	25	13	45	151	0	25	2	1.458
	Com-Recent	25	13	45	151	0	25	2	1.458
	Harmonized	10	9	45	97	14	25	83	1.157
	Com-Harm.	10	10	45	100	14	27	91	1.205
Groenlo	Recent	23	27	46	121	35	57	182	1.804
	Com-Recent	23	28	46	123	32	56	181	1.811
	Harmonized	23	27	46	117	35	57	188	1.795
	Com-Harm.	23	28	46	122	32	55	185	1.811
Viersen	Recent	8	5	47	91	0	8	2	294
	Com-Recent	8	5	47	91	0	8	2	294
	Harmonized	6	5	47	83	4	10	17	276
	Com-Harm.	6	5	47	83	4	11	19	284

The same setting can be assumed for the worst-case scenario (see Table 3.21). Only in one single case there is a slight difference in impact between the basic strategy and the same strategy with a distributed destruction capacity: Borken Harmonized compared to Borken Com-Harmonized. But this is again a result of the stochastic character of the model.

In Table 3.22 the economic effects of distribution of destruction capacities have been presented. Again, the differences are not significantly to the median run. For the 95 % percentile run there are slightly different results, but this is as well motivated by the simulation model.

Table 3.21: Effects of alteration of destruction capacity on the epidemiological results (95%-percentile)

Index	Strategy	Detected farms (number)	Frequency jumps (%)	Length HRP (days)	Length epidemic (days)	Pre-empt. farms (number)	Culled farms (number)	Vacc. farms (number)	Surveill. zone farms (number)
Boekel	Recent	100	27	58	228	56	153	849	5.896
	Com-Recent	102	27	58	246	54	164	881	5.571
	Harmonized	90	27	58	218	56	161	856	5.896
	Com-Harm.	90	26	58	244	54	153	900	5.698
Borken	Recent	125	13	61	367	0	125	44	3.739
	Com-Recent	125	13	61	367	0	125	44	3.739
	Harmonized	58	9	61	200	25	74	381	3.460
	Com-Harm.	53	10	61	176	24	71	366	3.302
Groenlo	Recent	69	27	62	230	54	115	508	4.367
	Com-Recent	66	28	62	216	53	114	562	4.622
	Harmonized	58	27	62	208	56	107	557	4.099
	Com-Harm.	62	28	62	197	54	107	573	4.609
Viersen	Recent	36	5	65	196	0	36	21	1.447
	Com-Recent	36	5	65	196	0	36	21	1.447
	Harmonized	21	5	65	179	10	34	86	1.202
	Com-Harm.	21	5	65	179	10	34	87	1.202

Table 3.22: Effects of alteration of destruction capacity on the economic results (median + 95%-p.)

Index	Strategy	Median				95% percentile			
		Direct costs (mEuro)	Consequ. costs (mEuro)	Market damage (mEuro)	Total costs (mEuro)	Direct costs (mEuro)	Consequ. costs (mEuro)	Market damage (mEuro)	Total costs (mEuro)
Boekel	Recent	58.3	30.0	123.4	225.8	103.7	64.6	190.0	332.0
	Com-Recent	58.1	30.8	116.9	213.6	106.2	62.4	213.8	366.6
	Harmonized	58.3	30.1	138.2	229.6	104.6	62.3	294.1	439.1
	Com-Harm.	58.1	30.8	132.0	220.6	106.5	62.4	263.7	416.5
Borken	Recent	39.2	5.8	0.0	45.4	82.9	20.7	182.1	291.0
	Com-Recent	39.2	5.8	0.0	45.4	82.9	20.7	182.1	291.0
	Harmonized	39.2	3.7	68.3	114.0	76.2	13.1	198.5	279.1
	Com-Harm.	39.2	3.7	69.2	112.1	78.9	10.7	190.5	265.6
Groenlo	Recent	45.8	11.4	100.7	168.9	88.0	28.4	183.3	278.6
	Com-Recent	45.7	11.8	101.5	171.1	89.1	30.6	173.3	268.2
	Harmonized	45.8	11.3	112.4	175.4	85.9	25.8	241.7	344.3
	Com-Harm.	45.7	11.8	116.3	178.5	86.7	25.8	256.1	356.7
Viersen	Recent	36.1	0.8	0.0	36.9	71.0	5.7	122.0	170.6
	Com-Recent	36.1	0.8	0.0	36.9	71.0	5.7	122.0	170.6
	Harmonized	36.6	0.7	59.5	96.8	70.9	5.0	175.5	242.8
	Com-Harm.	36.6	0.7	59.5	97.6	70.9	5.0	175.5	242.8

3.3.4 *Effects of market damage*

The results presented in this study are always based on the recent economic context which leads to effects like they are illustrated in Table 3.23. In order to simulate the reduction of market damage effects the calculations have been made with lower damage effects. This calculation is based on the Harmonized strategy. This strategy was calculated with two different scenarios: assumed market damage reduction of 50 % (Harmonized-1) and 33 % (Harmonized-2) compared to the basic scenario (Harmonized).

Table 3.23: The starting value of three different market scenarios

Cost category	Value	Economic scenario		
		Harmonized	Harmonized-1	Harmonized-2
Vaccinated piglets	%	-75	-40	-25
Vaccinated fatteners	%	-35	-20	-10
Logistics slaughtering vaccinated fatteners	Euro/fattener	9	9	9
Other piglets	%	-20	-10	-5
Warehouse costs pig meat	Euro/tons/ 6months	154	154	154
Period	Months	6	3	2

Table 3.24: Results of the alternative market damage scenarios

Index	Strategy	Median				95% percentile			
		Direct costs (mEuro)	Consequ. costs (mEuro)	Market damage (mEuro)	Total costs (mEuro)	Direct costs (mEuro)	Consequ. costs (mEuro)	Market damage (mEuro)	Total costs (mEuro)
Boekel	Harmonized	58.3	30.1	138.2	229.6	104.6	62.3	294.1	439.1
	Harmonized-1	58.1	30.8	67.5	158.1	106.5	62.4	135.5	289.9
	Harmonized-2	58.1	30.8	39.1	131.8	106.5	62.4	78.5	233.8
Borken	Harmonized	39.2	3.7	68.3	114.0	76.2	13.1	198.5	279.1
	Harmonized-1	39.2	3.7	34.5	77.8	78.9	10.7	95.3	174.6
	Harmonized-2	39.2	3.7	21.2	64.0	78.9	10.7	55.8	138.7
Groenlo	Harmonized	45.8	11.8	112.4	175.4	85.9	25.8	241.7	344.3
	Harmonized-1	45.7	11.8	58.6	122.6	86.7	25.8	128.2	227.2
	Harmonized-2	45.7	11.8	33.7	95.7	86.7	25.8	73.0	178.8
Viersen	Harmonized	36.6	0.7	59.5	96.8	70.9	5.0	175.5	242.8
	Harmonized-1	36.6	0.7	29.4	67.3	70.9	5.0	87.4	147.1
	Harmonized-2	36.6	0.7	18.6	56.3	70.9	5.0	51.5	119.3

The results of the simulation of alternative market damage are presented in Table 3.24. It seems crystal-clear that if the market damage is reduced this leads to a significant reduction of the total damage. This is especially true if the share of the market damage is greater in than the total damage and if the area has a high density of livestock (Boekel and Groenlo) and finally if it is a worst-case scenario (95 % percentile).

3.4 Discussion

It has been shown that the recent control strategy contains several advantages for the Netherlands compared to the alternative strategies. The EU basis strategy has some general defects when it comes to an effective control of CSF outbreaks. Even if a strategy containing preventive culling of livestock is still highly rated, the amount of animals is largely reduced when using the recent strategy in the Netherlands. This of course has a positive side effect on the public recognition of CSF-control measures, since culling has no high acceptance any more. On the opposite, a huge amount of livestock that has been vaccinated can be a real problem from the economic point of view: it might be difficult to find a market for these products what will cause a serious damage to the market and the development of prices. This view is shared by BERGEVOET et al. [2007].

In rather densely populated livestock areas, like Borken in NRW, control strategies with a more strict approach than the recent strategy are evaluated positively when it comes to a reform of animal disease control. It has been shown that both, a strategy based on preventive culling and vaccination, can lead to a radical descent of infected holdings and a shortage of the length of the epidemic. A strategy based on preventive culling contains the advantage that the efficiency of control can be increased easily without having the costs rising above the level of recent strategies, even if the high amount of fixed costs makes it difficult to gain an economic advantage due to the epidemiological advantage.

Nevertheless, the disadvantage of strategies based on vaccination is that the overall costs are likely going to be doubled due to the fact that marketing of meat will be difficult. The marketing of piglets is a less important factor in NRW compared to the Netherlands. Both countries indeed have difficulties with the upcoming protest against preventive culling of livestock. In less populated livestock areas, like Viersen, more strict strategies have a minor effect on the consequences. For vaccination strategies the same conclusion can be made: compared to alternative strategies the risk of having large marketing difficulties will make the overall costs rise.

If one takes a close look on cross border harmonization from an epidemiologic point of view it becomes quite clear that the Netherlands cannot draw many advantages from that scenario. The recent Dutch strategy has already brought large advantages to their crisis management. For NRW this bundle of advantages is indeed still to come. A cross border harmonization would be as important for NRW as the implementation of the recent strategy have been for the Netherlands. For the Netherlands it would be a positive side effect that having the same level of CSF-control in NRW the risk of cross border infection of CSF will be getting less.

From the economic point of view a harmonization of strategies would be responsible for a large increase of overall costs. This is not alone due to the harmonization process but due to the fact that vaccination would be the determining factor of the cross border strategy.

In short, having a harmonization of measures on the recent economic background would mean that NRW would have to be responsible for the financial effort. Therefore it would be only attractive to harmonize strategies if one talks at the same time about market assimilation procedures.

According to the results of this study it is difficult to gain economic advantages by harmonizing the recent control strategies because of the critical perspective on marketing procedures. Nevertheless, it would have a large effect on the potential economic damage of a CSF outbreak if the High Risk Period (HRP) could be shortened by specific veterinary cooperation. The shorter the HRP is, the less pig holdings become infected. This is of vital importance for areas with a dense livestock population like Boekel and Groenlo. A positive side effect would be that the risk of cross border spread of an epidemic would be reduced.

The question is how one can identify specific cross border control measures that help reducing the HRP and as a consequence reduce the potential damage to the market. In order to reduce the HRP it is necessary to establish new techniques and systems that help increasing the disease awareness and the alerting of the veterinary authorities. Therefore common early warning systems can have an impact on the reduction of HRP in the border region.

In this study one interesting issue has been analyzed in order to find a cross border approach for the shortening of the HRP. Based on recent CSF-control strategies it can be interesting to use capacities and data of rendering plants for early warning. While the common use of rendering capacities would only in extreme CSF-outbreak situation with a high mortality would be necessary the analysis of data in rendering plants could have an important advantage for early warning in the cross border region [GD, 2007].

When it comes to the potential market damage of CSF outbreaks this study illustrated that market damage is the major part of economic consequences. Therefore reducing the epidemiological consequences of CSF-outbreaks will automatically reduce the damage done to the market. Reducing the epidemiological effect can be either achieved by shortening the HRP or by optimizing the control measures.

For the cross border area, reducing the market damage, a high priority of cross border CSF-control is relevant: both countries are anyway interested in less market damage. Reducing the negative effects on the market would bring NRW in a better position when it comes to harmonizing the CSF control strategies incl. vaccination programs. A cross border economic management approach would therefore be the organization of cross border marker solutions for vaccinated piglet and meat.

3.5 Conclusions

Coming to the conclusion of this study the following perceptions can be listed up:

- if vaccination is part of CSF-control strategies, the damage to the market is a crucial factor. A harmonization of CSF-control strategies between the Netherlands and NRW does only make sense if it is accompanied by market strategies e.g. for the cross border distribution of vaccinated products;
- both countries have to concentrate on reducing the market damage that is motivated in control measures like vaccination;

- an important tool for both countries will be the shortening of the HRP in order to reduce the overall costs and the risk of further spread;
- an important factor could be the use of data in rendering plants for early warning.

Looking at the economic situation in the cross border area it is obvious that without agreements in marketing procedures for vaccinated and not vaccinated products no further harmonization of CSF-control strategies is adequate. Specific economic cross border cooperation measures, like early warning via rendering plants, can indeed be helpful when it comes to reducing the HRP, but the general approach has to be: veterinary authorities need to evaluate their epidemiological measures on behalf of economic information.

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4 Concept for cross border decision making support in animal disease control by supply of data and information transfer guidelines

Abstract

The objective of this study is to contribute to a standardization of data and information transfer in cross border crisis management. The guidelines presented in this paper are developed in order to improve the identification of data or information gaps while preparing cross border cooperation plans for crisis management. In a second step these gaps have to be repaired before cross border cooperation can possibly implemented into national animal disease regulation. The concept is built on different theoretical elements: It combines decision theory, information theory, quality management and innovation theory to an integrated approach that finally can be used by veterinary authorities as a tool for cross border crisis management preparation. The results are presented as a practical model to transform system innovation.

4.1 Introduction

Due to the strong interconnectedness of trade and the heterogeneous production patterns in the European meat sector the development of efficient information management is of vital importance. This is particularly relevant if cross border connected economic regions want to protect against animal disease outbreaks [Petersen et al., 2002; Schulze Althoff et al., 2002; Petersen, 2003]. In earlier research it has been shown that missing information as well as time-consuming or interrupted communication channels is an obstacle to an efficient quality- and crisis management [Slütter et al., 2010]. Especially the threats that are related to an outbreak of highly pathogenic livestock diseases do bring the coordination of information channels between public and private stakeholders as well as between different countries strongly on the agenda. In case of disease outbreak the supply of public crisis managers with decision relevant information is a basic precondition for a chance on a shorter High Risk period (HRP) [Breuer et al., 2008]. A successful crisis management depends on fast decision making that is in need of a direct transfer of information [Nienhoff, 2008]. According to Tuot and Schneider [2010] another weak point is the heterogeneity of information, which is first of all motivated in different data standards, access procedures and representations. Therefore, a network of services and knowledge is important in order to represent the data sources of public and of private origin and to describe suggestions for engage and exchange options.

One can learn from crises that have happened to the meat sector that production chains can react fast and efficient if cooperation is established between public and private decision makers [Petersen et al., 2008]. When it comes to a cross border establishment of cooperation measures, the preparatory work becomes even more complex, because of the different governmental stakeholders that are involved.

In this study the following hypothesis is put up for debate: The implementation of cross border cooperation in animal disease control is often handicapped by the missing availability of decision relevant information in good quality. This is due to the lack of information of a certain quality and to data privacy regulation that keeps existing information under lock and key. Thus, it is expected that an effective information management can contribute to enhancing the room for cross border cooperation and as a consequence improve the quality of animal disease control.

The objective of this study is to develop a concept that can support data collection and transfer that is relevant for decision making in crisis. The concept deals with information at the time of crisis preparation and not in a crisis situation. This is because of the fact that all elements of cross border cooperation have to be regulated and implemented in national contingency plans before execution in crisis is possible. It is the general assumption in this research that no cross border cooperation measure can be implemented unless all decision relevant information is available.

The central assumptions that describe the initial situation are:

- missing decision relevant information is a limiting factor for cross border cooperation in animal disease control
- the quality of decision relevant information can be deduced and assessed
- information management systems in national veterinary authorities are recently under construction and do benefit from the implementation of an engage and exchange model
- cross border decision processes can efficiently prepared by a structured concept for information management

Therefore, the aim of this study is the development of a concept that contributes to the detection and the assessment of decision relevant information. Besides, it will be illustrated by means of a case study how cross border cooperation attempts in CSF control can lead to a higher efficiency by using a common approach for the transformation of data into knowledge.

This leads to the assumption that guidelines developed in a case study are not made for the synchronization of national contingency plans but for the establishment of interfaces between both animal disease regulations. Consequently, the cross border information exchange guidelines will provide veterinary authorities with a sort of connecting linkage between national animal disease control manuals. The concept contains that cooperation measures are an addition to national contingency plans and will not include the synchronization of veterinary systems.

4.2 Theoretical framework

The following section contains the theoretical building stones of the concept: the single components derive from decision theory, information theory and innovation theory. In a proper combination the components result in the information transfer concept which is presented in the upcoming section.

4.2.1 Decision theory

Several core elements of this concept are taken from decision theory. The different units described in this section are basically used for the detection and illustration of decision processes. Principally, it has to be said that every decision process contains the production and processing of information [PETERSEN, 1985]. In Figure 4.1 a complete decision process is brought into picture. It contains all phases from data collection to action. According to TUOT and SCHNEIDER [2010] supply and upgrading of data are the most important issues in decision support.

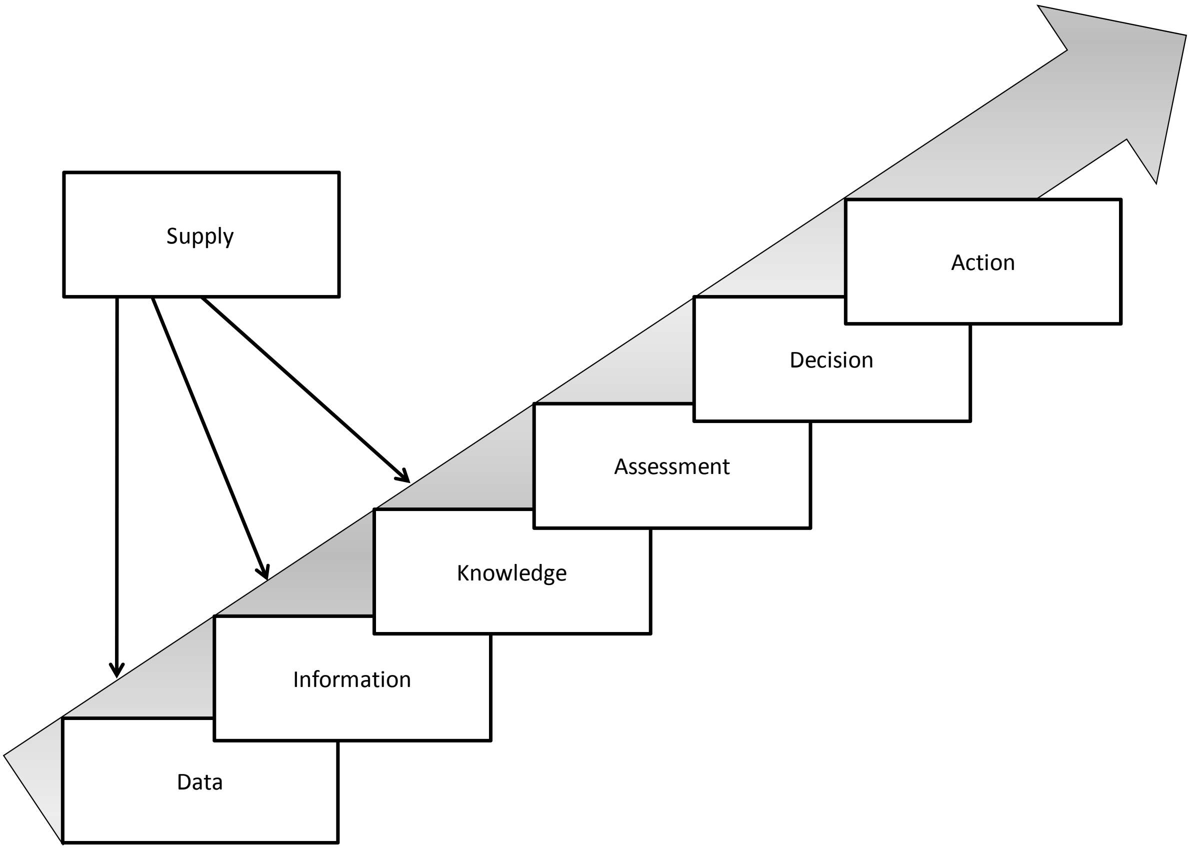

Figure 4.1: Transformation of data into action [modified after MÖWS, 2008]

In order to support decision making in crisis as good as possible the decision maker need to be well informed about the type and quality of information they need to proceed in action. National contingency manuals do simply regulate the standard national procedures for a specific livestock disease. Therefore, any cross border cooperation measure needs to be well prepared regarding the need for information [BREUER et al., 2008].

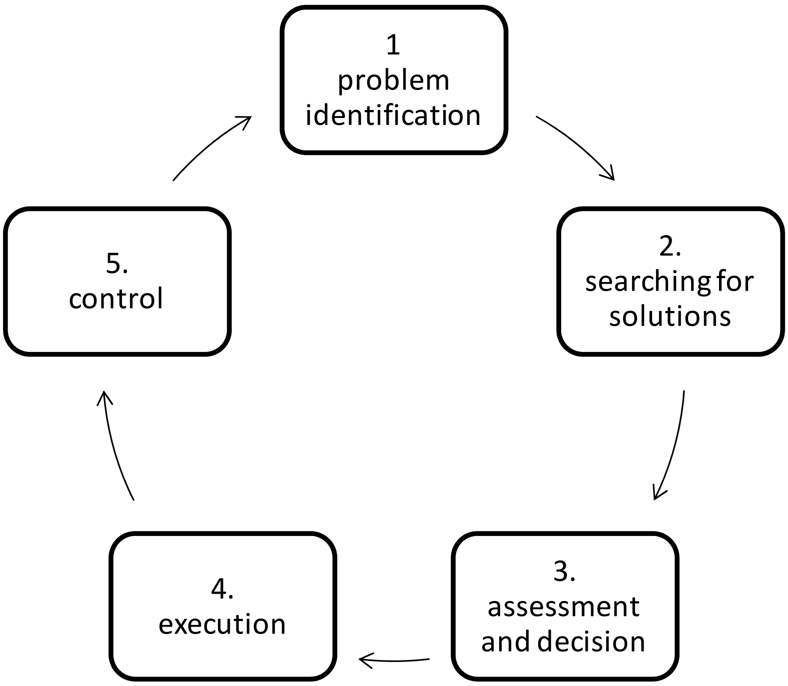

Figure 4.2: Phases of a decision process [modified after STROTMANN, 1989]

Figure 4.2 shows a decision circle containing five different phases. In every single phase either the collection of relevant data is managed or the knowledge that and reason why data is not available [STROTMANN, 1989].

4.2.2 Information theory

From information theory a sequence of useful elements are introduced to the concept. Firs t of all, basics on information quality and information management are necessary to provide a standardized way to detect and to transfer information properly. Consequently, all information introduced to this concept are assess based on standardized criteria and made up for transfer.

Coming to the quality of information it can be measured along quality criteria. Particularly, it can be figured out how trustworthy an information is and to what extent it can be used as a basis for own action. According to DOLUSCHITZ und SPILKE [2002] core issues to information quality are completeness, free of error and timeliness. In this study fifteen dimensions of information quality have been taken into account (see Table 4.1).

Table 4.1: Fifteen dimensions of Information Quality (IQ) [DGIQ, 2010]

Criteria	Comment
Accessibility	Information is accessible, if a user can fetch it directly and by simple procedures.
Appropriate amount of data	Information is of an appropriate amount, if the amount of data fits the users demand.
Believability	Information is believable, if certificates of a high quality standard can be produced or if data collection and transfer are carried out with high cost.
Completeness	Information is complete, if it is not lacking and if it is available at all relevant points in decision processes.
Concise representation	Information is concise, if the right amount of data is presented in a fitting and subsumable format.
Consistent representation	Information is consistently representated, if it is continuous represented.
Ease of manipulation	Information is manipulated in ease, if it can be handled and changed easily and used for different purposes.
Free of error	Information is free of error, if it matches reality.
Interpretability	Information is interpretable, if it can be followed in a common and correct way.
Objectivity	Information is objective, if it is highly functional.
Relevancy	Information is relevant, if it provides the information the user requires.
Reputation	Information has a highly reputation, if the source of information, the transport medium and the processing system are highly regarded.
Timeliness	Information is timeliness, if it provides a realistic picture of the object in recent shape.
Understandability	Information is understandable, if it can be properly followed by users.
Value-added	Information is value-added, if its usage can lead to an increase in value.

In order to guarantee information quality one is in need of an efficient information management [ELLEBRECHT, 2008]. First of all, this includes that the need for information is detected. The need for information is defined as following: type, amount and quality of information that a person requires to fulfil his tasks in a certain period of time [PICOT et al., 2001]. According to the guidelines of information management the information economy is responsible for the balance between supply and demand. According to KRCMAR [2005] the building stones of information economy are the following:

- supply of decision makers with relevant information
- ensuring a high information quality
- optimization of information flows

If an insufficient information level is detected, this can be motivated by different reasons [BEIERSDORF, 1995]:

- difficulties in collecting information
- renouncement of information collection due to cost reasons

- not collection data unwittingly because of misinterpretation of its quality

In this study another core unit out of information theory is the closed loop model. The application of this model allows a categorization of information in different types. Besides, it provides a pattern that is helpful in sorting out information after its position in decision making processes.

In order to understand the stakeholders concerned and their tasks in crisis management they are represented as regulators in a socio-technological closed loop model (see Figure 4.3). The ambition of regulation processes is to stabilize a system against the impact of unforeseen disorder. Regulators need four information categories for decision making in this model defined by PETERSEN [1985]: Information can be descriptive, diagnostic, predictive and prescriptive [HARSH, 1981]. PETERSEN [1985] describes a closed loop model as the role of actors as controlling units in complex systems. In this paper the model has been adapted to parts of the crisis management systems in the Netherlands and Germany. As already stated veterinarians, farmers as well as public crisis managers have to take their decisions fast and efficient. Every necessary decision process contains the production and edition of information. If decision makers or policy makers aim to regulate certain processes they need to have full information at their free disposal. Hence the following data assessment tools are irreplaceable for an efficient crisis management: substantial monitoring, regular outlines and systematic evaluation [PETERSEN, 1985]. Diagnostic information is particularly important as it enables decision makers to identify and analyze certain problems [BERG, 1985]. As soon as a problem is detected the actors concerned are in need of information about the causes of the disorder in order to draw necessary conclusions for optimal response measures. At this time he is depending on the different categories of information. Descriptive information means regulations, contingency plans or any kind of data coming from the husbandries. Predictive information is an answer to the question: What, if…? They contain prospective scenarios with results that can be illustrated in percentages. Finally prescriptive information is given to be the right course of action in decision making. It is directed towards answering the question: what should be done [HARSH, 1981].

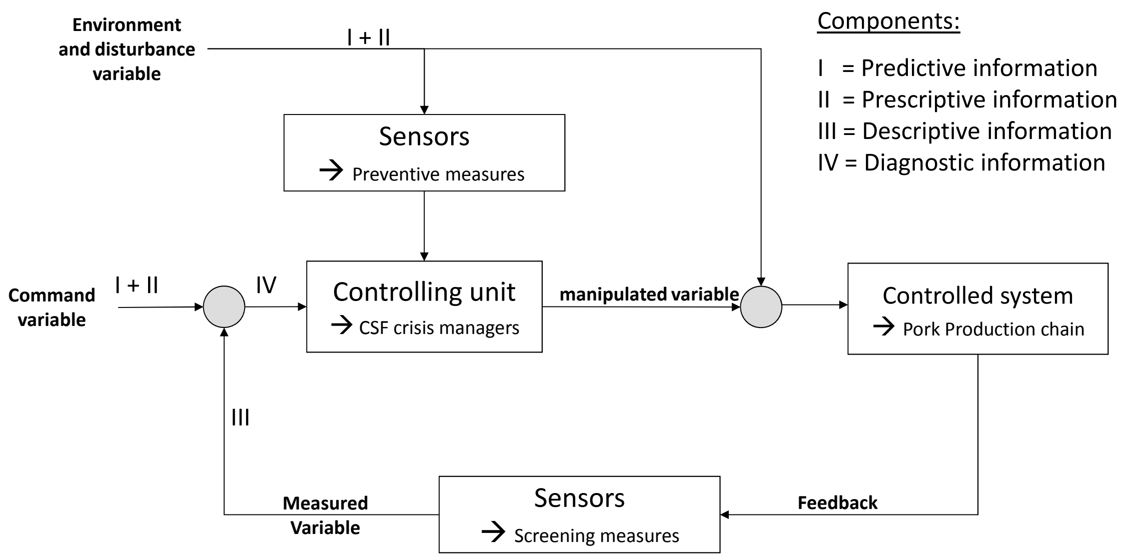

Figure 4.3: Closed loop model [modified after PETERSEN, 1986]

Another tool that has its origin in information theory is the Process reference model (PRM). This model is useful when it comes to the assessment of data bases and information systems. The testing based on this model contains criteria for the availability and quality of information systems. Based on the results of this model differentiations can be made about the different types of information.

The Process reference model is part of a superior methodology that contains the determination of a maturity level with a reference model [WAGNER and DÜRR, 2008]. If the maturity level of an information system is determined by ISO IEC 15504 it is important to address the abilities that fit the demands [SCHMELZER and SESSELMANN, 2008]. In opposite to benchmarking procedures comparing of processes with other organizations is not taken into account. It is always the best possible state that the assessment is based on.

The Process reference model contains the acquisition and description of elementary procedures in a reference model [BRENNER et al., 2010]. A first step in this procedure is the arrangement of processes in capability levels [KÖHLER, 2006]. Having the objective to achieve the superior capability level one can derive the strengths and weaknesses from the testified processes. Thus, the PRM can be regarded as a tool for process improvement. The Process capability determination according to ISO IEC 15504 defines both process dimensions and capability dimensions. Consequently, the productivity of processes can be estimated. In the following assessment phase a combination of process and capability level dimensions takes place.

The capability dimensions do consist of six different levels (see Table 4.2). They are the measurement for the productivity of processes. For every part of a process a capability level is determined. In doing so both the existence of a process activity and the adequate execution are rated. The rating of process attributes takes place according to the scale in Table 4.2. The highest level of capability is achieved as soon as a process innovation takes place.

Table 4.2: Interpretation of maturity levels according to ISO IEC 15504-2

Capability level	Interpretation
0 „incomplete“	Process is not implemented, purpose is not fulfilled
1 „executed“	Basics are executed and do fulfil its purpose
2 „managed“	Process is planned, followed and updated
3 „established“	Process is standardized and achieves predefined results
4 „predictable“	Process is analyzed and directed, results are predictable
5 „optimized“	More process aims are determined, process innovation takes place

4.2.3 Innovation theory

In literature that focuses on innovation systems the following working hypothesis of an innovation system is used: A system of innovation is a set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provide the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies [van Mierlo et al., 2010].

Leeuwis et al. [2006] and Bruns [2011] identify defaults in the current knowledge infrastructure that obstruct a fruitful interaction of different disciplines. And it is precisely this type of interaction that is desperately needed to stimulate innovations that will bring about transformational change contributing to cross border crisis management. Ludwig [2001] explains that complexity and wickedness of problems indicate the end of the traditional management paradigm.

Looking at innovation for cross border crisis management as a continuous process of engagement may prove to be a very promising perspective for realizing innovation. Engagement implies a respectful consideration of value that other parties bring to the table. This is precisely what is needed in the cross border crisis management debate, since the arguments here revolve around the specific notion that is attributed to responsibility by different individuals, groups and institutions. The real boost for addressing the process aspects of joint risk and crises management stems from the notion of wicked problems and the recognition that joint crisis management can be consider as such The notion of wicked problems evolved primarily in operations research and social planning as<a reflection to the situation where a problem did not seem to have a clear solution.

Rittel and Weber [1973] use nine more or less formal characteristics to discern between wicked and normal problems in the social planning domain:

1. There is no definitive formulation of the problem,
2. There is no stopping rule in problem solving
3. Solutions are never true of false, but only better or worse
4. There is no immediate or ultimate test of any given solution
5. Every attempt for a solution counts significantly, there is no trial-and-error
6. There is not a set of potential solutions nor permissible operations
7. Every problem is essentially unique
8. Every problem can be considered a symptom of another wicked problem
9. The explanation of the problem determines the proposed solution.

Taking these characteristics and hold them against the problem of how to attain cross boarder risk and crises management, all of them seem to apply. Since all solutions are under constant debate and the outcomes are part of discussions, an ultimate test for any solution is impossible (4). And finally, since the problem definition is based on the problem as perceived by the various stakeholders, all solutions that are derived from such a problem definition will be determined by same underlying value set (9).

So, it appears that cross border risk and crisis management can be regarded as wicked problems. Stressing the importance of solving the related problem will therefore not lead to satisfactory solutions. Instead, accepting the wicked character of the problem and address in a process of engagement may be more useful. In such a process, different stakeholder can bring their values and related problem perception to the table. In recent literature, various authors have suggested this approach and came forward with elements of a possible action perspective. The analytical bridge between the notion of wickedness and the different approaches that rely on nonlinearity and complexity is formed by the uncertainties that come into play once wickedness of the problem is recognized. Palmer et al. [2007] advocate a trans-disciplinary approach that includes higher order thinking that transcends discipline boundaries and the generation of new knowledge and new resolutions not available in multidisciplinary and interdisciplinary environments.

VAN BUEREN et al. [2003] bring forward the notion that three different types of uncertainty play a role in the wicked behaviour of problems:

1. Cognitive uncertainty: we just do not know about the problem and the potential causes to effectively address the problem.
2. Strategic uncertainty: there are many actors involved that have different perceptions of the problem and its solutions. Diverging and sometimes even conflicting strategies are the results that cause stagnation in debate, or – in rare cases – lead to surprising and unexpected outcomes.
3. Institutional uncertainty: decisions are made in different places and policy arenas in which actors from various policy networks participate. This gives rise to a highly fragmented institutional setting that breaks down the legitimacy of choices and actions.

The lack of description of the problem and its potential solution leads to a different approach to the issue of problem solving and to a debate on the role of science and scientific analysis in this context. Science and scientists are forced to share their role as professional adviser to the decision making process with a large group of involved stakeholders. This forms an essential element of the needed engagement of science. Add to this the same levels of engagement in business, government and societal groups and the outlines of a process approach as system innovation to deal with cross boarder outbreaks of animal diseases.

Dealing with wicked problems and thus dealing with cross border crisis management needs experimentation. The SafeGuard-Project was initiated to gain experience with innovative types of experimentation. Based on the literature a set of motivating assumptions provides a framework to following action experiments. This approach is based on the methodology of grounded theory [STRAUSS and CORBIN, 1990] that describes the way in which a large number of findings and information can be used as a database on which inductive theories are built. Starting with experimenting and induced theory from the findings led to assumptions that together constitute a sequential line of reasoning.

4.3 Methodology of concept development

The development of a concept for the preparation and execution of cross border information transfer in crisis management measures is based on a four level approach:

1. Description of specific problems in cross border regions
2. Definition of motivating assumptions for cross border crisis management
3. Guidelines for preparation of information transfer in crisis management trainings
4. Evaluation of tools supporting cross border crisis management

By combination of the methodological building stones presented in section 2 of this paper a concept arises that is made for a standardized support of cross border information management in animal disease control. This concept is purely focused on the development of cooperation activities before crisis and not tested on its value for decision support in crisis.

4.3.1 Description of specific problems in cross border regions

The investigation and description of problems in animal disease control regarding cross border cooperation have been exposed in earlier studies based on expert elicitation activities [BREUER et al., 2008]. A part of these results – related to availability and transfer of information – have been introduced to the process reference model.

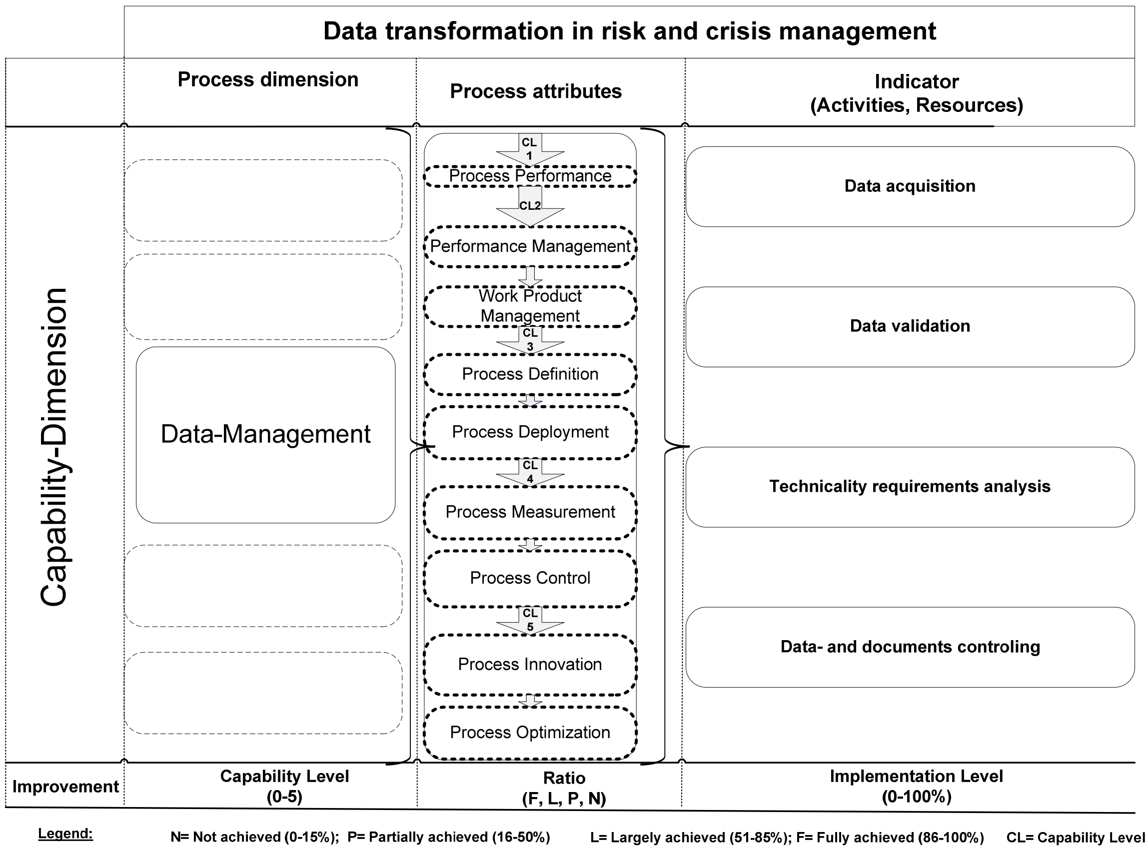

Figure 4.4: Process reference model for process dimension data management

For the structuring and assessing of information and communication processes a categorization in process dimensions, common features and process indicators has been performed [SLÜTTER et al., 2010]. To exemplify the process reference model an extract has been produced for data management (see Figure 4.4). This example has been taken because the underlying process is focused on information quality and information production.

Based on theoretical knowledge five process dimensions are detected. All of them have been validated by interviews with public experts in animal disease control.

- *Data management:*
  The purpose of data management process is to guarantee that data is properly collected, validated and directed. The data management is supported by a technical requirement analysis.
- *Staff management:*
  The purpose of staff management is to assure that by means of staff policy any structural asymmetries in human crisis management resources can be prevented.
- *Resource management:*
  The purpose of resource management is to secure that all involved stakeholders are provided with information and materials on time.
- *Coordination management:*
  The purpose of coordination management is to guarantee that by means of knowledge management decisions are made precisely and on the right time. It is additionally important to prevent any double activities. Therefore, a subsequent communication is inevitable.
- *Strategic alliance:*
  The purpose of strategic alliances is to assure that at least between two German Bundesländer information can be exchanged based on concrete cooperation agreements.

Besides, every single data management indicator can be matched with a specific purpose:

- *Data production:*
  All data that is relevant for animal disease control issues will be produced.
- *Data validation:*
  Ensuring the collected animal disease data with regard to data standardization, data quality and the additional need for specific information.
- *Technical demands:*
  Description of demands for the complete system consisting of different hard- and software components and the combination of these in terms of efficient information supply for all stakeholders that are concerned.
- *Distribution of data and documents:*
  Complete, systematic and quick supply of information for specific users.

The basic practices of the four indicators include the execution of the fifteen criteria for information quality. The level of information quality will be determined in a second step by means of predefined common features. Henceforth, basic assumptions can be made with regard to the availability and the quality of specific information relevant for decision making in animal disease control.

4.3.2 Definition of motivating assumptions for cross border crisis management

In addition to the methods for initial problem definition this study is provided with five motivating assumptions that are used as general pre-conditions for regulating the information transfer activities in crisis management preparation:

1. Crisis management is a dynamic process
2. Crisis management needs systematic innovation
3. Systemic innovation is a non-linear learning process
4. Systemic innovation requires a multi-stakeholder approach
5. Multi-stakeholder approaches imply trans-disciplinary knowledge creation

This set of five motivating assumptions is applied as a framework to stimulate cross border crisis management in a diverse set of more than 35 working groups. These working groups are all aiming towards improving the cross border cooperation in the agri-food business. By gaining experiences in scientific experiments the SafeGuard consortium wants to:

1. test the validity of the assumptions in various situations,
2. get insight in the practical do´s and don´ts when applying the framework.

Finally, the assumptions together with the practical implementations constitute the basis for taking the following steps in transforming crisis management innovation. This innovation process has various contributions to cross border risk- and crisis management.

As already stated this research is based upon earlier studies [BREUER et al., 2008]: public and private stakeholders have been identified and integrated in this study in order to create knowledge about information quality and availability relevant for cross border decision making in crisis. This concept is built to give guidelines on information transfer in crisis management so that systemic innovation is possible.

4.3.3 Guidelines for preparation of information transfer in crisis management trainings

Based on these assumptions it can be deduced that it has to be the objective to facilitate systemic innovation by regular training activities. Hence, the guidelines of this concept contain a stepwise process beginning with problem identification and ending in controlling activities that contain training measures.

In Table 4.3 all phases of the information transfer concept are listed and provided with explanations on working steps and methods.

Table 4.3: Guidelines for a generic information management concept in crisis management

Concept phase	Working step	Outline	Methods
Problem identification	Detection of information deficits	By means of cooperation scenarios certain information deficits can be determined	Scenario management, information management, process reference model
Searching for solutions	Identification of available data sources	All data sources that are at hand are detected and described	Process reference model
Assessment and decision making	Assessment of existing information and communication systems	Based on process capability determination the quality of information systems is rated and the availability of information is described	Process capability determination
	Assessment of information relevant for decision making	In this step all available information are assessed by the relevant decision maker	Process reference model
	Decision for the adequate data source	Based on results a decision can be made about the data or information source that is most adequate for the tested decision process	Process reference model
Execution	Establishment of the complete decision process in national crisis management manuals	The responsible stakeholders do have to introduce the decision process into national law in order to have the opportunity in times of crisis	Scenario management, closed loop model
Control	Evaluation of decision process	In crisis exercises or trainings the cross border cooperation plans are going to be evaluated	Scenario management, Failure Mode and Effects Analysis

As soon as the responsible authorities have agreed about the benefit of a cooperation measure, the implementation into national contingency plans has to be prepared [Breuer et al., 2008]. Therefore, for all relevant decision points of the concerned process it has to be checked where decision relevant information is available and where not. If a lack of information has been identified, the problem identification phase of the information transfer guidelines has started.

4.3.4 Evaluation of tools supporting cross border crisis management

The development of this concept is still an ongoing process. For all five concept phases research activities are continuing in a Dutch-German INTERREG IVA project called SafeGuard. Therefore, in this section a short overview is provided on the nature of project based research concerning this concept.

In SafeGuard animal health and food production experts from North Rhine Westphalia, Lower Saxony and the Netherlands are analyzing the strengths and weaknesses of prevention, control and monitoring measures. Altogether 38 partners from science, industry and public authorities are participated in the development of measures and concepts.

Representatives of the public authorities, business enterprises and research institutes have defined the core issues of this project in a common approach. By transfer of technology and knowledge between research institutes and industry as well as public organisations this research project will set new standards in the area of organisational processes as well as technical innovations.

All scientific activities concerning the Process reference model and the Process capability determination are hosted in a working group headed by the University of Bonn. Here, the benefit of rating capability level in animal disease control is analyzed by means of cross border effects. The public private approach has a central position in this research as data and information exchange in crisis needs both sides to cooperate.

The evaluation of these tools will be finally done in a Dutch German crisis management exercise that is planned in the SafeGuard project for autumn 2012. Here the benefit of the complete cross border crisis management concept where these information transfer guidelines are a part of, will be tested and validated, before it is finally delivered for implementation.

4.4 Combination of tools exemplified in a cross border case study

After having explained how these conceptual guidelines for cross border information transfer are scientifically grounded and motivated, in this section the application of these guidelines are illustrated in a simple case study. In the following five sections key issues that have been raised in the working groups will be explored.

4.4.1 Problem identification

As already mentioned before, the problem identification phase starts as soon as a cross border crisis management plan is lacking decision relevant information. Before starting the concept, the decision plan that is going to be reviewed has to be filled in a fact sheet. The intention of doing so is that these fact sheets demand a certain amount of information about the decision process which is relevant for the further research steps: How many decision points does the process contain, who is the relevant decision maker, what benefit does the decision maker have, what kind of limiting factors could be an obstacle for the decision process and what missing activities need to be done by decision makers in order to fulfil his decision tasks? Finally, according to the Closed loop model the category of information is determined for each decision point.

In Table 4.4 a pullout of a fact sheet is illustrated. In this case study attention is directed towards decision point 2 out of the scenario "Restriction areas and compartment building" which has been worked out based on the expert elicitation in earlier research [Breuer et al., 2008]. The decision options this fact sheet gives detailed information on are represented in a scenario tree. In this scenario the first decision point is the request of the North Rhine Westphalian agricultural ministry (MKULNV) for cross border data for the preparation of restriction zones.

Table 4.4: Pullout of a fact sheet to exemplify the documentation of problem identification aspects in animal disease crisis management

Decision point	Decision maker	Benefits of cross border decision	Limiting factors of acting in cross border consensus	Missing activities	Category of information relevant for decision making
1	MKULNV	No direct benefit yet; but expecting benefit through cooperation	Lack of access to relevant stakeholders	Establishing communication channels for debate on data and information exchange	diagnostic information
2	EL&I	EL&I can receive data from NRW in exchange to optimize prevention; private sector can count on a faster ending of trade bans in NRW	Data privacy problems; technical boundaries between data bases	Finding agreements and interfaces about the exchange of data	descriptive information
3	MKULNV	More specific information about contact structure in cross border region facilitates crisis management	European veterinary regulation, national veterinary regulation	Making a request for the adjustment of European and national regulation	prescriptive information

Legend: MKULNV – Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes Nordrhein-Westfalen; NRW – Nordrhein-Westfalen; EL&I - Ministerie van Economische Zaken, Landbouw en Innovatie (Nederland)

The decision maker who is responsible for this decision point is the Dutch ministry of agriculture [EL&I]. After having received the request for information on contact structures they have to decide whether they share information with the German colleagues or not? If they decide to share information, the limiting factors and missing activities for information transfer have to be considered. In this case it is possible, that data privacy problems can occur as well as technical boundaries between different data bases. As soon as the problem identification is completed the second phase can be started with.

4.4.2 Searching for solutions

After having detected the need of information the next step is to find available data sources that can fit the information demand. In this case study this procedure is exemplified for the German veterinary data sources in public and in private hands [Deimel et al, 2008; Slütter et al., 2010]. The results that are included in this study are part of an initial expert assessment of public and private animal health information and communication systems in Germany. The assessment of the Dutch system is still ongoing.

Taking a closer look on the German information and communication systems it has been obvious that on the one hand different data is available on livestock statistics. On the other hand, certain part of information that lies in these public data bases is obsolete [Slütter et al., 2010]. According to expert interviews with Balvi [2010] a reason for the heterogeneity of data is the lack of standardized data management as well as the differences in data management by public authorities. DOLUSCHITZ [2007] and BALVI [2010] see another important aspect in the lack of standardization of interfaces that are needed for engaging and exchanging relevant information in crisis management. In this context SLÜTTER [2010] has identified more significant problems: one aspect is the low differentiation of livestock data in some public sources. These differences make a standardized data exchange impossible. Consequently, the principals for data transfer are different for each stakeholder [BALVI, 2010]. Without a standardization of requirements for data transfer the establishment of interfaces cannot be successful. In expert interviews this assumptions has been richly validated: livestock disease data have been occasionally unemployable in times of crisis due to different data formats [SLÜTTER et al., 2010].

Based on this general assessment some insights can be given for these case study example. As already explained, the scenario on Restriction areas and compartment building shows that decision point 2 requires the exchange of information about cross border contact structure. The theoretical example needs the Dutch ministry of EL&I to decide whether the required data is available, free and compatible with the German system. A preview on the ongoing analysis illustrates that the relevant data is available. If an exchange of information with the German colleagues can be enabled, depends strongly on internal debate between the relevant agencies. This debate is of course highly influenced by several factors: e.g. the quality of information that is asked, the point in crisis the demand is uttered and finally the circumstances at the time that can be influenced by political or economic issues. Consequently, missing activities can be drawn from this example when it comes to the technical boundaries and the definition of possible data sets that can be useful in specific crisis situations. If the circumstances will allow data transfer is a decision that can only be made in a real crisis situation.

4.4.3 Assessment and decision

In this section a series of aspects are summed up. The Process reference model provides a rating of the information and communication systems that are available as a result from the analysis made in the second phase of these guidelines. From this assessment conclusions can be made about the quality of data that is theoretically available to data exchange. In a second step the assessment of specific information can be executed in order to find the information that is relevant for decision making. Therefore, it is highly important that the decision maker in a data receiving position is responsible for the data assessment. In Table 4.5 a pullout gives insight in the to-do-list for two different information quality criteria.

Table 4.5: Pullout of to-do-list for the compliance of information quality criteria

Capability level	Process indicator	Compliance of accessibility of information	Compliance of interpretability of information
1 Process executed	TA	☒ Data exchange is enabled	☒ Data formats are applicable/ readable
	DG	☐ --	☐ --
	DV	☒ Mandatory and optional data are determined	☒ Data standardisation is guaranteed
	DL	☒ User-specific requirement catalogues are created	☒ User-specific requirement catalogues are created
2 Process managed	TA	☒ Technical equipment is tested on: Actuality ☒ Rapidity ☒ Reliability ☒ Age ☒ Accuracy ☐ Software equipment is tested on: ☒ Data transmission ☒ Data exchange	☒ Software equipment is identical and compatible ☐ ☐ ☐ ☐ ☐ ☐ ☐
	DG	☒ Data privacy aspects are considered	☒ Data standards are determined (data format, terminology, completeness, etc.)
	DV	☒ Access rights are clearly defined	☒ Plausibility test is active (control of Data, user input, interpretability of text fields, etc.)
	DL	☒ Data transmission channels are defined	☐ --
3 Process established	TA	☒ Requirements for technical equipment is defined	☒ Software types are determined
	DG	☒ Infrastructure for homogeneous data transmission is determined for every stakeholder	☒ Data standardization is proved
	DV	☒ Data privacy proofs are available	☐ --
	DL	☒ Data is proceeded in a user-specific manner ☒ Strategies for the security of private data are developed	☒ Data is proceeded in a user-specific manner ☐
4 Process predictable	TA	☒ Homogeneous technical equipment is proved	☒ Homogeneous application software is proved
	DG	☐ --	☐ --
	DV	☒ Proper transmission of data is guaranteed	☒ Action alternatives can be derived from data in short time
	DL	☒ Effective data transmission by means of data channelling is proved ☒ Data channelling assures rapid action alternatives ☒ Data privacy measures are proved	☒ User specific preparation is proved/ error messages can be generated ☐
5 Process improves	TA	☒ The actual equipment secures the maximal use of data transmission	☒ Relevant software panoply is as big as necessary and as small as possible
	DG	☒ All stakeholders are provided with the most effective way of data transmission	☐ --
	DV	☐ --	☒ Data standardization is continuously adjusted to animal disease regulations
	DL	☒ Improvement of efficiency by means of data channelling is continuously tested	☐ --

Legend: TA – Technical requirement analysis; DG – Data production; DV – Data validation; DL – Data- and document directing; -- = not relevant for these criteria

As the Table 4.5 shows, the compliance of the first capability level leads to a consideration of all relevant information quality criteria. The level of information quality is then determined in the following capability levels. In this case study the assessment is only exemplified for two information quality criteria: accessibility and interpretability.

For the cross border scenario it can be concluded that after having successfully implemented the complete information quality criteria the third phase of these information transfer guidelines would have been accomplished. Concretely, this would mean that the Dutch and the North Rhine Westphalian authorities would have to come to a specific agreement about the exchange of contact structure data in cross border crisis situations.

4.4.4 Execution

Based on all results that have been collected in the first three phases the next step is to implement the cooperation plan into national animal disease control guidelines. The national veterinary authorities can use the scenario plan and the fact sheets as a basis for final debate about the cross border regulation. In this step no more scientific support can be given as it is a political decision that has to be made. In this part of the concept the introduction of the Exchange and engage model is necessary. Here, all aspects are considered that contribute to the regulation of exchanging and engaging decision relevant information in crisis situations [SCHÜTZ et al., 2007; BREUER et al., 2008; SLÜTTER et al., 2010]. This model has already been tested in research projects and is still part of an ongoing cross border initiative. Its main output is the definition of the exact point of time when specific information can be transferred in order to improve crisis management procedures immensely [BREUER et al., 2008].

Currently, the University of Bonn is heading a scientific panel that prepares the validation of this model. The aim of this project is to develop a generic procedure for the common implementation of the Exchange and engage model. Therefore, a combination of organisational and technical innovations for the support of decision makers in crisis management will be provided. Final results can be expected in autumn of 2013 [SAFEGUARD, 2010].

4.4.5 Control

The final section of this concept contains guidelines to all measures that contribute to the control of information collected in a decision process. At this point of time the effectiveness of a cross border initiative has to be tested in crisis management exercises and training activities. The concept is provided with several tools from quality management. In this section the Failure Mode and Effects Analysis (FMEA) is important to consider when it comes to the final testing of cooperation plans. By using this procedure it can be investigated what kind of risks are connected to the implementation of a new measure [SCHMITZ, 2005]. In Figure 4.5 insight is given in the risk assessment procedure according to the FMEA. All risks that can be identified can be listed in this chart according to probability of appearance (A) and the extent of losses (E) that is assumed.

	Risk assessment				
(A)	Likely	3			
	Possible	2			
	Unlikely	1			
			1	2	3
			Small risk	Great risk	Critical risk
				(E)	

Legend:(A) = appearance probability; (E) =Extent of losses

Figure 4.5: Risk assessment schedule after FMEA

The results of these guidelines are produced and delivered in a structured manner so that all public authorities can easily introduce them into crisis management exercises. In the SafeGuard project a crisis management exercise will be planned in order to illustrate the decision support potential of this concept.

4.5 Discussion

In the following section answers will be given to the central objectives of this study. Furthermore, all results will be compared to the findings of other research activities on the field of information transfer in animal disease control. Finally, the capacities of this concept will be described and evaluated.

Based on the illustration it has been exemplified that standardized guidelines for cross border information transfer are a crucial element to the preparation of cross border cooperation on animal disease control. Without such guidelines the investigation of decision relevant information deficits and its solution is hardly possible. Or, regarded from an opposite perspective, having these guidelines allows public authorities a clear communication along standardized parameters about the information missing and thus an efficient and purposeful preparation of cross border cooperation agreements. A central issue is of course the time saving capability of using a standardized concept. And saving time is a very familiar aim to veterinary crisis managers not only in the Netherlands and in Germany.

This study contains several findings [DGIQ, 2010; SLÜTTER, 2010] that are giving insight to the research objectives posted in the introduction of this paper. First off all, the question was how the quality of decision relevant information can be deduced and assessed in order to find a common standard. In this study 15 criteria for information quality have been included as a basis to all further steps of this concept. As a result the data receiver can make a rating of the received information along standardized criteria and give clear instructions to the sender if the data quality is not sufficient for the relevant decision. As soon as a cooperation measure has been implemented the data quality that is necessary for single decision can be exactly described in national cooperation plans. Consequently, in a crisis situation it is absolutely clear who has to provide what kind of information in what situation. The time saving potential of this guideline is assumingly high.

Regarding the initial assumption that a lack of decision relevant information is a limiting factor for cross border cooperation in animal disease control in this study a basic analysis has been executed that illustrates the quality of existing information and communication systems in Germany. The findings have given a basic insight into heterogeneous veterinary data systems that are partly motivated in missing standardization of data transfer between authorities [SLÜTTER et al., 2010]. By means of expert interviews practical experiences from past crises have been included into this study. They confirm the earlier findings and show that in some cases technical problems have lead to data transfer failures or data format failures [SLÜTTER et al., 2010]. Currently, the University of Göttingen is working on similar subjects on the field of cross border information and communication in animal disease control. Preliminary results come close to the findings in this study [DEIMEL et al., 2008; ARENS and THEUVSEN, 2010a; ARENS and THEUVSEN, 2010b]. The fact that information and communication systems in Germany are already heterogeneously do underline the importance of information transfer guidelines for the cross border situation immensely. Hence, a standardization of information transfer would have a positive consequence for both national and cross border cooperation in crisis management. Research on the Dutch situation is currently done at the universities of Bonn and Göttingen. A grounded theory approach is used in this research [Strauss and Corbin, 1990]. To begin with, a theory testing revision cycle has been started. The empirical evidence was collected using scientific case studies. The initial hypothesis of this study has been tested in several working groups in SafeGuard. A combination of grounded theory and case studies was appropriate given the exploratory nature of this research. It needed to consider a wide variety of potential performances and explanatory attributes in the context of a limited number of cases.

The case study example on cross border data exchange shows that concrete problems like technical boundaries and data privacy issues do arise while preparing fact sheets on single decision points of a decision process. This example illustrates another important aspect: without predefined conditions on cooperation there is no room for cooperation in a crisis situation as there is no time for debate on the nature of conditions and consequences of cooperation. Therefore, the assumption has been proved by means of a case study example that cross border decision processes can efficiently prepared by a structured concept for information management. Even more, the might be no chance on cooperation if the predefinitions by this concept are missing. Therefore having a concept that leads to definite agreements before crisis can be regarded as a precondition for cooperation in crisis. Finally, the findings of this study do confirm that this concept contributes to the preparation of cross border cooperation in crisis management. Without the general guidelines in this concept no transparent remarks can be made on the relevant information and its quality for cross border decision making. The concept provides a structured guideline that allows the identification of problems, the searching for solutions and the implementation and testing of sufficient actions.

Of course, all data and information that is determined, collected and rated along the guidelines of this concept does have to be technically engaged and exchanged in crisis. Consequently, the University of Bonn is currently working on a procedure that contains solutions for organisational and technical aspects of exchanging data in crisis [SCHÜTZ et al., 2007; BREUER et al., 2008; SLÜTTER et al, 2010].

The findings of this study are part of a superior concept that is developed in order to allow a structured preparation of cooperation measures in animal disease control. This cross border crisis management concept has six different phases (see Table 5.1). The guidelines presented in this paper are contributing to the fifth phase of this concept, where limiting factors such as lack of data and information are investigated and repaired.

Table 4.6: Phases of Cross border crisis management concept (CBCM)

Phase	Step of CBCM-concept procedure
1	Selection of subjects for development of a cross border cooperation plan
2	Definition of objectives for ambition levels
3	Specification of the initial crisis situation
4	Setting up scenario plans for the minimum ambition level
5	Representation of limiting factors/ benefits in fact sheets
6	Instructions for scenario application to training and exercising activities

The superior concept includes all relevant steps beginning with the ranking of subjects relevant for cross border cooperation (1), continuing with the selection and description of ambition levels (2) and the construction of theoretical cooperation scenarios (3+4). In the fifth step the concept presented in this study is executed before finally measures are taken that contribute to the validation of developed decision plans by means of crisis exercises or trainings (5).

The key objectives of this management approach are learning to learn and creation of knowledge. To do this study needed to stimulate reflection and respondence to emerging issues. Thus, managing cross border crises is an explorative process that needs to include both impact and processes. REGEER [2010] describes the need for mode-2-strategies. These strategies share a commitment to addressing complex communication problems by involving multiple stakeholders (notably social and natural scientists, entrepreneurs, administrators, etc.) acknowledging the multi-level nature of the problems and articulating multiple perspectives.

In order to involve stakeholders some scientists to advice to include boundary organizations mainly in terms of mediating tasks between different stakeholders. Here, REGEER [2010] describes a conceptual distinction between knowledge integration and knowledge creation. She argues, based on research in practical experiments that a well guided learning process can unlock a huge knowledge resource which is very valuable for the innovation process.

4.6 Conclusions

The following main conclusions can be drawn from this study:

- Crisis management in border regions can be regarded as an innovation target
- Characteristics of innovation and the innovation system in this field are:
  1) New IT-technologies and systems to communicate in crisis
  2) EEM-modelling approach as a common procedure for public and private actors
  3) Practical guidelines for dealing with the intrinsic properties of crisis management
  4) Implementing liaison officers in crisis management systems

There are five motivating assumptions for enhancing the substantial development of joint crisis management in cross border regions:

1) Crisis management is a dynamic process
   There is no final definition to this concept. What is relevant is including stakeholder opinion in a set of valued dimensions that evolve in time.
2) Crisis management needs systemic innovation
   The hardware, software and orgware of public-private cross border partnership must be innovated if cooperation in crisis management will be achieved.
3) System innovation is a non-linear learning process
   The normal scientific approach of problem solution must be replaced by a process of learning that contains consensus, joint knowledge creation.
4) System innovation requires a multi-stakeholder approach
   All stakeholders bring existing knowledge and concern to the process. Beside, their collective presence is needed for legitimacy and productive creativity.
5) Multi-stakeholder approaches imply trans-disciplinary knowledge creation
   Complex problems do not have disciplinary boundaries. All relevant skills and knowledge must be combined and extended to create new knowledge that will lead to a cross border crisis management system.

More research will be done with regard to the practical usage of this concept. Currently, two large research projects contain studies on this information transfer concept. In SiLeBAT the benefit of this concept is analysed for the milk and beef production chains, while in SafeGuard the cross border cooperation between the Netherlands and Germany on animal disease control is in the spotlight.

The variability of performance allows conclusions to be drawn about the efficiency of the five motivating assumptions and, at least provisionally, how generally these conclusions may be applied on the management of other crisis situations.

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5 Cross border management of animal disease outbreaks: Introducing a crisis management concept for the preparation and implementation of Dutch-German CSF control measures

Abstract

In the fifth section of this study a Cross border crisis management concept was developed as a support tool for national veterinary authorities. The design of this concept has been described in several sequences and its capabilities have been illustrated in a single cooperation strategy example. A combination of scenario theory, simulation theory and information theory has been combined to an integrated approach. As a core result, the evaluation of the first application of this crisis management concept made clear how benefits of cross border cooperation can be implemented and, at the same time, how to deal with a variety of limiting factors that are standing in the way of a successful implementation.

5.1 Introduction

In recent years many European member states have been confronted with the complexity of challenges that modern animal disease crises can bring about. Highly pathogenic livestock diseases like Classical Swine Fever (CSF), Foot and Mouth disease (FMD) and Highly Pathogenic Avian Influenza (HPAI) confront the food and feed industry and the national crisis management authorities with a bunch of negative impacts: direct and indirect economic costs, epidemiological impacts, social-ethical aspects, environmental problems and particularly human health issues [LONGWORTH, N. and H.W. SAATKAMP,2007]. In addition most animal disease outbreaks rapidly develop into cross border crisis situations, as they spread along complex trade patterns within the Single European Market. While production and trade networks are running on international channels, the veterinary crisis management is still build on a national fundament. Even if the European regulation on animal diseases is the basic strategy for each member state, the national implementation of European directives gives room for specific solutions which again makes bilateral cooperation difficult [BREUER et al., 2008].

While the political establishments of several European countries already agreed about having regular round tables on important cross border issues or about investments in international research and development initiatives [MUNLV, 2007], there are so far no designated cross border animal disease control measures implemented in national contingency plans. Looking at the specific situation of the leading food and feed business area between the Netherland and Germany one core argument for the absence of cross border measures is the different governmental organization that is followed by heterogenic veterinary systems. Another aspect might be that economic competition between countries is widely regarded as the stronger argument compared to epidemiological cooperation. Therefore cross border crisis management options have to be attractive for both public and private stakeholders. Nevertheless, crisis management experiences and recent research activities have proven that cross border cooperation is an important factor in efficient CSF control systems [BREUER et al., 2008]

Hence, the objective of this study is to introduce a concept for the development of cross border cooperation scenarios that can be tested according to their benefit in a qualitative crisis simulation compared to the existing national strategies. It is the aim of this concept to provide clear instructions on how to test and implement cross border cooperation strategies. BREUER et al. [2008] have already identified all stakeholders concerned and their priorities in cross border Classical Swine Fever (CSF) control in earlier research. Now the question arises, how these specific ambitions for an efficient cooperation between Dutch and German authorities can be technically framed in a crisis management concept?

First of all, bringing cross border cooperation measures into practice means that one has to be aware of the core challenges that have to be overcome:

1. Lack of knowledge about the veterinary system of neighboring states;
2. No or less coordination between national contingency plans;
3. No or less availability of relevant data and information in critical decision making.

Based on this pre-information, the concept presented in this study is built on qualitative procedures from scenario and simulation methodology as well as information and communication theory in quality management. The usage of scenario and simulation methodology in crisis management procedures is widely known and commonly recognized [KLEIBOER, 1997; SAGUN, 2000; ALEXANDER, 2000; BOIN, 2005], but there are no concepts that are specifically prepared for cross border crisis situations. It is therefore necessary to analyze the established scenario and simulation procedure in order to find a new concept that enables public actors in animal disease control to develop cross border cooperation measures. In earlier research this concept has already been pre-tested in different fields of the food and feed industry [NACHTIGAL, 2007; GLASNER, 2007], where the cross border aspect was given by the organizational border between public and private actors. Now, for the first time a national border area has been chosen as a subject of research.

The cross border concept will be exemplified for one specific cross border cooperation approach in Dutch and German CSF control: Starting with an initial crisis scenario situation the concept describes a sequence of tasks that will finally lead to a specific cross border cooperation plan. The intention of this procedure is to illustrate the potential benefits of the cross border decision options and to underline the limiting factors that have to be taken care of in order to come to an implementation.

Finally, the identified stakeholders will receive a cross border concept that has been pre-tested with an expert group in a single pilot study. It provides relevant information for the implementation of a specific cross border cooperation option and at the same time a concept that can be used for the preparation and evaluation of further cross border options.

5.2 Methods and materials

As already stated, the aim of this study is to develop a cross border crisis management concept that enables public crisis management authorities to understand the potentials and the limitations of certain cross border management options in CSF control. In the following passages the theoretical framework and the methodological building blocks of the concept will be illustrated in detail.

In the history of mankind innumerous examples of planning and developing strategies in terms of scenario based thinking are documented. Especially in military history scenario planning elements can be reconstructed back to the ancient times. A very popular example is Hannibal the great commander of Carthage who used a complex way of what if-thinking to beat the superior Roman Empire on various occasions [SEIBERT, J., 1997; MESSER, R.J., 2009]. In 1798 the Prussian army was the first military organization that invented game play instructions for training devices [STARR, 1994]. After World War II military gaming was developed further at the RAND Corporation, Harvard University and the Massachusetts Institute of Technology to accommodate the nexus between military and political dimensions of crisis management [KLEIBOER, 1997]. According to KLEIBOER [1997] it was in this time when the scope of scenario and simulation methodology was widened to include other types of crises: terrorism, health threats, nature disasters and many other political environments featured by high threats, short decision times and high uncertainty.

One can conclude from these various historical examples that scenario planning methodology has always been used to achieve advantages compared to the opponent´s strategies. What all scenario based approaches have in common are two core factors that are necessary to develop powerful strategies: knowing your enemy well is an absolute requirement to find a tactical approach that fits on his strengths and weaknesses; having access to relevant data and information on time is important for decision making in the course of the events. In scientific literature on scenario methodology many authors have found the comparison between scenario planning and chess game very significant [BECKER, 1976; SELTEN, 1999]. According to literature scenario based methodology is most appropriate for the management of critical situations that can contain a great deal of uncertainty in praxis. Therefore the control systems of so called modern crises [BOIN et al., 2004] – where the degree of uncertainty is significantly high – are often equipped with scenario approaches. Another advantage is that for scenario methodology it is completely irrelevant what kind of crisis is at hand, as long as the critical agent and all relevant actors can be identified and described.

As already stated this study is focused on the control of animal disease outbreaks exemplified on CSF control. The main features this concept has to take into account can be described as follows:

- basic European regulation for control of contagious livestock diseases;
- national regulation of countries in a cross border area;
- potentials, prospects and limitations of specific cross border cooperation options.

Therefore this cross border crisis management concept is provided with a multi level approach that contains the construction of ambition levels, the design of qualitative scenarios and the identification of benefits and limiting factors that need to be taken care of before an implementation of cross border cooperation can take place. In earlier research the potential, the prospects and the possible limitations of CSF outbreaks have been evaluated [BREUER et al., 2008]

In Table 2.1 the single steps of the multilevel concept and the relevant methodologies are presented. Phases 1 and 2 have already been executed in earlier research [BREUER et al., 2008]. In this study the phases 3-6 are going to be performed. Therefore, in the following passages the relevant methodological aspects of scenario planning and simulation theory are explained.

Table 5.1: General survey of the Cross border crisis management concept

Level	Task	Output	Methodology
1	Selection of a subject for development of a cross border cooperation plan	Priority ranking of subjects	Expert elicitation
2	Definition of objectives for ambition level	Ambition level chart	Expert elicitation, scenario bundle method
3	Specification of the initial crisis situation	Determination of surrounding conditions	Scenario bundle method
4	Set up of scenario plan for minimum ambition	Initial cooperation scenario	Scenario bundle method
5	Representation of limiting factors/ benefits	Information fact sheets	Closed loop model, process reference model
6	Validation and implementation	Instructions for scenario based validation in exercise and training activities	Simulation methodology

5.2.1 Ambition level approach

In cross border cooperation planning it is of vital importance to pay attention to the ambition that all actors concerned do bring along. According to this research approach different groups of actors are in the position of having their own view on the need of cooperation (see Table 5.2). In earlier research it has been illustrated that veterinary authorities, private actors and political administration can easily come to different assessments [Breuer et al., 2008].

Table 5.2: Categorization of stakeholders and interests in cross border cooperation

Nation	Category of actors	Stakeholder	Main interest (+)/ reservations (-) in cross border cooperation
Germany (NRW)	Veterinary authority	BMELV	+ support for national CM issues
		MKULNV	+ support for regional CM issues
		LANUV	+ support for local CM issues
		KOB	+ support for local CM issues
	Private stakeholders	Livestock	+ more flexibility in crisis + reduction of costs and losses
		Services	+ cross border contacts in crisis - more competition
	Consumers		+ freedom of consumer movement
Netherlands	Veterinary authority	EL&I	+ support for national CM issues
		VWA	+ support for regional/ local CM issues
	Private stakeholders	Livestock	+ more flexibility in crisis + reduction of costs and losses
		Services	+ cross border contacts in crisis - more competition
	Consumers		+ freedom of consumer movement

That means that one has to be aware of the fact that even if local crisis management authorities do agree about maximum cooperation political arguments of higher authorities can stand in the way. Therefore in a first step of this cross border crisis management concept the relevant experts need to identify not only their own ambition for cooperation but also economical or political constraints to a certain subject. This leads to a rising chart of ambitions that can be sorted from a minimum to a maximum ambition level. The intention then is to illustrate the common minimum ambition level that finally can be worked out to a cooperation scenario. This procedure guarantees that all actors concerned do agree about the chosen level of cooperation and will very likely work together on a successful implementation.

The ambition level approach is divided into two phases: On the one hand, every single cross border solution approach is worked out to a base-line cooperation scenario plan. Based on this cooperation scenario the requirements for cross border cooperation become clear and it is possible to evaluate this plan within simulation activities. The nature of these limitations can be lawfully, organizational or technical. Hence it will become clear e.g. where certain data is missing in order to be able to take critical decisions. Finally every actor concerned can experience if there is a benefit for his work and how important the availability of data could be for CSF-control. On the other, every single cross border solution approach can be enhanced with innumerous layers that contain more cooperation on this subject. These so called ambition levels illustrate a stepwise integration of cooperation until a maximum cooperation level is accomplished. This procedure is of vital importance for the political motivation of cross border cooperation. The experts of both countries can decide to start with the best possible common ambition. If they succeeded in implementing the first cooperation level they can immediately approach the next step of cooperation on this subject. This procedure can be regarded as a continuous cooperation strategy until the maximum level has been accomplished.

5.2.2 Qualitative scenario methodology

After a common ambition level has been identified a scenario plan can be constructed. The way a scenario can be written is richly described in crisis management literature [Harrald et al., 1993: Kleiboer, 1997; Alexander, 2000; Boin et al., 2004; Ranganathan, 2007]. A scenario is defined as the description of a complex situation in the future that cannot be foreseen with great accuracy. It is simply the illustration of a likely development from a certain point of view. For animal disease control this might be true for the practical experiences with crisis scenarios. In general terms the events of a CSF outbreak are more or less foreseeable due to the knowledge about the nature of the pathogen and the spread of the disease. But the quantification of the impact parameters is rather uncertain.

In this sense, scenarios are forms of imagined reality, in that they provide participants with an opportunity to enact possible states and future developments of a particular social system [Kleiboer, 1997]. By scenario methodology it is possible to construct plausible, consistent and logical scenarios even if the underlying information is of a high complexity. Based on scenarios one can extract the chances, challenges and dangers that have to be addressed by crisis management measurement.

According to KLEIBOER [1997] scenarios are generally made of three different elements:

1. a description of the status quo in a particular sector of a society or organization;
2. a description of a number of plausible and/ or (un)desirable future states of the system;
3. a description of the factors and interaction sequences that may be involved in moving from the current to the future state or in preventing such a development from occurring.

In order to give an example on how the development of a scenario plan for an ambition level will be worked out, Table 5.2 will provide valuable insight.

Table 5.3: Instructions for the construction of a cross border cooperation scenario

1	Definition of a starting event, e.g. CSF outbreak in pig holding confirmed
2	Responsible actors in CM staff have to take decisions along the national contingency plan, e.g. about restriction areas
3	Cross border cooperation task is illustrated as an alternative option to the national contingency plan
4	Taking the cross border option can include certain conditions that have to be fulfilled
5	After all tasks are completed the natural ending point of the scenario is accomplished, which is at the same time the starting point for the next ambition level scenario

One specific example for the qualitative construction of prospective scenarios has been developed by SELTEN [1999]. The so called scenario bundle method describes an instruction for scenario building based upon expert elicitation. “The scenario bundle method is a systematic way of submitting such questions to a panel of knowledgeable persons. Group discussions produce qualitative judgments which serve as a basis of model construction. Scenario bundles do not require the specifications of numerical parameters. Qualitative judgments are sufficient“ [SELTEN, 1999].

The scenario bundle method is a component of the classical games theory [SELTEN, 1999; REITER et al., 2003]. It is a systematic method to the collection of expert verdicts from which simple game theoretical models can be drawn. This method enables researchers to illustrate the different alternatives decision makers have in concrete crisis situations. The construction of scenarios is based upon expert information that contains answers to the following questions:

- Who are the relevant players?
- What are the motivating factors which determine the players´ preferences?
- What are strategic possibilities of the players?
- What are the consequences of various combinations of strategic choices?

Scenario bundles indicate possible future developments and generate prospective information. SELTEN [1999] compares the benefit of information coming from scenario bundles with decisions taking in a chess game: Predictive reliability cannot be promised. Human decision making in chess seems to be analogous to the construction and evaluation of scenario bundles. Generally, a chess player who tries to plan ahead cannot really predict the future course of a game. Nevertheless, he will approach his decision problem in a predictive spirit. It will be his aim to explore the likely consequences of a selection of plausible moves. Finally they will provide decision makers with the answers to the following questions:

- Which initial options are likely to be taken?
- Which initial options are not likely to be taken?
- What are the likely consequences of internal events?

Implementing the preliminary findings into scenario bundles is an optimal way to evaluate their possible benefit for CSF control in forms of concrete courses of action: According to the closed loop system one can state that the Scenario bundle method helps gathering predictive information in order to define prescriptive information [BREUER et al., 2008].

Bringing theory in to practice, any specific scenario bundle can be used as a game instruction for crisis simulation exercises. The scenario bundle method allows a concrete preparation of logical scenarios that easily can be used for training activities.

5.2.3 Information and communication methods from quality management

In addition to the ambition level concept and the scenario and simulation methodology aspects the crisis management concept is based on information and communication methodology. All information that is relevant for decision making processes is categorized according to the closed loop model [HARSH, 1981]. PETERSEN [1985] uses the closed loop model to describe the role of actors as controlling units in complex systems. In this study certain parts of the model have been adapted to the information process in crisis decision making. As already stated veterinarians, farmers as well as public crisis managers have to take their decisions fast and efficient. Every necessary decision process contains the production and edition of information. If decision makers or policy makers aim to regulate certain processes they need to have full information on time at their free disposal. Hence the following data assessment tools are irreplaceable for an efficient crisis management: substantial monitoring, regular outlines and systematic evaluation [PETERSEN, 1985]. Diagnostic information is particularly important as it enables decision makers to identify and analyse certain problems [BERG, 1985]. As soon as a problem is detected the actors concerned are in need of information about the causes of the disorder in order to draw necessary conclusions for optimal response measures. At this time he is depending on the different categories of information. Descriptive information means regulations, contingency plans or any kind of data coming from the husbandries. Predictive information is an answer to the question: What, if…? They contain prospective scenarios with results that can be illustrated in percentages. Finally prescriptive information is given to be the right course of action in decision making. It is directed towards answering the question: what should be done [HARSH, 1981]. In this case study the application of the closed loop model will be illustrated in a core example for one critical decision point.

In this study the categorization of information will be used in the assessment of benefits and limiting factors that are described in so called fact sheets for every decision in scenario planning in phase 5.

5.2.4 How to define and develop simulations

A simulation is an instrumentalization of specific scenarios in order to rebuild reality. Compared to scenarios a simulation is mostly dynamic. One basically knows three different forms of simulations: all-computer simulations (e.g. flight simulators), computer/ human models (e.g. SimCity software) and human models. Starting from a baseline scenario t=0 simulations confront participants with a series of interrelated sequences. They refer to developments and problems that require decisions and actions on their part at times (t=1, t=2, t=n) [KLEIBOER, 1997]. Sometimes, the defined border between scenarios and simulation in literature is slightly blurred. Most researchers are talking about simulation methodology when it comes to the practical effects of scenarios for example in training activities. According to ALEXANDER [2000] scenarios are widely used in emergency management training. For him scenarios are a “low level form of simulation”. He adds that hypothetical scenarios can help bridge the gap between classroom instruction and practical training and can give students or expert personnel the opportunity to learn how to apply theoretical knowledge, which functions as a sort of road map amid the chaos of emergencies, to carefully chosen examples of practical problems [ALEXANDER, 2000].

The usage of simulation methodology in crisis management has different reasons. First of all simulations are interesting from a research point of view. A second issue is the field of teaching and training instruments where simulation methods take in a large part. One of the first establishments in this purpose is the RAND cooperation where policy trainings in different themes are organized since the early 1946s [KLEIBOER, 1997]. Another issue where simulation methods are used in is the development and evaluation of crisis management measures. According to KLEIBOER there are different aspects that have to be taken care of in crisis simulation procedure:

1. Reveal weakness in existing plans;
2. Reveal gaps in resource planning;
3. Improve coordination among operational elements;
4. Achieve higher levels of individual performance;
5. Gain public recognition of an emergency operational capability and raise faith in system;
6. Assure the effective implementation.

Furthermore, simulations can help designing decision support systems that generate and evaluate a range of options on a computer basis. Finally, simulations are widely used in assessment centres.

In this study simulation methodology is used in phase 6, where the predefinition is made for scenario evaluation in future simulation activities.

5.3 Cross border crisis management concept: A case study in CSF-control

The single phases of the crisis management concept explained above will be tested in CSF-control systems of the Netherlands and North Rhine-Westphalia. After some minor pre-tests in different areas of the agri-business [Nachtigal, 2007; Glasner, 2006] where first of all the expert elicitation strategies have been evaluated, the whole concept has been introduced into two large cross border research projects [INTERREG IIIA project "Managing risks", 2006-2008; INTERREG IVA project "SafeGuard", 2008-2013]. More experimental research activities in different case studies have already got under way, e.g. the adoption of the concept to threats in beef and milk production.

In the first research called Managing risks the agricultural ministries of the Netherlands and of North Rhine-Westphalia decided to spend money on the evaluation of risks that can appear as a consequence of livestock disease outbreaks in the cross border area. Therefore all relevant public and private actors have been invited by the authors to share their knowledge in several workshops and expert surveys in order to illustrate the nature and the amount of differences between the national veterinary systems that are concerned with the control of livestock diseases. In close cooperation researchers from the universities in Wageningen and in Bonn developed the cross border crisis management concept in order to be able to evaluate the findings due to possible cross border strategies. At the end of this project the partner organizations were provided with concrete overviews about the veterinary systems of both countries and about the need of cooperation between certain parts of veterinary authority [Breuer, O. and B. Petersen, 2008].

The next research initiative called SafeGuard has been supported by the ministries of the Netherlands, North Rhine-Westphalia and Lower Saxony in order to present specific cooperation plans for the cross border challenges that have been identified earlier. Again all relevant stakeholders were part of the project. Having these ideal conditions at hand a qualitative research approach was easy to administer. In this study one of the starting scenario plans (restriction areas) will be presented as an example for the procedure. More scenarios are recently running in the project and will be published after a cross border training exercise in 2014 [http://safeguard.giqs.org].

5.3.1 Selection of subject for cross border cooperation plan

By expert elicitation methods a ranking of cross border cooperation priorities has been illustrated [Breuer et al., 2008]. In the run-up to this illustration the political debate in Germany and in the Netherlands about in relevant aspects of animal disease control measures gave reason for veterinary authorities to chose the subject "Restriction areas and compartment building" as an interesting case study to exemplify the benefits of the cross border concept. In the expert survey in 2008 this subject landed on second place; just behind the topic "preventive vaccination" which was also a huge debate shortly after the 2006 CSF crisis in Germany. Concerning the Cross Border Crisis Management concept it is of course not mandatory to select a subject by expert elicitation.

In this study this has been the most appropriate way to receive representative results on a scientific basis. After implementation of the concept many different ways of selecting a subject are suitable, e.g. expert workshops or CVO decisions, as long as the relevant stakeholders agree with the chosen subject.

Under the subject "restriction areas and compartment building" all veterinary measures are gathered that are at hand when it comes to the separation and definition of geographical units due to animal disease outbreaks. Every national CSF-contingency plan contains prescriptions about restriction zones. In case of CSF-outbreaks in the EU, one needs to resort to the slaughtering of all pigs in the infected farms and the destruction of cadavers. A protection zone (3 km radius) and surveillance zone (10 km radius) are established around each outbreak, with restrictions on pig movements. Some countries – e.g. the Netherlands and North Rhine Westphalia – have organized the separation of their premises into regional compartments in order to reduce the effects of trade bans by making trade possible within compartments. The question is now, how certain cross border specifications can be made in order to gain advantages for crisis management on both sides of the border?

5.3.2 Definition of objectives for ambition level

Having selected an ambition level category for the case study the next step is to define the minimal ambition level and to give a general impression how the following ambition levels could possibly develop. In a base-line ambition the common interest of both veterinary authorities in cross border cooperation is described. Having a base-line ambition includes the possibility that one country would be interested in more cooperation, meaning a higher ambition level. Therefore, it is an option in this concept to define more levels of ambition up to a maximum ambition level, even if their implementation is not yet the objective of both countries. The maximum ambition level stands for a limit of cooperation. In this case study for example beyond a common cross border administration of compartments no more cooperation is conceivable. All ambition levels in between are completely flexible in number and in objective. This depends completely from the discourse of the relevant stakeholders. In Figure 5.1 one can see how ambition levels can be illustrated in a short overview. Here, the base-line ambition is already filled in. After the implementation of the base-line level the next step would be the regulation of cross border corridors for slaughtering pigs.

↑	*Max. ambition level*	Common cross border administration of compartments
	Level x	...
	Level 4	to be filled after completing level 3
	Level 3	to be filled after completing level 2
	Level 2	to be filled after competing level 1
	Level 1	Cross border corridors for slaughtering pigs
	Min. ambition level	Gathering information about cross border contact structures in animal trade

Figure 5.1: Ambition level category 2: restriction areas + compartment building

Generally it can be summed up, that every single ambition level is targeted on a specific cross border cooperation benefit. The base-line ambition level in this case study is focused on the disposability of an overview that contains information about the cross border contact structures. The benefit for veterinary authorities would be that they can build up restriction zones and compartments with the knowledge about the contact structure of certain animal husbandries. Like a doctor who can consult the x-ray results before going into surgery the measures of veterinary authorities become more accurate. There are several advantages to this ambition level procedure: even if the actual ambition for cooperation is comparatively low, the stakeholders can think forward to what would be possible on this subject? This is especially important if one country is already interested in more cooperation than the other. When the ambition for more cooperation arises, the experts already can provide a scenario based plan for implementation.

5.3.3 Specification of an initial situation

Without an initial situation a crisis management process cannot be started. According to SELTEN [1999] the application of the scenario bundle method starts from the situation in a specific geographical area at a specific point of time. He refers to this situation as the initial situation. In this case study the set-up can be drawn very simply: After the outbreak of CSF has been confirmed in a NRW livestock holding close to the Dutch border the crisis management staff needs to take a decision about the establishment of restriction areas and the regulations in the compartments. Hence the first decision to be made lies in the hands of the crisis staff hosted at the ministry in Düsseldorf (MKULNV). The other stakeholders concerned in this scenario are the local veterinary authority and the ministries in Berlin and Den Haag. This is according to scenario planning methodology the first step in predefinition activities of a scenario bundle. The cross border decision options of the base-line scenario are illustrated in a game tree. For every decision point one figure is provided. In this example the relevant stakeholder always chooses the cross border option until the end of the scenario is achieved. In Figure 5.2 the initial situation is illustrated.

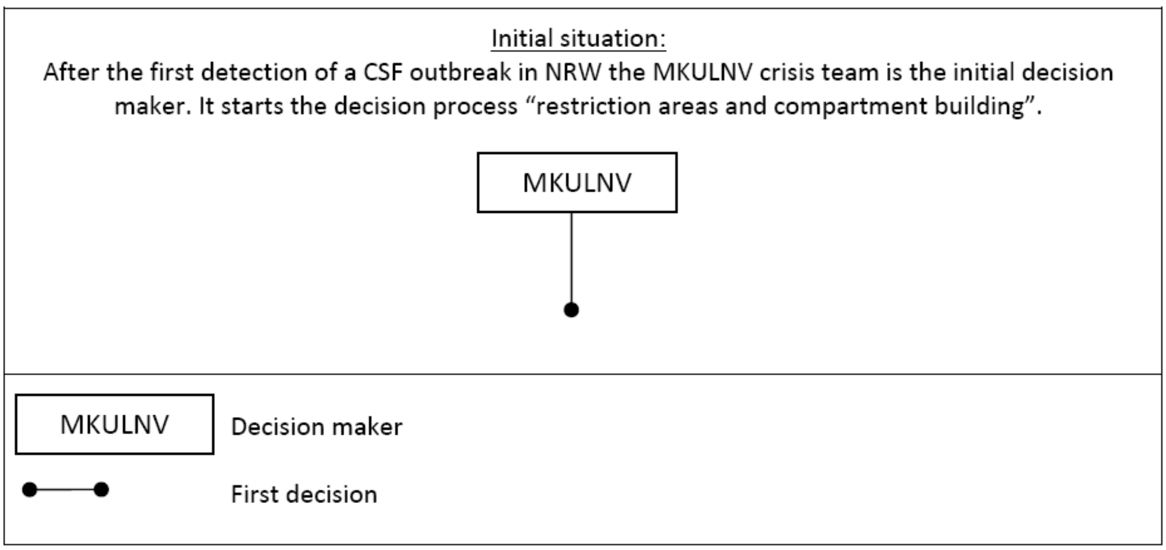

Figure 5.2: Ambition level compartment and restriction areas: initial situation

5.3.4 Set up of scenario plan for minimum ambition

Every scenario bundle or scenario plan is about decision options. The word option is used for actions which may or may not be taken by an actor in a scenario. Initial options are options which are open in the initial situation before anything else has happened [SELTEN, 1999]. In the construction of scenarios one has to concentrate attention on possible actions with strong impact on the crisis management system. The analysis should not be burdened by the inclusion of relatively unimportant management moves. Therefore a professional team of trainers should coordinate all steps in the crisis management concept.

The initial option of each actor is suggested by his goals and fears. In animal disease control the goal of each actor is clearly defined by contingency plans. Therefore the initial option is always the choice between the tasks defined in the national contingency plan and – if present – the cross border option. If the relevant stakeholder decides to use the cross border option, the scenario illustrates what further steps are to be taken that are not part of the national contingency plan. If the decision would be to prefer the national contingency plan, it is clear what to do but it can still come to cross border interferences. So for each ambition level scenario bundle there are in fact two different directions of development: a national one and a cross border one. In this study only the cross border options are being followed.

The graphical representation by a game tree is a natural way to describe a scenario. Every game tree has a starting point. The origin of a tree corresponds into the initial situation. For scenarios generated by initial options the origin is a decision point of an individual actor or a coalition. A game tree, also called the extensive form, is a graphical representation of a sequential game. It provides information about players, payoffs, strategies, and the order of moves. The game tree consists of nodes or vertices, which are points at which players can take actions, connected by edges, which represent the actions that may be taken at that node. An initial node represents the first decision to be made. Every set of edges from the first node through the tree eventually arrives at a terminal node, representing an end to the game. Each terminal node is labeled with the payoffs earned by each player if the game ends at that node [SHOR, 2010].

After the outbreak of CSF in a NRW holding has been confirmed, there is 72 hours time for the crisis management team to sort out the general control strategy that is appropriate. Thereby different tasks are to be taken care of at the same time e.g. the description of the regulations in protection zones, surveillance zones and compartments. As already stated, the crisis managers are legally bound to establish restriction zones after the confirmation of an outbreak [GERDES, 2010]. Therefore in this scenario it is first of all not the question whether to take decisions about the establishment of restriction zones or not, but whether to use certain information or not in order to come to specific decisions about the nature of the restriction zones. Hence the initial option is to decide if national data is the basis for the establishment of restriction zones or if cross border data – meaning all relevant contact structure information for the animal husbandry that is infected – can be used.

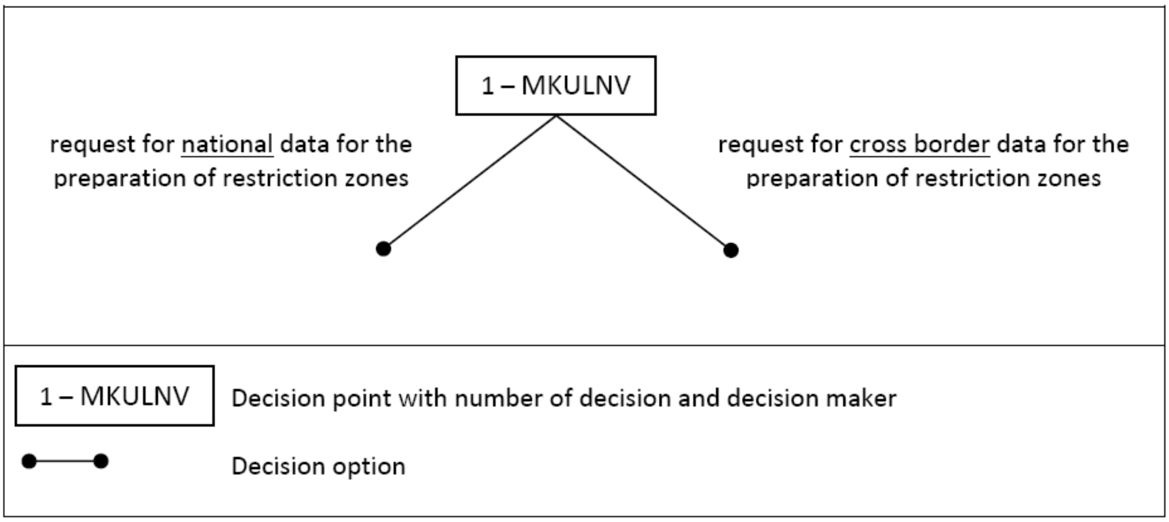

Figure 5.3: Ambition level compartment and restriction areas: decision point 1

In order to continue the construction of a scenario bundle the following question has to be asked: suppose that the cross border option has been taken; is there an actor under immediate pressure to make a connecting decision? And if yes, what are the options in decision point 2? In this pilot scenario the Dutch ministry has to decide whether to provide data and information from Dutch premises to their German colleagues or not. In Figure 5.4 it becomes clear that in decision point 2 the Dutch Ministerie van Economische Zaken, Landbouw en Innovatie (EL&I) decides to share data for the preparation of restriction zones. The motivation for this decision can be very simple, e.g. the reduction of crisis induced impacts on both sides of the border, but the implementation of it can be very difficult and time-consuming. Hence, even if cross border data sharing could be possible during a crisis without pre-crisis preparations, it definitely will proceed faster when there are clear regulations at hand.

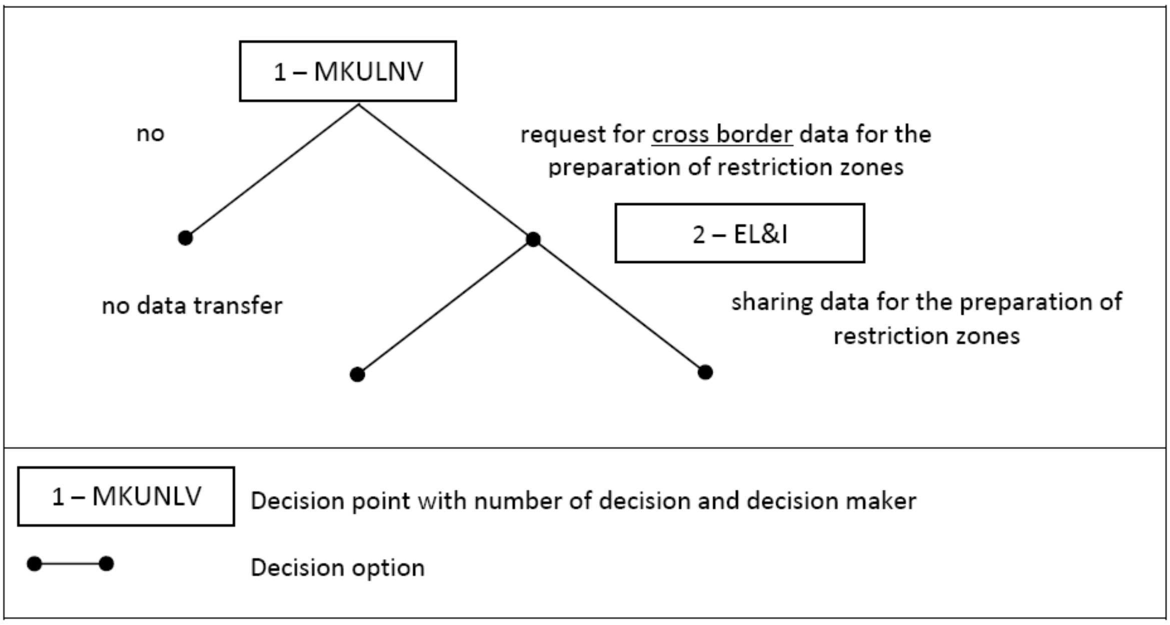

Figure 5.4: Ambition level compartment and restriction areas: decision point 2

The construction of a scenario bundle cannot be continued indefinitely. An ending point is a node beyond which the construction of a scenario bundle is not continued. Different stopping principles correspond to different types of ending points. According to SELTEN [1999] the construction of a scenario bundle is continued until a further continuation would have to go beyond a blind alley end point, an inferiority end point or a normal end point. In animal disease control the general ending point is defined to be a normal one: The scenario ends when the crisis is officially over. For all sub- scenarios the ending point is achieved as soon as the target of an ambition has been approached. In Figure 5.5 decision point 3 is at the same time the ending point of this sub-scenario. After having received the Dutch information about contact structures relevant for the actual outbreak the authorities in NRW come to a final decision about the settings of restriction zones and the regulations in the compartments. In a real crisis this process can be much more detailed: several exchanges about the request for and the release of data can be possible before the restriction zones are established. For this exemplified illustration it has been more important to show the general constitution of an ambition based cross border scenario in a game tree, than to fill the study with loads of possible decision points.

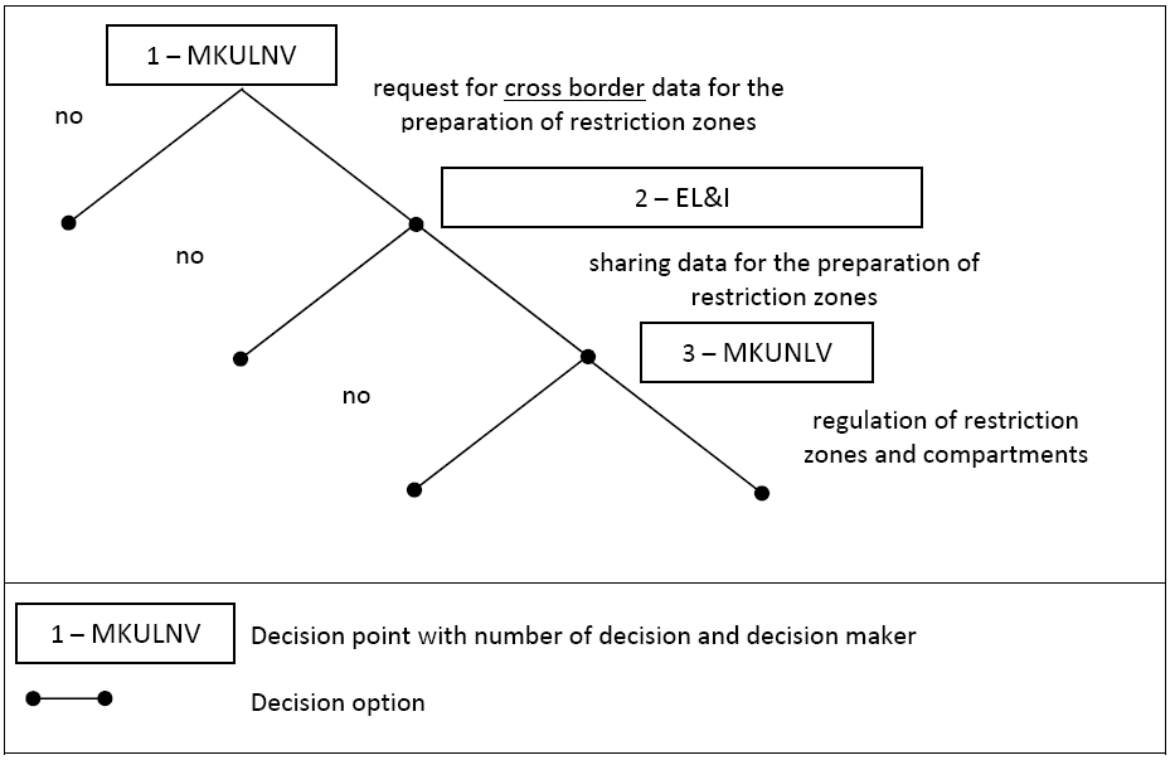

Figure 5.5: Ambition level compartment and restriction areas: decision point 3

5.3.5 Representation of limiting factors and benefits

After having illustrated a possible sequence of decision points in a game tree the next task of the concept is to represent the benefits that can be achieved by every decision for each stakeholder and at the same time to describe the limiting factors that can prevent a decision from being taken at every single decision point. At this level of the concept it is of vital importance not only to describe relevant information about benefits and limiting factors but also to clarify what type of information is at hand and to what actor it has to be available, in order to simplify the supply of information.

As already explained the representation of benefits and limiting factors is an important issue when it comes to the feasibility of implementation. The stakeholders concerned with crisis management tasks need to know precisely about both the advantages and the obstacles that are paired with the cross border cooperation measures they would like to use. Therefore for every single decision point the actors receive a specific fact sheet. Hence, the question arises how these fact sheets can be filled with relevant information? Here it is first of all very important to define the quality of information that can be used to emphasize the benefit and the limitations of cross border cooperation. In order to come to a characterization of information we first of all need to build up different groups of information. Arguments for a benefit and for a limiting factor do logically correspond to the potential fields of impact by an animal disease outbreak. Hence information should be gathered under the following headings: political, economic, epidemiologic, social-ethical, environmental [LONGWORTH and SAATKAMP, 2007]. Asking then how relevant information can be gathered the answer is quite clear: depending on what group of information is in the focus the adequate method can be of a qualitative or quantitative nature.

In Table 5.4 the quantitative and qualitative methods that are adequate for the elicitation of information about benefits and limitations are described in an overview.

Table 5.4: Methods and stakeholders for the elicitation of fact sheet information in scenarios of CSF control case study

	Political information	Economic Information	Epidemiological information	Social-ethical information	Environmental information
Methods	expert elicitation, literature	quantitative simulation; expert elicitation, literature	quantitative simulation; expert elicitation, literature	expert elicitation, literature	expert elicitation, literature
Actors NL	EL&I	EL&I, PVE	EL&I, VWA	EL&I	EL&I
Actors GE	BMELV, MKULNV	DBV, WLV, RLV	BMELV, MKULNV, FLI	BMELV, MKULNV	BMELV, MKULNV

In every single step the construction of a crisis management scenario is a team thinking task. The stakeholders that are involved are indispensable when it comes to the assessment of benefits and limitations. Every actor that takes a decision needs to be aware of the benefits and limitations that are connected to it. Therefore, in scenario planning procedure the crisis management stakeholders is directly involved in the assessment of benefits and limitations. In some issues other sources of information can be addressed: e.g. the results of quantitative simulation studies or other research results like evaluations of crises of the past (see Table 5.4).

The motivation of taking a certain decision in crisis management is to achieve a maximum effect in a minimum time frame. Therefore crisis management decisions need to be prepared carefully. This concept is written to give an instruction for the preparation of cross border decision options.

The first thing a crisis manager needs to know is what benefit he can achieve by taking a decision. In this concept the advantages that arise from a cross border decision are described in a brief annotation mark on the fact sheet. The first decision of this case study example the ministry of North Rhine Westphalia has to make is whether they gather only national information about relevant issues to the building of compartments and restriction zones or if they have use for cross border information. In a crisis this decision has to be made very fast. It is therefore very unlikely that a crisis management team takes a decision that is not well prepared and transparent in risk and advantages. Hence, as long as cross border decisions are not part of the crisis management plan they are not a real option.

In a training exercise the situation is different. The crisis management team members can take their time to investigate: what if we decide to take the cross border option? For every cross border decision point the team can define the benefits of a decision, the limiting factors to the decision, the tasks that are necessary to remove the limiting factors and finally the information transfer that needs to be established from now on. Having cleared these issues the fact sheets can be used as a checklist for the implementation of this cross border option.

Table 5.5: Fact sheet for ambition level compartment and restriction areas

Decision Point	Decision maker	Benefits of cross border decision	Limiting factors of acting in cross border consensus	Missing activities	Category of information relevant for decision making
1	MKULNV	No direct benefit yet; but expecting benefit through cooperation	Lack of access to relevant stakeholders;	Establishing communication channels for debate on data and information exchange	diagnostic information
2	EL&I	EL&I can receive data from NRW in exchange to optimize prevention; private sector can count on a faster ending of trade bans in NRW	Data privacy problems; technical boundaries between data bases	Finding agreements and interfaces about the exchange of data	descriptive information
3	MKULNV	More specific information about contact structure in cross border region facilitates crisis management	European veterinary regulation, national veterinary regulation	Making a request for the adjustment of European and national regulation	prescriptive information

Legend: MKULNV – Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes Nordrhein-Westfalen; NRW – Nordrhein-Westfalen; EL&I - Ministerie van Economische Zaken, Landbouw en Innovatie (Nederland)

The fact sheet that is provided in Table 5.5 contains information about the decision maker, the benefits and limitations to a single decision, the missing activities for implementation and the category of information that is relevant for this decision point for the sub-scenario of this study.

While there already can be direct benefits to a single decision (or not), the focus lies on the benefit that is provided by the final decision which makes the main target of this scenario come true. What is even more important in this fact sheet is the overview on limiting factors and missing activities: This can be used as a check lists for the relevant stakeholders while preparing the implementation of this ambition level. For example, decision point 2 is about sharing information between the Dutch and the NRW ministry. Even if the political commitment has been given, there can be technical boundaries or data privacy regulations that make the transfer impossible, until the missing activities have been accomplished.

Finally, according to the closed loop model information can be described due to its intention within a closed loop of actors concerned [PETERSEN, 1984]. In Table 5.5 for every decision point the category of information is described. This is necessary in order to regulate the information processes between the crisis management actors. Thus, in decision point 1 diagnostic information is given from the MKULNV to the EL&I. The MKULNV informs the actors about the initial situation and asks for descriptive information in return.

5.3.6 Instructions for scenario use in simulation activities

In the last sequence of this Cross Border Crisis Management concept all scenario-based ambition levels can be used as an instruction for simulation trainings with crisis management staff. As already stated it is highly necessary that a team of experienced moderators is in control of the training activities that have to be organized based on the scenarios. The experience of professional crisis management bureaus shows that the optimal procedure of preparing simulation activities contains that in a first step together with the relevant experts in charge the scenarios are constructed based on the findings deriving from the concept. In a second step the training activities are performed with the crisis management teams of the experts that have prepared the scenarios before. This procedure guarantees that the scenarios are plausible and that the experts in charge can support the crisis management bureau in evaluating the performance of their own teams.

These training activities are obligatory regulations of the European Union directives on national animal disease control systems. Therefore the expense of cross border trainings that every nation would have to take is low. A cross border scenario simulation can easily be adjusted to the regular training activities. The veterinary administrations of the Netherlands, Belgium and Luxemburg are meeting regularly for so called BeNeLux table top exercises in animal disease control. The intention of these trainings is described in three main issues: the organizations will get the opportunity to get to know each other, their veterinary systems and possible points of interest for cross border cooperation [MinLNV, 2010]. The last simulation exercise has been officially visited by the North Rhine Westphalian ministry.

Compared to this Cross Border Crisis Management concept the simulation procedure of the BeNeLux table top exercise comes quite close. Using scenario planning methods to prepare the real time simulation exercises fits exactly with the instructions of this concept. The difference is indeed that the BeNeLux training concept misses the preparation of ambition level and the definition of fact sheet information about benefits and limiting factors. One could say that it aims for cross border operation rather than for cross border strategies.

5.4 Discussion

In this study it has been showed that a Cross Border Crisis Management concept can be described in sequences and illustrated in a single case study focused on the establishment of compartments and restriction areas in CSF-control. Having successfully constructed this single cooperation scenario with all actors in charge the ministries are holding in hand a protocol for the implementation of a specific cross border solution. This example shows that this qualitative approach can be useful for the design of practical approaches for cross border cooperation in CSF-control. Every single scenario that arises from this concept can be implemented in the national contingency plans as an instruction for cross border cooperation in times of crisis.

What this crisis management concept underlines is not only the benefits of cross border cooperation but also the variety of limiting factors that are standing in the way of a successful implementation. This is an important issue for the implementation of cross border cooperation options: even if the actors in charge are motivated to use cross border cooperation measures they need to know what obstacles have to be removed first. Therefore ambition levels and fact sheets are a useful support in cross border scenario planning procedure.

The results of this study illustrate that the nature of these limiting factors is clearly of a different kind. Most important is the effect of limitations that come from two different sources: economic side effects of veterinary control measures and data transfer problems due to privacy regulations. The fact that a majority of limitations to cross border veterinary measures are more or less economically motivated puts the question up for debate how an economic management of animal diseases could look like? What role can private actors take in and how can veterinary authorities calculate the economic side effects while reducing the epidemiological threats of animal disease outbreaks? Pioneer research activities on the field of economic management of animal diseases are underway at the Wageningen University [personal correspondence to SAATKAMP, 2010].

The limiting factors motivated by data transfer problems will be a core task of future research activities at the University of Bonn. One important aspect is the lack of information about the availability and the quality of data settled in various data bases in the cross border area. The question will be how relevant data can be made available for decision makers on time and in the right form without giving reason for debate on privacy issues [SLÜTTER et al., 2010].

Another issue that is important for the completion of this crisis management concept is the challenge of emerging infectious diseases. Compared to classical animal diseases like CSF or Food and Mouth Disease (FMD) the crisis preparedness is significantly lower as there is a higher level of uncertainty when it comes to emerging diseases. An assessment of important factors in prevention and control of emerging infectious diseases is recently developed at the University of Bonn [personal correspondence to WILKE, 2010].

Concerning the crisis management concept that has been presented in this paper the next step will be the evaluation of the concept in a pilot experiment: Together with the Dutch and German veterinarians in charge it has been decided that the complete cross border crisis management concept will be tested in a Dutch German table top exercise in 2012.

5.5 Conclusions and implications

Based on the findings of this research the general conclusion is that a cross border crisis management concept contributes to the preparation of cross border measures in animal disease control. The combination of different theoretical elements provides public decision makers with a concept for structured cross border cooperation planning. It has been shown that preparing cross border cooperation is a complex task that contains several organizational and technical hurdles. This concept gives insight in the ambition of stakeholders, the nature of relevant decision processes and determines all steps to take in order to reach the finishing line.

A core challenge for the implementation of this concept is the availability of decision relevant data and information. Another crucial aspect is the ambition of experts to contribute to this concept. Without their input this procedure will not be working. Therefore, the establishment of a liaison office would be necessary to coordinate the cross border cooperation activities by means of this concept. This office could be the interface between the Dutch and the German authorities and could guarantee for a regular time schedule and independent analysis.

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6 General discussion

6.1 Introduction

Meat is a product of rising popularity and growing variety on a worldwide scale. It is produced and transported under a wide spectrum of risks ranging from balefulness over parasite infestation to the infection of high pathogenic livestock diseases. To prevent critical impacts on meat production chains and to reduce their effects when they have occurred are core challenges to public and private crisis management organization [DEPNER et al., 2005; SCHULZE ALTHOFF et al., 2006; HUIRNE and SAATKAMP, 2007]. In this thesis it has mainly been dealt with the veterinary crisis management systems in the Netherlands and Germany being responsible for the prevention and control of livestock pathogens.

The main objective of this research was to find out if cross border cooperation in animal disease control can help improving the quality of public crisis management organization. Therefore insight has been gained into the effects of cross border cooperation measures between the Dutch and the German authorities in CSF control. Based on the results of this research a cross border cooperation concept has been developed. This concept can support the preparation and evaluation of specific cross border cooperation measures before bringing them into praxis.

The core activity of this thesis has been to design and to discuss a cross border cooperation concept that can be used by public authorities to prepare measures of control for veterinary crisis management. The requirements of developing a concept can be summarized by the main objectives in each chapter of the thesis:

To begin with, in chapter 2 a short preview on the management concept is illustrated and the results of cross border expert elicitation are presented. The survey results do form the basis for further specification of cross border cooperation measures for veterinary authorities. In chapter 3 the question is answered whether cross border cooperation has a significant impact on the quality of animal disease management in a border area. Chapter 4 provides insight in the nature of limiting factors to the establishment of certain cross border cooperation measures, while chapter 5 contains a description of the full concept for cross border cooperation escorted by concrete recommendations for veterinary authorities about a possible establishment of the concept.

This General Discussion is focused on the research design (6.2), a summary of all findings per chapter (6.3), the full presentation and discussion of the cross border crisis management concept (6.4) and, finally, on the main conclusions (6.5) of this thesis. It also gives an overview on practical implications (6.6) and suggestions on further research on cross border cooperation in animal disease control.

6.2 Research design and objectives

The initial step of any research is to define the objectives and the system of interest. While the main objective has already mentioned in the introduction to this General Discussion, the system that stands in the spotlight of this thesis needs to be specified in a few more sentences. As mentioned before, veterinary crisis management authorities in the Netherlands and in Germany are the addressees of the results of this research. In this study by veterinary crisis management all stakeholders and guidelines are meant that contribute to the control of animal disease outbreaks on their national premises. Both systems have been studied and compared to each other in order to find the existing and the still missing interfaces. In the end, the identified crisis management authorities are provided with a concept that can establish cooperation without synchronization of the systems. In the following sections the side objectives that are the basis for each chapter are presented in detail. To gain insight into the effects of different crisis management strategies two different basic approaches are available: performing empirical studies and computer modelling [T´HART, P., 1997; BOIN et al., 2004]. In this study elements of both approaches have been combined to a research design. Each research design has its own benefits and limitations. Certainly, the benefit of empirical studies is that some actual influences are included in the experiment and that it provides data from real life. Core limitations to such an approach are the fact that they are time-consuming, retrospective and only exemplifying on specific case studies [BANKS, 1998].

Chapter 2: Priority setting

In this section the identification of relevant actors and their responsibilities within the veterinary systems were indicated. Therefore, interviewing relevant stakeholders and the distribution of a survey was the appropriate way to study the veterinary systems in Germany and the Netherlands. The data collection has been convoyed by literature study. Thus, in a first step the veterinary systems of the Netherlands and Germany had to be described and compared to each other in order to find differences and uniformities. Based on the results from expert elicitation activities it was important to analyze, how the identified stakeholders think about the effects of cross border cooperation in CSF control as an additional option to national crisis management measures. A second aim in this section was the ranking of expert priorities for cross border crisis management solutions: the question arises, where the identified experts would emphasis to set up specific cross border solutions for CSF-control measures in order to overcome differences or intensify measures that already correspond?

Chapter 3: Prosperity check

After the priorities for cross border cooperation had been identified, the question was raised how the different effects of cross border measures compared to purely national crisis management settings could be framed. Therefore, in *chapter 3* the prosperity of cross border cooperation measures has been analysed compared to basic control strategies. In order to illustrate the different effects, simulation models were introduced in this study. The advantage of simulation models is that they can be stochastic which means that uncertainty is included [MANGEN, 2002]. As knowledge about the interaction and relations between the different effects of animal disease control measures was limited, two separate models were used. One that addresses epidemiological aspects and one for the economic aspects of CSF control. To what extent can cross border cooperation reduce negative impacts on local economies and at the same time are certain measures strong enough to enhance the epidemiological power without raising the cost level above a degree of effectiveness? *Chapter 3* contains an estimation of impact of the qualitative results in *chapter 2*.

Chapter 4: Practical boundaries

This section is focused on the relevance of practical limitations to the implementation of cross border cooperation measures. Even if the needs for and prospects of cooperation can be sufficiently demonstrated, the obstacles to an implementation can be large. Thus, the question is how limitations can be foreseen in cross border crisis management preparation activities? Therefore, as one core example for practical boundaries, in *chapter 4* it is analyzed and described how to deal with information and communication restrictions in cross border crisis management. In this chapter a concept has been provided that shows how to deal with this limiting factor in order to make cross border solutions convertible for national contingency plans.

Chapter 5: Cross border concept

Based on the main findings of the previous chapters, the cross border crisis management concept is finally developed and presented in this chapter. The concept gives a possible approach to the question, how cross border cooperation in crisis management can be thoroughly prepared and bindingly implemented into national contingency plans. The construction of the cross border crisis management concept is built upon two central methodological elements:

1. Qualitative scenario and simulation methodology,
2. Information and communication methodology

The set up of scenario based cooperation plans that derive from this study is ready made for training activities or direct implementation in national contingency plans [ALEXANDER, 2000].

In the following section the results that have been obtained in every single chapter of this study are presented in a summary (6.3). Based on these building stones the components of the cross border crisis management concept are formally described in section 6.4.

6.3 Summary

This summary is focused on the main findings that have been received from each chapter of this study. In this section not only the outcomes are illustrated but also a critical assessment of the own results is given in order to make clear, whether the expectations before starting this study diverge from final findings or not.

Chapter 2: Priority setting

This chapter contains the results of preliminary expert elicitation activities as well as the first approach for cross border crisis management concept construction. In a first step the identification of stakeholders and their responsibilities in animal disease control have been executed. The identification of stakeholders led to a code chart containing all public players and their crisis management tasks divided into four High Risk Periods (HRP). A second code chart was filled with an illustration on differences and analogies between the organisation of animal health control systems in the Netherlands and in Germany. The results confirmed the initial assumption that due to different governmental systems a range of differences were found on the level of administrative responsibility. In some points there were even clear differences in animal disease control strategy. Based on these results analogies and differences were illustrated in a second code chart in order to compare not only responsibilities and strategies but crisis decision making processes. Again, the nature of most differences is motivated in governmental systems. After evaluation of the findings from data collection an expert survey was prepared in order to validate the results from expert interviews and to bring a ranking into cross border cooperation plans that had been derived from the interviews. Looking at the outcomes, three out of the top five cross border cooperation categories (Restriction areas; Communication and information transfer; early warning) contain major organisational differences between the Netherlands and Germany. Finding the category communication and information transfer on fourth place underlines that the knowledge about each other is particularly scarce.

First concepts for both organisational and technical innovations in animal disease management are presented in this chapter. Using methods from game theory and quality management in order to structure the experiences that experts already have made about crisis management before predictive information are gathered from scenario bundles has turned out to be a solid approach in supporting critical decision making. Illustrating first experiences with scenario bundle construction by analysing further cooperation within the category information and communication transfer showed that gaining relevant information at the right moment is a crucial task for an efficient crisis management. As all top 5 minimum strategies underline, are Dutch and German experts sharing the opinion that starting cooperation means gathering more information about each other. This statement takes private and public actors into account.

Chapter 3: Prosperity check

In this section of the thesis the prosperity of cross border animal disease control is illustrated by means of quantitative simulation. The aim of this study was to compare the epidemiological and economic effects of recent strategies against livestock disease with cross border cooperation strategies. The main findings of this chapter give insight in the basic differences in CSF control in the Dutch German border area. The simulation model is used for four different control strategies. If vaccination is part of CSF control strategies, the damage to the market is always a crucial factor. Hence, a harmonization of CSF control strategies between the Netherlands and NRW does only make sense if it is accompanied by specific market strategies e.g. for the cross border distribution of vaccinated products. According to the simulation results both countries have to concentrate on reducing the market damage that is motivated in control measures like vaccination. An important aim for both countries will be the shortening of the High Risk Period (HRP) in order to reduce the overall costs and the risk of further spread. Another important factor could be the use of data in rendering plants for early warning.

Looking at the economic situation in the cross border area this paper shows that without agreements in marketing procedures for vaccinated and not vaccinated products no further harmonization of CSF-control strategies is adequate. Specific economic cross border cooperation measures, like early warning via rendering plants, can indeed be helpful when it comes to reducing the HRP, but the general approach has to be: veterinary authorities need to evaluate their epidemiological measures on behalf of economic information. Besides, it has to be taken into account that the advantage or disadvantage of cross border cooperation is always a question of perspective: In this simulation it became clear that it is difficult to find cooperation strategies that provide both countries with a comparable level of advantages. Therefore, it is even more important to consider market effects before starting with cross border cooperation strategies.

Chapter 4: Practical boundaries

The objective of this study was to contribute to a standardization of data and information transfer in cross border crisis management. The guidelines presented in this chapter are developed in order to improve the identification of data or information gaps while preparing cross border cooperation plans for crisis management. In a second step these gaps have to be repaired before cross border cooperation can possibly implemented into national animal disease regulation. The concept is built on different theoretical elements: It combines decision theory, information theory, quality management and innovation theory to an integrated approach that finally can be used by veterinary authorities as a tool for crisis management preparation. A central result is the definition of fact sheets for all stakeholders concerned in information transfer activities. These instructions refer to the tasks and benefits each actor has in order to make information transfer possible.

Finally, five general assumptions have been confirmed that give insight in the nature of common crisis management in cross border regions:

a) Crisis management is a dynamic process

b) Crisis management needs systemic innovation

c) System innovation is a non-linear learning process

d) System innovation requires a multi-stakeholder approach

e) Multi-stakeholder approaches imply trans-disciplinary knowledge creation

Chapter 5: Cross border concept

In this final study it has been illustrated on a scientific basis that a cross border crisis management concept can be relevant for the work of veterinary authorities and possible to introduce into their organizational procedures. As CONNOLLY (2007) points out, trans-national crisis management relates to the cross border nature of crises. He adds, that there is serious doubt that the mono-centric view of crisis decision making is capable of modern crises. The design of the concept has been described in several sequences and its capabilities have been illustrated in a first example that was focused on the establishment of compartments and restriction areas in cross border CSF control.

As a core result, the design of this crisis management concept makes clear how the benefits of cross border cooperation can be implemented and at the same time how to deal with a variety of limiting factors that are standing in the way of a successful implementation. Even if the stakeholders in charge are motivated to find agreements on cross border cooperation they do need to know what obstacles have to be removed first. Therefore, this concept provides them with scenario plans, ambition level tools and fact sheets that are useful tools of crisis management preparation and highly contributing to the cross border scenario planning procedure.

The results of the case study lead to several conclusions concerning the capacity of this concept:

- its capacity depends first of all on the participation of all relevant decision makers: only based on full expert judgements the decision plans developed by means of this concept can be worthy enough for practical implementation
- in future all cross border cooperation plans have to be tested in crisis management trainings or exercises before they are ready for implementation
- the concept should be managed by a third party, a cross border liaison office, in order to coordinate the cross border cooperation activities by means of this concept. This office could be the interface between the Dutch and the German authorities and could guarantee for a regular time schedule and independent analysis.

6.4 Cross border crisis management concept

In this section of the General discussion the cross border crisis management concept is formally described and discussed considering the effects it has on different issues. In a first step the components of the concept are illustrated including methods and outputs. Afterwards, the involvement of stakeholders and their specific roles and contributions to the capability of this concept is explained. This section continues with the characterization of strategies for knowledge transfer activities. It is a core issue that all stakeholders understand the importance of introducing the results of this concept into their regular crisis management training and exercise activities. In the following paragraph a differentiation of the concept and its capability is made. What could happen, if the concept is really implemented into Dutch and German contingency plans, what are the risk and benefits for the public and the private authorities and does this concept have any effects on EU regulation? Finally, as a sort of side effect to this research, the general experiences with Dutch German cooperation are outlined. After more than five years of cross border team work in research initiatives at least some significant differences have been observed that should be considered in future cooperation attempts.

Components of preparation

This concept has been built using methods from different academic disciplines. Beginning with the selection of a subject for cross border cooperation it is passing six phases until finally the instructions for introducing a decision scenario in training and exercising activities are ready.

Every single phase contains a package of methods and produces outputs that are relevant for making it to the next level of this concept. In table 6.1 a general survey is given containing the number of levels, tasks, outputs and methods that belong to the cross border crisis management concept. Level 1 starts with the selection of a subject for cross border cooperation. The policy office team that is operating according to the concept needs to come to a priority ranking of cross border relevant subjects. In this study this aim is achieved by a bundle of expert elicitation methods. To begin with, experts have been identified. Consequently, they have been asked what kind of animal disease control measures are missing a cross border aspect. In a second questionnaire these experts have been asked to prioritize the identified control measures according to the need of cross border cooperation. Finally, a scientifically based ranking of cross border relevant control measures can be provided.

Table 6.1: General survey of the Cross border crisis management concept

Level	Task	Output	Methodology
1	Selection of a subject for development of a cross border cooperation plan	Priority ranking of subjects	Expert elicitation
2	Definition of objectives for ambition level	Ambition level chart	Expert elicitation, scenario bundle method
3	Specification of the initial crisis situation	Determination of surrounding conditions	Scenario bundle method
4	Set up of scenario plan for common ambition	Initial cooperation scenario	Scenario bundle method
5	Representation of limiting factors/ benefits	Information fact sheets	Closed loop model, process reference model
6	Validation and implementation	Instructions for scenario based validation in exercise and training activities	Simulation methodology

In level 2 the aim is to evaluate the degree of ambition that the relevant stakeholders have for cooperation on the chosen subject. This element of the concept gives insight in the details of motivation for cooperation. Even if all stakeholders agree about cross border cooperation on a specific subject, it is still possible that the degree of cooperation is not absolutely balanced. Therefore, by means of expert elicitation methods ambition level charts are determined. They start with the common ambition of all stakeholders concerned in decision making. Additionally, if some stakeholders have higher ambitions these can already be included in the ambition level chart. This allows a structured identification of different ambitions and gives direction to more cooperation at a later time. The scenario bundle method is used for the expert identification.

Based on the common cross border ambition level the following step is to make all necessary specifications for the initial crisis situation where this cross border cooperation would be activated. This includes the determination of all relevant surrounding conditions according to the scenario bundle method. What stakeholders are concerned, what kind of crisis situation is at hand and what kind of information is already available? These questions and depending on the nature of this crisis scenario several more have to be answered on before the next level of the concept can be approached. These specifications are applicated as a sort of commentary to the ambition level chart.

After all specifications for the basic ambition level have been made the initial cooperation scenario – based on scientifically tested scenario approaches – can be worked out [Harrald and Mazzuchi, 1993; Alexander, 2000; Fischhoff et al., 2006]. In level 4 the decision process of this scenario is illustrated in a flow chart. This flow chart contains information on decision points, decision makers and decision options. In this study the flow charts are always worked out for the ideal cross border decision procedure. Consequently, the results can be used as instruction for an implementation of a best practice example. What has to be done until an implementation of these decision plans is possible, will be part of level 5 in this concept.

The next section of this concept is aiming on the identification and repair of limiting factors that are obstacles to the implementation of cross border cooperation plans. At the same time in this fifth level the benefits that can be achieved by implementing the cross border cooperation plan are described as well. This combination provides decision makers with a to-do list containing missing activities that have to be done before implementing the cooperation plan as well as motivating factors. In this study the research has been concentrated on data and information availability as a limiting factor to cross border cooperation. Therefore, the process reference model has been used in order to produce assessments of information and communication systems and of the data and information available. Finally, the findings are introduced in information fact sheets that are addressed to the relevant decision makers.

The final level of this concept contains guidelines for validation and implementation of the completed cooperation plan. Experience shows that not every theoretical concept produces results that have positive effects in practice. Therefore, in this concept the validation by means of expert trainings and crisis exercises is an important issue. Based on simulation theory the content of cooperation scenarios is prepared for application in different kinds of crisis management trainings [Batterink et al., 2004]. Thus, the final result of this concept is a cooperation scenario including instructions for a scenario based validation in exercise and training activities.

Involvement of stakeholders

The participation of public and private stakeholders is particularly important for the success of this concept. Without strong support from the Dutch and the German veterinary authorities and various enterprises in several research projects this concept would never have seen a spot of daylight. The reason for this prominent role of stakeholders is chiefly grounded in the general orientation of this study: the use of expert information for cross border crisis management preparation is a precondition for the development of realistic and practical cooperation approaches. For this study the definition of an expert is as follows: any person who is directly or indirectly in charge of animal disease control activities.

In this study first of all public stakeholders have contributed immensely to the development of this concept and to the CSF case study that has been used to exemplify the concept. As scientific literature on cross border cooperation on CSF control is scarce, the importance of expert opinion becomes even greater. In all 6 levels of the concept expert opinion has been needed to proceed. Of course, the main input has been included in level 1 and 2, but on working group level the contribution has been substantial. The nature of their contribution to this concept has been of a various nature: experiences made in past crises, evaluation of recent challenges, information about national systems and last but not least critical assessment of findings that have been generated in this study.

From the group of stakeholders that has been contributing to this concept the most important role is taken by the national ministries of agriculture. Here the implementation of crisis management measures is executed. Therefore, all activities aiming towards practical cross border cooperation approaches have to be worked out in close cooperation with veterinary policy officers.

At the same time the public stakeholders that are responsible for the execution of crisis management measures are an indispensable source of information. Their experiences in crisis management in cross border regions are highly important for starting phases of this concept. Here, most specific ideas about cross border cooperation come from as they do have a very concrete view on the subject.

When it comes to data and information transfer the private stakeholders are big in business. During the last decade more and more initiatives have started heading for the enhancement of public-private partnership on information and communication exchange in animal health science. The study made to develop this concept has illustrated how important public-private cooperation is for cross border animal disease control. Economic aspects are a dominating factor for public cross border animal disease control. At the same time private data bases are becoming more and more relevant for an efficient livestock disease management.

All told, both public and private stakeholders need to contribute to this concept in order to produce worthy cross border cooperation measures that are implemented to be a benefit to all stakeholders.

Strategies for knowledge transfer

One of the main conclusions of this study is that improving crisis management systems is a dynamic process. This can be drawn from the fact that crisis management administration changes regularly, new research findings have to be included and practical experiences can be made from time to time that provides new insight in the strategies to choose [ROSENTHAL, 2003]. Therefore all strategies for knowledge transfer that are included in this concept need to adapt this situation. As already mentioned, the cross border crisis management concept has been developed on a basis of results deriving from different research projects. Knowledge transfer activities are a core issue of research projects. Unfortunately, this knowledge transfer usually ends as soon as the research funds are expired. Therefore, one general assumption of this study is that knowledge transfer activities have to be installed in the dynamic process.

The results that are generated by this concept are scenario-based and can therefore easily be integrated in regular crisis management exercises. Every European member state is committed to organize crisis management exercises on a regular basis [EU, 2007]. As soon as the veterinary authorities decide to use these conceptual guidelines for cross border cooperation development an integrating of the results into regular exercises would be comparatively easy.

Thus, the establishment of a liaison office for cross border crisis management would be helpful in order to support the national veterinary authorities in concept navigation. At the same time in a liaison office the evaluation of cross border management plans would be executed by a neutral agency. This is necessary for both a dynamic procedure and an independent position in the preparation process of cross border cooperation.

Differentiation of the concept

It is widely expected, that the implementation of this concept into Dutch and German contingency plans contains only benefits and almost no risks. In the worst case, the concept does not bring a single cooperation process to implementation. But even then, a cross border learning process takes place while stakeholders are in debate about the potential benefit of cross border measures and have the opportunity to learn about each other. In the best case, the concept is successful and once in a while cross border cooperation measures are brought to the finishing line. In that case Dutch and German stakeholders will both benefit from this implementation and will certainly be interested in more cooperation. Here, some more research is relevant to the degree of benefits that both countries can expect from this concept. First experiences show that an equivalent benefit is difficult to achieve.

Once this cooperation process has started, the private sector will experience positive effects on the competitiveness of the Dutch German border area. From the perspective of the private sector one risk might be that more cooperation between veterinary authorities can lead to more competition between enterprises in the area. This of course can be regarded as a negative effect by several enterprises of the sector.

Another interesting question might be, whether the implementation of this concept has any effects on European veterinary regulation? It is common knowledge that cross border cooperation within Europe is principally assessed positively [EU, 2007]. Of course, all attempts have to comply with European regulation and in some cases the cooperation plan has to be applied for at the European Union. But, as in many other policy fields, the Dutch German border area has often been a spearhead for the development of processes that later on became a European standard [WIELENGA, 2000]. So why not in cross border animal disease control development? In several expert interviews it has been speculated about this issue. One of the most popular arguments has been that it is simply lack of tenacity. After several approaches to establish cross border cooperation the elaborate work has finally not been finished. This is another reason for a liaison office that can fully concentrate on the task.

Dutch-German partnership

The results presented in this study have been compiled in almost five years of Dutch German cooperation in joint projects and scientific workshops. Consequently, not all relevant empirical experiences can be expressed in scientific surveys and statistics. In this section the question is raised: What did we learn about the Dutch German relationship in general that is essential to make this cooperation concept a full success? Are there any socio-cultural factors that need to be considered while planning cross border cooperation or is there not a single experience that is explicit enough to lead to a general assumption about the Dutch German relationship?

To begin with, all cooperation activities where accompanied by a very collegial and professional atmosphere. This can be said for formal and informal contacts between veterinary authorities and private stakeholders. Formally, all approaches to contact a neighbouring state remain at the authority of the national ministry of agriculture. Therefore, the official communication line between Germany and the Netherlands runs between the Dutch EL&I and the German BMELV. Informal communication, meaning any kind of communication between authorities or stakeholders without the authority to decide, is highly inspired by cross border projects like Managing risks (2006-2008) and SafeGuard (2008-2013). At these levels many attempts for cross border cooperation are prepared in workshops and meetings before the superior authorities are officially included.

Due to the federal organisation of Germany the sixteen different *Bundesländer* are provided with their own ministries of agriculture. Consequently, Nordrhein Westfalen and Niedersachsen have of course the greatest interest of all in Dutch veterinary policy. The administration of both countries cherishes the relationship to their Dutch colleagues even if they do not have an official mandate to do so. Hence, the differences in governmental organisation can lead to slight uncertainties on the Dutch and the German side. The experience shows that it is indeed a fine line between informal cooperation and the lack of jurisdiction. In this respect cooperation between Dutch and German colleagues can become difficult as e.g. the German side often refers to political issues standing in the way of more cooperation while the Dutch side is much more to the bottom line due to their central organisation. Nevertheless, in the course of project time these uncertainties became dwindling.

Another issue that became obvious in this Dutch German partnership is the conflict of interest regarding the economic orientation of both countries. While the Dutch agri-business is strongly focused on export the German agri-sector is still more concentrated on regional trade. This of course has consequences on the interest of enterprises and on the policy strategy of national veterinary authorities. With regard to cross border cooperation these issues need to be considered when marketing agreements are necessary for the implementation of cross border measures.

Finally, the bottom line of Dutch German partnership is extremely positive. In the experience of these research activities, only some specific circumstances need to be attended to in order to guarantee a good atmosphere for successful cooperation. Besides, the interest for cooperation on the German side of the border is high enough to make several veterinaries learn the Dutch language in order to contribute to a positive atmosphere and communication.

6.5 Conclusions

With the research described in this thesis the insight into cross border crisis management options between Dutch and German veterinary authorities has increased. The multidisciplinary approach to the problem, combining elements of information theory, decision making theory, quality management and innovation theory has contributed to this insight. Finally, the following conclusions have been drawn:

- Cross border crisis management is possible, but stakeholders have to find official agreements in normal times. As soon as a crisis is at hand, there is no more room for debate about cross border cooperation.

- The majority of Dutch and German stakeholders are supporting the idea of cross border cooperation in CSF control. But, every single cooperation plan will be assessed differently by stakeholders as cooperation benefits always depend on the perspective a stakeholder has on a certain subject.
- Simulation of cooperation strategies has shown that advantages can be expected from cross border cooperation compared to standardized European veterinary regulation. But, at the same time the stakeholder perspective shows that e.g. benefits for the Netherlands can contain disadvantages for North Rhine Westphalia and vice versa.
- A great barrier for the implementation of cross border cooperation is the lack of decision relevant information: in this study it has been illustrated that there are organizational and technical solutions at hand. But, several basic activities are missing and expert elicitation shows that strong arguments are against cross border data transfer.
- The implementation of the cross border cooperation concept into national veterinary praxis allows the responsible stakeholders to develop and test new cooperation measures on a scientific basis: the concept provides clear instructions for all stakeholders and leaves no room for diffuse political argumentation about the impossibility of cooperation on certain subjects. But, a full evaluation of the feasibility of this concept in veterinary praxis has not yet accomplished. It can be assumed that some components, e.g. the assessment of information availability, can be executed in a time saving way e.g. via expert-in-charge rating.
- There is no such thing as an ideal crisis management concept. But, this concept offers a structured procedure that supports crisis managers in cross border cooperation and makes clear communication possible.
- Improving crisis management systems is a dynamic process. Therefore, all knowledge transfer measures that are necessary to bring concept findings into practice have to be established on a regular basis
- The establishment of a liaison office for cross border crisis management would be helpful in order to support the national veterinary authorities in concept navigation. At the same time the evaluation of cross border management plans could be executed by a neutral agency.
- When some specific issues are attended to, the Dutch German relationship contains no aspects that would be an obstacle to successful cross border cooperation.

6.6 Implications for practical implementation

As already mentioned before, the practical implementation of the cross border crisis management concept has certain challenges of its own. Therefore, in this section a short survey is given on implications for practical implementation of this concept.

The stakeholders in charge for implementing this concept have been identified in the initial expert elicitation phase of this study. They have closely participated in the development of this concept and are therefore well informed about the benefits of this concept.

According to the findings of this research the implementation of this crisis management concept would be an easy task. Even if the concept is successfully implemented in Dutch and German crisis management plans there is still no obligation to agree on specific cooperation plans. The implementation of this concept would simply be the first step towards having a standardized procedure that allows the preparation of cross border cooperation proposals. Hence, with regard to the results of this study no barriers to the implementation can be identified.

The opinion of private stakeholders about the implementation of this concept is expected to be more diverse. On the one hand, cross border cooperation always has to consider economic issues and will therefore naturally accompanied by the advice op private stakeholders. On the other hand, it is rather predictable that certain lobbies will not agree on a harmonization process in the Dutch German border area. This is chiefly due to economic competition and cannot be prevented. As one implication for implementation it has to be recommended that private interests have to be consulted, but not in order to incorporate arguments out of competition interests.

It has to be concluded, that the implementation of this Cross border crisis management concept can easily be done if all stakeholders agree on the potential of this concept. Another question will be how this concept is regularly applied after implementation?

Based on extensive conversation in Dutch German workshops it turned out be a good idea to establish a liaison office as an independent switch point between all stakeholders involved, This office could take over the management of the concept and provide the decision makers with cross border cooperation plans that finally need to be transformed into national animal disease regulation. The activities in the SafeGuard project can be regarded as a pilot for this liaison office. Here, the concept has been initially developed and is currently been tested on several cooperation plans. Finally, in 2012 a cross border crisis management exercise will be arranged in order to evaluate the cooperation plans that have been developed in the SafeGuard teamwork.

6.7 Suggestions for further research

Supplementation of the concept is needed in several aspects. First of all there is still capacity for more research on information and communication transfer between public and private stakeholders in the Dutch German border area. As already mentioned, the universities of Bonn, Göttingen and Wageningen are busy for some time with specific research on the quality of information systems and communication transfer. Hereby, a core issue will be the assessment of Dutch information systems and the possibility to include them into the Exchange and Engage Model developed at the University of Bonn. This model is recently validated and expanded in a new research project called SiLeBAT, where the procedure is transferred on the milk and beef production chains.

What is missing as well is detailed information about cross border trade patterns according to risks and opportunities in reducing spread mechanisms. In Germany researchers at the Friedrich Löffler Institute (FLI) and at the Helmholtz-Centre for Environmental Research (UfZ) are currently working on different simulation modelling approaches that can give more insight in the nature of trade patterns and spread mechanisms. In the Netherlands, comparable research is done at

Wageningen University. Here, a new focus is turned towards the economic effects of animal disease control measures on a cross border scale.

Another interesting factor is the validation of the Cross border cooperation concept by adaption to other case studies. Currently, the University of Bonn is investigating the challenges that emerging infectious diseases bear for cross border cooperation. Additionally, it has to be analyzed to what degree the Cross border cooperation concept has to be altered if it is not used for preparation of animal disease control measures but for zoonozes? Here, during the past years both countries had to make experiences with Highly Pathogenic Avian Influenza. Therefore, this would be an excellent case study for adaption of the concept.

Even if the construction of crisis management decision scenarios is richly evaluated in scientific literature there is an obvious lack of experiences with the introduction of scenarios in crisis exercises and trainings. For the Cross border crisis management concept this is indeed of a vital importance: Without the evaluation of cooperation plans in crisis management exercises, the potential benefits remain rather theoretical. Consequently, it has been scheduled that in 2012 a Dutch German crisis management exercise will take place in order to give insight in the possibilities of scenario based crisis management simulation.

6.8 References

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